RUSSIAN RIVER BIOLOGICAL ASSESSMENT

INTERIM REPORT 4:
WATER SUPPLY AND DIVERSION FACILITIES

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
San Francisco District
San Francisco, California

and

SONOMA COUNTY WATER AGENCY
Santa Rosa, California

Prepared by:

ENTRIX, INC.
Walnut Creek, California

January 12, 2001

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The Sonoma County Water Agency (SCWA), the U.S. Army Corps of Engineers (USACE) and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD) are undertaking a Section 7 Consultation under the Federal Endangered Species Act (ESA) with the National Marine Fisheries Service (NMFS) to evaluate effects of operations and maintenance activities on listed species and their critical habitat. The Russian River watershed is designated as critical habitat for threatened stocks of coho salmon, steelhead, and chinook salmon. SCWA, USACE and MCRRFCD operate and maintain facilities and conduct activities related to flood control, channel maintenance, water diversion and storage, hydroelectric power generation, and fish production and passage.

Federal agencies such as USACE are required under the ESA to consult with the Secretary of Commerce to insure that their actions are not likely to jeopardize the continued existence of listed species or adversely modify or destroy critical habitat. As part of the Section 7 Consultation, USACE and SCWA will submit to NMFS a biological assessment (BA) that will provide the basis for NMFS to prepare a biological opinion (BO) that will evaluate project operations. The BA will integrate a number of interim reports on various project operations.

This interim report addresses the potential effects associated with operation and maintenance of the SCWA water supply and transmission system on the three threatened species of salmonids and their designated critical habitat in the Russian River. SCWA is the provider of potable water for approximately 550,000 people in Sonoma County and portions of Marin County. Since its creation in 1949, SCWA's role as a water supplier has evolved into two primary responsibilities including operation of the Russian River Project and operation of the water transmission system.

Operation of the Russian River Project: As the local sponsor for the two federal water supply/flood control reservoir projects in the Russian River watershed (Coyote Valley Dam/Lake Mendocino, and Warm Springs Dam/Lake Sonoma) SCWA, under operational agreements with the USACE, manages the water supply storage space in these reservoirs to optimize the water supply yield of the system and maintain flows in the Russian River and Dry Creek. SCWA holds water rights permits to divert[1] Russian River and Dry Creek flows and re-divert[2] water stored and released from these water supply reservoirs.

Operation of the water transmission system: Downstream of Lake Mendocino and Lake Sonoma, SCWA diverts and delivers wholesale water to its customers through its water transmission system. The water transmission system consists of diversion facilities, treatment facilities, pipelines, water storage tanks, booster pump stations, and groundwater wells.

Potential effects of SCWA's water supply and diversion facilities include direct and indirect effects on the listed fish species and their habitat. The potential effects that are discussed in this report are summarized as follows.

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[1]Divert - refers to water diverted directly from streamflows into distribution systems or reservoirs.
[2]Re-divert - refers to water that has been diverted to storage in a reservoir, then released and diverted again at a point downstream.

1) Potential direct effects on fish;

   a) Passage past project facilities for adult and juvenile salmonid migration and salmonid rearing,

   b) Stranding potential from deflation of the inflatable dam, and

   c) Injury to listed species from maintenance activities;

2) Potential alterations to critical habitat;

   a) Alteration of critical habitat from inflatable dam inflation or deflation,

   b) Water quality related effects of water storage and release for diversion

   c) Water quality effects from accidental releases of water additives and facility maintenance substances,

   d) Alteration of critical habitat from operation and maintenance activities;

3) Potential Indirect Effects;

   a) Increase in predation risk from maintenance and operation activities.

Key findings from this investigation are provided in the following sections.

Adult Migration Effects

To augment the rate of recharge to the Russian River aquifer, SCWA operates several infiltration ponds near Mirabel and Wohler. A water-filled inflatable dam on the Russian River upstream of the Mirabel area raises the water level to increase recharge of the aquifer, and to facilitate the diversion into the infiltration ponds. Potential effects from operation of the inflatable dam on adult salmonid upstream migration are evaluated. The dam has two fish ladders. Two factors that influence the success of adult migration through the fish ladders are analyzed, including 1) fish ladder design and 2) operation and attraction flows.

Examination of the engineering drawings indicates that the ladders are built within the guidelines of published criteria. Data from video monitoring of adult migration through the ladder indicate successful passage by adult salmonids, and even less proficient swimmers, such as Pacific lamprey. Attraction flows at the ladder are suitable to attract upstream migrants to the ladders. A hydrologic computer simulation indicated that there are sufficient attraction flows for the majority of the time, and that inadequate attraction flows (during storm events) are infrequent and short in duration.

In addition, the normal timing of the operations of the inflatable dam avoids peak upstream migration periods for all three species, although the dam could be operated earlier of later. Because steelhead spawning migrations do not generally occur during the normal operating period of the inflatable dam, the risk for steelhead is very low. There is a slight potential overlap with coho salmon upstream migrations in November of some years. However, these migrations are usually correlated with increasing river flow and the time when the inflatable dam is lowered, and coho are therefore at a low risk. Adult chinook salmon depend the most on successful passage using the fish ladders at the inflatable dam because the early portion of their spawning run overlaps with the normal operating period of the dam. However, even their peak spawning runs occur after November.

All three protected species are likely to have successful upstream passage since the fish ladder is designed and operated to pass them, attraction flow is provided under nearly all conditions, and their peak upstream migration is likely correlated with increasing river flow and the time when the inflatable dam is lowered.

Juvenile Emigration and Rearing Effects

When inflated, the dam at Mirabel impounds water for approximately two miles upstream. This impoundment decreases current velocity, which has the potential to delay emigrating smolts. Because smolts have a finite time to complete the physiological process that prepares them to survive in saltwater (smoltification), a substantial delay could result in a reversal of this process. This would mean they would have to spend an additional year in fresh water, and if summer conditions are unsuitable, could increase mortality of the unsuccessful emigrants.

The inflatable dam raises the water level in the river and submerges the intakes to three diversion pumps that transport water to the Mirabel infiltration ponds. Canals provide gravity-fed water to the two Wohler infiltration ponds when the dam is in operation. A slide gate is opened to fill the Wohler ponds. The effects of diversion facilities on young salmonids were examined at both the Mirabel and Wohler diversion facilities. The risk of impingement, entrainment or injury to fish on fish screens at diversion facilities was evaluated both at high (flooding) and low (summer) flows. We also evaluated the risk of stranding or displacement of young salmonids when the inflatable dam is lowered, about once or twice a year.

JUVENILE EMIGRATION DELAY AT THE INFLATABLE DAM

As part of a five year monitoring program, SCWA is assessing juvenile steelhead passage at the inflatable dam, including the average time elapsed from released to passage, the percentage of fish that pass the dam, the percentage of fish that failed to pass the dam, smolt behavior in the impounded area, and the physiological stage of smoltification in released fish. This data will be used in the BA to assess the effects of the inflatable dam on juvenile migration.

IMPINGEMENT, ENTRAINMENT, OR INJURY AT DIVERSION FACILITIES

The levees surrounding the infiltration ponds are sometimes overtopped during floods, trapping fish in the ponds after the river level recedes. When water is diverted to the ponds for water supply, listed fish species may be affected. Improperly designed diversion facilities can cause impingement or entrainment of fish, delay migration, or kill or injure fish. Entrainment in the ponds may result stranding or increased predation on fish.

Potential effects from the diversions are evaluated by examining fish protection measures at the diversions (fish screen design and operation) and by assessing the opportunity for fish to be impinged on the fish screen, entrained in the infiltration ponds, or injured at the diversion facilities. The potential for fish to be impinged, entrained or injured is evaluated with two components, including the percentage of the migration period that the diversion facility is in operation and the percentage of the total surface water diverted. Effects are evaluated for juvenile and fry life history stages of all three protected salmonid species.

Operations during Low Flows

<u>Mirabel</u>

Engineering design and critical operating parameters for the two fish screens at Mirabel meet most of the NMFS criteria for juvenile salmonids. While there are some small areas on the screens with approach velocities that are higher than NMFS criteria, particularly on the upstream screen, the risk to juvenile salmonids is low. The opportunity for entrainment based on the proportion of flow diverted is moderate; between 25-50 percent of water flow is diverted when juvenile fish are present. The Mirabel diversion operation normally does not overlap significantly with the juvenile outmigration period of coho salmon and chinook salmon, but the overlap with steelhead is greater. However, because the screen is designed and operated mostly within NMFS screen criteria for juveniles, the overall risk to all three species is low.

Because the Mirabel screen design is not within NMFS criteria for salmonid fry (juvenile fish less than 60 mm long), there is a higher risk of entrapment, impingement, or injury for fry of any of the three species that may be present. The risk for steelhead fry is slightly higher than other species because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, there is a low probability that large numbers of fry would be found here because suitable spawning habitat does not exist in the area, and rearing habitat is limited during the warm summer months. Therefore, while some individual fry, particularly steelhead fry that may be swept downstream in the spring, may be at a high risk for entrapment, impingement or entrainment, the overall risk to the populations of listed species is likely to be low.

<u>Wohler</u>

The Wohler diversion screen design and operation are not within NMFS criteria for juvenile or fry. Young fish that are exposed to the facility have a high risk of entrapment, impingement, injury or migration delay. While in some years the diversion may be operated earlier or later than the normal May to November period, the diversion is normally operated during a small portion of the coho and chinook salmon outmigration period, and a larger portion of the steelhead outmigration period (about 40% overlap). The risk is somewhat reduced since only about 5% of total river flow is diverted at Wohler. Combining these two components, juvenile coho salmon and chinook salmon are at a low to moderate risk for entrapment, impingement, injury or migration delay, primarily because the Wohler diversion operation does not overlap significantly with the juvenile outmigration period. The risk for steelhead entrapment, impingement or injury is higher, based on a greater overlap with diversion operation and juvenile outmigration period, and therefore, steelhead juveniles are at a moderate risk.

Because the Wohler ponds are not used continuously during the diversion period, and because fish rescues are conducted within two weeks after the ponds are filled, the risk may be reduced. However, rescue efforts are delayed (up to two weeks) and difficult to achieve in a manner that would insure safe recovery of fish from the Wohler ponds.

The risk for steelhead fry injury is slightly higher than for coho or chinook salmon fry because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, large numbers of fry are not likely to be present, because suitable spawning habitat does not exist in the area and poor quality rearing habitat is available during the warm summer months. Therefore, while some individual fry, particularly steelhead, may be at a high risk for entrapment, impingement or entrainment, the overall risk to the populations of listed species is likely to be low.

Operations during High Flows

During high flows, levees can be overtopped and the Mirabel and Wohler infiltration ponds can be flooded. The opportunity for fish to be entrained or injured at the facility is assessed. Analysis includes computer simulations to estimate 1) the frequency in which the ponds would have flooded on a yearly basis and 2) the time of year the ponds would have flooded.

<u>Mirabel</u>

Of the 35 water years modeled, Mirabel ponds would have overtopped 28 days or about 0.1% of the time. The only months the ponds would have overtopped are December through March. Because the ponds at Mirabel do not overtop often, the opportunity for entrainment at Mirabel during high flows is small. Although the portion of surface water that enters the Mirabel infiltration ponds during flooding has not been measured, it is estimated as only 5% of the flow.

Because less than 5% of streamflow during flood events enters the Mirabel ponds, and the ponds overtop during only a very small portion of the steelhead juvenile migration period, steelhead are subject to a low risk. Coho and chinook salmon juveniles are more likely to be migrating through the area when the ponds overtop, subjecting them to a moderate risk of entrapment or migration delays when the ponds overtop. However, the ponds do not overtop very often, so that while individual fish may be affected, the overall risk to the populations is likely to be low. Chinook salmon were found in the Mirabel ponds during rescue operations in 1998, but coho salmon or steelhead may be found in future years. Although some fish may be lost to injury or stress during rescue operations, recently modified rescue operations at the Mirabel infiltration ponds significantly minimize the overall risk at Mirabel.

<u>Wohler</u>

The Wohler ponds are at a greater risk of being overtopped and flooded from the river than the Mirabel ponds. Computer simulations estimate that Wohler pond 1 would have overtopped 533 days over 35 years, or about 4% of the time, and Wohler pond 2 about 625 times (approximately 5% of the time). Wohler ponds flood almost every year. In general, the months of flooding are concentrated from November through April. Although the portion of the surface water that enters the pond during flooding has not been measured, it is estimated as less than 5% of the flow. The Wohler ponds are relatively small (1.4 acres), so it is assumed that a small portion of the mainstem flood flows enter the ponds.

Fish rescues in 1998 and 1999 found steelhead, and chinook salmon were found in 2000. Although data from two years of fish rescue operations did not find coho salmon juveniles, they are likely to be migrating through the area when the ponds overtop and may be at risk as well. Juvenile steelhead have been lost to injury or stress during rescue operations in the past, but current practices and fish rescue operations reduce the risk to protected species. Although 13 hatchery fish out of 29 steelhead (primarily hatchery fish) recovered during rescue operations in Wohler pond 2 in 1998 were dead, a connection from Wohler pond 2 to the river decreased the number of fish rescues needed in the 1998-1999 winter season and no mortalities were found. Because an effective, continual connection is maintained between the pond and the river, fish are able to return to the river at will, and the overall risk is likely reduced to a lower level.

Stranding or Displacement from Flow Fluctuation

When the inflatable dam is lowered, stranding or displacement of salmonids due to dewatering effects could occur in two miles of river upstream. Evaluation of the risk is based on the change in water stage in the river when the dam is lowered, the number of times per year habitat may be dewatered, the habitat characteristics of the channel that may affect the potential for stranding, and species and life history stages present.

The risk of stranding is highest during spring deflation of the dam because juvenile salmonids are more likely to be present than in the fall. Adults are less vulnerable to stranding. Because summer temperatures limit rearing habitat, and the area is far from spawning grounds, large numbers of fry are not likely to be present in the impoundment when the inflatable dam is deflated. The inflatable dam was lowered, on average, 1.5 times per year over a recent 20-year period. The stage change within the impoundment behind inflatable dam is estimated at about 0.46 feet per hour, but because the dam is lowered in response to increasing flows associated with storm events, this stage change is likely to be attenuated.

Generally, habitat in the two-mile reach that is affected by impounded water above the inflatable dam does not have characteristics that increase the potential for stranding. Before the inflatable dam is raised, the channel upstream of the dam is primarily run habitat with fine gravel, cobble, and boulder substrates. It appears to be a single channel river that has a relatively straight trajectory through the area and relatively few structural features that would create low areas outside of the main channel. The slopes of the river margins have a low gradient, but are sloped to the main channel. The wetted channel extends from bank to bank whether the dam is inflated or deflated, so it is unlikely that dewatering of the riverbed is a concern.

The attenuated stage change within the impoundment behind the inflatable dam is small enough that there is a low risk of stranding for juvenile salmonids. The dam is not lowered frequently, (on average less than two times per year) the channel shape presents little risk of stranding, and dewatering of the riverbed is unlikely. Therefore, deflation of the inflatable dam presents a low risk of stranding to juvenile salmonids

Habitat in Wohler Pool

When the inflatable dam impounds water, the two-mile stream reach behind the inflatable dam is changed from a combination of run/riffle/pool habitat to primarily pool habitat; pool habitat is likely to increase on an order of 30 to 70 percent over free-flowing conditions. This reach may provide some rearing habitat in the spring for steelhead or chinook salmon, but summer water temperatures limit rearing habitat. An increase in pool habitat above the dam may decrease food transport and very slightly increase water temperatures. However, with limited rearing conditions available in this reach during the summer, primary rearing habitat is likely to be found elsewhere, and the overall risk to salmonid populations is likely to be low.

Water Quality Related Effects of Water Storage and Release for Diversion

Water supply operations at Coyote Valley Dam and the Mirabel and Wohler facilities have the potential to affect temperature, dissolved oxygen, and turbidity. Water quality in the outflow of Warm Springs Dam is determined by operations of the Don Clausen Fish Hatchery, and will be assessed in the draft and final BA.

COYOTE VALLEY DAM

Temperature

The intake to the control tower of Coyote Valley Dam is in the cooler bottom waters of Lake Mendocino, so the coolest water available is released. Mean daily temperature data from below the dam were used to assess the effect on each life history stage of each species based on published temperature criteria. As there is only limited use of the East Fork Russian by coho salmon, the species most likely to be affected are steelhead and chinook salmon. Water temperatures are relatively stable from year to year, but late summer and fall water temperatures can be high for salmonid egg incubation and juvenile rearing. Most of the suboptimal temperatures occur in the late summer and fall, which could affect the early part of chinook salmon spawning and incubation periods. However, peak chinook spawning occurs after November, and temperatures are usually lower by this time. Water temperatures are generally suitable for all coho life history stages except for rearing in the late summer and early fall. Coho salmon are not currently rearing in the East Fork Russian River.

Dissolved Oxygen

Because Lake Mendocino is stratified in the summer, water drawn from the lower depths of the lake may be low in dissolved oxygen. Turbulence in the outflow channel and in runs and riffles below the dam are likely to help restore dissolved oxygen levels. Dissolved oxygen levels are not monitored at the outflow to the dam, but they are monitored at the hydroelectric power plant. Continuous compliance with FERC guidelines for dissolved oxygen has been maintained in the hydroelectric facility, and the outflow from the hydroelectric facility would help to maintain dissolved oxygen in the water below Coyote Valley Dam.

Turbidity

Data from water quality monitoring at the Coyote Valley Fish Facility at the base of Lake Mendocino show that turbidity criteria are generally met for rearing and migration for each species. Infrequent, high turbidity values are probably related to storm runoff events that result in releases that are more turbid. Based upon the available turbidity data from the fish facility, turbidity is not generally increased to harmful levels due to operations of the Coyote Valley Dam for water supply purposes.

MIRABEL AND WOHLER FACILITIES, INFLATABLE DAM

Temperature

When the inflatable dam impounds water, water temperatures may increase. Similar effects may occur related to deepening areas of gravel bars downstream of the dam. The inflatable dam operation is basically a run-of-the-river operation, and preliminary data from 1999 suggest there is only a slight increase in water temperature through the Wohler Pool (0.5°C). A five year monitoring study will produce data to further assess any potential effects. Limited steelhead rearing may occur in the area, but chinook and coho salmon are thought to use the area primarily for passage. No spawning occurs in the area. By summer, temperatures in the inflatable dam impounded area, as well as free-flowing areas above and below the dam, are warmer than published water temperature criteria for salmonids. This small increase in temperature (0.5°C) is not likely to affect smolts migrating through the area, but may slightly reduce the quality of rearing habitat here during the early summer.

Dissolved Oxygen

Preliminary dissolved oxygen data collected in 1999 indicate dissolved oxygen levels meet criteria for rearing habitat for all three species. Dissolved oxygen levels are not negatively affected by operations in the inflatable dam area.

Water Quality Related Effects from Water Treatment Additives and Facility Maintenance Substances

Potential risks related to the use of toxic materials as water treatment additives and facility maintenance substance are assessed. Chlorine, NaOH and Ortho-Phosphate are used, or have been used and stored to treat water for safe human consumption. Petroleum products are used and stored for operation and maintenance of water supply facilities. These substances can have deleterious or lethal effects on salmonid species if they enter water bodies in high concentrations. Normal operations and maintenance activities are structured to avoid adverse effect on aquatic habitats or salmonids, because they are carried out under specified permits and restrictions, and by trained personnel. A catastrophic spill has the potential to have serious, but fairly localized effects on salmonid populations. Spill prevention, containment and control measures significantly decrease the risk of injury or death from an accident. Adult and juvenile life stages of the three threatened salmonid species are at a low risk from a potential spill.

Critical Habitat Alteration and Fish Injury from Operation and Maintenance Activities

SCRAPING OF GRAVEL BARS

Infiltration capacity at the Wohler and Mirabel diversion facilities is augmented by periodically recontouring three gravel bars in the Russian River upstream of the inflatable dam (Wohler, McMurray and Bridge gravel bars) and one bar downstream of the inflatable dam near the Mirabel infiltration ponds (Mirabel Bar). Work in other gravel bars may be required in the future if the pattern of gravel bar formation in the river changes. At the Mirabel Bar, gravel is removed to an elevation below the low-flow water surface elevation of the river, and fish could potentially become trapped in the excavated area at low flows. The McMurray and Mirabel bars are approximately 1,000 feet long and 200 feet wide. The other two gravel bars are about 500 feet long and 100 feet wide. At the Wohler, McMurray and Bridge bars, gravel bar scraping operations take place in the spring outside of the active low-flow channel and before the inflatable dam is raised and submerges those areas. The gravel scraping activity in the upstream sites normally occurs after the coho and chinook salmon outmigration periods, although in some years it may occur during the later portion of the outmigration. There is a greater risk to steelhead juveniles, which are more likely to be present during gravel bar scraping activities.

There is no risk of injury to fish (based on type of operation and magnitude of the activity) to migrating juvenile salmonids from gravel bar scraping activities at the Wohler, McMurray and Bridge bars. Since work at the upstream sites is done outside of the wetted channel, it is not expected that fish would be trapped or that there would be additional sediment input to the river.

The potential to injure juvenile steelhead at the Mirabel Bar is greater than at the other gravel bars because there is a possibility steelhead may be trapped in the excavated area. Best management practices (BMPs) reduce the risk. Gravel bar grading at Mirabel normally occurs in late summer, and does not normally coincide with migration of salmonids. Fish rescues are conducted, and no salmonids were found in fish rescues in 1999. Additional monitoring will provide more data in upcoming years. Spawning does not occur in this area. Sediment input from instream activities is reduced with the use of gravel berms.

After gravel bar grading operations are completed, SCWA contours the bars to an approximately 2 percent grade to reduce the potential for fish stranding. The two mile reach above the inflatable dam has relatively few structural features that would create low areas outside of the main channel, and given the characteristics of the river, gravel bar scraping activities are not likely to significantly change the geomorphology of the channel. Bank stability has not been affected by gravel bar grading activities.

Effects from gravel bar grading operations are restricted to immediate, short-term effects, including a low risk of entrapment of migrating juveniles and short-term turbidity spikes as the Mirabel Bar is isolated or reconnected to the river. Therefore, the overall risk for injury and habitat degradation is low. If additional bars form in the future that may need grading, particularly between Caisson 6 and Caisson 3, the same BMPs would be applied to minimize the risk to salmonids and their critical habitat.

MAINTENANCE OF THE INFLATABLE DAM

Before the inflatable dam is raised in the spring, it may be necessary to remove gravel that has accumulated during the winter on top of the dam and in the fish ladders. This activity could potentially increase suspended sediment concentrations that could affect juvenile salmonids. Sediment would be removed with a suction dredge and the discharge diverted to a temporary siltation pond to prevent turbid water from reaching the river. Spoils are stored offsite. These practices are likely to limit the risk of sediment input to the stream. SCWA's five year monitoring plan will produce turbidity data in the future if this activity occurs.

VEGETATION REMOVAL

Vegetation is removed with Rodeo and by hand along access roads to levees associated with water supply operations. Levee roads are mowed in the late spring. Vegetation removal related to water supply projects does not occur on the streambank. Because there is only limited use of an herbicide approved for aquatic use, and application is in up-slope areas away from the stream, there are not likely to be direct effects on protected fish species or on the riparian corridor.

PREDATION RISK FROM MAINTENANCE AND OPERATION ACTIVITIES

Reservoirs or smaller impoundments can provide habitat for introduced and native species that prey on salmonids. The risk of predation was evaluated for operations at Warm Springs Dam, Coyote Valley Dam, the inflatable dam and the Wohler Pool.

Warm Springs Dam

Lake Sonoma has a non-native warmwater fishery, and predators could be introduced to Dry Creek. Juvenile salmonids are not concentrated directly below the dam and predators are not present in large numbers in Dry Creek. Because water is drawn from the deeper and cooler depths of the reservoir in the summer, warmwater predators are less likely to be entrained and introduced to the river. Furthermore, cool temperatures in Dry Creek reduce the suitability of the habitat for these predators. Introduction of predators that may survive in the warmer reaches of the mainstem Russian River could affect migrating steelhead and coho salmon smolts, and possibly juvenile chinook salmon that may rear in the lower reaches of the river. However, warmwater predators were already established in the mainstem of the Russian River. Therefore, the possible introduction of predators from operations of Warms Springs Dam is not likely to introduce a new predation risk, but may contribute to predator populations in downstream reaches.

Coyote Valley Dam

The inlet tower pipes at Coyote Valley Dam are not screened. As with Warm Springs Dam, it is possible that predators could pass through the dam and establish themselves in the warmer reaches of the mainstem Russian River. Because warmwater predators have already been established, operations of the dam are not likely to introduce a new risk.

Striped bass have been stocked in Lake Mendocino, and they could escape into the stream. Suitable spawning conditions do not exist below the dam for striped bass, and striped bass are only rarely found in the upper mainstem or the East Fork. Therefore, the risk for predation on salmonids is probably low.

Inflatable Dam

The inflatable dam impounds water, resulting in an increase in pool habitat that has the potential to increase predator habitat in Wohler Pool. This has the potential to increase predation on migrating juveniles. There is a low probability that fry-sized salmonids are in this area. Young-of-the year steelhead have been found in the area, but not young-of-the-year coho salmon. Older, larger predators can prey on juvenile salmonids, but small ones can not. Preliminary sampling in 1999 found predators (smallmouth bass) in vastly larger numbers in young age classes than older age classes. There were very few predators in Wohler pool (smallmouth bass and Sacramento pikeminnow) that were large enough to prey on the smallest salmonids likely to be present, chinook salmon and young-of-the-year steelhead. The age distribution was nearly the same for predators in the impoundment and in free-flowing river reaches. Preliminary temperature monitoring in both the impounded area and in the free-flowing river areas found favorable temperatures for warmwater predator populations, and that impoundment of water behind the dam increases water temperature only slightly (about 0.5°C).

Operation of the inflatable dam may slightly increase the risk of predation on salmonids by creating additional pool habitat favorable to predators for a portion of the year. However, actual numbers of large predators found during preliminary sampling in 1999 have been low. It may be that the impounded reach creates favorable conditions for spawning predator species, but conditions are unfavorable for rearing when the dam is deflated in the winter.

Synthesis of Effects

The risk of adverse effects on species/life history stages of threatened species and their critical habitat was assessed. Examination of current operational and maintenance practices and the substantial improvements implemented by SCWA in recent years reflect a clear commitment to the prevention and minimization of adverse effects to protected populations.

Many operations have no risk or a low risk to protected fish species. The inflatable dam does not impede adult salmonid passage while lowered, and when in operation, the fish ladders are effective at passing all salmonid species without delay. Salmonids are at a very low risk of stranding when the inflatable dam is deflated. Standard water quality parameters, especially cooler water released from the reservoirs, could have a positive effect overall. The normal use of chemicals or petroleum products for maintenance and operation activities are done under state and federal regulations by trained personnel. While a catastrophic spill (e.g. diesel fuel) could have significant effects over a local area, it is highly unlikely with spill prevention and control measures in place. Water supply operations at Warm Springs and Coyote Valley dams are not likely to increase the risk of predation on protected species, while operations at the inflatable dam may slightly increase the risk of predation.

Maintenance activities (particularly sediment input to the stream during gravel bar grading operations) have short-term effects on habitat quality, but are limited in area and duration. Juvenile fish may be trapped in the Mirabel Bar during gravel bar scraping activities, but the timing of the activity and fish rescues minimize the risk. Gravel bar grading operations are not likely to change channel morphology or increase the risk of stranding of juvenile salmonids. Therefore, gravel bar grading operations are not likely to have significant effects on salmonids.

The diversion and infiltration systems at the Mirabel facilities conform to most established fish screening criteria for protecting juvenile life stages of salmonid species but not fry. Steelhead fry that may be present are at a high risk. However, there is a low probability that large numbers of fry are present, so the overall risk to the populations of protected species is low.

The most significant effects are related to operations at the Mirabel and Wohler diversion facilities. The Wohler diversion system, although considerably smaller than the one at Mirabel and with less opportunity for injury to fish, is ineffectively screened and presents a moderate risk to fry and juvenile salmonids that are rearing or migrating through the area when the infiltration ponds are filled. Fish rescues reduce the risk, but are delayed and difficult to achieve in a manner that would insure safe recovery of fish. Because steelhead rearing is limited in this area, the overall effect on the rearing life history stage (fry or juveniles) is low, but migrating juveniles of all three species, particularly steelhead, are likely to be affected. When floods overtop the infiltration ponds at Mirabel and Wohler, juvenile fish can be entrained. Because the Mirabel ponds overtop infrequently, migrating salmonids are at a low risk, and recent modifications for more effective fish rescue efforts minimize this risk. Because the Wohler ponds overtop more frequently, migrating salmonids are at a moderate risk of entrainment. While fish rescue operations may reduce the risk, some juvenile steelhead have been lost to injury or stress during rescue operations in the past. A continual connection from Wohler pond 2 provides effective passage back to the river during the flood season, and this has significantly reduced the need for fish rescues in the pond.

The current operations of the SCWA water supply and transmission system are likely to adversely affect the listed fish species primarily because the Wohler diversion facility is ineffectively screened, because migrating juveniles may be trapped in the Mirabel or Wohler infiltration ponds when they overtop during flood events, and because the Mirabel diversion is ineffectively screened for fry. Juvenile salmonids that pass through the Wohler area during diversion operations or periods when the ponds overtop are likely to be at a moderate risk, but because only a portion of migration periods are affected, the overall effect on populations of the protected species is likely to be low to moderate. Recent improvements in fish rescue operations at the Mirabel ponds reduce the risk to the few salmonids that may be entrained, so the overall risk to the population is likely to be low. Because large numbers of fry are not likely to be present in the Mirabel area, the risk to the populations of protected species from the Mirabel screens is likely to be low.

The current operations of the SCWA water supply and transmission system are likely to adversely affect the designated critical habitat of the listed fish species because gravel bar grading operations in a wetted channel may introduce short-term spikes of suspended sediment concentrations. Because only a few individual fish may be affected, the overall effect to populations is likely to be very low.

It may seem to the reader that it is contradictory to state that there is a low risk of adverse effects to protected populations, along with the statement that the proposed project is likely to adversely affect the listed species. However, the first statement is a general assessment of the risk to the larger population of the protected fish species, while the second statement reflects the possibility that one or more fish might be harmed by certain activities. These conclusions will assist NMFS with preparing a BO which may include an incidental take statement (with regard to the individual fish that may be harmed by the proposed action), as well as a determination of whether the proposed action is likely to jeopardize the continued existence of the species.

1.1 SECTION 7 CONSULTATION

The Sonoma County Water Agency (SCWA), the U.S. Army Corps of Engineers (USACE), and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD) are undertaking a Section 7 Consultation under the Federal Endangered Species Act (ESA) with the National Marine Fisheries Service (NMFS) to evaluate effects of operations and maintenance activities. The activities of the USACE, SCWA, and MCRRFCD span the Russian River watershed from Coyote Valley Dam and Warm Springs Dam to the estuary, as well as some tributaries. The Russian River watershed is designated as critical habitat for threatened stocks of coho salmon, chinook salmon and steelhead. The SCWA, USACE, and MCRRFCD operate and maintain facilities and conduct activities related to flood control, water diversion and storage, hydroelectric power generation, and fish production and passage. The SCWA, USACE, and MCRRFCD also are participants in a number of institutional agreements related to the fulfillment of their respective responsibilities.

Federal agencies such as the USACE are required under the ESA to consult with the Secretary of Commerce to insure that their actions are not likely to jeopardize the continued existence of listed species or adversely modify or destroy critical habitat. The USACE, SCWA, and NMFS have entered into a Memorandum of Understanding (MOU) which establishes a framework for the consultation and conference required by the ESA with respect to the activities of the USACE, SCWA, and MCRRFCD that may directly or indirectly affect coho salmon, chinook salmon and steelhead in the Russian River. The MOU acknowledges the involvement of other agencies including: the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), the State Water Resources Control Board (SWRCB), the North Coast Regional Water Quality Control Board (RWQCB), the State Coastal Conservancy, and the Mendocino County Inland Water and Power Commission (MCIWPC).

1.2 SCOPE OF THE BIOLOGICAL ASSESSMENT

As part of the Section 7 Consultation, the USACE and SCWA will submit to NMFS a biological assessment (BA) that provides a description of the actions subject to consultation, including the facilities, operations, maintenance and existing conservation actions. The BA will describe existing conditions including information on hydrology, water quality, habitat conditions, and fish populations. The BA will provide the basis for NMFS to prepare a biological opinion (BO) that will evaluate the project, including conservation actions.

This document presents an analysis of the potential for adverse impacts to the Russian River populations of coho salmon, steelhead, and chinook salmon as a result of certain activities. Because the ESA prohibits take of any individuals, the document will come to a conclusion of “likely to adversely affect” if any individual fish could be harmed by the proposed action, even if the overall risk of adverse impact to the overall population is low. Such a conclusion would mean that one or more listed fish might be harmed by the proposed action. Once a BA containing this determination is submitted to NMFS, formal consultation under the ESA will be initiated. During the formal consultation process, NMFS will make an assessment of whether the proposed action is likely to jeopardize the continued existence of the species. NMFS will present this conclusion in the form of a BO.

The BA will integrate a number of Interim Reports:

Report 1	Flood Control Operations
Report 2	Fish Facility Operations
Report 3	Instream Flow Requirements
Report 4	Water Supply and Diversion Facilities
Report 5	Channel Maintenance
Report 6	Restoration and Conservation Actions
Report 7	Hydroelectric Projects Operations
Report 8	Estuary Management Plan

This report evaluates the effects of current and proposed operations and maintenance of water supply and diversion facilities on listed fish species and designated critical habitat in the Russian River. In general, the facilities include water storage in Lake Mendocino and Lake Sonoma and release downstream, a water transmission system with diversion and treatment facilities and a distribution system comprised of pipelines, storage tanks, pumps, and groundwater wells.

1.3 STATUS OF COHO SALMON, STEELHEAD AND CHINOOK SALMON IN THE RUSSIAN RIVER

The primary biological resources of concern within the project area are coho salmon, steelhead and chinook salmon. These species are each listed as threatened under the ESA. The pertinent Federal Register notices for these species are provided in Table 1-1. Coho salmon and steelhead are native Russian River species, although there have been many plantings from other river systems (CDFG 1991). It is uncertain whether chinook salmon used the Russian River historically (NMFS 1999). They have been stocked in the past, were not stocked in the last two years, but continue to reproduce in the watershed. The Central California Coast Coho Salmon Evolutionarily Significant Unit (ESU), which contains the Russian River, extends from Punta Gorda in northern California south to and including the San Lorenzo River in central California, and includes tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. The Russian River is the largest drainage included in the Central California Coast Steelhead ESU, which extends from the Russian River down the coast to Soquel Creek near Santa Cruz, California. The chinook salmon listing defined the population unit that contains the Russian River as the California Coastal ESU. This ESU encompasses the region from Redwood Creek in Humboldt County to the Russian River (Sonoma County).

Critical habitat for each of these species within the Russian River is designated as the current estuarine and freshwater range of the species including "all waterways, substrate, and adjacent riparian zones.…" For each species, NMFS has specifically excluded areas above Warm Springs and Coyote Valley dams and within tribal lands.

Table 1-1 Federal Register Notices for the Salmonids of the Russian River

Species	Listing	Take Prohibitions	Critical Habitat
Coho Salmon	Vol. 61, No. 212, Pgs. 56138-56147 Oct. 31, 1996	Vol. 61, No. 212, Pgs. 56138-56147 Oct. 31, 1996	Vol. 64, No. 86, Pgs. 24049-24062 May 5, 1999
Steelhead	Vol. 62, No. 159, Pgs. 43937-43954 Aug. 18, 1997	Vol. 65, No. 132, Pgs. 42422-42481 July 10, 2000	Vol. 65, No. 32, Pgs. 7764-7787 February 16, 2000
Chinook Salmon	Vol. 64, No. 179, Pgs. 50394-50415 Sept. 16, 1999	Not yet issued	Vol. 65, No. 32, Pgs. 7764-7787 February 16, 2000

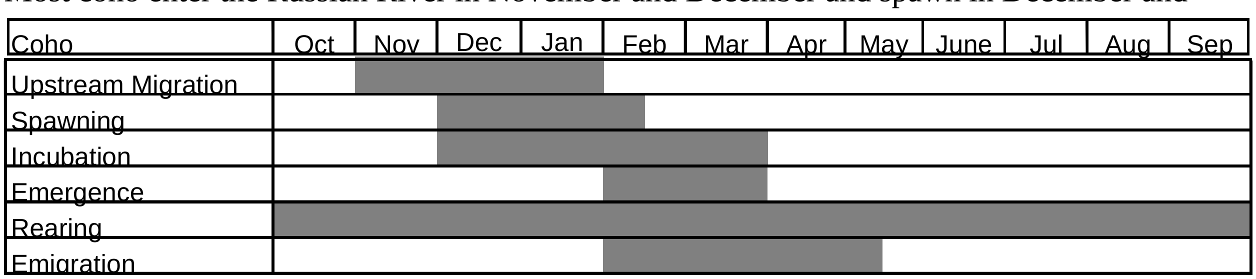
Life history descriptions for these species are provided in sections 1.3.1 through 1.3.3 so that effects from project operations can be evaluated. All three species are anadromous, but steelhead may also exhibit a life history type that spends its entire life cycle in freshwater. These species migrate upstream from the ocean as adults and spawn in gravel substrate. Their eggs incubate for a short period, depending on water temperature, and generally hatch in the winter and spring. Juveniles spend varying amounts of time rearing in the streams and then migrate out to the ocean, completing the cycle. Details on life history, timing and habitat requirements are provided for each species.

1.3.1 COHO SALMON

Coho salmon are much less abundant than steelhead in the Russian River basin. Spawning occurs in approximately 20 tributaries of the lower Russian River, including Dry Creek. In wet years, coho salmon have been seen as far upstream as Ukiah. The Don Clausen Fish Hatchery produced and released an average of about 70,000 age 1+ coho salmon each year (1980-1998). However, no coho have been produced in the last two years.

1.3.1.1 Life History

The coho salmon life history is quite rigid, with a relatively fixed three-year life cycle. The best available information suggests that life history stages occur during times outlined in Figure 1-1. Most coho enter the Russian River in November and December and spawn in December and



(EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-1 Phenology of Coho Salmon in the Russian River Basin

January. Spawning and rearing occur in tributaries to the lower Russian River. The most upstream tributaries with coho salmon populations include Forsythe, Mariposa, Rocky, Fisher, and Corral creeks. The mainstem below Cloverdale serves primarily as a passage corridor between the ocean and the tributary habitat.

After hatching, young coho will spend about one year in freshwater before becoming smolts and migrating to the ocean. Freshwater habitat requirements for coho rearing include adequate cover, food supply, and water temperatures. Primary habitat for coho includes pools with extensive cover. Outmigration takes place in late winter and spring. Coho salmon live in the ocean for about a year and a half, return as three-year-olds to spawn, and then die. The factors most limiting to juvenile coho production are high summer water temperatures, poor summer and winter habitat quality, and predation.

1.3.2 STEELHEAD

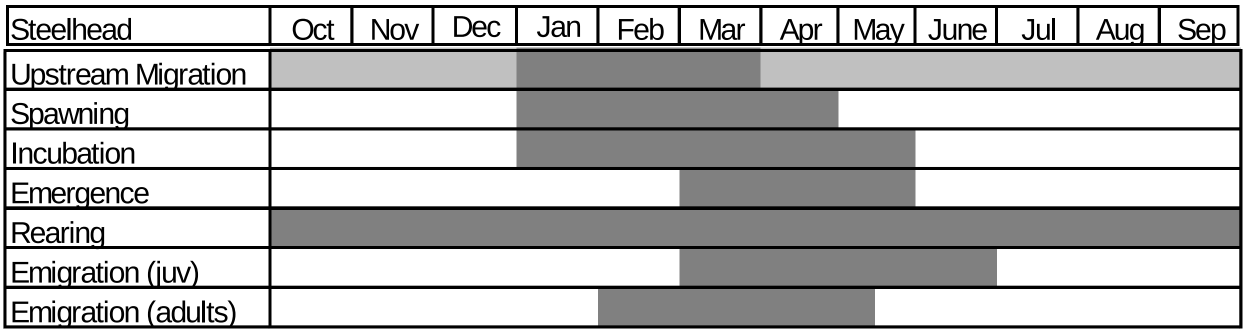
There have been no recent efforts to quantify steelhead populations in the Russian River, but there is general agreement that the population has declined in the last 30 years (CDFG 1984, 1991). SCWA, CDFG and NMFS are currently developing programs to monitor trends in salmonid populations within the designated critical habitat boundaries for the basin. There has been substantial planting of hatchery reared steelhead within the basin, which may have affected the genetic constitution of the remaining natural population. Almost all steelhead planted prior to 1980 were from out-of-basin stocks (Steiner 1996). Since 1982, stocking of hatchery reared steelhead has been limited to progeny of fish returning to the Don Clausen Fish Hatchery and the Coyote Valley Fish Facility.

Steelhead occupy all of the major tributaries and most of the smaller ones in the Russian River Watershed. Many of the minor tributaries may provide spawning or rearing habitat under specific hydrologic conditions. Steelhead use the lower and middle mainstem Russian River primarily for migration to and from spawning and nursery areas in the tributaries and the mainstem above Cloverdale. The majority of spawning and rearing habitat for steelhead occurs in the tributaries. However, it is possible that juvenile rearing may occur in the mainstem before smolt outmigration.

1.3.2.1 Life History

Adult steelhead generally begin returning to the Russian River in November or December, with the first heavy rains of the season, and continue to migrate upstream into March or April. Adults have been observed in the Russian River during all months (S. White, SCWA pers. comm. 1999). However, the peak migration period tends to be January through March (Figure 1-2). Flow conditions are suitable for upstream migration in most of the Russian River and larger tributaries during the majority of the spawning period in most years. Sandbars blocking the river mouth in some years may delay entry into the river. However, during the times the sand barrier is closed, the flow is probably too low and water temperature is too high to provide suitable conditions for migrating adults further up the river (CDFG 1991).

Most spawning takes place from January through April, depending on the time of freshwater entry (Figure 1-2). Steelhead spawn and rear in tributaries from Jenner Creek near the mouth, to upper basin streams including Forsythe, Mariposa, Rocky, Fisher and Corral creeks. Steelhead



Note: Peak upstream migration occurs January through March, but adults have been observed in all months.
(EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-2 Phenology of Steelhead in the Russian River Basin

usually spawn in the tributaries, where fish ascend as high as flows allow (USACE 1982). Gravel and streamflow conditions suitable for spawning are prevalent in the Russian River mainstem and tributaries (Winzler and Kelly Consulting Engineers [Winzler and Kelly] 1978), although gravel mining and sedimentation have diminished gravel quality and quantity in many areas of the mainstem. In the lower and middle mainstem (below Cloverdale) and the lower reaches of tributaries, water temperatures exceed 55^{o}F by April in some years (Winzler and Kelly 1978) which may limit the survival of eggs and fry in these areas.

After hatching, steelhead spend from one to four years in freshwater. Fry and juvenile steelhead are extremely adaptable in their habitat selection. Requirements for steelhead rearing include adequate cover, food supply, and water temperatures. The mainstem above Cloverdale and upper reaches of the tributaries provide the most suitable habitat, as these areas generally have excellent cover, adequate food supply, and suitable water temperatures for fry and juvenile rearing. The lower sections of the tributaries provide less cover, as the streams are often wide and shallow and have little riparian vegetation, and water temperatures are often too warm to support steelhead. In the summer, these areas can dry up completely. Available cover has been reduced in much of the mainstem and many tributaries because of loss of riparian vegetation and changes in stream morphology.

Emigration usually occurs between February and June, depending on flow and water temperatures (Figure 1-2). Sufficient flow is required to cue smolt downstream migration. Excessively high water temperatures in late spring may inhibit smoltification in late migrants.

1.3.3 Chinook Salmon

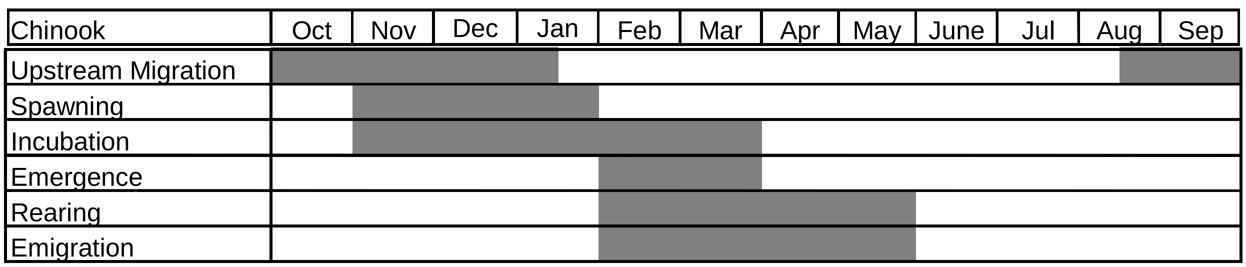
The historic extent of naturally occurring chinook salmon in the Russian River is debated (NMFS 1999). Whether or not chinook were present historically, the total run of chinook salmon today, hatchery and natural combined, is small. Historic spawning distribution is unknown, but suitable habitat formerly existed in the upper mainstem and in low gradient tributaries. Chinook currently spawn in the mainstem and larger tributaries, including Dry

Creek. Chinook tissue samples were collected this year by the SCWA, CDFG and NMFS from the mainstem, Forsythe, Feliz, and Dry creeks, and there were anecdotal reports of chinook in the Big Sulphur system.

1.3.3.1 Life History

Adult chinook salmon begin returning to the Russian River as early as August, with most spawning occurring after Thanksgiving. Chinook may continue to enter the river and spawn into January (Figure 1-3) (S. White, SCWA, pers. comm., 1999).

Unlike steelhead and coho, the young chinook begin their outmigration soon after emerging from the gravel. Freshwater residence, including outmigration, usually ranges from two to four months, but occasionally chinook juveniles will spend one year in fresh water. Chinook move downstream from February through May (Figure 1-3). Ocean residence can be from one to seven years, but most chinook return to the Russian River as two to four-year-old adults. Like coho salmon, chinook die soon after spawning.



(EIP Assoc. 1993, SCWA 1996, SWRCB 1997, RMI 1997, S. White, SCWA, pers. comm. 1999).

Figure 1-3 Phenology of Chinook Salmon in the Russian River Basin

1.4 GENERAL DESCRIPTION AND BACKGROUND

SCWA is the provider of potable water for approximately 550,000 people in Sonoma County and portions of Marin County. Since its creation in 1949, SCWA's role as a water supplier has evolved into the two following primary responsibilities.

> Operation of the Russian River Project: As the local sponsor for the two federal water supply/flood control reservoir projects in the Russian River watershed (Coyote Valley Dam/Lake Mendocino, and Warm Springs Dam/Lake Sonoma), SCWA, under operational agreements with the USACE, manages the water supply storage space in these reservoirs to optimize the water supply yield of the system and maintain flows in the Russian River and Dry Creek. SCWA holds water rights permits to divert[1] Russian River and Dry Creek flows and re-divert[2] water stored and released from these water supply reservoirs.

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[1] Divert - refers to water diverted directly from streamflows into distribution systems or reservoirs.
[2] Re-divert - refers to water that has been diverted to storage in a reservoir, then released and diverted again at a point downstream.

> Operation of the water transmission system: Downstream of Lake Mendocino and Lake Sonoma, SCWA diverts and delivers wholesale water to its customers through its water transmission system. The water transmission system consists of diversion facilities, treatment facilities, pipelines, water storage tanks, booster pump stations, and groundwater wells.

SCWA is responsible for the operation of the water transmission system through an existing water supply agreement between itself and eight cities and water districts in Sonoma County and northern Marin County, collectively referred to as the water contractors.[3] This agreement, titled "Tenth Amended Agreement for Water Supply and Construction of Russian River-Cotati Intertie Project" (Tenth Amended Agreement), executed in 1974 and most recently amended in 1997, provides the authority for the financing and construction of diversion facilities, transmission lines, storage tanks, booster pumps, conventional wells, and any appurtenant facilities necessary to meet peak month deliveries at an average of 92 million gallons per day (mgd). In addition, the Tenth Amended Agreement requires that SCWA provide 20 mgd of standby capacity, which would allow SCWA to meet currently authorized water deliveries during periods when existing facilities are out of service (i.e., routine maintenance, equipment failure, system failures caused by earthquakes, floods, power outages, or other emergencies). These facilities are all elements of the Russian River to Cotati Intertie Project, which was approved by SCWA's Board of Directors in 1974. The Environmental Impact Report (EIR) was certified in December 1998.

Expansion of the existing water transmission system was approved by SCWA's Board of Directors in December 1998, with the Water Supply and Transmission System Project (WSTSP). The WSTSP's objective is to provide a safe, economical, and reliable water supply to meet the defined future needs in the SCWA service area. The three components of the proposed WSTSP include: 1) implementation of water conservation measures that would result in the savings of approximately 6,600 acre-feet per year (AFY) and expansion of the water education program; 2) increasing the amount of water diverted from the Russian River (a combination of re-diversion of stored water and direct diversion of winter flow) by 26,000 AFY, thereby increasing the total amount of diversion from 75,000 AFY to approximately 101,000 AFY; and 3) increasing the transmission system capacity by 57 mgd, thereby increasing the total capacity of the transmission system from 92 mgd to 149 mgd.

The Tenth Amended Agreement has been revised to provide the authority for financing and construction of water transmission facilities necessary to meet peak month deliveries at an average of 149 mgd, as identified in the WSTSP. The revised agreement, the "Eleventh Amended Agreement for Water Supply" (Eleventh Amended Agreement), would not increase the required standby capacity from 20 mgd. The Eleventh Amended Agreement has not been approved by all of the parties to the agreement to date.

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[3] The eight water contractors are the cities of Cotati, Petaluma, Rohnert Park, Santa Rosa and Sonoma; and the Forestville, North Marin, and Valley of the Moon water districts.

1.5 COMPONENTS OF THE SCWA WATER SUPPLY AND TRANSMISSION SYSTEM

1.5.1 WATER SUPPLY STORAGE RESERVOIRS

Three major reservoir projects provide water supply storage for the Russian River watershed: Lake Pillsbury on the Eel River, Lake Mendocino, and Lake Sonoma. Water imported from the Eel River augments streamflow in the Russian River during the summer months. Streamflows are also augmented by releases from Lake Mendocino and Lake Sonoma (Figure 1-4).

1.5.1.1 Lake Pillsbury and Potter Valley Project

This subsection is provided as background information for this interim report. Lake Pillsbury and the Potter Valley Project (PVP) are being addressed in a separate Section 7 Consultation between NMFS and the Federal Energy Regulatory Commission (FERC) (NMFS 2000a).

In 1908, W.W. Van Arsdale and the Eel River Power & Irrigation Company (later the Snow Mountain Power Company) completed construction of Cape Horn Dam and Van Arsdale Reservoir on the Eel River in Mendocino County, along with a diversion tunnel that led from the Eel River through the mountains to the East Fork Russian River (see Figure 1-4). The 450-foot drop in elevation between the Eel River and the East Fork Russian River is used to generate electrical energy at the Potter Valley Power Plant, located approximately 25 miles northeast of the City of Ukiah.

By 1921, Van Arsdale Reservoir had substantially filled with silt. At this time, Scott Dam was constructed upstream on the Eel River, forming Lake Pillsbury. Scott Dam is a concrete gravity dam that captures the drainage from an area of 298 square miles. Lake Pillsbury began storing water in December 1921 and had an original gross storage capacity of 94,400 acre-feet. However, based on bathymetric (water depth) surveys conducted by the U.S. Geologic Survey in 1959 and 1984, sedimentation in the intervening period has reduced the lake's gross storage capacity to an estimated 1998 value of 76,824 acre-feet. Lake Pillsbury has a surface area of 2,280 acres at the normal maximum pool elevation of 1,828 feet above mean sea level (MSL). Water is released from Lake Pillsbury to the Eel River, then diverted 12 miles downstream at Cape Horn Dam to the Potter Valley Power Plant through the diversion tunnel. The water then flows through Potter Valley in the East Fork Russian River to Lake Mendocino.

Since 1908, diversions from the Eel River have been used to generate power, irrigate agricultural land in Potter Valley, and augment summer flows in the Russian River. All of the facilities described above, including Scott Dam and Lake Pillsbury, Cape Horn Dam and the diversion tunnel, and the Potter Valley Power Plant, comprise the PVP. The Pacific Gas and Electric Company (PG&E) purchased the PVP in September 1929.

The quantity of water that can be diverted to PG&E's Potter Valley Power Plant is affected by the releases required to maintain the fishery in the Eel River. The release schedule is included in the Federal Energy Regulatory Commission (FERC) license for the PVP. PG&E also has an agreement with the U.S. Forest Service to maintain high reservoir levels in Lake Pillsbury until Labor Day of each year for recreational use. From 1922 to 1992, diversions to the Russian River watershed averaged 159,000 AFY.

Significant changes to the release criteria and minimum flow provisions in the 1983 FERC permit for the PVP have been proposed by various parties, including PG&E, Department of the Interior/NMFS, SCWA, Round Valley Indian Tribe, and others. The proposed changes are the subject of an Environmental Impact Statement (EIS) prepared by FERC. If implemented, any of the action proposals would significantly reduce the quantity of water diverted to the Russian River Basin via the PVP.[4]

1.5.1.2 Lake Mendocino

Lake Mendocino, located approximately 3 miles east of the City of Ukiah, is the major feature of the USACE Coyote Valley Dam Project (CVDP). Lake Mendocino is impounded by Coyote Valley Dam, located on the East Fork Russian River, 0.8 mile upstream of the East Fork Russian River's confluence with the Russian River (Figure 1-5). Coyote Valley Dam is a rolled earth embankment dam with a crest elevation of 784 feet above mean sea level (MSL), which is 160 feet above the original streambed. Lake Mendocino, which began storing water in 1959, has a capacity of 122,400 acre-feet (AF) at the spillway crest elevation of 764.8 feet above MSL, and captures a drainage area of about 105 square miles. A bathymetric (water depth) study in 1985 (SCWA and USGS 1985) indicated that the storage capacity was 118,900 acre-feet, a difference of 3,500 acre-feet. The water supply pool capacity of Lake Mendocino, which was originally 72,300 acre-feet, has been reduced by sedimentation to about 69,000 acre-feet[5]. The remaining capacity of over 69,000 AF is used for flood control (see Figure 1-4). SCWA and the MCRRFCD share state water rights permits to store up to 122,500 AFY in the reservoir. SCWA determines releases to be made from the water supply pool; however, when the water level rises above the top of the water supply pool (seasonally between elevations 737.5 feet and 748 feet above MSL) and into the flood control pool, USACE determines releases. USACE also determines releases during inspections and during maintenance and repair of the project.

During the rainy season (October through May), natural streamflow (rather than reservoir releases) accounts for most of the flow of the Russian River. From June through September, however, the natural flow in the Russian River downstream of Coyote Valley Dam and above Dry Creek is augmented by water that is imported from the Eel River via the PVP and stored in Lake Mendocino.

1.5.1.3 Lake Sonoma

Lake Sonoma is impounded by Warm Springs Dam at the confluence of Warm Springs Creek and Dry Creek, about 10 miles northwest of the City of Healdsburg (Figure 1-4). Warm Springs Dam is a rolled earth embankment dam with a crest elevation of 519 feet above MSL, which is 319 feet above the original streambed. Lake Sonoma began storing water in 1982 and became fully operational for water supply in 1984.

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[4] The impacts of the proposed changes and a description of related proceedings are described in more detail in *Interim Report 3: Instream Flow Requirements*.

[5] For the purposes of reporting, SCWA uses the storage/capacity table developed in the 1985 bathymetric survey. However, the USACE continues to use the original storage/capacity table. Consequently, discrepancies will appear in reservoir storages reported by SCWA and USACE. All storage volumes discussed in this report are the 1985 bathymetric survey values reported by SCWA.

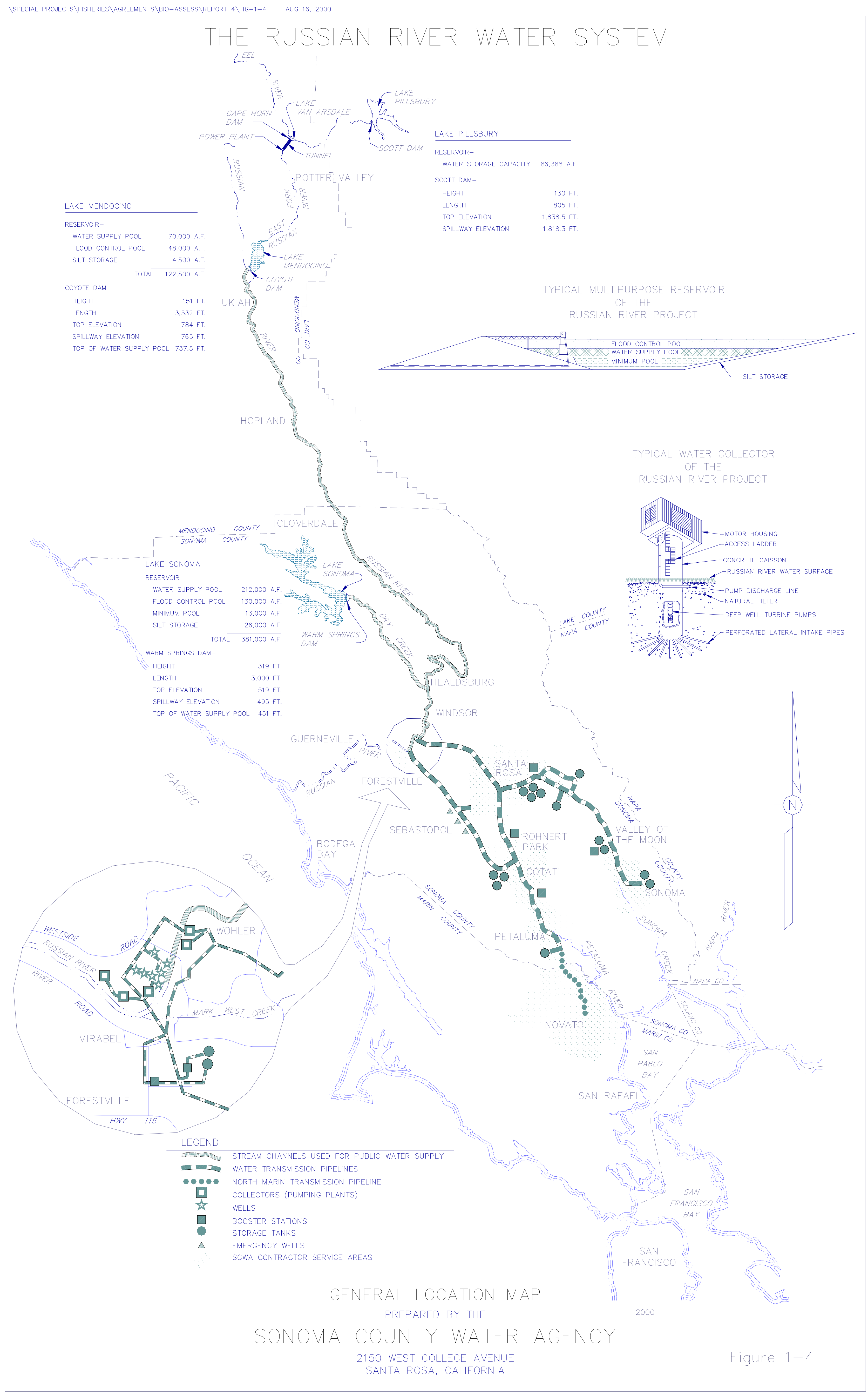

Figure 1-4 The Russian River Water System – General Location Map

Lake Sonoma has a gross capacity of 381,000 acre-feet at the spillway crest elevation of 495 feet above MSL and captures a drainage area of about 130 square miles. Under a contract with the federal government, SCWA has a right to the 212,000 acre-feet of water supply storage space in Lake Sonoma. As with Lake Mendocino, SCWA determines the rate of release of water from the water supply pool in Lake Sonoma (Figure 1-4). USACE determines releases when the water level rises above the top of the water supply pool (elevation 451 feet above MSL) and into the flood control pool. USACE, in consultation with SCWA, SWRCB, NMFS and other regulatory agencies, determines releases during inspections, maintenance and repairs of the project scheduled outside of the flood control season.

Water from Lake Sonoma storage is released to augment flows in the Russian River for re-diversion by the SCWA water supply system. Generally, this occurs when flows are normally low and water demand is high (summer). The water quality of the outflow, including temperature, dissolved oxygen, and turbidity, are managed by mixing water from two of the three low-flow tunnels that draw water from different levels of Lake Sonoma. The selection of water intake levels from Warm Springs Dam is determined by USACE in coordination with CDFG to meet the water quality needs of the fish hatchery. This controls the water quality of releases to Dry Creek as well. Turbidity levels in the deeper levels of the lake, from the flood control tunnel, are too high to be used in the hatchery. The portal nearest to the lake's surface is out of service and can not be used. Only the two intermediate portals are typically used to provide water for the hatchery and for downstream releases. USACE data for dam outlet temperatures for Warm Springs Dam from January through November of 1999 demonstrates the ability to draw water from deeper, cooler depths of Lake Sonoma, which keeps the outlet temperatures cooler during summer months (Figure 1-5). Analysis of water quality effects from the operation of Warm Springs Dam will be in the draft and final BA.

Water quality, including turbidity, suspended sediment concentrations, temperature and dissolved oxygen, has been monitored at the Don Clausen Fish Hatchery twice every month for as long as the hatchery has been in operation. Because dissolved oxygen measurements are taken near the hatchery's aeration ponds, these records may not indicate the level of dissolved oxygen from the outflow of the dam to the creek. However, they give a good indication of turbidity.

Seasonal temperature requirements of water delivered to the fish hatchery range from 52-55°F (11.1-12.7°C) during October through April and 55-58°F (12.7-14.4°C) from May to September. It is estimated that only during the year of maximum drawdown, or about once in fifty years, will the reservoir be unable to provide water that meets hatchery temperature requirements, based on current water rights (USACE 1998).

1.5.2 Russian River Project, Instream Flow Requirements, and SCWA Water Rights

Lake Sonoma and Lake Mendocino, collectively referred to as the Russian River Project, are operated in accordance with criteria established by the SWRCB's 1986 Decision 1610 (Decision 1610) which established instream flow requirements for Dry Creek and the Russian River (Figure 1-6). Decision 1610 adopted (with one minor change) the criteria included in an

Box Plot Section

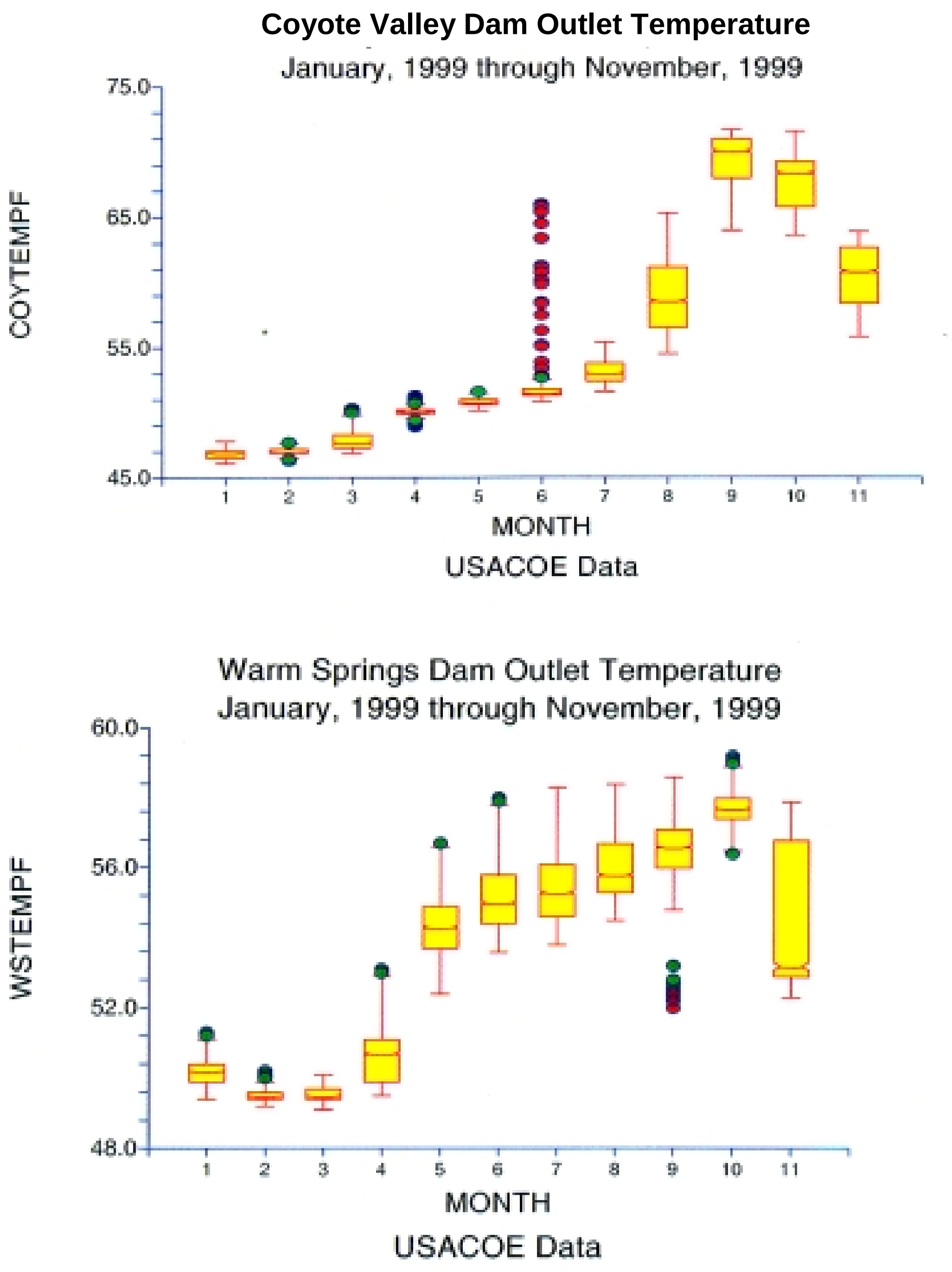

Figure 1-5 Outlet Temperatures for Warm Springs Dam for 1999

The box plot encompasses the 25th through 75th percentiles. The 5th and 95th percentiles are shown as symbols below and above the 10% and 90% caps. Data outside the 10th and 90th percentiles are also shown.

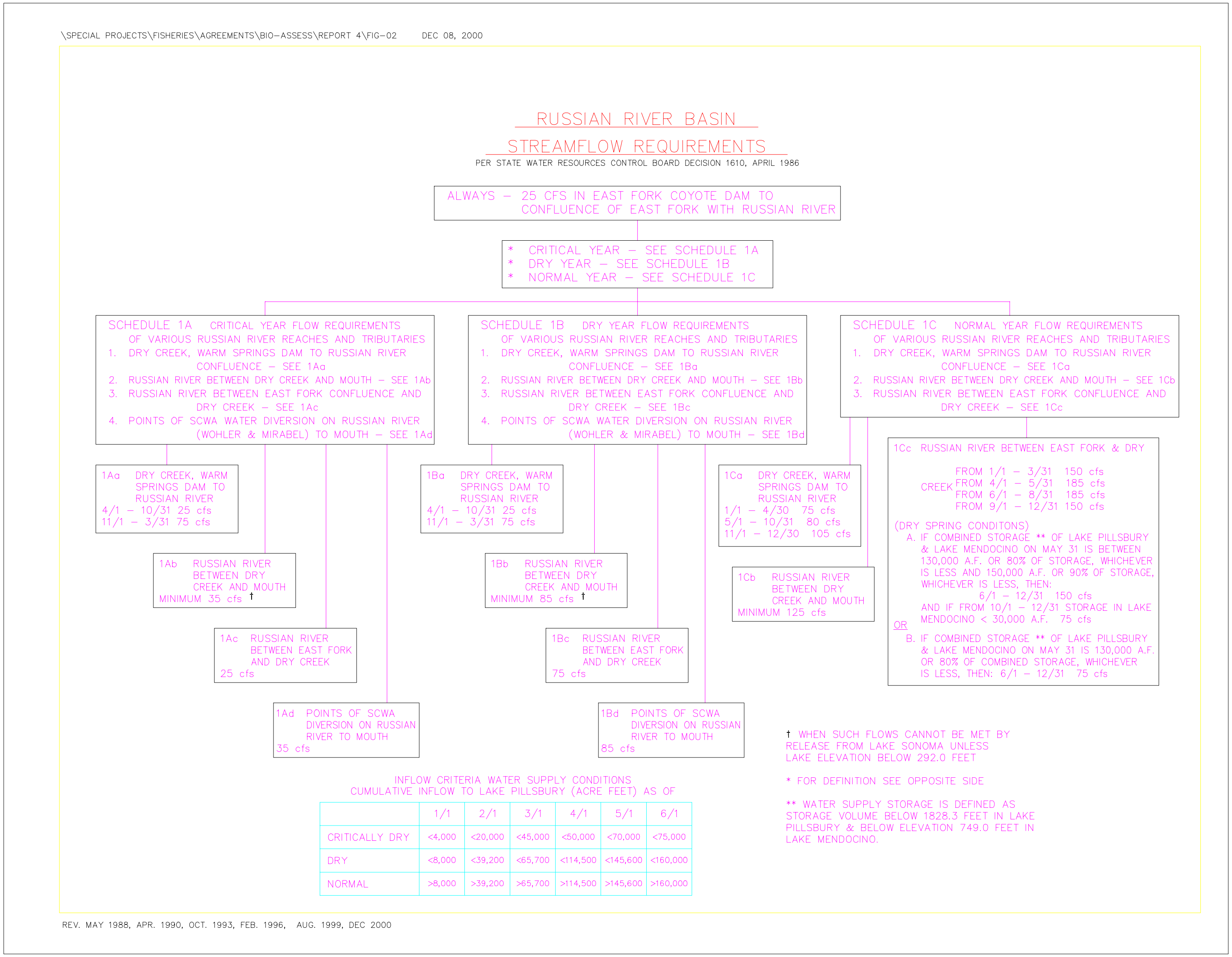

Figure 1-6 Russian River Basin Streamflow Requirements

agreement between the CDFG and SCWA. The examination of instream flow and related habitat in Dry Creek and the Russian River are provided in a separate interim report (*Interim Report 3: Instream Flow Requirements*).

The instream flow requirements for the Russian River upstream from the Dry Creek confluence were based primarily upon intent to maintain the historic post-CVDP flows. SCWA makes no diversions from the Russian River between Lake Mendocino and the Russian River's confluence with Dry Creek but does authorize diversions by others under its water rights permits. The instream flow requirements (for the Lake Mendocino to Dry Creek reach of the Russian River) were set with the assumption that all the water supply available from Lake Mendocino would be available to satisfy instream flow needs between Lake Mendocino and Dry Creek and expected diversions along this reach of the Russian River. The instream flow requirements for this reach were limited only by the mutual interests of SCWA and CDFG to avoid dewatering Lake Mendocino.

The instream flow requirements for the Russian River downstream from its confluence with Dry Creek during normal water supply conditions were based primarily on an interest to maintain flows for the substantial recreational canoeing industry on the Russian River that developed since the dams became operational. The reduced instream flow requirements for dry and critical water supply conditions were determined in consideration of warmwater fish and wildlife needs, since the lower portion of the Russian River is too warm to provide optimum rearing habitat for steelhead and salmon (CDFG 1991).

The instream flow requirements for Dry Creek were based upon an extensive instream flow needs investigation performed by CDFG in 1975 and 1976. These requirements meet the fish spawning, passage and rearing needs as determined by CDFG in 1985.[1] These flows are designed to sustain the native fish populations below Warm Springs Dam, to provide an enhanced steelhead and salmon spawning and nursery habitat in Dry Creek, and to facilitate the Don Clausen Fish Hatchery operations.

SCWA determines releases from the water supply pool from the Coyote Valley Dam and Warm Springs Dam projects under water rights issued and modified by the SWRCB in Decision 1030, adopted on August 17, 1961; Decision 1416, adopted on March 15, 1973; Order WR 74-30, adopted on October 17, 1974; Order WR 74-34, adopted on November 21, 1974; and Decision 1610, adopted on April 17, 1986.

Among the provisions contained in water rights permits are terms limiting rates of direct diversion and re-diversion. Direct diversion refers to water diverted directly from streamflows. Re-diversion refers to water that has first been diverted to storage in a reservoir, then later is released and re-diverted at a point downstream. The proportions of water diverted and re-diverted in any water year vary widely and depend on the amount of runoff and water demand.

SCWA is currently authorized to divert and re-divert a total of up to 92 mgd and 75,000 AFY from the Russian River, at a maximum rate of 180 cubic feet per second (cfs). Under the

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[1]Stipulation by Sonoma County Water Agency and State of California Department of Fish and Game, March 8, 1985.

WSTSP, SCWA is proposing to increase total diversions and re-diversions to maximum amounts of 101,000 AFY, and expand and revise operation of the water transmission system to 149 mgd.

Additional information regarding instream flow requirements may be found in *Interim Report 3: Instream Flow Requirements. Interim Report 3* also analyzes the potential effects of instream flow releases.

1.5.3 Transmission System Facilities

Downstream of Lake Mendocino and Lake Sonoma, the SCWA diverts and delivers wholesale water to its customers through its water transmission system. SCWA's water transmission system includes diversion and treatment facilities at the Russian River; a distribution system comprised of pipelines, storage tanks, pumps; and groundwater wells. This system conveys water from the diversion facilities on the Russian River to service areas in Sonoma County and in northern Marin County. The locations of SCWA's existing transmission system facilities are shown in Figures 1-7 and 1-8. Each of these system components is described below and categorized as diversion facilities, distribution facilities, or treatment facilities. The descriptions are also divided into operations and maintenance activities for existing facilities. The diversion, distribution, and treatment facilities are presented in three sub-categories including existing, remaining authorized, and proposed facilities. Existing facilities are those that have been previously constructed and are currently in operation. Remaining authorized facilities are those facilities that are elements of the Russian River to Cotati Intertie Project and authorized by the Tenth Amended Agreement, and are under construction or scheduled for construction in the near future. Remaining authorized facilities are not yet constructed, but are needed to meet existing demands. Proposed facilities are those facilities identified in the WSTSP that will be needed to serve future demands, and expand the capacity of the existing transmission system.

1.5.3.1 Existing Diversion Facilities – Operation

SCWA’s diversion facilities along the Russian River are located in the Wohler and Mirabel areas, on SCWA property. Facilities in this area are shown on Figure 1-8, and an aerial view is shown on Figure 1-9. The SCWA operates five Ranney collector wells adjacent to the Russian River near Wohler Road and Mirabel, which extract groundwater from the aquifer beneath the streambed. Each Ranney collector well consists of a 13-foot diameter caisson (i.e., concrete cylinder) extending 80 to 100 feet deep into the streambed gravel (Figure 1-10). Perforated horizontal intake pipes extend radially from the bottom of each caisson to a maximum of 175 feet into the aquifer. Each collector well houses two vertical turbine pumps which are driven by 1,000 to 1,250 horsepower (hp) electrical motors (Figure 1-11).

The ability of the Russian River aquifer to produce water is generally limited by the rate of recharge to the aquifer through the streambed near Mirabel and Wohler. To augment this rate of recharge, the SCWA has constructed several infiltration ponds. A water-filled inflatable dam is located on the Russian River just upstream of the Mirabel area. When the dam is inflated, it raises the water level and submerges the intakes to three diversion pumps. The water is pumped through pipes in the levee adjacent to the river into a lined ditch, which conveys water to four infiltration ponds. The backwater created by the inflatable dam also raises the upstream water level. This increased water level allows SCWA to flood two infiltration ponds in the Wohler

Figure 1-7 Existing and Proposed Transmission System Facilities

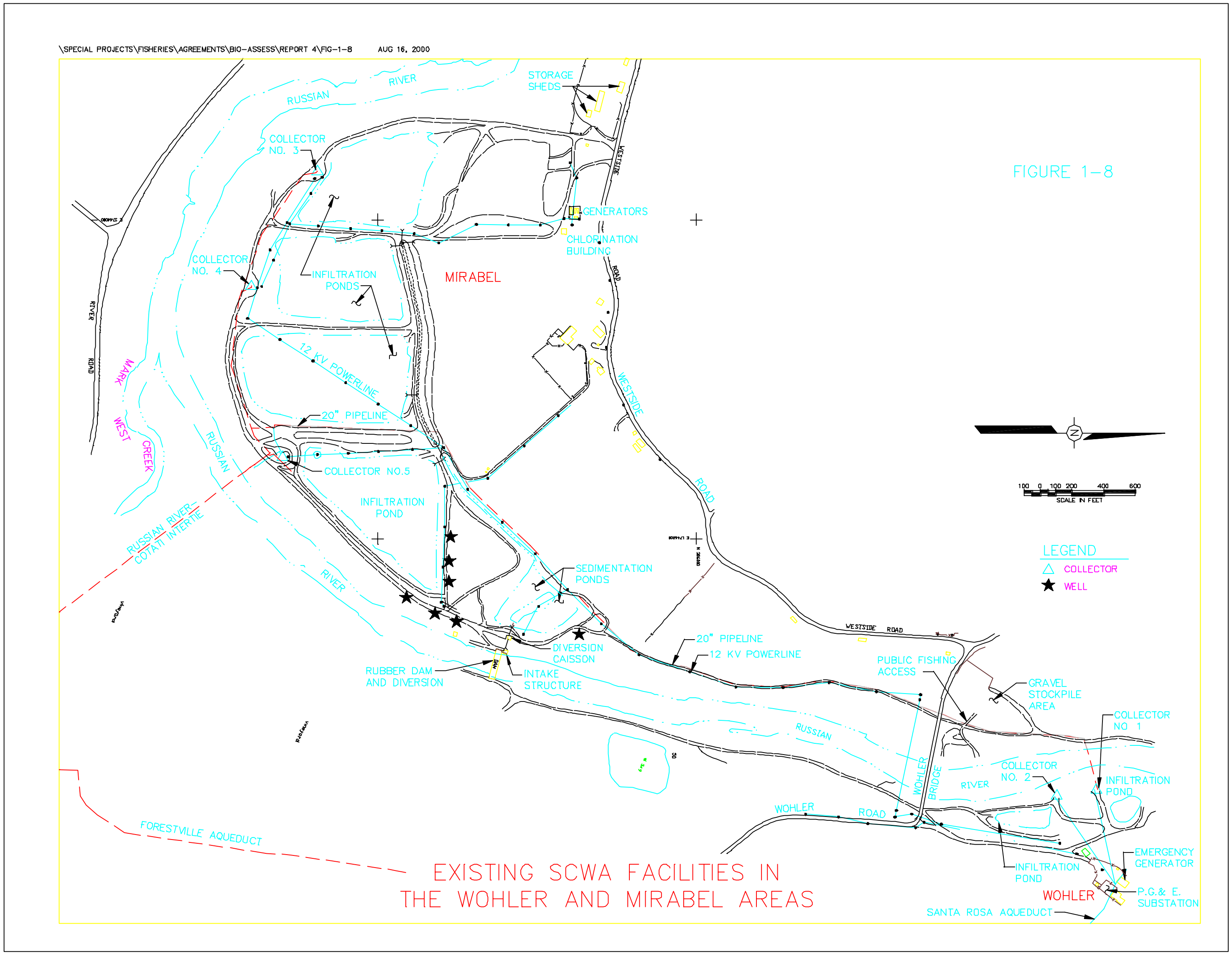

Figure 1-8 Existing SCWA Facilities in the Wohler and Mirabel Areas

Figure 1-9 Aerial Photograph of the Wohler and Mirabel Areas

Figure 1-10 Typical Russian River Ranney Water Collector

Figure 1-11 Photograph of Typical Mirabel Collector Pumphouse

area. The flow of water to these ponds is controlled by slide gates at the entrance of the ditches serving each pond. The backwater created by the dam submerges a larger streambed area along the river, which increases water depth and submerged area. This significantly increases infiltration to the aquifer, and increases the yield of all five Ranney collector wells.

Inflatable Dam Operation

Figure 1-8 shows the location of the inflatable dam. The inflatable dam is fabricated of a synthetic rubber material and is attached to a concrete foundation in the riverbed. When inflated, the dam is approximately 11 feet in height. At the intake structure to divert water for the infiltration ponds, water is drawn through two rotating-drum fish screens to the diversion caisson. A cross-section of the Wohler diversion is included in Figure 1-12, and the diversion intake structure at the inflatable dam is identified on Figure 1-13. The diversion caisson houses three pumps capable of pumping a total of 100 cfs to the infiltration ponds. Diversion rates to the infiltration ponds are based on demands on SCWA's water supply and transmission system. After flowing through a sedimentation pond adjacent to the diversion caisson, diverted water enters a small open channel, which distributes water to each infiltration pond through manually operated slide gates.

Table 1-2 shows the dates that the inflatable dam was raised or lowered, and the corresponding river flows, between 1978 and 1998. During this period, the average river flow at the Hacienda gage is approximately 560 cfs, when the dam is raised and lowered. Because of increasing water demands, SCWA has had to raise the dam at higher river flows. In general, the river flows are declining when the dam is raised, and rising when the dam is lowered. The average number of months the dam is inflated is slightly under seven. Under some spring conditions, when demands were rising sharply, the dam has been raised when flows are between 1,000 and 2,000 cfs.

The inflatable dam is equipped with a Denil-style fish ladder near the riverbank on each side of the dam, both of which are in operation when the dam is raised. When the dam is deflated, it does not impede migration or create a backwater (Winzler and Kelly 1978). An example of a Denil fish ladder is shown in Figure 1-14. Each fish ladder can allow approximately 40 cfs of flow through the ladder. Two 24- to 36-inch bypass pipelines provide water at each of the fish ladder entrances to attract adult fish to the ladder. Each bypass pipeline can allow approximately 22 cfs of flow through the pipeline. In 1999, flows through the bypass pipeline on the east side of the river were decreased to enhance fish passage through the east side fish ladder. The bypass line produces turbulent flow at the downstream entrance of the east side fish ladder. Decreasing the flow in the bypass pipeline has decreased this turbulence which has enhanced the function of the fish ladder. SCWA staff plans to modify the east side bypass pipeline so that it can be operated at its 22-cfs capacity without creating turbulence at the mouth of the east side fish ladder. The west side bypass line and fish ladder function properly.

Diversion Structures and Infiltration Ponds Operation

During a portion of the year, surface water is diverted into infiltration ponds to increase water production. The existing infiltration ponds at Mirabel cover approximately 40 acres, and water is supplied by a pumped diversion at the inflatable dam. Two more ponds (1.7 acres combined) near the Wohler collectors can be filled when the inflatable dam raises the river water surface.

Figure 1-12 Cross-Section of the Wohler Diversion

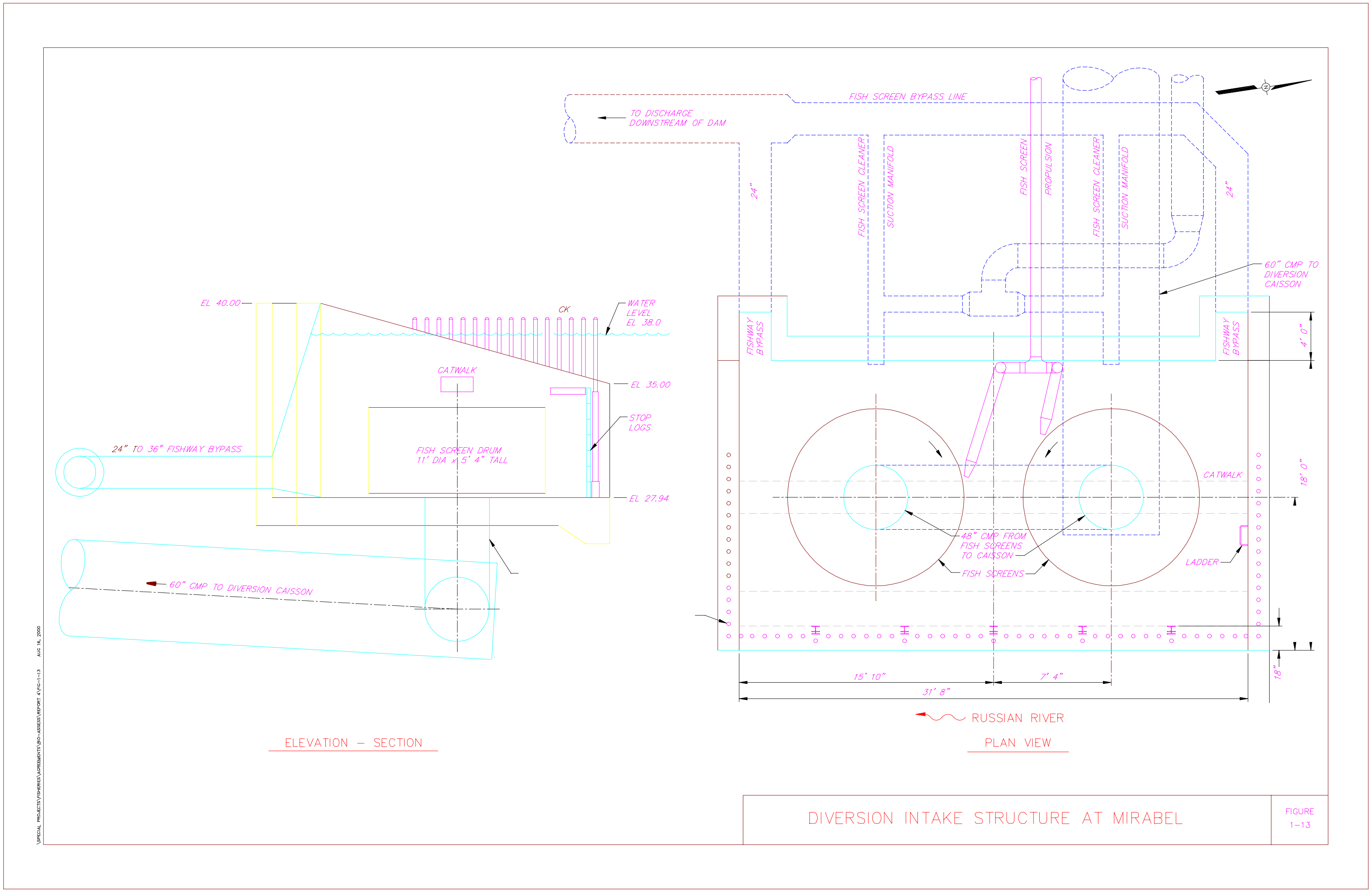

Figure 1-13 Diversion Intake Structure at the Inflatable Dam

Figure 1-14 Typical Denil Fish Ladder

Table 1-2 Inflatable Dam Operation History

Table 1-2 Inflatable Dam Operation History (continued)

Each year at the Wohler diversion, a screen constructed out of metal T-posts and ¼-inch hardware cloth is installed in front of the inlet into the Wohler infiltration ponds. Flows diverted into the Wohler ponds are not measured. At the Mirabel intake structure, water is drawn through two rotating-drum fish screens to the diversion caisson. Flows through the Mirabel screens can be up to 100 cfs. The existing fish screens for the Mirabel pumped diversions were constructed in 1976 as part of the overall diversion facilities, which included the inflatable dam foundation, inflatable dam fabric, diversion caisson and other related equipment.

The fish screens at Mirabel are 11 feet in diameter, 5 feet 4 inches high, and rotate with a vertical axis. The top portion of the screen, which is submerged and screened, has a different configuration than the rest of the screen in that it is horizontal rather than vertical. The screen open area is not available. The screen opening size is 5/32 inch. The diversion pumps are capable of pumping a total of 100 cfs through the screens. The fish screens are submerged on the west side of the river in a side structure (pool), and when in operation, appear to have little variability in hydrologic conditions. The water surface elevation ranges from 37 to 40 feet msl, and 37 to 38 feet msl during normal summer operation. A vertical fixed brush cleans the screen of debris and biological fouling as the screens rotate..

The velocity vector of the flow in a canal on a fish screen is broken into two components, the approach velocity and the sweeping velocity. The approach velocity is the component that is perpendicular to the screen, and the sweeping velocity is the component that helps fish move along the screen face. Field measurements were taken to evaluate the performance of the screens in June of 2000 (Borcalli & Assoc., Inc 2000). The rate of diversion during the test was 100 cfs, and the amount of water flowing through both bypass inlets simultaneously was estimated to be 18.5 cfs. The approach velocities at the Mirabel screens average 0.18 feet per second (fps) at the downstream screen and 0.41 fps at the upstream screen. Field data indicate that large portions of the screens have approach velocities below 0.45 fps, and some areas have negative approach velocity values, indicating flows away from the screen (Borcalli & Associates 2000). There are small areas along the screens where approach velocities are higher, up to 0.95 fps. The screens rotate, while these "hot spots" remain in a stationary position. Average sweeping velocity was 1.04 fps at the upstream screen and 0.45 fps at the downstream screen. Some sweeping velocity is created as the screens turn. Test results indicate that the majority of flow is pulled through the upstream screen. Table 1-3 presents critical operating parameters for the Mirabel fish screens.

Table 1-3 Critical Operating Parameters for Mirabel Fish Screens

Water surface elevation	Ranges from 37' msl to 40'msl; 37' to 38' msl during normal summer operations.
Net equivalent screen area	345.6 square feet
Screen open area	40% (Calculated from construction drawings.)
Approach velocity	Upstream screen: Average 0.41 fps Downstream screen: Average 0.18 fps
Sweeping velocity	Upstream screen: Average 1.04 fps Downstream screen: Average 0.45 fps
Screen opening size (square openings)	5/32 inch diameter and 7/32 inch staggered center spacing (per original construction drawing)

The drum screens were originally constructed with hydraulically driven motors to rotate the drums past the vertical fixed brush, which keeps the screens free of silt and other debris. In 1995, after a leak occurred in one of the hydraulic lines, the hydraulic motors were removed and replaced with a water-jet drive system. A small water jet drives paddle blades attached to the top of the screen to rotate the screens. SCWA maintenance staff has also found that the river current itself is often adequate to rotate the screens without assistance from the water-jet drive. The suction manifold is connected to the screen bypass lines, as shown in Figure 1-13.

The levees surrounding the infiltration ponds at Wohler and Mirabel are sometimes overtopped during floods, trapping fish in the ponds after the river level recedes. At Mirabel, this occurs only when the river rises to a gauge level of approximately 37.7 feet or 3 feet above its flood level (as measured at the Hacienda Bridge). Prior to overtopping of the Mirabel pond levees, culverts are opened to allow water to enter the ponds. Back flooding of the Mirabel ponds reduces damage to the levees from overtopping. The culverts, which are built through the levee of Mirabel pond No. 3, are typically opened at approximately 36 feet as measured at the Hacienda Bridge. Wohler pond 1 is overtopped when the river rises to a gauge level of approximately 18.3 feet (as measured at the Hacienda Bridge) or 12,700 cfs and Wohler pond 2 at 17.3 feet or approximately 10,600 cfs. Both of the Wohler ponds have flooded for extended periods of time during most winters.

Prior to 1996, the CDFG informally conducted post-flooding fish rescue efforts at Wohler and Mirabel facilities as needed. SCWA assumed responsibility for fish rescue efforts with the establishment of its Fisheries Enhancement Program in 1996. Fish rescues are accomplished by wading the ponds with beach seine nets after pond levels drop to a depth where wading is possible. In 1998, to improve the success of fish rescues and the survival of trapped fish, the infiltration ponds at Mirabel were graded to drain towards a shallow channel excavated along one edge of each pond, which in turn was graded to drain to a sump at one end. Prior to this change, the pond levels would sometimes drop too quickly after a flood to allow all fish to be rescued, stranding trapped fish in warm shallow water. The channel provides a refuge area of somewhat deeper, cooler water when the ponds drop to low levels. The grading also simplified the fish rescue operation by concentrating fish in a smaller area.

In addition to the infiltration ponds, the SCWA augments infiltration capacity by periodically scraping gravel bars in the river in the area of diversion to increase infiltration in the river. The gravel bars are graded to lower the level of the streambed so that the area is flooded when the inflatable dam is raised. SCWA currently conducts grading at four bars in the Mirabel and Wohler areas. Three of the bars are upstream of the inflatable dam and are referred as the Bridge Bar, Wohler Bar, and McMurray Bar. The bar at Mirabel is the Mirabel Bar. Future changes in gravel bar formations may require grading in additional locations. These would likely be located between the proposed Caisson 6 and Caisson 3.

Gravel bar skimming operations are performed on the Wohler, McMurray and Bridge gravel bars in the spring of each year when stream flows drop below approximately 800 cfs, and before the dam is inflated. The time at which this work is performed varies, depending on the flow in the river and demands on the water system, but the work is generally performed between March and July. The Mirabel gravel bar is skimmed between July and October, depending on flow conditions.

Gravel at these locations is generally pushed up on the bank using bulldozers and scrapers, and sometimes it is removed and stockpiled. The largest of these bars (McMurray Bar) forms approximately 2,000 feet upstream of the Wohler Bridge near the mouth of Porter Creek. At flows above 800 cfs, the McMurray Bar is not accessible. It currently can not be accessed because the river has cut a secondary channel between it and the northern bank. When the water level in this secondary channel drops below about 3 feet at the crossing point, equipment can be moved out onto the bar to conduct grading operations. The Bridge Bar is located on the north (Mirabel side) bank of the river near the Wohler Caissons. A second smaller bar located near the SCWA's Mirabel collectors is also skimmed each year. The Wohler grave bar is located on the eastern shore of the Russian River near Caisson Number 1. Gravel at this bar is either pushed into piles along the banks, or is removed from the bar using scrapers and placed in a stockpile located between Caisson 2 and Wohler Bridge. The Mirabel Bar is located near Caisson 3 on the northern side of the Russian River. Gravel from this bar is removed, using bulldozers and scrapers, and placed in a stockpile north of infiltration pond number 1. Gravel from both the Mirabel and Wohler stockpiles are removed by gravel contractors.

The spoils from the gravel bar grading operations are mounded in the riverbed, and in some cases are relocated/stockpiled outside of the floodplain. The sediment size varies from year to year but is generally fine material. The operation is done during the dry season (e.g., July in 1999), and, if necessary, a dike is built to keep water out of the work area. The dike is breached to let water in once the sediment is removed.

The area and volume of sediment removed from the gravel bars varies from year to year. In the summer of 1999, about 6,500 cubic yards of gravel were removed in the Mirabel area and in 1998 approximately 1,650 cubic yards. In 1999 in the Mirabel area, two D-6 Cats, a motor grader, and a water truck for dust control were used. The equipment entered the bar from the west bank.

The following best management practices (BMPs) for gravel bar grading operations will be implemented and evaluated by SCWA during a five year monitoring study (SCWA 2000):

- Biological oversight is provided by fisheries biologists. Agency biologists inspect the gravel bars prior to beginning gravel skimming work to 1) evaluate the need for silt fences, and 2) identify environmentally sensitive areas.

- Permanent vegetation on the riverbanks is not removed.

- Sediment fences are employed to prevent the input of sediment into the river.

- Coffer dams are constructed both upstream and downstream of the work areas, if necessary, to allow access to the work areas.

- Operation of heavy equipment in the active stream channel is limited to moving equipment to and from the mid-channel gravel bars, and is very short in duration. All equipment is removed from the gravel bars at the end of each day.

- No fueling or equipment service is performed on the gravel bars.

- Gravel skimming operations are limited to material above the waterline.

- After gravel bar grading operations are completed, gravel bars are contoured to an approximately 2 percent grade to reduce the potential for stranding fish.

- Continuously recording turbidity meters are installed upstream and downstream of gravel bar grading operations.

- Breaching of the lower berm is conducted late in the evening or early in the morning to reduce visual impacts to recreational visitors to Steelhead Beach.

1.5.3.2 Existing Distribution System – Operation

Figure 1-7 shows the location of the pipelines (also referred to as aqueducts and interties), storage tanks, booster pump stations, and groundwater wells on the SCWA water transmission system. The pipeline system is designed to carry the anticipated average daily demand during the month of maximum demand (peak month), usually July or August. Peak demand on the water transmission system reached a maximum average monthly demand of approximately 81 mgd in July 1999.

The original pipeline system (consisting of the Santa Rosa Aqueduct, the Petaluma Aqueduct, and the Sonoma Aqueduct) was constructed in the late 1950s and the early 1960s. The two collector wells at Wohler provided the water supply to this original system. In the mid-1970s, demands in the service area increased, and the Russian River-Cotati Intertie pipeline and the three collector wells at Mirabel with connecting pipelines and additional storage tanks were authorized by the SCWA's water contractors. The Russian River-Cotati Intertie pipeline and two collectors were constructed immediately, and most of the remaining facilities were constructed in subsequent years.

Collector Wells

Ten vertical turbine pumps, two installed in each of the five Ranney collectors, provide the primary pumping for the distribution system. Each pump at Wohler is rated to deliver up to 10.0 to 11.5 mgd, and at Mirabel each pump is rated to deliver up to 10.0 to 14.5 mgd; although the highest pumping rates cannot be sustained on a continuous basis. The pumping capacity of each of the collectors is heavily dependent on the current storage and pumping status of other water transmission components. For example, one Wohler pump operating by itself will produce about 11 mgd, three pumps operating at Wohler produce about 27 mgd, and four pumps produce a total of about 30 mgd. Figure 1-15 provides a summary of annual water production by the SCWA since it first began operation in 1959.

Groundwater Wells

The SCWA system includes three groundwater wells located along the Russian River-Cotati Intertie pipeline at Occidental Road, Sebastopol Road (Highway 12), and Todd Road. The three wells are shown on Figure 1-7. In 1998 and 1999, the SCWA drilled and developed replacement wells at the Occidental Road and Sebastopol Road well sites to restore the original water production capacity of the wells. The loss in capacity was a result of the Occidental Road Well screen having collapsed, and the Sebastopol Road Well producing excessive amounts of sand. The two new wells at Occidental Road and Sebastopol Road and the existing well at Todd Road are cased to depths of 770, 1,040 and 805 feet, respectively. The three wells are capable of producing a combined total of approximately 5 to 7 mgd.

Prior to 1999, these wells were used for emergency purposes only and were pumped for approximately 20 minutes each month to maintain their operability. In April 1999, at the request of SCWA, the Department of Health Services (DHS) amended the SCWA's domestic water supply permit to allow the wells to be used as active, rather than stand-by, sources.

Chlorine is added to the water produced at each of the three well sites to maintain protective residual levels of chlorine within the system and prevent contamination. In addition, a treatment system has been installed at the Todd Road Well, which adds a small dose of an ortho-polyphosphate compound to the well water. The treatment was installed to determine whether it would be effective at eliminating the hydrogen sulfide odor, which frequently occurs in the water produced at all three wells. Although the hydrogen sulfide does not affect the potability of the water, it is a secondary water quality concern, which significantly affects its taste.

Seven conventional groundwater wells, collectively referred to as the Russian River Well Field, are located in the Mirabel area, and are shown on Figure 1-7. These wells withdraw water from the aquifer adjacent to the Russian River. The wells provide 7 to 9 mgd of additional production capacity. Water from the Russian River Well Field may either be sent directly to the Cotati Intertie, or it may be discharged into Caisson 1 and re-pumped into the Santa Rosa aqueduct.

Storage Tanks and Booster Pump Stations

Storage tanks provide water storage for emergencies, to meet peak demand during maximum demand periods (usually July or August), and provide hydraulic stability. Figure 1-7 shows the location of water storage tanks. Sixteen steel water storage tanks in the system provide a combined storage capacity of 108.8 million gallons (mg). Their locations and capacities are given in Table 1-4.

Table 1-4 Location and Capacities of Water Storage Tanks

Tank Name	General Location	Number of Tanks	Total Capacity (million gallons)
Ralphine	Spring Lake Park, Santa Rosa	4	36.0
Cotati	West Sierra Avenue, Cotati	3	36.0
Forestville	Anderson Road, Forestville	2	1.3
Annadel #1	Oakmont, Santa Rosa	1	2.5
Annadel #2	Los Guilucos, Santa Rosa	1	3.0
Eldridge	Sonoma Valley Park, Valley of the Moon	2	8.0
Sonoma	1st Street West, Sonoma	2	10.0
Kastania	Kastania Road, Petaluma	1	12.0
TOTAL			108.8

Figure 1-15 Annual Water Production by the SCWA since 1959

Operation of the water storage tanks in the SCWA system sometimes requires discharges of water from the tanks. These discharges are mostly under controlled conditions, although uncontrolled discharges may occur in some circumstances. This could result from a failure in valve control equipment, which is expected to be very infrequent.

The water transmission system also includes eight booster pump stations. Booster pumps are necessary to increase water pressure and/or to move water to areas of higher elevation. The station name, number of pumps at each station, and hp of each pump are shown in Table 1-5.

Table 1-5 Location and Capacities of Booster Pump Stations

Station Name	Number of Pumps	Total Rated Horsepower
Forestville #1	2	15
Forestville #2	2	60
Sonoma #1	3	855
Sonoma #2	1	250
Wilfred	1	700
Ely	2	1,000
Eldridge	1	75
Kastania	2	650

Pipelines

The pipelines in the SCWA water transmission system include valves, which may occasionally discharge chlorinated potable water to various creeks and drainage swales or ditches. These valves were installed to protect pipelines by relieving the pressure surges created when an abrupt change in flow occurs. Most, if not all, pressure surges and discharges occur when power outages trigger a sudden pump shutdown. There are six of these valves, referred to as slow-closing air valves or surge valves, in the SCWA system. Chlorinated potable water may also be discharged from tank overflow lines, although this occurs far less frequently. The maximum residual chlorine concentration in these discharges is approximately 0.6 to 0.7 parts per million (ppm). The volume of such a discharge is difficult to estimate but is likely to be as much as several thousand gallons.

Another feature designed to protect the integrity of the pipeline system is cathodic protection, which consists of buried anodes, made of a cast magnesium alloy, attached to the pipeline at regular intervals. Cathodic protection prevents corrosion on the exterior of the SCWA pipeline using the anodes to generate a small electrical current in the pipeline. While the anodes reduce pipeline corrosion, these anodes do corrode and must be replaced after several years. The buried anodes are typically installed at every one to two pipe joints, or every 20 to 40 feet. Not all of the SCWA pipelines were constructed with cathodic protection, and SCWA has an ongoing program to install anodes on approximately 2,000 to 4,000 feet of unprotected pipeline each year. Installation of the anodes involves excavation with a backhoe tractor to expose the pipe joint material, and installation of the anodes and anode test stations. These test stations consist of a wire lead to the ground surface, which allows Operation and Maintenance staff to test the anodes without excavating the pipeline. Where pipelines cross creeks or other waterways, anodes are installed on either side of the crossing behind the tops of the banks. In areas where anodes cannot be installed over a significant distance, a small direct current is applied directly to the pipeline.

1.5.3.3 Existing Water Treatment Facilities – Operations

Water diverted from the Russian River is filtered through the gravel aquifer below the streambed and infiltration ponds, requiring no further filtration. Gaseous chlorine is added for disinfection at 0.6 ppm at three chlorination facilities.

In September 1995, SCWA completed construction of pH adjustment/corrosion control facilities to limit lead and copper content in drinking water. This system was constructed in response to 1991 Environmental Protection Agency (EPA) regulations. These facilities are located at the SCWA Wohler Maintenance Yard and the River Road Chlorination Building, which are shown on Figure 1-8. The facilities treat water in each of the SCWA's two primary water transmission lines, the Russian River-Cotati Intertie pipeline and the Santa Rosa Aqueduct, with caustic soda ($NaOH$). Although the water produced by the existing collectors contains no detectable levels of lead and copper, the water is naturally moderately corrosive and can leach lead and copper from indoor plumbing and water fixtures. Corrosion control treatment also assists the water contractors and other sanitation districts to meet water quality limits on the dissolved metals content in treated sewage discharges, which are even more stringent than the limits for drinking water.

SCWA currently adds about 0.6 parts chlorine per million parts water for disinfection. Chlorine has a low boiling temperature, therefore a leak from a chlorine tank would produce a gaseous cloud. In its gaseous state, chlorine is about 2½ times as heavy as air and is greenish-yellow in color. In its liquid state, chlorine is about 1½ times as heavy as water. Chlorine concentrations in the air above 3 ppm can usually be detected as an odor. Chlorine is normally delivered to SCWA's chlorine buildings in 1-ton pressurized cylinders. The pressurized cylinders are constructed in accordance with strict regulations and are capable of withstanding severe shock if dropped. The chlorine is mixed with water inside the chlorine buildings to form a concentrated chlorine and water solution. This chlorine and water solution is transported through underground pipes to each collector. The chlorine and water solution is injected into the collector caissons to sanitize the water before it is pumped into the transmission system. SCWA buildings that house chlorine are equipped with leak detection alarm systems that send a signal to the Operations and Maintenance Center indicating the location of any leak; the alarm also sounds at the chlorination building. Chlorine is stored in 100-lb. cylinders at the Occidental, Todd, and Sebastopol Road well sites.

Caustic soda is purchased as a 50% water, 50% caustic soda solution, delivered by tanker trucks, and stored in two 10,000-gallon containers (one at Wohler and one at the River Road facilities). The Wohler pH control building is located approximately 250 yards from the Russian River. The River Road pH control building is located approximately 200 yards from Mark West Creek. The concrete masonry walls of the pH control buildings are designed to provide secondary containment to prevent caustic soda from contaminating a large area if a leak occurs within the pH control buildings. Caustic soda (sodium hydroxide) is used by SCWA to raise the pH level of the water to reduce the corrosion of copper pipes in household plumbing. The adjusted pH levels also help wastewater treatment facilities meet the discharge standards for copper levels in treated wastewater. In its concentrated form (50% solution), caustic soda has a corrosive action on body tissues. It can cause burns, deep ulcerations, and scarring. Caustic soda does not have the low boiling point of chlorine and is safer to handle or contain in the event of an accidental spill. The primary hazard of concentrated caustic soda is its extreme corrosivity.

Minor amounts of chlorinated water are discharged from the Ranney collector wells and other nearby facilities. These may be discharges from sampling and motor cooling lines in the collector wells, which operate continuously; from pumps used to de-water the Ranney collector wells for maintenance; from the inflatable dam as it is lowered; or from other related activities. Water from motor cooling lines is discharged at an estimated rate of approximately 5 gallons per minute when the pump motors are running. This discharged water at the Mirabel facilities flows into the settling and infiltration ponds. At Wohler, this discharge water flows into the Russian River. SCWA is currently looking into other options for cooling in order to alleviate this discharge. These incidental discharges and the pipeline discharges are covered under a waiver issued by the North Coast Regional Water Quality Control Board (NCRWQCB) in 1987 (NCRWQCB Resolution 87-113).

1.5.3.4 Existing Diversion Facilities – Maintenance

Road and Levee Maintenance

Main levee roads on the west side of the river in the Mirabel area are gravel roads that are maintained on an as-needed basis after storms. The main levee road is approximately 250 feet from the Russian River. Maintenance generally includes grading and replacement of gravel. This road provides access to the Mirabel collector wells, infiltration basins, diversion caisson, and the west side of the inflatable dam. This access road continues north underneath the Wohler bridge along an intertie pipeline route that connects the Wohler and Mirabel facilities. This access road is also used as an access location for periodic scraping of two large gravel bars that form under and upstream of the Wohler Bridge.

Access roads at Wohler are dirt roads that are generally maintained during the spring to repair damage from high river flows that can occur during the winter months. This access road is used to access the Wohler collectors, and continues south along the east side of the Russian River to access the east side of the inflatable dam. Maintenance generally consists of repairing washouts and filling potholes. This access road is approximately 200 feet from the Russian River.

Infiltration Pond Maintenance

Because silt and other organic materials accumulate on the infiltration pond beds and gradually impede infiltration to the aquifer after sustained use during the summer, the ponds are periodically drained and the silt and organic matter are removed with a grader and scraper to restore infiltration capacity. The materials are stockpiled and removed over time by private contractors.

Extensive repairs are sometimes necessary for pond and levee maintenance at the Mirabel and Wohler sites if they are overtopped during flood conditions. As the river level rises and overtops the Mirabel levee at its low points, cascading water on the inboard side of the levee causes substantial erosion damage to the levee embankment. Culverts, which run through the levees at Mirabel, have been installed so that they can be opened during flood conditions. If overtopping of the levees is probable, the culverts are opened to fill the infiltration ponds and reduce erosion from water running over the top of the levees. Repairs to the levee require replacing the eroded material and rock riprap on the embankment. Flood water also deposits as much as 1 to 2 feet of impermeable silt material in the pond beds, which must be removed before the ponds can be used again. The removed material is placed on separate stockpiles at the Wohler and Mirabel sites.

Inflatable Dam Maintenance

Each time the dam is lowered, the fish screens are removed to prevent damage to them during high-water events. Raising the dam may sometimes require removing gravel which has accumulated during the winter on top of the flattened dam fabric and within the fish ladders. The accumulated sediment is removed using a portable suction dredge, with the dredge discharge directed to a temporary siltation (settling) pond to prevent turbid water from reaching the river channel. The water is allowed to re-enter the river after the sediment has settled. Spoils are then stored out of the flood plain, and some is hauled away to be used as topsoil. No sediment transport or turbidity monitoring data has been collected when the inflatable dam has been lowered; however, the proposed river monitoring station at the Mirabel diversion facilities will provide year-round turbidity information in the future.

1.5.3.5 Existing Distribution System – Maintenance

Groundwater Wells Maintenance

Operation of the SCWA's Occidental Road, Sebastopol Road, and Todd Road wells frequently requires discharging well water to surface drainages for sampling or flushing purposes. These discharges usually involve un-chlorinated water, although minor discharges of chlorinated water from nearby locations on the Russian River-Cotati Aqueduct pipeline may be necessary for sampling purposes. This sampling is for water quality parameters that are normally used to determine compliance with potable water regulations.

Water Storage Tanks Maintenance

Maintenance of the water storage tanks includes periodic re-coating of the interior tank surfaces, which requires that the tanks be emptied. To the extent possible, the water in the tanks is drained into the transmission system. However, in order to maintain pressures within the transmission system, a portion must be released from the tank to surface water drainage. In these cases, the SCWA maintenance staff estimates the remaining volume and adds a corresponding amount of dechlorinating chemical (metabisulfide) to eliminate any chlorine residual in the discharge.

Controlled discharges occur approximately once every four years as part of maintenance activities. Controlled discharges are done only after obtaining permission from the California Department of Health Services and the RWQCB. The Forestville tanks are the SCWA's closest tanks to the Russian River (approximately 1 to 2 miles). Discharges from the Forestville tanks flow into a riprapped drainage ditch adjacent to the access road off of Anderson Road in Forestville. Riprapping in the drainage ditches serves to dissipate the energy of discharged flows to reduce the potential for erosion. Discharges into this ditch flow in a southwesterly direction towards an unnamed tributary of Atascadero Creek approximately 0.5 miles to the south. Atascadero Creek is a tributary of Green Valley Creek, which eventually flows into the Russian River.

Overflow pipelines in each water storage tank provide a necessary emergency release route if water levels in the tank should unexpectedly rise too high. While automated control valves in the water transmission system have been installed to prevent this, overflows may nonetheless occur under certain unforeseen circumstances. In these cases, chlorinated water may be discharged to surface water drainage. At a maximum, the water in the tanks would have a chlorine level of approximately 0.6 ppm.

Vegetation Control

Vegetation control along the levee access roads is done on an as-needed basis. Vegetation control is done through the use of contact herbicide applications (Rodeo) and removal by hand. Blackberries that grow in channels connecting the diversion sediment ponds with the infiltration ponds are removed by hand once a year. Mowing on levee roads generally occurs in the late spring each year.

Equipment maintenance

Maintenance of equipment is a continual process with varying work schedules. Maintenance of facilities occurs on a weekly, monthly, quarterly, annual, and tri-annual basis. Maintenance work on diversion and distribution facilities is done either inside of the facility (inside the caisson or motor housing), or the equipment is brought back to SCWA's Operations and Maintenance building in Santa Rosa for maintenance. The storage yard at Mirabel is used to store small amounts of supplies needed for maintenance activities (paints, oils). Occasionally the storage area at Mirabel is used as a staging area to store anti-freeze as part of maintenance activities associated with the diesel generators at Mirabel.

SCWA uses diesel fuel powered generators for emergency and standby power production. SCWA has a total of approximately 31,000 gallons of diesel fuel storage capacity at various facilities. Diesel storage is located adjacent to the standby generators at the Wohler and Mirabel chlorine buildings. Both diesel storage locations are approximately 250-300 yards from the Russian River. Diesel fuel is stored in above-ground, double-containment tanks that are out of the floodplain. Concrete block walls around fuel tanks provide additional containment capability. Fuel tanks are designed, manufactured, and constructed in accordance with the Uniform Fire Code, the Uniform Building Code, and applicable local codes and ordinances.

1.5.3.6 Remaining Authorized Diversion Facilities

Facilities that remain to be completed under the Tenth Amended Agreement include 20 mgd of standby pump and collector capacity. The SCWA plans to achieve the additional 20 mgd of standby capacity through construction of Collector No. 6, a Ranney-type collector well and pumphouse with a vertical concrete caisson extending approximately 80 to 110 feet below the ground surface. An Environmental Impact Report (EIR) has been published for this development (SCWA 1996) and this facility underwent informal consultation with NMFS in

1999 (NMFS 2000b). The Ranney collector and pumphouse would be similar to the existing Ranney collectors at SCWA's Mirabel diversion facilities. Collector No. 6 would be located in the Wohler area, adjacent to the Russian River, north of Wohler Bridge and approximately 10 miles west of the city of Santa Rosa. The location of Collector No. 6 is shown on Figure 1-16.

1.5.3.7 Proposed Diversion Facilities

Diversion facilities would be located in the general area of the Russian River watershed downstream of Lake Sonoma/Warm Springs Dam, as shown in Figure 1-4. Types of diversion facilities may include Ranney-type collector wells, conventional wells, infiltration ponds, diversion structures, water treatment facilities, pumps, connecting pipelines, and appurtenances. SCWA is in the process of identifying the actual types and locations of diversion facilities. However, brief descriptions of the major types of potential diversion facilities are presented below and should be considered conceptual. It was assumed that the facilities would be located in an area where it would be possible to achieve the required water production capacity for the WSTSP of 57 mgd.

Ranney-type Collector Wells (Collectors)

Collectors would be similar to that described above for existing diversion facilities. Approximately three collectors would be constructed, operated, and maintained, and each collector would consist of a vertical concrete caisson with horizontal perforated intake pipes to collect naturally filtered water from an aquifer associated with Dry Creek or the Russian River. At the top of the caisson would be a pumphouse with electric motors, pumps, and appurtenant controls for operation of the collector. Other appurtenances may include, but would not be limited to: connecting pipelines, access roads, observation wells, electrical equipment, radio telemetry equipment, water treatment (disinfection) equipment, and emergency power generators and associated fuel storage. If production capacity could be achieved via natural recharge to the aquifer, no additional diversion structures or infiltration ponds would be necessary; however, if artificial recharge is necessary, it is likely that additional infiltration ponds or diversion structures would be required.

Conventional Wells

Assuming a production capacity of two to three mgd per each conventional well, approximately 19 to 29 production wells placed approximately 400 feet apart would be constructed, operated, and maintained. Well depths would be approximately 100 feet. Each well would be equipped with submersible or vertical turbine pumps. Other appurtenances may include, but would not be limited to: connecting pipelines, access roads, observation wells, electrical equipment, radio telemetry equipment, water treatment (disinfection) equipment, and emergency power generators and associated fuel storage. If production capacity could be achieved via natural recharge to the aquifer, no additional diversion structures or infiltration ponds would be necessary; however, if artificial recharge is necessary, it is likely that additional infiltration ponds or diversion structures would be required.

Water Treatment Plant

A surface water treatment plant would consist of the construction, operation, and maintenance of a conventional filtration treatment plant would treat water diverted from Lake Sonoma, Dry Creek, and/or the Russian River. Basic unit processes at the plant may include, but would not be limited to, rapid mixing, coagulation, flocculation-sedimentation, filtration, and disinfection. Facilities associated with the plant may include buildings, access roads, headworks, clarifiers, filters, storage ponds and/or tanks, electrical equipment, radio telemetry equipment, disinfection equipment, and emergency power generators and associated fuel storage. A facility to divert surface water to the treatment plant would also be included. Chemicals used in the treatment and/or disinfection processes may include, but would not be limited to alum, cationic and nonionic polymers, chlorine, and caustic soda.

1.5.3.8 Remaining Authorized Distribution Facilities

The Kawana Springs Pipeline and Booster Pump Station are being constructed as part of the existing transmission system. The Kawana Springs Pipeline would connect the Russian River-Cotati Intertie to Kawana Springs Tank No. 1. The Kawana Springs Pipeline consists of approximately 41,700 linear feet of 36-inch diameter pipeline, and will serve to meet the demand, storage, and pressure requirements on the transmission system in the south Santa Rosa area. The booster pump station is located in west Santa Rosa, near the intersection of Sebastopol and Wright Roads. The locations of the Kawana Springs Pipeline and Booster Pump Station are shown in Figure 1-7.

Kawana Springs Tank No. 1 is currently under construction. The tank is located in an unincorporated area adjacent to the southerly limits of the city of Santa Rosa, approximately ¾ of a mile easterly of the intersection of Kawana Springs Road and Petaluma Hill Road. The tank location is shown in Figure 1-7. The steel tank has a capacity of 10 mg and, once it is in operation, will increase the total storage capacity of the existing transmission system to 118.8 mg. The Wohler-Forestville Pipeline also remains to be constructed as part of the existing transmission system. This pipeline would extend from SCWA's facilities at the Wohler area, generally parallel to the existing Forestville Aqueduct for approximately 2.5 miles, and connect with the existing Russian River-Cotati Intertie pipeline near Forestville. The pipeline location is shown on Figure 1-11. The pipeline would consist of approximately 12,000 linear feet of 36 to 60-inch diameter pipe. The pipeline would connect the 20 mgd of standby capacity provided by Collector No. 6 to the Russian River-Cotati Intertie pipeline.

1.5.3.9 Proposed Distribution Facilities

Four major pipelines are proposed to meet the future demands on the transmission system and were identified as part of the WSTSP. Pipeline construction would involve the underground installation of approximately 229,000 linear feet of 18 to 60-inch diameter, mortar-lined and coated, steel pipe and appurtenances. The four proposed pipeline routes would generally parallel existing transmission pipelines, and are shown in Figure 1-7. SCWA is in the process of identifying the actual pipeline routes. The details of each of the four pipelines are conceptually described below.

Figure 1-16 Collector No. 6 and Wohler-Forestville Pipeline Project

Mirabel-Cotati Pipeline: The Mirabel-Cotati Pipeline would extend from SCWA's facilities in the Mirabel area and generally parallel the existing Russian River-Cotati Intertie pipeline for approximately 14 miles to Cotati. The pipeline would consist of approximately 72,000 linear feet of 36 to 54-inch diameter pipe.

Cotati-Kastania Pipeline: The Cotati-Kastania Pipeline would generally parallel a portion of the existing Petaluma Aqueduct, extending from the Cotati Tanks to the southern end of Petaluma, for a distance of approximately 13 miles. The pipeline would consist of approximately 66,000 linear feet of 24 to 48-inch diameter pipe.

Kawana-Ralphine Pipeline: The Kawana-Ralphine Pipeline would connect with SCWA's Kawana Springs Tanks site at the end of Kawana Springs Road in southeast Santa Rosa and extend in a northeasterly direction to connect with SCWA's Ralphine Tanks and the Sonoma Booster Pump Station, a distance of approximately 5 miles. The pipeline would consist of approximately 26,000 linear feet of 30 to 36-inch diameter pipe.

Annadel-Sonoma Pipeline: The Annadel-Sonoma Pipeline would generally parallel the existing Sonoma Aqueduct from the area of Pythian Road to the Sonoma Tanks, a distance of approximately 13 miles. The pipeline would consist of approximately 65,000 linear feet of 18 to 24-inch diameter pipeline.

In order to meet the future demands identified under the WSTSP, an increase of 55.5 mg of storage is necessary along the transmission system, increasing the existing storage from 118.8 mg to 174.3 mg. Three to five steel water storage tanks would be constructed, operated, and maintained to provide this additional water storage. One of these tanks would be a second storage tank at the Kawana Springs location and is shown in Figure 1-4. The proposed site for this tank is adjacent to Kawana Springs Tank No. 1, approximately ¾ of a mile easterly of the intersection of Kawana Springs Road and Petaluma Hill Road. Conceptually, one to three additional tanks could be located near the existing tanks just west of Cotati; and another tank could be located near the existing Kastania Tank, just south of Petaluma. Conceptual tank locations are shown in Figure 1-7.

Two booster pump stations have been proposed as part of the WSTSP. As with the proposed pipelines, the specific locations of the pump stations are in the process of being identified. Conceptual locations are shown in Figure 1-7. The booster pump stations are necessary to ensure that the full delivery potential of the expanded transmission system can be achieved. The two proposed booster pumps are conceptually described below.

Cotati-Kastania Booster Pump Station: This booster pump station would be located along the Cotati-Kastania Pipeline. The pump size would be between 500 and 1,500 hp, and the size of the electrical substation would be between 500 and 1,700 kilowatts. Diesel fuel storage would be needed for approximately 25,000 gallons of fuel.

Sonoma Booster Pump Station Modification (Station No. 2, Pumps No. 2 and 3): This booster pump station would be a modification of the existing Sonoma

Booster Pump Station No. 2, located near Spring Lake Park in east Santa Rosa. Two pumps, each approximately 250 hp, would be installed, and modifications to the existing electrical substation would be necessary to increase power by 500 kilowatts. Existing diesel fuel storage at the site would be increased by 15,000 gallons.

1.5.3.10 Remaining Authorized Treatment Facilities

The Tenth Amended Agreement provided for the construction of an "early warning" system to alert SCWA to the presence of contaminants in the Russian River. The Early Warning Station Project was initiated in 1991 in response to requirements set forth by the Department of Health Service's as part of the SCWA's domestic water supply permit. Early warning station sites were constructed at three sites in Sonoma County. Early Warning Station No. 1 is located off of Westside Road, adjacent to the Mirabel diversion facilities. Early Warning Station No. 2 is located near Mark West Creek, just downstream of Mark West Creek's confluence with Windsor Creek. Early Warning Station No. 3 is located near the Healdsburg Memorial Dam on the westerly bank of the Russian River. Each early warning station was intended to consist of a river intake, river sample and discharge line, biomonitor and physio-chemical monitors, and auto sampler and telemetered alarm system housed within an approximately 8-foot by 12-foot masonry or metal building. The original early warning system design intended to use the behavior of living organisms (fish or aquatic invertebrates) to detect contaminants. All three of the early warning stations are complete, but they are not operational due to problems with clogging filters. Because of the ongoing operation problems, the use of living organisms to detect contaminants is no longer being considered for use at the present time.

In October of 1998, the SCWA tested a water quality monitoring probe at the Mirabel river diversion structure for approximately one month. The water quality probe performed well and demonstrated the performance desired by the SCWA. The SCWA will use the probe to monitor for dissolved oxygen, pH, temperature, turbidity, depth, and conductivity. The probe will not detect toxic materials; however, a spill in the river would be expected to alter at least one of the parameters being monitored. If an anomaly is detected, samples will be collected and sent to a laboratory for analysis. Due to the changing parameters of the project, the SCWA is referring to the project as the "River Monitoring Stations Project" rather than the "Early Warning Station Project."

The proposed River Monitoring Stations Project includes a total of six river monitoring stations. The SCWA would like to pursue using two of the Agency's existing sites (Mirabel river diversion structure and Healdsburg Memorial Dam) for river monitoring station sites. In addition, the SCWA has proposed using three additional stations at U.S. Geological Survey gauging stations located at Hopland, Hacienda, and Guerneville. One additional site location remains to be determined. Figure 1-6 shows the locations of the five identified river monitoring stations.

1.5.3.11 Proposed Treatment Facilities

Additional treatment facilities may be needed as part of the expansion of the transmission system to meet future demands. However, specific facilities will be dependent on the type and location of diversion facilities ultimately selected. Please refer to the previous section "Proposed Diversion Facilities," for a listing of alternative treatment methods and facilities.

1.5.3.12 Monitoring Studies

SCWA staff has initiated a monitoring study of the diversion facilities, referred to as the Mirabel Rubber Dam Monitoring Study (Monitoring Study) (SCWA 1999). The Monitoring Study, developed in consultation with CDFG and NMFS, is intended to investigate the potential effects of the inflatable dam on local fish populations in the mainstem Russian River. Information collected during this study will be used to improve management of the inflatable dam to reduce potential effects to fish, and to answer questions that may arise during Section 7 consultations.

Components of the study include the following:

- Habitat mapping in the area affected by the inflatable dam
- Water quality effects
- Gravel bar grading effects
- Smolt emigration issues
- Adult salmonid upstream migration issues
- Boat electrofishing as a sampling method

An initial draft of the first year's studies provides valuable information on critical habitat and life histories for the threatened salmonid species (SCWA 2000). Although the results are in draft form (subject to revision), they were used to assist in the evaluation for this report.

The Mirabel inflatable dam impounds a two-mile section of the river known as the Wohler Pool. Within the impounded reach, water depth is increased and current velocity is decreased. These changes in the natural hydrology of the river may potentially alter fish species composition, distribution, and abundance. SCWA began the project in April 1999, and is studying the effects of the dam operation on steelhead, coho, and chinook salmon. The study is specifically designed to assess the operation of the dam on adult immigration, smolt emigration, species composition, relative abundance and water quality in the Wohler Pool. Trapping, radiotelemetry, video monitoring, and electrofishing are being used to sample different fish life stages throughout the year. In 1999, SCWA completed the first season of downstream migrant trapping using a rotary screw trap. To determine whether the dam was causing a delay in migration, more than 9,000 steelhead smolts from the Warm Springs Hatchery were marked with fluorescent dye and released above the dam. Although few marked fish were recaptured, trapping revealed important information about the characteristics of smolts emigrating during late spring. The frequent occurrence of juvenile chinook salmon (a poorly documented species in the Russian River basin) was particularly informative. The trap showed promise for providing information on the timing, size, and age of emigrating smolts, as well as providing a chance to collect tissue samples for DNA analysis.

This section outlines the potential effects associated with operation and maintenance of the SCWA water supply and transmission system on the three threatened species of salmonids and their designated critical habitat. The three species include coho salmon, steelhead, and chinook salmon. Potential effects include direct and indirect effects on the fish or their habitat. Evaluation criteria are presented to assist in objectively evaluating potential effects. These same criteria will be used to compare risks and benefits of alternative project operations in the final BA.

Tables 2-1 and 2-2 identify the potential effects associated with the main components of the water supply system facilities. Operations and maintenance activities have the potential to affect critical habitat and to affect listed species directly and indirectly. These potential effects can be organized into several basic subcategories:

Potential direct effects on listed species

- Passage past project facilities for adult and juvenile salmonid migration, and salmonid rearing
- Stranding potential from deflation of the inflatable dam, and
- Injury to listed species from maintenance activities

Potential to alter critical habitat

- Instream flow effects on critical habitat (addressed in *Interim Report 3: Instream Flow Requirements*)
- Alteration of critical habitat from inflatable dam inflation or deflation
- Water quality related effects of water storage and release for diversion
- Water quality effects from accidental releases of water additives and facility maintenance substances
- Alteration of critical habitat from operation and maintenance activities

Potential Indirect Effects

- Increase in predation risk from maintenance and operation activities

Each issue of concern is described and evaluation criteria were developed based on peer-reviewed literature and, if available, current standards. The evaluation criteria are provided in table format which presents a value (score) associated with the evaluation criteria categories or descriptions for the degree of a potential effect. References are provided to other interim reports that cover related issues of concern. Cases are noted where there have been significant and/or

Table 2-1 Identification of Potential Effects on Threatened Salmonid Species from Existing, Remaining Authorized and Proposed Water Supply and Diversion Facilities – Operations

Component	Potential Alteration	Species	Life Stage	Potential Fisheries Effects	Component Time	Biological Time	Further Analysis*
Water Supply, Storage and Release (Ranney wells, surface diversion water release from storage)	Instream habitat Predation Water quality	CO	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	Y
Inflatable Dam – Structure <u>Water impoundment</u> (Water depth/flow, temperature, dissolved oxygen)	Predation	CO	Juvenile	Emigration	Spring through Fall	Feb 1-May 15	Y
		CH	Juvenile	Emigration		Feb 1-May 30	Y
		ST	Juvenile	Emigration		Mar 1-Jun 30	Y
<u>Fish Ladders</u>	Access	CO	Adult	Immigration	Spring through Fall	Nov 1- Feb 1	N
		CH	Adult	Immigration		Aug 15 - Jan 15	Y
		ST	Adult	Immigration		All year	Y
Diversion at Inflatable Dam <u>Fish screens</u> (Pumped diversion at dam and upstream at Wohler infiltration ponds)	Impingement Entrainment Injury/delay	CO	Juvenile	Emigration	Spring through Fall	Feb 1-May 15	Y
		CH	Juvenile	Emigration		Feb 1-May 30	Y
		ST	Juvenile	Emigration		Mar 1-Jun 30	Y
<u>Infiltration Pond Flooding</u> (Wohler and Mirabel)	Entrainment Injury/Mortality	CO	Juvenile/Adult	Migration	April through November	Nov 1- May 15	Y
		CH	Juvenile/Adult	Migration		Jan 1-Mar 1	Y
		ST	Juvenile/Adult	Migration/Rearing		all year	Y
Russian River Wellfield <u>Water Extraction</u>	Instream habitat	CO	Juvenile/Adult	Migration/Rearing	all year	all year	N
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	N
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	N
Distribution Facilities (pipelines/storage tanks/pumps) <u>Spills</u> (Chlorine, NAOH)	Injury/mortality Toxic exposure	CO	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	Y
Water Treatment Facilities <u>Spills</u> (Chlorine, NAOH)	Injury/Mortality Toxic exposure	CO	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	Y

***** Further analysis involves development of criteria and if warranted scoring categories for evaluation of present and alternative scenarios

Table 2-2 Identification of Potential Effects on Threatened Salmonid Species from Existing, Remaining Authorized and Proposed Water Supply and Diversion Facilities – Maintenance

Component	Potential Alteration	Species	Life Stage	Potential Fisheries Effects	Component Time	Biological Time	Further Analysis*
Ranney Collectors Superclorination (Chlorine)	Injury/mortality Toxic exposure	CO	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	Y
Inflatable Dam Raising and lowering of dam	Stranding Injury/Mortality	CO	Juvenile	Migration	Fall and early Winter	Nov 1- May 15	Y
		CH	Juvenile	Migration		Feb 1-May 30	N
		ST	Juvenile	Migration/Rearing		all year	Y
Normal Maintenance (Cleaning of fish screen bay, diversion piping, rubber bladder, fish ladders)	Suspended sediment exposure Avoidance/Injury	CO	Juvenile/Adult	Migration	Spring and fall	Nov 1- May 15	Y
		CH	Juvenile/Adult	Migration		Feb 1-May 30	Y
		ST	Juvenile/Adult	Migration/Rearing		all year	Y
Infiltration Ponds Bottom scraping, tailings deposition, pond and levee repair)	Suspended sediment exposure Avoidance/Injury	CO	Juvenile/Adult	Migration	Summer	Nov 1- May 15	N
		CH	Juvenile/Adult	Migration	Low flow	Feb 1-May 30	N
		ST	Juvenile/Adult	Migration/Rearing		all year	Y
In-River Gravel Bars Bottom scraping, Tailings deposition	Suspended sediment Avoidance/Injury/Mortality Habitat disturbance	CO	Juvenile/Adult	Migration	Summer	Nov 1- May 15	N
		CH	Juvenile/Adult	Migration	Low flow	Feb 1-May 30	N
		ST	Juvenile/Adult	Migration/Rearing		all year	Y
Groundwater Wells Sampling/flushing (Chlorine, orthophosphate)	Injury/Mortality Toxic exposure	CO	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		CH	Juvenile/Adult	Migration/Rearing	all year	all year	Y
		ST	Juvenile/Adult	Migration/Rearing	all year	all year	Y

***** Further analysis involves development of criteria and if warranted scoring categories for evaluation of present and alternative scenarios recent changes in operating or maintenance procedures that provide a baseline condition today that may reflect an improvement which may assist in the recovery of the species of concern.

2.1 Adult Upstream Migration

2.1.1 Issue of Concern

During the summer, the inflatable dam is inflated to create a spillway height of 11 feet. Two Denil-style fish ladders incorporated into the structure provide fish passage. The issue of concern is successful passage of threatened adult salmonids through the fish ladders with minimal or no delay at the inflatable dam.

Adult salmonid passage is not impeded when the inflatable dam is not in operation because water flows freely over the foundation (Winzler and Kelly 1978). When the dam is inflated, it has the potential to affect spawning migrations. The operation history indicates that the inflatable dam has been raised around March or April and lowered in October or November, although the dam has been raised to allow water diversion during other times of the year for maintenance activities and during drought conditions (Table 1-2).

2.1.2 Evaluation Criteria

To provide successful fish passage, Denil fishways must be carefully engineered for width and depth relationships to provide the low velocity flows required in their design. Furthermore, there must be enough water flowing through the ladder at a range of flows that enables fish to find the entrance of the passage structure (attraction flow) and pass upstream with minimal delays. Established criteria for a properly operating Denil-style fish ladder are summarized below (Bell 1986, Powers and Orsborn 1985, and Thompson 1972).

- Fishway slope has a ratio of at least one to six.
- Individual run is less than 30 feet.
- Resting areas with velocities of 0.1 feet per second (fps) or normal swimming speed.
- Maximum of 12 inches drop between pools.
- Average maximum velocities over weirs of 4 fps.
- Entrance velocities of 4 to 8 fps.
- Water depth as a weir measurement over pool weir 6 inches minimum and 12 inches maximum.
- A 0.2 cubic foot of space in pool per pound of fish.
- Ten percent of total flow provided as attraction flow.

Adult salmonid passage evaluation criteria are presented in two components related to the two main influences on passage. First, the fish ladder should be built to pass fish as described in standard engineering terms. Second, the fish ladder should have sufficient attraction flows (10 percent of total flow so fish can find the entrance to the passage structure). Table 2-3 provides the scoring categories for design and operation of the ladder from an engineering perspective. A score of 5 is the best, 1 or 0 is the worst. Effective fish ladder designs generally pass fish with minimal delay. Table 2-4 provides the scoring categories for attraction flows based on how often flows through the ladder meet a minimum requirement of 10% of stream flow.

Table 2-3 Passage Evaluation Criteria for Adult Salmonids at the Inflatable Dam – Fish Ladder Design and Operation

Category Score*	Evaluation Categories
5	Fish ladder passes adult salmon with minimal delay.
4	Fish ladder passes adult salmonids with slight delay.
3	Fish ladder passes adult salmonids with moderate delay.
2	Sporadic function of fish ladder.
1	Poor design of fish ladder.
0	Fish ladder not provided.

*A score of 5 is the best score, 0 is the worst.

Table 2-4 Passage Evaluation Criteria for Adult Salmonids at the Inflatable Dam – Opportunity for Passage Related to Attraction Flow

Category Score	Evaluation Categories
5	10% of total streamflow is provided for fish attraction continuously during migration.
4	10% of streamflow is provided for fish attraction 75-99% of time during migration.
3	10% of streamflow is provided for fish attraction 50-74% during migration.
2	10% of streamflow is provided for fish attraction 25-49% of time during migration.
1	10% of streamflow is provided for fish attraction 0-24% of time during migration.

2.2 JUVENILE EMIGRATION AND REARING EFFECTS

2.2.1 JUVENILE EMIGRATION DELAY AT THE INFLATABLE DAM

When inflated, the dam at Mirabel impounds water for approximately two miles upstream. This impoundment decreases current velocity, which has the potential to delay emigrating smolts. Because smolts have a finite time to complete the physiological process that prepares them to survive in saltwater (smoltification), a substantial delay could result in a reversal of this process. This would mean they would have to spend an additional year in fresh water, and if summer conditions are unsuitable, could increase mortality of the unsuccessful emigrants.

2.2.2 IMPINGEMENT, ENTRAINMENT, OR INJURY AT DIVERSION FACILITIES

2.2.2.1 Issue of Concern

The levees surrounding the infiltration ponds at Wohler and Mirabel are sometimes overtopped during floods, trapping fish in the ponds after the river level recedes. Operation of the diversion facilities for water supply may also affect listed fish species. In general, death or injury of juvenile salmonids at water diversion intakes has been identified as a major source of fish mortality (NMFS 1994). Improperly designed diversion facilities can cause impingement or entrainment of individuals, or delay migration, which may cause death and injury directly or may cause stress-related injury or death. Entrainment in the infiltration ponds may result in increased predation on juvenile salmonids. Entrapment may result in stranding.

Since water in the infiltration ponds can be shallow and stagnant, water quality can deteriorate and become detrimental to salmonids. In addition, as water levels drop, the flat bottom of the ponds can cause stranding of salmonids. There is little cover in the ponds, predatory fish like bass, Sacramento pikeminnow or carp can also become trapped, and predation on juvenile salmon by aquatic and avian species can occur. Entrapped adults may be at a higher risk from poachers. Futhermore, there is a potential for physical and stress-related injury to salmonids handled during a fish rescue operation.

The diversion structure at the inflatable dam is equipped with fish screens to prevent entrainment of young salmonids in the water diverted to Mirabel infiltration ponds. The effectiveness of these screens was evaluated to determine if salmonid juveniles or fry can pass the diversion without injury or delay. The diversion to Wohler ponds is ineffectively screened and entrainment into the infiltration ponds may result in detrimental effects to both juvenile and adult salmonid migrating through the area.

2.2.2.2 Evaluation Criteria

NMFS has developed fish screening criteria for anadromous salmonids, for both fingerling and fry life history stages (NMFS 1997). Fish screens at diversion intakes should meet NMFS criteria at all flow conditions. NMFS criteria state that if biological justification can not demonstrate the absence of fry-sized salmonids in the vicinity of the screen, fry will be assumed to be present. NMFS defines fry as less than 60 mm in length. Young-of-the-year steelhead were caught in rotary screw traps near the inflatable dam in the spring of 1999 (SCWA 2000), and preliminary unpublished data for 2000 also indicate the presence of some fry with sizes as low as 21 mm (fork length). Some steelhead rearing may occur in the area in the spring, but during the warmest months of the summer, water temperatures are unsuitable for steelhead. The following is a summary of the more important fish screen elements recommended for salmonid fry and juveniles by NMFS. The criteria are presented for 1) pump intake design, 2) river and canal screen design, and 3) escape or return mechanism design.

1. General guidance for pump intake design.

- Approach velocity shall not exceed 0.33 fps for fry and 0.8 fps for juveniles.
- Sweeping velocity shall be greater than approach velocity.
- Perforated plate screen opening shall not exceed 3/32 inches in diameter for fry, ¼ inches for juveniles, and shall have a minimum of 27 percent open area for fry and 40 percent for juveniles.
- Face of screen surfaces shall allow fish unimpeded movement parallel to screen face and ready access to bypass routes.
- Structural features shall protect fish screens from large debris.
- Design shall attempt to eliminate undesirable hydraulic effects (e.g. eddies, stagnant flow zones) that may delay or injure fish, or provide predator opportunities.

- Screen and bypass shall work in tandem to move out-migrating salmonids (including adults) to the bypass outfall with minimum injury or delay.
- Bypass entrance shall be provided with independent flow control.
- Bypass entrance must equal or exceed the maximum velocity vector resultant along screen, upstream of the entrance.
- Bypass entrance must extend from floor to water surface; smooth interior pipe surfaces and joints shall be required; fish shall not free-fall; pressure in the bypass shall be equal to or above atmospheric pressure; fish shall not be pumped within the bypass system.
- Bypass system shall minimize debris clogging and be accessible for cleaning; depth of flow shall be 0.75 feet or greater; ambient river velocities at bypass outfall should be greater than 4.0 fps.
- Bypass outfall shall be located to minimize avian and aquatic predation; bypass shall be located where there is sufficient depth to avoid fish injury; impact velocity shall not exceed 25.0 fps, bypass outfall discharges shall be designed to avoid adult jumping injuries.
- Fish screens shall be automatically cleaned; fish screen system shall be evaluated for biological effectiveness and available for inspection to NMFS.

2. General guidance for river and canal screens.

- Where practical, construct screen at diversion entrance.
- Screen face should be generally parallel to river flow and aligned with adjacent bankline.
- Minimize eddies and undesirable flow patterns in the vicinity of the screen.
- Provide sufficient hydraulic gradient to route fish between trash rack and screen to safety.
- Screens downstream of diversion entrance shall provide an effective juvenile bypass system to collect juvenile fish and safely transport them back to the river with minimum delay. The angle of the screen to flow should be adequate to effectively guide fish to the bypass.
- If fish are entrained within a canal or infiltration pond, escape or return to the river can mitigate some of the effects. Alternatives are provided as criteria below, in order of preference.

The following criteria are provided by ENTRIX for the purpose of evaluating the site-specific conditions of the project.

General criteria for fish escape or return mechanisms.

- Provide a structure that returns the fish safely to the river prior to entrapment in a canal or pond.
- Provide a structure that allows the fish to voluntarily return to the river after entrainment.

- Provide rescue of entrapped fish which minimizes stress, injury and death through rapid response (rescue within one week), and design and/or methods of capture and release that reduce potential physical injury.

Juvenile passage evaluation criteria were developed in relation to potential influences of project operations. First, fish screens were evaluated according to their performance standards and ability to pass juvenile and fry sized salmonids within NMFS criteria (Table 2-5). If effective fish rescue or escape is provided for entrained fish, the risk to the population may be reduced by reducing the level of mortality associated with entrainment. Second, an estimate of the risk of entrainment, impingement, or injury at the diversion facilities is based on 1) the proportion of surface water diverted (Table 2-6), and 2) the degree of overlap between the migration period and the period of diversion operation (Table 2-7). Chinook and steelhead smolt movements are closely associated with rising flows, in addition to other factors (Mundy 1997). Although rearing juvenile salmonids may be more likely to utilize the margins of the river than the center, many migrants move in mid- to near-surface waters away from the river banks (McDonald 1960, cited in Northcote 1984). In general, if more water is diverted, the potential to affect fish increases. The opportunity to affect the population of a protected species is evaluated by assessing the degree of overlap between the migration period and project operations. The greater the percentage of a species migration period that the diversion facility is operated, the greater the risk to that species.

Table 2-5 Juvenile Salmonids Passage Evaluation Criteria for Screen Design

Category Score	Evaluation Category
5	Fish screens meet NMFS criteria and pass fish without injury or delay.
4	Facility provided with fish screens, but the facility has a low risk of entrainment, impingement, or migration delay.
3	Facility provided with fish screens, but the facility has a moderate risk of entrainment, impingement, or migration delay, effective rescue or escape is provided.
2	Facility provided with fish screens, but the facility has a high risk of entrainment, impingement, or migration delay, ineffective rescue or escape is provided.
1	Facility not provided with fish screens, no rescue or escape is provided.

Table 2-6 Passage Evaluation Criteria for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury During Operation – Amount of Water Diverted

Category Score	Evaluation Category
5	Facility does not affect any surface flow.
4	Facility diverts less than 25% of surface water flow.
3	Facility diverts between 25-50% of surface water flow.
2	Facility diverts between 50-75% of surface water flow.
1	Facility diverts more than 75% of surface water flow.

Table 2-7 Passage Evaluation Criteria for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury – Time Water is Diverted

Category Score	Evaluation Category
5	Facility does not affect surface water flow during migration period.
4	Facility diverts surface water flow during less than 25 % of migration period.
3	Facility operates between 25 and 50 % of migration period.
2	Facility operates between 50 and 75% of migration period.
1	Facility operates during more than 75% of the migration period.

2.3 INSTREAM FLOW EFFECTS ON CRITICAL HABITAT

2.3.1 ISSUE OF CONCERN

Operation of the SCWA water supply and transmission system can affect streamflow in Dry Creek and the Russian River mainstem. Habitat quality for the threatened salmonid species is directly related to streamflow. Changes in streamflow occur from releases of water in reservoir storage that are re-diverted at the SCWA facilities near Wohler and Mirabel. The issue of concern is the potential effect of current and proposed diversion and re-diversion in Dry Creek and the lower Russian River on instream critical habitat. Operational practices of interest are the current, remaining authorized, and proposed water releases from storage (diversion) and re-diversion of that water at the SCWA facilities. The portions of water diverted and rediverted in any water year vary widely and depend on the amount of natural streamflow, which is largely determined by runoff.

Results of habitat changes for instream flow changes from operation of the SCWA water supply operations are described in *Interim Report 3: Instream Flow Requirements*. *Interim Report 3* contains results from all instream flow related issues (minimum flows, water supply flows and flood control flows) to provide a more consistent treatment of the flow/habitat related project elements and a way to more easily compare results.

2.3.2 STRANDING OR DISPLACEMENT FROM FLOW FLUCTUATIONS

2.3.2.1 Issue of Concern

The inflatable dam is lowered about one or two times per year. Lowering the inflatable dam at the end of the season changes the water level in approximately 3.2 linear kilometers (2 linear miles) of the Russian River upstream of the inflatable dam. As the dam is deflated, water levels recede. When water levels in critical habitat fluctuate, stranding or displacement of salmonids can occur. Unnaturally rapid changes in the river stage (minutes, hours, or days) can cause rapid fluctuation in water levels and can dewater habitat occupied by juvenile and adult salmonids. Stranding occurs when fish are separated from flowing water. Stranding can occur on riffles, gravel bars, side channels, and in backwater pools if flow becomes intermittent. Mortality may result if fish become desiccated or suffocate. Displacement of fish due to rapid decreases in flow can increase predation and stress-related injury.

Streamflow fluctuations can also cause juvenile and adult fish to become trapped in shallow areas or residual pools. Fish are stressed when they are displaced from established rearing areas and crowded into residual pools. Residual pools with high fish densities may subject trapped fish to food competition or predation by avian species and vertebrates, including hatchery fish preying on wild fish.

Juvenile salmonids are significantly more vulnerable to stranding than adults. Steelhead vulnerability drops significantly when juveniles reach 40 mm and chinook 50 to 60 mm (Beck Assoc. 1989). The overall incidence of coho stranding is rather low in studies conducted to date (Hunter 1992). Stranding is more frequent during daylight hours. Fry that have just absorbed the yolk sac and have recently emerged from the gravel are the most vulnerable because they are poor swimmers and typically reside along shallow stream margins (Phinney 1974, Woodin 1984). Stranding of juvenile coho and rainbow trout on a gravel substrate in an artificial stream at low temperature was less frequent at slow rates of dewatering (6 centimeter per hour (cm/hr) stage change rather than 30 cm/hr) and if flow reductions occurred at night (Bradford, *et al*. 1995). Bradford also found that stranding of juvenile coho was reduced when the slope of the bar exceeded 6%.

Coho salmon and steelhead do not spawn in the portion of the Russian River affected by the inflatable dam because suitable spawning habitat is not available, so the probability that large numbers of fry are present is low. Chinook spawning does occur upstream in the Russian River mainstem above Asti, but chinook spawn earlier in the year. Therefore, fry that have emerged by the end of March have had a longer time to grow if the dam is deflated in the early spring in response to rising river flows. Rotary screw traps located approximately 60 meters downstream of the inflatable dam site in late April and in May of 1999 captured 193 chinook salmon smolts, before and after the dam was inflated. Chinook vulnerability to stranding drops when juveniles reach about 50 to 60 mm, and these smolts ranged in length from 55 to 106 mm fork length (FL). Chinook juveniles are not present when the dam is normally deflated in the fall.

2.3.2.2 Evaluation Criteria

The Washington Department of Fisheries has proposed a rate of stage change that will generally protect fish (Hunter 1992). Hunter's ramping guidelines are modified with the phenology of salmonids in the Russian River for the period of time that the inflatable dam may be deflated (Table 2-8). The more conservative stage change (0.08 ft/hr.) is designed to protect salmonid fry. During juvenile rearing periods, which occur year-round for coho salmon and steelhead in the Russian River and February through May for chinook salmon in the area of the inflatable dam, a 2 inch/hour (0.16 feet per hour [ft/hr]) stage change would apply.

Table 2-8 Rates of Stage Change Based upon Hunter (1992) and Life History Stages for Salmon and Steelhead in the Russian River

Season	Stage Change Rates
March 1 to July 1	1 inch/hour (0.08 ft/hr)
July 1 to November 1	2 inches/hour (0.16 ft/hr)

Comparisons of the Hunter criteria with observation of fish stranding in other portions of the Russian River watershed helps to substantiate proposed criteria for stage changes (Table 2-9). Significant stranding has occurred in the upper Russian River associated with 50 cfs/hr reductions in flow during inspection and maintenance activities on Coyote Valley Dam. This stranding was related to younger and smaller fish than are likely to occupy the Wohler area. Stage-discharge relationship information generated by HEC-RAS hydraulic modeling on four cross-sections on the mainstem Russian River below the Forks indicate that stage changes associated with 25 cfs/hr flow reductions would be similar to the 0.16 ft/hr stage change criterion for most flow intervals (see *Interim Report 1*). Only limited stranding occurred in Dry Creek in May of 2000 when Warm Springs Dam was ramped down with 25 cfs/hr reductions in flow. Stage-discharge relationship information generated by the HEC-RAS model on cross-sections below Dry Creek indicates that this ramping rate meets the 0.16 ft/hr Hunter criterion within most of the flow ranges below 250 cfs (see *Interim Report 1*). While information from these modeling results and ramping events at the dams cannot be directly applied to the inflatable dam site, they do suggest that where potential stranding is a concern, the Hunter 0.16 ft/hr stage change criterion may be generally appropriate for fry-sized salmon in the Russian River watershed. The Hunter criterion of 0.16 ft/hr is therefore considered protective in this analysis and is associated with the higher evaluation scores.

The Hunter (1992) guidelines are considered to represent a rigorous and conservative ramping standard for the Russian River. Hunter developed his guidelines based on streams located in the northwest, a hydrologic regime that is dominated by snowmelt processes. Snowmelt streams usually have relatively gradual changes in runoff conditions. In the Russian River drainage, streamflow is driven by often intense Pacific frontal storms that naturally result in very “flashy” runoff conditions and therefore relatively larger changes in stage compared with snowmelt runoff conditions.

USACE, in consultation with NMFS and CDFG, developed interim guidelines for release changes during flood control operations that would protect spawning gravel and juvenile salmonids in Dry Creek and the Russian River. These criteria are less stringent than the Hunter criteria, but are appropriate to use for intermediate scores for this evaluation because the inflatable dam is deflated when rising river flows are expected. The stage level and discharge (water behind dam and normal river flow) are similar to high flow conditions, at least during about one half of the deflation operation. Because the dam is generally lowered in response to rising river flows, rising flows would attenuate stage changes caused by dam deflation.

USACE criteria designate three ramping rates determined by flow in cfs. This evaluation uses the mid-flow category, which is for a river flow in the river between 250 and 1,000 cfs. The ramping criterion for these flow conditions is maximum rate change of 250 cfs/hour. To estimate the stage change that is related to the interim ramping criteria at the inflatable dam, two cross-sections in the impounded area are used to correlate change in water elevation to a 250 cfs flow difference. Using HEC-RAS modeling, a 250 cfs flow change behind the inflatable dam is estimated at approximately a 0.32 foot change in stage.

Site specific conditions may have an important influence on juvenile salmonid stranding, so companion criteria are developed to accompany the stage change criteria. The importance of habitat components with respect to opportunity for stranding increases with low-gradient river channel configuration, presence of long side channels, larger substrate type, and frequency of flow reductions. A river channel with many side channels, potholes, and low gravel gradient bars has a greater incidence of stranding than a river confined to a single channel with steep banks (Bauersfeld 1978, Beck Associates 1989, and Hunter 1992). Most documented observations of stranding have occurred on gravel and vegetation (Becker *et al.* 1981 and Satterthwaite 1987). More frequent flow reduction events provide increased opportunity for stranding or displacement. For example, daily fluctuation associated with hydroelectric project peaking operations in other river basins provide much more opportunity for stranding than an occasional event such as a flow reduction after a seasonal flood. Furthermore, salmonids may have developed local adaptations to naturally occurring flow recessions.

The following scoring criteria are developed to assess the effects of deflation of the inflatable dam. These criteria address the rate of stage change according to species and life stage (Table 2-9 and Table 2-10). Because fry are more vulnerable, evaluation criteria for fry are more stringent than for juveniles. The criteria also address the opportunity for stranding or displacement dependent on frequency of occurrence (Table 2-11). The opportunity for stranding or displacement is also dependent on physical habitat present (Table 2-12). A single steep sided channel, with fine substrate and no instream vegetation or potholes is likely to present no risk. The presence of side channels, low gradient banks, gravel bars, pot holes or instream vegetation would increase the risk. A large area with many habitat features that are likely to induce stranding would have a greater risk than a smaller area with fewer of these habitat features.

Table 2-9 Ramping and Stage Change Evaluation Criteria for Juvenile and Adult Salmonids

Category Score	Evaluation Categories
5	Meets 0.16 ft /hr maximum stage change
4	Meet 0.32 ft /hr maximum stage change
3	Meet 0.48 ft/hr maximum stage change
2	Meet 1.4 ft/hr maximum stage change
1	Greater than 1.4 ft/hr maximum stage change

Table 2-10 Ramping and Stage Change Evaluation Criteria for Fry

Category Score	Evaluation Categories
5	Meets 0.08 ft/hr maximum stage change
4	Meets 0.16 ft/hr maximum stage change
3	Meet 0.32 ft/hr maximum stage change
2	Meet 0.48 ft/hr maximum stage change
1	Greater than 0.48 ft/hr maximum stage change

Table 2-11 Flow Fluctuation Evaluation Criteria related to Opportunity for Stranding or Displacement Dependent on Frequency of Occurrence for Fry, Juvenile and Adult Salmonids

Category Score	Evaluation Category
5	Less than two fluctuations per year in critical habitat
4	Between three and nine fluctuations per year in critical habitat
3	Between ten and 29 fluctuations per year in critical habitat
2	Between 30 and 100 fluctuations per year in critical habitat
1	More than 100 fluctuations per year in critical habitat
0	Daily fluctuations in critical habitat

Table 2-12 Flow Fluctuation Evaluation Criteria related to Opportunity for Stranding or Displacement on Habitat Type for Fry, Juvenile and Adult Salmonids

Category Score	Evaluation Categories
5	Habitat features unlikely to induce stranding
4	Few habitat features present to induce stranding
3	Some habitat features that induce stranding, but area affected is small (<30%)
2	Many habitat features that induce stranding, but area affected is small (>30%)
1	Some habitat features that induce stranding, area affected is large (>30%)
0	Many habitat features that induce stranding, area affected is large (>30%)

2.4 WATER QUALITY RELATED EFFECTS OF WATER STORAGE AND RELEASE FOR DIVERSION

2.4.1 TEMPERATURE, DISSOLVED OXYGEN, AND TURBIDITY

2.4.1.1 Issues of Concern

Temperature, dissolved oxygen, and turbidity can potentially be altered by operation of the SCWA water supply system. This subsection addresses water quality in relation to water storage and release for diversion. Water quality may be altered from storage and release of water from Lake Sonoma for re-diversion at the SCWA facilities, from storage and release of water from Lake Mendocino, or from modification of streamflow at the inflatable dam. Water from Lake Sonoma is stored and released for rediversion at the SCWA facilities near Wohler and Mirabel. Water quality in the release from Lake Sonoma is controlled by operations at the Don Clausen Fish Hatchery, and will be addressed in the final BA.

The inflatable dam impounds water over an approximately 3.2 kilometer (2.0 miles) reach of river. The inflatable dam alters the naturally occurring riverine habitat from run/riffle/pool (68.1% run/glide) to solely pool habitat (SCWA 2000). Salmonids may be affected in several ways. Water temperature and related water quality can be degraded due to the longer solar exposure of water in the pool. The food production (invertebrates) and transport structure changes because of reduced current and water quality. The populations of predatory fish, especially warmwater species preferring pool habitat, might increase, thus affecting species composition.

This section addresses changes in temperature, dissolved oxygen, and turbidity. Separate criteria are provided for predation in subsection 2.7 (*Predation Effects from Maintenance and Operation Activities*). Operation and maintenance activities that have the potential of altering water quality parameters which are not related to impoundment of water are described in the following subsections (2.5 - *Water Quality Effects from Water Treatment Additives, Facility Maintenance Substances and Vegetation Control* and 2.6 - *Critical Habitat Alteration Effects from Maintenance Activities*).

2.4.1.2 Evaluation Criteria

Temperature

As salmonids are cold-blooded, water temperature influences their metabolism, growth and feeding rates. Unsuitable temperatures can lead to stress, resulting in disease, altered timing of migration, and accelerated or retarded maturation. Salmon and steelhead may delay upstream migration to spawning areas if water temperatures are too warm. While fish do have some natural flexibility in migration schedules, human-induced changes may produce unfavorable conditions for which native stocks cannot adapt. Steelhead and salmon have migrated upstream at temperatures between 3 and 20°C (Bell 1986). Egg development is also sensitive to temperature, and there are high and low temperature thresholds beyond which egg mortality increases (Raleigh *et al*. 1984, Raleigh *et al*. 1986, McMahon 1983, Bjornn and Reiser 1991).

There are optimum temperature ranges for salmonid growth, but even at slightly higher temperatures, fish can grow given an adequate food supply. However, at elevated temperatures without plentiful food, fish could experience a slower growth rate, or lose weight.

Temperature criteria are based on peer reviewed literature values (Bell 1986, Brett 1952, Bjornn and Reiser 1991, McMahon 1983, Raleigh *et al*. 1984, Raleigh *et al*. 1986). Scoring categories for temperature based upon these literature values for each species and life history stage are given in Table 2-13. Most literature values have been based on studies conducted in the Pacific Northwest. As the Russian River watershed lies in the southern and warmer range of salmonid species, criteria based on these values would be conservative. Values based on California stocks were given preference.

Dissolved Oxygen

Dissolved oxygen (DO) requirements vary with species, age, temperature, water velocity, activity level and concentration of substances in the water (McKee and Wolf 1963 cited in Raleigh *et al*. 1984). As temperatures increase, DO saturation levels in the water decrease while the oxygen needs of the fish increase. Optimal oxygen levels for rainbow trout (the nonanadromous form of steelhead) appear to be $\geq$7 milligrams per liter (mg/l) at <15°C and $\geq$9 mg/l at >15^{O}C (Raleigh *et al.* 1984). Incipient lethal levels of DO for adult and juvenile rainbow trout are approximately 3 mg/l, depending primarily on temperature.

Reduced concentrations of dissolved oxygen can reduce the swimming performance of migrating adult salmonids. Maximum sustained swimming speeds of juvenile and adult coho salmon at temperatures between 10-20°C were reduced when DO dropped below air-saturated levels (about 8-9 mg/l at 20°C), and performance declined sharply when DO fell to 6.5-7.0 mg/l at all temperatures (Davis *et al*. 1963).

For embryos, the amount of oxygen available is influenced by flow through redds. Embryos are most sensitive to hypoxial conditions during their early stages of development (Alderdice *et al.* 1958, cited in Bjornn and Reiser 1991). While embryos may survive when DO concentrations are below saturation (but above a critical level), their development is often abnormal. Newly hatched steelhead and chinook alevins are smaller and weaker when incubated as embryos at low and intermediate DO concentrations than at higher concentrations (Silver *et al.* 1963). Reduced DO lengthened the incubation period of coho embryos, and they hatch as smaller alevins (Shumway *et al*. 1964, cited in Bjornn and Reiser 1991). In field studies, survival of steelhead (Coble 1961) and coho embryos (Phillips and Campbell 1961) is positively correlated with intragravel DO in redds. Phillips and Campbell (1961) conclude that intragravel DO must average 8 mg/l for embryos and alevins to survive well. Bjornn and Reiser (1991) recommend that concentrations should be at or near saturation and that temporary reductions should drop no lower than 5.0 mg/l. The USFWS (Raleigh *et al.* 1986) recommends that for chinook, the lower limit of DO for survival with short-term exposures is ≥ 2.5 mg/l at temperatures ≤ 7°C with optimal levels of ≥ 8 mg/l at temperatures ≥ 7, but ≤ 10°C and ≥ 12 mg/l at temperatures >10°C.

Growth rate and food conversion efficiency in coho juveniles are limited by DO concentrations less than 5 mg/l (Bjornn and Reiser 1991). Davis (1975) reviewed information on incipient DO response thresholds and has developed oxygen criteria related to concentration, water temperature and percent saturation. Davis concludes that salmonids would not be impaired at concentrations near 8 mg/l (76-93% saturation) and that initial symptoms of DO deprivation would occur at about 6 mg/l (57-72%) saturation (Bjornn and Reiser 1991). Because rainbow trout fry occupy habitat contiguous with adults, their DO requirements are assumed to be the same as adults (Raleigh *et al.* 1984). Bustard (1983, cited in Raleigh *et al.* 1986) reports that chinook juveniles survived with DO ranging from 3-7 mg/l. The USFWS concludes that chinook juveniles can survive short-term exposures to 3 mg/l at temperatures ≤ 5°C, but optimal levels are ≥ 9 mg/l at ≤ 10°C and 13 mg/l at > 10°C. Evaluation Scores for dissolved oxygen are given in Table 2-14. They are based primarily upon the literature cited and the habitat suitability index models developed by the USFWS.

Table 2-13 Temperature Evaluation Criteria by Species and Lifestage

Coho

Habitat Score	Nov.1-Jan.31 T (°C) Up migration	Dec.1-Feb.15 T (°C) Spawning	Dec.1-Mar.31 T (°C) Incubation	All year T (°C) Rearing
0	≤3.0	≤1.7	0	1.7
1	>3.0 ≤4.0	>1.7 ≤3.0	>0 ≤3.0	>1.7 ≤4
2	>4.0 ≤5.0	>3.0 ≤4.0	>3.0 ≤3.5	>4 ≤7.0
3	>5.0 ≤6.0	>4.0 ≤6.0	>3.5 ≤4.0	>7 ≤8
4	>6.0 ≤7.2	>6.0 <7.0	>4.0 <4.4	>8 <12
5	≥7.2 ≤12.7	≥7.0 ≤13.0	≥4.4 ≤13.3	≥12. ≤14
4	>12.7 ≤14	>13.0 ≤14.0	>13.3 ≤14.0	>14 ≤15
3	>14 ≤15.0	>14.0 ≤15.0	>14.0 ≤15.0	>15 ≤16
2	≥15.0 >16.0	>15.0 ≤16.0	>15.0 ≤16.0	>16 ≤20.0
1	≥16.0 >21.1	>16.0 <17.0	>16.0 <18.0	>20.0 <26
0	≥21.1	≥17.0	≥18.0	≥26

Steelhead

Habitat Score	Oct.1-Sept.30 T (°C) Up migration	Dec. 1-Apr.30 T (°C) Spawning	Jan.1-May31 T (°C) Incubation	All year T (°C) Rearing
0	≤ 4.0	≤4.0	≤1.5	≤0
1	>4.0 ≤5.0	>4.0 ≤5.0	>1.5 ≤3.0	>0 ≤2.0
2	>5.0 ≤6.0	>5.0 ≤6.0	>3.0 ≤4.5	>2.0 ≤4.0
3	≥6.0 ≤7.0	≥6.0 ≤7.0	≥4.5 ≤6.0	>4.0 ≤8.0
4	≥7.0 <7.8	>7.0 >7.8	>6.0 >7.8	>8.0 <12.8
5	≥7.8 ≤11.0	≥7.8 ≤11.1	≥7.8 ≤11.1	≥12.8 ≤15.6
4	>11.0 ≤13.0	>11.1 ≤14.0	>11.1 ≤13.0	>15.6 ≤18.0
3	>13.0 ≤15.0	>14.0 ≤16.0	>13.0 ≤15.0	>18.0 ≤20.0
2	>15.0 ≤17.0	>16.0 ≤18.0	>15.0 ≤17.0	>20.0 <22.0
1	>17.0 <21.1	>18.0 >20.0	>17.0 >20.0	>22.0 <23.9
0	≥21.1	≥20.0	≥20.0	≥23.9

Chinook

Habitat Score	Aug.15-Jan.15 T (°C) Up migration	Nov.1-Jan.31 T (°C) Spawning	Nov.1-Mar.31 T (°C) Incubation	Feb.1-May31 T (°C) Rearing
0	≤0.8	≤1.0	≤1.0	≤1.0
1	>0.8 ≤3.0	>1.0 ≤2.5	>1.0 ≤2.0	>1.0 ≤4.0
2	>3.0 ≤5.2	>2.5 ≤3.5	>2.0 ≤3.0	>4.0 ≤6.0
3	>5.2 ≤7.9	>3.5 ≤4.5	>3.0 ≤4.0	>6.0 ≤8.0
4	>7.9 <10.6	>4.5 <5.6	>4.0 <5.0	>8.0 <12.0
5	≥10.6 ≤15.6	≥5.6 ≤13.9	≥5.0 ≤12.8	≥12.0 ≤14.0
4	>15.6 ≤17.0	>13.9 ≤14.5	>12.8 ≤14.2	>14.0 ≤17.0
3	>17.0 ≤18.4	>14.5 ≤15.2	>14.2 ≤15.0	>17.0 ≤20.0
2	>18.4 ≤19.8	>15.2 ≤16.0	>15.0 ≤15.8	>20.0 ≤23.0
1	>19.8 <21.1	>16.0 <16.7	>15.8 <16.7	>23.0 <26.0
0	≥21.1	≥16.7	≥16.7	≥26.0

Table 2-14 Dissolved Oxygen Evaluation Criteria by Species and Lifestage

Coho

Habitat Score	DO (mg/l) Up migration	DO (mg/l) Spawning/ incubation	DO (mg/l) Rearing	DO (mg/l) Down migration
5	≥ 6.5	≥ 8.0	≥ 8.0	8.0
4	6.0	6.8	6.5	6.0
3	5.5	6.2	6.0	5.5
2	5.2	5.5	5.2	5.2
1	4.8	4.5	4.5	4.6
0	< 4.5	<3.0	≤ 3.0	3.0

Steelhead

Habitat Score	DO (mg/l) Up migration	DO (mg/l) Spawning/ incubation		DO (mg/l) Rearing	DO (mg/l) Down migration
		≤15°C	>15°C		
5	≥ 6.5	7	9	≥ 8.0	8.0
4	6.0	5.3	7.3	6.5	6.0
3	5.5	4.7	6.5	6.0	5.5
2	5.2	4.0	5.9	5.2	5.2
1	4.8	3.3	5.4	4.5	4.6
0	< 4.5	3.0	5.0	≤ 3.0	3.0

Chinook

Habitat Score	DO (mg/l) Up migration	DO (mg/l) Spawning/incubation[1]			DO (mg/l) Rearing	DO (mg/l) Down migration
		≤ 5°C	>5 ≤ 10°C	> 10°C		
5	≥ 6.5	9	9	13	≥ 8.0	8.0
4	6.0	7.5	8.0	11.3	6.5	6.0
3	5.5	6.5	7.2	9.5	6.0	5.5
2	5.2	5.0	6.0	8	5.2	5.2
1	4.8	3.9	5.3	6	4.5	4.6
0	< 4.5	2.8	4.5	4.5	≤ 3.0	3.0

[1]Raleigh *et al*. 1986

Turbidity and Suspended Sediments

Turbidity reduces the amount of light that can penetrate water. While the terms “turbidity” and “suspended solids” are sometimes used interchangeably, the degree of turbidity does not always indicate the amount of particulate matter in the water. Turbidity is measured by the amount of light that penetrates the water and is measured in nephelometric turbidity units (NTUs) or Jackson turbidity units (JTUs). It is not a measure of the quantity or type of suspended matter, and similar concentrations of different types of suspended matter could result in different turbidity readings. Furthermore, pigments from vegetation may impart color to the water, increasing turbidimeter readings. An increase in suspended solids can be caused by increased sediment loading, and sediment load can be measured in mg/l. Suspended sediment concentrations (SSC) are more difficult to measure than turbidity. Equations have been developed to estimate SSC from turbidity measurements, but researchers caution that relationships differ between drainages due to specific sediment characteristics (Lloyd *et al* 1987).

In most streams, there are times when the water is naturally turbid, usually when storms produce runoff. Moderate levels of turbidity may give juveniles protection from predators. Turbidity levels of about 23 NTU apparently reduced the perceived risk of predation on juvenile chinook (Gregory 1993). Chinook salmon are known to occupy turbid rivers for a significant portion of their early life.

High suspended solid concentrations cause physiological and behavioral stress responses (Newcombe and MacDonald 1991), but low or moderate exposures of short duration can be tolerated by the fish. In general, however, salmonids survive better in clear water at all life stages, and high, long-term levels of turbidity can negatively affect them (Newcombe and Jensen 1996).

Newcombe and Jensen (1996) analyzed data from 80 studies on fish responses to suspended sediment in streams and estuaries and related biological response to duration of exposure and SSC. Behavioral effects included avoidance responses and abandonment of cover. Sublethal effects included reductions in feeding and physiological stress. Lethal effects included reduced growth, delayed hatching, increased predation, alterations to habitat, and mortality.

When water carries very high silt loads, migrating salmonids avoid this water and will cease migration (Cordone and Kelly 1961, cited in Bjornn and Reiser 1991), but they can migrate with high turbidity levels often associated with rainfall events. Suspended sediment effects on eggs are related to the percent of fines in the gravels more than suspended sediment concentrations in the water. When an excess of silt is deposited after spawning, intergravel flow is reduced, and eggs can be "smothered." This results in a loss of dissolved oxygen, accumulation of catabolic waste products, and the promotion of fungal growth.

Newly emerged fry are more susceptible to moderate turbidities than older fish (Bjornn and Reiser 1991). Turbidities in the 25-50 NTU range (equivalent to 125-275 mg/l of bentonite clay) reduced growth and caused more young coho salmon and steelhead to emigrate from laboratory streams than did clear water (Sigler *et al*. 1984). Larger juveniles and adults do not appear to be affected by ephemerally high concentrations of suspended sediments like those that occur during storms. Juvenile coho avoid water with turbidities exceeding 70 NTU (Bisson and Bilby 1982). Feeding and territorial behavior of juvenile coho are disrupted by short-term exposures (2.5-4.5 days) to turbid water (up to 60 NTU) (Berg and Northcote 1985). Juvenile salmonids tend to avoid chronically turbid streams (Lloyd *et al.* 1987) except when they use them as migration routes. Young salmonids subjected to continuous clay turbidities have lower growth rates than those living in clear water (Sigler, *et al*. 1984).

Chronic turbidity decreases light penetration in streams, which can reduce primary productivity (aquatic plants) (Lloyd *et al*. 1987). Dramatic changes in light penetration and primary production can be caused by even small (5-10 NTUs) increases in turbidity above naturally clear conditions (Lloyd *et al.* 1987). By modeling the effect of various turbidity levels on light available at depth, Lloyd calculates that a turbidity of only 5 NTUs can decrease the primary productivity of shallow, clear-water streams in Alaska by about 3-13%, and an increase of 25

NTUs by 13-50%. This can result in decreased production of zooplankton and macroinvertebrates (secondary production), and decreased abundance and production of fish (Lloyd 1987). Lloyd therefore suggests a moderate level of protection for salmonids would be 25 NTUs above natural conditions in streams. A higher level of protection would be 5 NTUs above natural conditions, which would bring total turbidities in salmonid streams to 8 NTUs. Absolute turbidities of 8 NTUs and higher have been shown to reduce sport fishing in Alaska.

The Water Quality Control Plan for the North Coast Region sets a standard for turbidity as:

> *Turbidity shall not be increased more than 20 percent above natural occurring background levels. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.*

The standard for suspended material is:

> *Waters shall not contain suspended material in concentrations that causes nuisance or adversely affect beneficial uses.*

It is difficult to determine what natural occurring background levels are. The North Coast RWQCB has proposed that the current sediment criteria are not specific enough to protect salmonid habitats from the cumulative effect of sediment related effects, and has begun work to develop numeric instream targets to integrate cumulative effects over annual time frames instead of indicators that measure instantaneous conditions. Criteria suggesting the use of instream indicators that address sediment related effects to the quantity and quality of instream habitat have also been proposed by the SCWA in draft form (SCWA 2000). The criteria proposed in this report are designed to be more specific than current RWQCB standards.

Criteria are developed for this analysis for turbidity measured in NTUs for rearing and spawning habitat (Table 2–15). These criteria give maximum, instantaneous values based on the peer reviewed literature cited previously. A conversion ratio for NTUs to mg/l suspended solids may give only a rough estimate of suspended solids concentrations in this watershed, therefore published criteria based on suspended solids concentration levels over specific timeframes were not be applied. Short exposures (a few hours to a couple of days) would have less of an effect than long exposures (a week or more). However, even short exposures of high turbidity (greater than 70 NTUs) can have severe effects (Sigler *et al.* 1984, Newcombe and Jensen 1996).

For migration corridors, a less stringent set of turbidity criteria is developed. Since turbidity and suspended solids are thought to protect juveniles from predators, if sections of the mainstem Russian River are too warm for juvenile rearing (but warm enough to support warm water predators) they should have relaxed turbidity standards, up to the point that physiological stress is not excessive. This would provide corridors for juvenile downstream migration. The Russian River Estuary and the lowest portion of the Russian River have cooler water temperatures than upstream areas because they lie in a coastal fog belt. Estuaries and lagoons are important areas for rearing of juvenile steelhead (Smith 1990).

Table 2-15 Turbidity Evaluation Criteria

Habitat Score	Rearing Turbidity (NTU)	Juvenile Migration Turbidity (NTU)
5	<10	<25
4		25-50
3	10-25	50-60
2	25-50[3]	
1	50-70[1]	60-70
0	>70[2]	>70

References
[1] Berg and Northcote 1985
[2] Bisson and Bilby 1982
[3] Sigler *et al.* 1984

2.5 WATER QUALITY EFFECTS FROM WATER TREATMENT ADDITIVES AND FACILITY MAINTENANCE SUBSTANCES

2.5.1 ISSUES OF CONCERN

Chlorine, NAOH, and Ortho-Phosphate are used and stored to treat water for safe human consumption. Ortho-Phospate is part of the operation, but is not used near the river, so criteria have not been developed for it. Diesel fuel is stored in significant amounts for operation and maintenance of water supply facilities. These substances can have deleterious or lethal effects on salmonid species if they enter water bodies in high enough concentrations. Storage and containment practices are evaluated for these substances.

2.5.2 CHLORINE

Chlorine is not a natural component of water. Chlorine reacts with nitrogenous organic materials to form chloramines that are toxic to fish. Toxicity is related to the concentration of free chlorine and chloramines. Salmonids are particularly sensitive. The 7-day LC_{50} for rainbow trout was 0.08 mg/l with an estimated median period of survival of 1 year at 0.004 mg/l (Merkens 1985, cited in EPA 1976). In marine water, the critical levels of chlorine for young Pacific salmon exposed for 23 days were <0.02 to <0.05 mg/l (Holland, *et al*. 1969). The lethal threshold for chinook salmon and coho salmon for a 72-hour exposure was noted by these investigators to be less than 0.1 mg/l chlorine. Mattice and Zittel (1976) showed that 20 µg/l appeared to be safe for marine organisms.

Based upon these studies, the EPA recommends a maximum total residual chlorine level of 2.0 µg/l for salmonids (EPA 1976). The American Fisheries Society (AFS) cites Brungs (1976) review and supports his recommendation that the criterion for continuous exposure of freshwater organisms should be 3 µg/l because of the analytical difficulties involved in low-level chlorine detection (AFS 1979). Furthermore, the mixing zone should be located so that it does not form barriers to migration. With careful site selection and design, the mixing zone can be designed to protect aquatic life.

2.5.3 Sodium

Sodium has little adverse effect on water in limited amounts. Criteria developed by Sylvester *et al.* (1967, cited in Bell 1990) recommend a goal (desirable level) of 10 mg/l over natural concentration and a standard (to be achieved immediately or within a short period of time) of 35 mg/l over natural concentration for fresh water. For salt water, the goal is 10,500 mg/l with a standard of 12,500 mg/l.

2.5.4 Hydrocarbons

While it is difficult to assess the effects of spilled oil on migratory fish, laboratory studies indicate that there is the potential for harm. Growth of salmonids can be inhibited by exposure to the water-soluble fraction of crude oil (Moles and Rice 1983, cited in Wang, 1992, Vignier *et al.* 1992). Sublethal exposures can cause metabolic changes and increased energy demands on fish. Development of alevins can be inhibited (Marty *et al*. 1997).

2.6 Critical Habitat Alteration and Fish Injury from Operation or Maintenance Activities

2.6.1 Issues of Concern

Infiltration capacity is augmented by periodically scraping gravel bars in the river and removing fine sediment from the bottom of the infiltration ponds. The gravel bars are recontoured so they become inundated. Depending on the time of year, location and method, the gravel bar scraping can have direct and indirect effects on salmonids migrating in the area.

Four general categories of potential effects of maintenance activities on critical habitat and fish are evaluated. They are 1) opportunity for injury, 2) sediment control, 3) magnitude of activity and habitat value, and 4) vegetation removal.

Direct effects of gravel bar grading operations can be related to disturbance or direct mortality of salmonids, and depending on the original habitat, the scraped area can become degraded in terms of sustaining juvenile fish. Indirect effects can be related to storage of spoils (fine sediment) from scraping gravel bars or removal of fine sediment from infiltration ponds. Improper storage can result in reentry of the fine sediment into the river. Refer to subsection 2.4.1.2 above for detailed information on potential effects related to suspended sediment and turbidity.

Gravel removal has the potential to increase the potential of stranding juvenile fish, and to affect the geomorphology of the river channel. Improper grading of streambanks could create large, flat, shallow areas along the stream margin or large depressions along the stream margin that become dewatered at low flows. Juvenile fish that take refuge in these areas can be stranded when these areas become dewatered at low flows. However, if the streambank is graded so that it slopes down toward the river channel, the risk of stranding can be reduced. Gravel bar grading generally results in a flatter streambed. If the riverine reaches in which this activity occurs are characterized by habitat types such as glides or runs, this activity is not likely to change the general habitat available to protected species.

Removal of native riparian vegetation can have long-term effects on salmonid habitat. Riparian vegetation, especially trees, provides canopy cover and shade, and removal may increase solar input and result in higher water temperatures in the summer (Hall and Lantz 1969). Riparian vegetation affects erosion and sedimentation processes. Bank erosion and lateral channel migration contribute sediments to the stream if protective vegetation and root systems are removed. Riparian vegetation is essential for building and maintaining stream structure and for buffering the stream from incoming sediments and pollutants. When vegetation is reduced, flood events are more likely to damage channel morphology by widening the stream and decreasing bedform roughness, potentially filling pools with sediments and reducing the quality of spawning gravels. Trees provide streambank stability with their root systems, and when older trees fall into a stream, they create high-quality pools and riffles as well as controlling the slope and stability of the channel (Beschta and Platts 1986). Streambank stability is also maintained by flexible vegetation such as willows and grasses. During floods, water transports large amounts of sediment in the stream. Vegetation mats on the streambank reduce water velocity, causing sediment to settle and become part of the bank, increasing nutrients so important to productive riparian vegetation.

Riparian vegetation provides cover, an important determinant of fish biomass. Well-vegetated banks gradually erode, creating undercuts important as refuge habitat. Root systems of grasses and other plants can trap sediment to help rebuild damaged banks. Riparian vegetation provides the basis for food production. Plant matter provides organic material essential to the stream for production of aquatic insects. Vegetation also provides habitat for terrestrial insects, which are an important food for salmonids. Vegetation removal can be beneficial if it involves the removal of non-native, noxious species that reduce the ability of beneficial native plant species to survive.

2.6.2 Evaluation Criteria

Potential effects of construction and maintenance activities on critical habitat and fish are evaluated by four related categories. The categories are 1) opportunity for injury, 2) sediment control, 3) magnitude of activity and habitat value, and 4) vegetation removal.

Opportunity for Injury

Immediate effects from maintenance or construction activities are scored according to the opportunity for injury to protected species (Table 2-16). BMPs are generally implemented to reduce the risk of injury to fish and may include scheduling the work when protected species are not present or when the stream channel is dry, conducting a biological survey of the project area to assess appropriate BMPs, isolating the project area from stream flow, and providing escape or rescue for fish that may be present. Site-specific factors dictate appropriate BMPs. For example, isolating a construction or maintenance area from streamflow may be a preferred alternative for some projects, but may result in an unacceptable disruption of habitat for other activities, such as one that takes place in a long reach of stream but involves minimal instream work. While a fish rescue may reduce the risk of injury, it has risks associated with it, and there may be times when providing escape is a preferred alternative.

High evaluation scores are associated with activities that have a low risk of injury, such as those that do not take place in the channel, or take place in a dry channel. If activities take place when no fish species are present, then no direct injury to fish would be expected. The greater the interaction with the stream, the higher the risk of direct mortality to fish and effects associated with increased turbidity and sedimentation of aquatic habitat. Some activities require almost no interaction with the stream channel or water in the stream. Occasionally, a project may require equipment in the flowing channel. Appropriate BMPs, such as project area surveys by a qualified biologist, isolation of the project area from flow, and fish rescue or escape, reduce the injury from equipment or stranding.

The lowest scores are given to activities that occur in a wetted channel where appropriate BMPs are not applied or applied in a limited way. There may be site-specific considerations that limit the ability of staff to apply appropriate BMPs. For example, emergency work after a landslide may restrict the ability of staff to implement all practices that might be desirable.

Table 2-16 Opportunity for Injury Evaluation Scores

Category Score	Evaluation Category
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).
2	Limited ability to apply appropriate BMPs.
1	Appropriate BMPs are not applied.

If there are biological or habitat conditions in a particular area that suggest there may be a more significant risk to protected fish species, the risk to protected fish species may be greater. For example, if a maintenance activity is scheduled in the late summer in the upper mainstem Russian River, where important rearing habitat is known to occur, the effects may be more significant than if the work were performed in the Mirabel area where high summer water temperatures are likely to limit the number of fish that are present. The level of risk is qualitatively assessed, based on general knowledge of the tributary or river where the work is done.

Sediment Control

Evaluation criteria for sediment control address two components, including instream and up-slope sediment control, and spoils storage (Table 2-17). Component 1 is instream sediment control. A high score for Component 1 indicates instream work practices with the highest degree of sediment containment, and a low score indicates poor or no sediment containment measures. Working in a channel that is dry, or rerouting streamflow from the construction area into a clean bypass or other method that reroutes streamflow, would isolate the construction area and prevent sediment input to the stream; therefore, these options are given a high score. A clean bypass is routing streamflow around the maintenance activity so that continuity of flow and water quality is maintained downstream. A clean bypass isolates the work area from the wetted stream channel. For work in flowing water, SCWA typically establishes a gravel berm downstream to filter turbid waters and reduce potential sedimentation.

Work up-slope also has the potential to increase sediment input into the stream or affect bank erosion. Component 2 is upslope sediment control, which evaluates the potential for upslope work, particularly work on the stream bank, to increase sediment input to the stream or to affect bank erosion. Component 2 evaluates the amount of disturbance, the effectiveness of erosion control measures, and whether bank stabilization is improved or degraded. Similar to the instream component, a high score indicates minimal or no slope disturbance and a low score indicates maintenance activities that are likely to cause slope failure or bank erosion, with resulting sediment input.

Table 2-17 Sediment Containment Evaluation Criteria

Category Score	Evaluation Category
	Component 1: Instream Sediment Control
5	Project area does not require rerouting streamflow
4	Clean bypass or similar method used
3	Effective instream sediment control (e.g., berm/fence)
2	Limited sediment control
1	No instream sediment control
	Component 2: Up-slope Sediment Control
5	No up-slope disturbance, or increase in up-slope stability
4	Limited disturbance with effective erosion control measures
3	Moderate to high level of disturbance with effective erosion control measures
2	Action likely to result in increase in sediment input into stream
1	Action likely to result in slope failure, bank erosion an uncontrolled sediment input to the channel or major changes in channel morphology

Magnitude of the Activity

The magnitude of maintenance activities is used as an indirect assessment of the long-term effects on fish habitat. Construction or maintenance projects that are of a small scale, for example, filling a scour hole below a culvert, are less likely to directly affect fish habitat conditions than projects that encompass a much larger channel area. The criteria for project size is proportionately scaled relative to the size of the channel on which maintenance activities are occurring. This scoring system allows a relative comparison of stream or river areas affected between project activities, and between future alternatives. We define small project sizes as less than 5 bankfull widths and large projects as greater than 30 times bankfull width. The bankfull stage (flow) is the discharge that forms the average morphologic characteristics of the channel, and on average has a recurrence interval of 1.5 years (Dunne and Leopold 1978). Bankfull width is the width of the river water surface at bankfull stage. Criteria for effects relating to the size of the project are given in Table 2-18.

Effects are evaluated separately for each type of activity for each of the target species, and applied separately to the spawning/incubation and rearing stages. A qualitative assessment is made of long-term project effects on critical habitat, including elements such as canopy cover, instream cover, sediment effects, and bank erosion. Since changes in these elements are difficult to quantify, actual scoring criteria have not been developed for them. Finally, the action is evaluated on whether it has a beneficial or negative effect.

Table 2-18 Magnitude of the Action Evaluation Criteria

Category Score	Evaluation Category
	Component 1: Lineal Distance Estimated in Bankfull Widths
5	<5 bankfull widths
4	5-10
3	10-20
2	20-30
1	> 30
	Component 2: Activity Width as a Percent of Bankfull Widths
5	<10% of bankfull width
4	10-25%
3	25-50%
2	50-75%
1	75-100%

Vegetation Removal

Vegetation is removed along levee access roads to water supply facilities, and blackberries that grow in channels connecting the diversion sediment ponds with the infiltration ponds are removed. Vegetation removal activities associated with channel maintenance activities are discussed in more detail in *Interim Report 5: Channel Maintenance*.

Long-term effects to habitat of riparian vegetation removal, such as reduction in canopy cover and increases in water temperature, are difficult to quantify, so criteria have not been developed for them. A qualitative assessment is made where appropriate. Removal of vegetation can have direct short-term effects based upon the particular method used. It should be noted that beneficial, long-term effects to habitat could outweigh direct, short-term effects of vegetation removal activities.

Vegetation control on the Russian River is usually accomplished by one or several methods including hand clearing, mechanized methods, and herbicides. Hand clearing generally disturbs the streambank less than mechanized methods, particularly if heavy equipment is used. In addition to sediment input and direct injury to fish (see Tables 2-16 and 2-17), vegetation removal may degrade water quality. For example, a direct effect may involve introduction of pollutants such as herbicides, or an indirect effect may occur such as the introduction of excessive amounts of decaying vegetation to the stream that decreases dissolved oxygen levels in the water.

Herbicides have been developed to try to minimize effects in riparian and wetland habitats. For some plants, such as the highly invasive, non-native weed *Arundo donax* (Giant Reed), a combination of mechanical/hand clearing and herbicide use are effective while the use of one method alone is not. A commonly used herbicide that has been EPA approved for use near aquatic areas is glyphosate, (Rodeo®). Glyphosate, when used according to directions, is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates (EXTOXNET 1996). The 96-hour LC50 is 86 mg/L in rainbow trout (Weed Science Society of America 1994).

Because vegetation removal related to water supply operations primarily occurs on levy access roads, it is not likely effect the riparian corridor. Evaluation criteria for vegetation control address herbicide use and assess the amount and quality of chemicals released into the aquatic environment when herbicides are used (Table 2-19). Higher scores are associated with practices that use only an aquatic contact herbicide, and limit herbicide use to smaller, targeted areas. Moderate to heavy herbicide use is associated with large-scale vegetation removal activities, for example, if a large infestation of *Arundo* had to be removed.

Table 2-19 Vegetation Control Evaluation Criteria

Category Score	Evaluation Category
5	No chemical release
4	Limited use of herbicide approved for aquatic use
3	Moderate to heavy use of herbicide approved for aquatic use
2	Use of herbicide not consistent with instructions
1	Herbicide not approved for aquatic use

2.7 PREDATION EFFECTS FROM MAINTENANCE AND OPERATION ACTIVITIES

2.7.1 ISSUES OF CONCERN

Reservoirs are generally good habitat for fish species that are known to prey on salmonids. Reservoirs may serve as a source population from which downstream areas are colonized. As the intakes to Warm Springs and Coyote Valley dams are not screened, fish may pass through the control structure and outlet works of the dams. Of particular concern are non-native largemouth bass and smallmouth bass, green sunfish and native Sacramento pikeminnow. There are self-sustaining populations of these species in the Russian River. The stocking of striped bass in Lake Mendocino might lead to the introduction of these predators in the stream reaches downstream of Coyote Valley Dam. However, striped bass do not reproduce at this location in the upper mainstem, because suitable spawning habitat for them does not exist in this area. Impounded water behind the inflatable dam (3.2 linear kilometers) can potentially provide more optimum conditions for predators.

Structures that concentrate prey increase the potential for predation on protected species. If there are holding areas that favor predators near structures that concentrate salmonids, and if predators are actually known to be present near those structures, protected species may be adversely affected. If a structure provides predators access to areas that already have established predator populations, the structure would not introduce a new risk to salmonids. Furthermore, water temperatures favorable to predators would be needed.

2.7.2 EVALUATION CRITERIA

To evaluate the risk of increased predation on protected species, three components were developed for predation criteria including 1) structural criteria, 2) access criteria, and 3) habitat criteria (Tables 2-20, 2-21, 2-22).

Predator habitat criteria are based on water temperatures favorable to warmwater predators, especially centrarchids and Sacramento pikeminnow. The optimum temperature for Sacramento pikeminnow is 26.3°C (Knight 1985). Warm water temperatures favor these predators at the same time that they negatively affect protected salmonids and their ability to avoid predation.

Table 2-20 Predation Structural Evaluation Criteria

Category Score	Evaluation Category
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.
1	Features that concentrate salmonids, predators abundant locally.

Table 2-21 Predation Access Evaluation Criteria

Category Score	Evaluation Category
5	Structure does not allow passage of predators, predators not present near structure.
4	Structure does not allow passage of predators, predators present near structure.
3	Structure provides limited passage of predators or limited passage to areas they are already well established, predators not present near structure.
2	Structure provides limited passage of predators to areas they have historically not been found or have been found in limited numbers, predators present in limited numbers near structure.
1	Structure provides passage of predators to areas they have historically not been found or found in limited numbers, predators present or migrate to structure

Table 2-22 Predator Habitat (Water Temperature for Warmwater Species) Evaluation Criteria

Category Score	Evaluation Category
5	Water temperatures $<13^{O}C$
4	Water temperatures $13\text{-}18^{O}C$
3	Water temperatures $18\text{-}20^{O}C$
2	Water temperatures $20\text{-}24^{O}C$
1	Water temperatures $\geq 24^{O}C$

The previous section identified potential effects on protected species and critical habitat of the Russian River system that may arise from facility operations. In addition, evaluation criteria were developed that reflect the range of effects that may occur from operation and maintenance of the SCWA water supply facilities. It is emphasized that many potential effects are influenced by independent and non-related operating procedures, and an unfavorable condition in a single factor may not necessarily produce a significant effect to the system.

In Section 3, each of the identified effects is summarized with respect to the various operating or maintenance procedures that factor into its integrated evaluation. Although many effects are not directly quantifiable, a semi-quantitative approach is presented by providing scores to the evaluation categories that reflect the water supply operations and maintenance activities. The evaluation criteria are applied to life history stages of the three protected species.

3.1 ADULT UPSTREAM MIGRATION EFFECTS

Effects to adult salmonid upstream migration are evaluated for the inflatable dam at Mirabel on the Russian River. Passage evaluation criteria evaluate fish ladder design and operation, and attraction flows. Criteria are applied for adult salmonid spawning migration periods for each of the protected species. The inflatable dam has generally been raised in May and deflated in early October or early November, as determined from pump records from 1997 and 1998 (Table 3-1) and the available operation history (Table 1-2). However, it is possible that the dam could be raised earlier or later in the year, possibly in any month. This timing varies, depending on climatic conditions and water demand. The Denil-style fish ladders at the inflatable dam are most likely to potentially affect upstream passage during the first half of adult chinook salmon migration and the very beginning of the coho salmon upstream migration. The dam is not usually inflated during peak steelhead spawning migration (Table 3-1).

Table 3-1 Average Number of Days per Month that the Inflatable Dam was in Operation (raised) as Indicated by Diversion Pump Records for 1997 and 1998 (SCWA 2000), and Adult Salmonid Upstream Migration Periods

Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Frequency	8	25	31	31	30	31	9	0	0	0	0	0
Adult Upstream Migration Period												
Coho							■	■	■			
Steelhead									■	■	■	
Chinook				■	■	■	■	■	■			

Total Average for year = 165 days

The design drawings used to build the Denil-style fish ladders show that the ladders are built within the guidelines of published criteria. Winzler and Kelly (1978) determined that migrating fall-run chinook salmon should not have difficulty ascending the fishways when the dam is inflated. The Denil-style fish ladders have approximate slopes of one foot of rise to eight foot of run. Turning pools located in each fishway provide temporary, in-transit, and resting areas. Baffle sections also provide less turbulent water on the bottom of each fishway. Water is provided for fish attraction flows. The fishways are equipped with a debris barrier.

The bypass line at the east side of the dam produces turbulent flow at the downstream entrance of the east side fish ladder. In 1999, flows through this bypass pipeline were decreased, and this decreased the turbulence and enhanced the function of the fish ladder. SCWA plans to modify the east side bypass pipeline so that it can be operated at its full 22-cfs capacity. The west side bypass line and fish ladder function properly.

Preliminary data on adult migration through the ladder in 1999 indicate salmonids can pass successfully (SCWA 2000). Video monitoring from mid-May through mid-November documented over 200 adult chinook salmon, 18 steelhead, and 98 unidentified salmonids using the ladder. No adult coho salmon were identified. The vast majority of the chinook salmon and "salmonids" passed during October and November. Even less powerful swimmers, such as Pacific lamprey (68 passed), used the ladder. Although SCWA is still in the beginning stages of a five year study to assess the potential effects associated with the Mirabel and Wohler facilities, it is already evident that all protected salmonids are able to pass the inflatable dam.

Snorkeling surveys were conducted below the inflatable dam during the summer of 1999 every two to three weeks to examine the possibility that adult salmon were holding below the dam before entering the ladders. If significant numbers of fish were found below the dam, it might indicate that there could be a delay in migration through the ladders. Although the data are described as having "limited usefulness" because turbidity limited visibility, no adult salmonids were observed. Approximately 137 adult chinook salmon and 88 unidentified "salmonids" (225 total) passed the ladder in October, indicating that delay in migration was not a problem.

Table 3-2 provides the current operations score based on fish ladder design and operation. All adult species of listed fish appear to pass the inflatable dam with little to no difficulty. The dam is generally not inflated during peak steelhead spawning migrations, but field data show that when steelhead do use the fish ladder, they pass successfully. Analysis of the fish ladder design and preliminary field data show that both chinook salmon and coho salmon have little to no risk in upstream passage at the dam. Therefore, the adult upstream passage score for the inflatable dam is a 5 for all three threatened species.

Adult salmonid passage is also affected by attraction flows from the fish passage facility (fish ladder and bypass outfall). Insufficient attraction flows could make it difficult for adult fish to find the entrance to the fish ladder, thereby creating migration delays. If the amount of water provided for the fish ladder and bypass system (exits at the ladder entrance) is 10% or more of the total flow, attraction flow is sufficient. Attraction flow is analyzed by 1) estimating the stream flow at the inflatable dam when it is raised, 2) subtracting the amount of water that is diverted either to the infiltration ponds or through the fish ladders and bypass facility provided by the fish passage facility. A hydrologic computer simulation provided the estimate for total stream flow at the dam. The average monthly diversion to the infiltration ponds was

Table 3-2 Current Operations Passage Scores by Species for Adult Salmonids at the Inflatable Dam – Fish Ladder Design and Operation

Category Score	Evaluation Categories	Current Operations Score*
5	Fish ladder passes adult salmon with minimal delay.	Co, Ch, St
4	Fish ladder passes adult salmonids with slight delay.	
3	Fish ladder passes adult salmonids with moderate delay.	
2	Sporadic function of fish ladder.	
1	Poor design of fish ladder.	
0	Fish ladder not provided.	

* Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

estimated from pumping records during 1997 and 1998, and water passed through the fish passage facility is obtained from engineering specifications. The diversion caissons are capable of pumping a total of 100 cfs.

The time frame used in the analysis is the period when the dam was raised and surface water diversion (pumping) occurred. In 1997 and 1998, pumping occurred during the months of May through November, or water months 1, 2, 8, 9, 10, 11, and 12. (A water year is October through September.) This time frame is used for this evaluation because this is the period that the operation would normally occur, but the facility could be operated earlier or later in the year. Table 3-1 summarizes the number of days per month that the inflatable dam was in operation based on 1997 and 1998 pump data at the diversion. In general, the inflatable dam was in operation during the months of June, July, August, September and October. During the months when the dam was raised and lowered (May and November), operation was approximately 25% of each month. This was typically the end of May and the beginning of November.

Table 3-3 provides a summary of the times the fish facility did not provide at least 10% of the total flow of the river from 1960 through 1995, based on the hydrologic simulation of current demands on various water year conditions. Of the 35 water years, attraction flow would have been less than 10% of total river flow about 400 times, or about 11.5 times per year. The daily data indicates that nearly all high flow events in the river occurred when the dam was in operation late in the year (i.e., late October or early November), although a few occurred early in the year associated with late spring storms. The dam is lowered to prevent damage from high storm flows. The high flow events (when the dam is raised) are the times when more water goes over the dam and therefore less than 10% of the flow is provided by the fish passage facility. The daily data also show that the duration of a high water event that would affect attraction flows is normally of short (i.e., two to three days).

Table 3-3 provides the number of days per year from 1960 to 1995 that attraction flows are estimated to be less than 10% of the total stream flow at the inflatable dam. Using the conservative assumption that all flows occurred during the upstream migration of adult threatened salmonids, yearly scores are provided in Table 3-3 using the evaluation criteria in

Table 3-3 Number of Days by Water Year that Attraction Flows Would Have Been Less than 10 Percent at the Inflatable Dam from 1960 through 1995 (Computer Simulation), Including Percent and Scoring Category

Water Year	Number of Days Attraction Flows less than 10%	Percent per Year	Category Score for Year
WY 1960	0	0%	5
WY 1961	7	3%	4
WY 1962	6	3%	4
WY 1963	29	14%	4
WY 1964	24	11%	4
WY 1965	16	7%	4
WY 1966	16	7%	4
WY 1967	32	15%	4
WY 1968	0	0%	5
WY 1969	0	0%	5
WY 1970	0	0%	5
WY 1971	8	4%	4
WY 1972	0	0%	5
WY 1973	13	6%	4
WY 1974	25	12%	4
WY 1975	3	1%	4
WY 1976	0	0%	5
WY 1977	0	0%	5
WY 1978	7	3%	4
WY 1979	7	3%	4
WY 1980	23	11%	4
WY 1981	0	0%	5
WY 1982	40	19%	4
WY 1983	53	25%	4
WY 1984	23	11%	4
WY 1985	21	10%	4
WY 1986	4	2%	4
WY 1987	0	0%	5
WY 1988	1	0%	5
WY 1989	7	3%	4
WY 1990	9	4%	4
WY 1991	0	0%	5
WY 1992	0	0%	5
WY 1993	3	1%	4
WY 1994	4	2%	4
WY 1995	20	9%	4
Total	401		
Average Score for the 35 Years			4.0

Based on Estimated Diversion and River Flow (Simulation)

Table 3-4. Table 3-4 provides the current operations passage scores by species for the inflatable dam related to opportunity for adult passage in terms of attraction flows. The estimated score for steelhead is 5 since the dam is not as likely to be in operation during the peak upstream spawning migration. The estimated score for chinook salmon and coho salmon is 4 because attraction flows are occasionally less than 10% during a portion of adult migration periods. In general, the attraction flows are sufficient to provide unrestricted passage for all three species of threatened salmonids.

Table 3-4 Current Operations Passage Scores by Species for Adult Salmonids at the Inflatable Dam – Opportunity for Passage Related to Attraction Flow

Category Score	Evaluation Categories	Current Operations Score*
5	Ten percent of total stream flow is provided for fish attraction continuously during migration	St
4	Ten percent of stream flow is provided for fish attraction 75-99% of time during migration	Co, Ch
3	Ten percent of stream flow is provided for fish attraction 50-74% during migration	
2	Ten percent of stream flow is provided for fish attraction 25-49% of time during migration	
1	Ten percent of stream flow is provided for fish attraction less than 24% of time during migration	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

In general, adults of all three listed salmonid species can pass through the fish ladder easily and without delay because the facility is designed and operated appropriately, there are sufficient attraction flows for the vast majority of the time, and inadequate attraction flows (during storm events) are infrequent and short in duration. It is estimated there is little risk for steelhead passage because the dam is not as likely to be inflated during steelhead spawning runs. Coho salmon have little risk in successful upstream passage since their upstream migration is likely correlated with increasing river flow and the time when the inflatable dam is lowered. Although adult chinook salmon are likely to pass through the fish ladder during a substantial portion of their migration period, they too are at low risk because they are able to pass successfully, as indicated by passage data and ladder operations.

3.2 Juvenile Emigration and Rearing Effects

When inflated, the dam at Mirabel impounds water upstream for approximately two miles. This impoundment decreases current velocity, which has the potential to delay emigrating smolts.

The Mirabel diversion is a pumped diversion at the inflatable dam that is used to supply water to the Mirabel infiltration ponds. The Wohler diversion is a gravity-fed diversion ditch that operates when water is backed up by the inflatable dam. Both of these diversions require the dam to be raised to operate, but neither automatically fills the infiltration ponds when the dam is raised. Impingement of salmonid juveniles on screens or entrainment in the ponds may cause death and injury directly, or may cause stress-related injury or death. Entrainment in the infiltration ponds may result in migration delays or increased predation on juvenile salmonids.

Three issues are evaluated for potential effects on juvenile salmonids: 1) juvenile migration delay behind the inflatable dam, 2) impingement, entrainment, or injury at diversion facilities, and 3) stranding or displacement from flow recessions when the inflatable dam is lowered. The second issue is evaluated under low flow (dry season) and high flow (rainy season) conditions for both the Mirabel and Wohler diversion facilities. The third issue is the potential for stranding of juvenile salmonids when water levels recede as the inflatable dam is lowered. The analysis for this subsection is organized as follows.

1) Juvenile Emigration Delay at the Inflatable Dam

2) Impingement, Entrainment, or Injury at Diversion Facilities

   a) Low flows: Mirabel and Wohler

   b) High flows: Mirabel and Wohler

3) Stranding or Displacement from Flow Fluctuation

   a) Lowering of inflatable dam

The evaluation is focused on the following smolt emigration periods (see Section 1-3).

Species	**Juvenile Emigration**
Coho	February - mid-May
Steelhead	March – June
Chinook	February - May

3.2.1 Utilization of the Mirabel and Wohler Areas by Juvenile Salmonids

SCWA is conducting a five-year study to assess the potential effects to protected fish species associated with operation and maintenance activities at the Mirabel and Wohler diversion facility. A reconnaissance level sampling program was conducted in 1999 to determine sampling methodologies that best assess the fish community and water quality (SCWA 2000), and the first year of the sampling program began in 2000. Data related to potential changes in habitat are discussed in *Section 3.2.5 Habitat in Wohler Pool.*

As one part of this study, information was collected on smolt emigration through the study reach. Rotary screw traps located approximately 60 meters downstream of the inflatable dam site are providing valuable information on the timing, size, and age of emigrating smolts, as well as providing the opportunity to collect tissue samples for DNA analysis. Hatchery fish were released at the upstream end of the impounded reach. The screw traps were fished downstream of the dam in the main channel where emigrating smolts are likely to be concentrated. These studies were conducted both before and after the dam was inflated. The rotary screw traps were fished over a longer period of time and later in the spring of 2000 to capture young-of-the-year steelhead. Because young-of-the-year steelhead are more likely to utilize the shallower margins of the river than smolts, these data may not indicate the relative abundance of different age categories. Furthermore, the trap may be more effective at capturing fish passing through with the current than fish that may be rearing (not migrating) in the area. The screw trap is very effective at capturing fish that are small or weak swimmers (S. White, SCWA, pers. comm. 2000).

In the 1999 reconnaissance sampling program, the recapture rate was not high enough to determine the rate of smolt emigration through the Wohler Pool, but the data did provide a preliminary indication of smolt migration periods. Preliminary scale sample analysis indicated that steelhead primarily emigrate at age 2+. In addition to steelhead and chinook smolts, some young-of-the-year steelhead were captured in 1999 and 2000. Preliminary data indicate that some steelhead smaller than 60 mm (NMFS definition of fry-sized) were present in early April, but that average sizes of steelhead were larger than 60 mm by the end of May, and greater than 80 mm by the end of June (S. White, SCWA, pers. comm. 2000). These data, combined with the absence of suitable spawning habitat in this area, suggest that large numbers of fry are not likely to be present in the area.

These data are preliminary and evaluation of the 2000 data is not yet complete. Sampling for juvenile steelhead, particularly the late summer/early fall period, is planned as part of the five-year study to determine if young-of-the-year steelhead are able to rear over the warmest part of the summer in this portion of the mainstem.

Temperature monitoring in 1999 and 2000 indicated that temperature in the late spring is optimal for growth of young salmonids in the Mirabel and Wohler areas. Young-of-the-year steelhead sizes doubled, and sometimes tripled, within weeks during the spring. However, preliminary data indicate that late-summer water temperatures may be too high to support adequate growth, and juvenile steelhead appear to leave the area by mid-July (S. White, SCWA, pers. comm. 2000). It is not known if young-of-the-year steelhead found in these areas during the spring migrate to tributaries or the estuary where water temperatures are cooler. It is also possible that these young-of-the-year steelhead suffer mortalities as the quality of rearing habitat degrades with high temperatures. Approximately 5 to 8 marked hatchery steelhead and possibly one naturally spawned steelhead were captured during electrofishing in the Mirabel and Wohler areas in August 2000, but they appeared to be stressed and in poor condition. While some rearing could occur in this portion of the mainstem Russian River in the spring, primary rearing habitat probably occurs in tributaries, and possibly the estuary. Water quality and other habitat parameters are not likely to meet steelhead requirements during the warmest summer months in the Mirabel and Wohler areas.

3.2.2 Juvenile Emigration Delay at the Inflatable Dam

As part of the five year monitoring program, SCWA is using radio telemetry to measure the length of time required for hatchery steelhead smolts to emigrate through the impounded reach of the river before and after inflation of the dam. Between April 7 and June 6, 2000, SCWA biologists surgically implanted uniquely coded radio tags in 79 smolts, recorded their movements in the river above the dam by boat using a manual receiver, and passage around the dam site with a fixed datalogging receiver. Four groups of 19-20 fish were released 4 km above the dam site: two groups before and two groups after the dam was inflated on May 2. Because smolts were held in the hatchery beyond their normal release date, biologists tested physiological stage of smoltification over time by measuring blood plasma sodium concentrations after 48 hour exposure to artificial seawater. The data currently being analyzed will provide information about the average time elapsed from release to passage, the percentage of fish that passed the dam, the percentage of fish that were detected by the receiver but failed to pass the dam, smolt behavior in Wohler Pool, and the physiological stage of smoltification in released fish. A final report on the study findings will be available in February 2001. The study, with some modifications, will be repeated in spring 2001. The effects of the inflatable dam on juvenile migration will be assessed in the BA.

3.2.3 Impingement, Entrainment, or Injury at Diversion Facilities

This section evaluates the effectiveness of fish screens during low flow (summer flows), and evaluates the effects of periodic overtopping of infiltration ponds during high flow periods (flooding) at the Mirabel and Wohler diversion facilities.

3.2.3.1 Low Flows

Mirabel

The Mirabel pump diversion evaluation examines 1) fish screen design and operation and 2) opportunity for fish to be impinged, entrained, or injured at the facility. The evaluation includes fry and juvenile life history stages of all three salmonid species of concern. There is a low probability that large numbers of fry-sized anadromous salmonids would be found at the site (Table 2-1), because suitable spawning habitat is not available in the area. Preliminary water temperature data from the inflatable dam impoundment indicate that water temperatures approach levels that are may be unsuitable for salmonid growth during the hottest part of the summer and early fall, when peak diversion is likely to occur (See Section 3.3.2.1 for preliminary water temperature data in the area).

Design drawings and field measurements were used to evaluate how well the Mirabel fish screens meet the NMFS criteria. Figure 3-1 shows the fish screen performance evaluation nodes for tests conducted in the spring of 2000 (Borcalli & Associates 2000). Graphic representation of the approach velocity distribution for the upstream (right) and downstream fish (left) screens are provided in Figure 3-2 and 3-3 respectively. Although there was some degree of fluctuation in the velocities measured, the averages are indicative of velocity conditions at the respective nodes. A comparison of the main variables is provided in Table 3-5.

Field data indicate that large portions of the screens have approach velocities below 0.45 fps, and some areas have negative approach velocity values, indicating flows away from the screen (Borcalli & Associates, Inc. 2000). There are small areas along the screens where approach velocities are higher than NMFS criteria for juvenile salmonids (up to 0.95 fps), particularly on the upstream screen. The screens rotate, while the “hot spots” remain in a stationary position, so

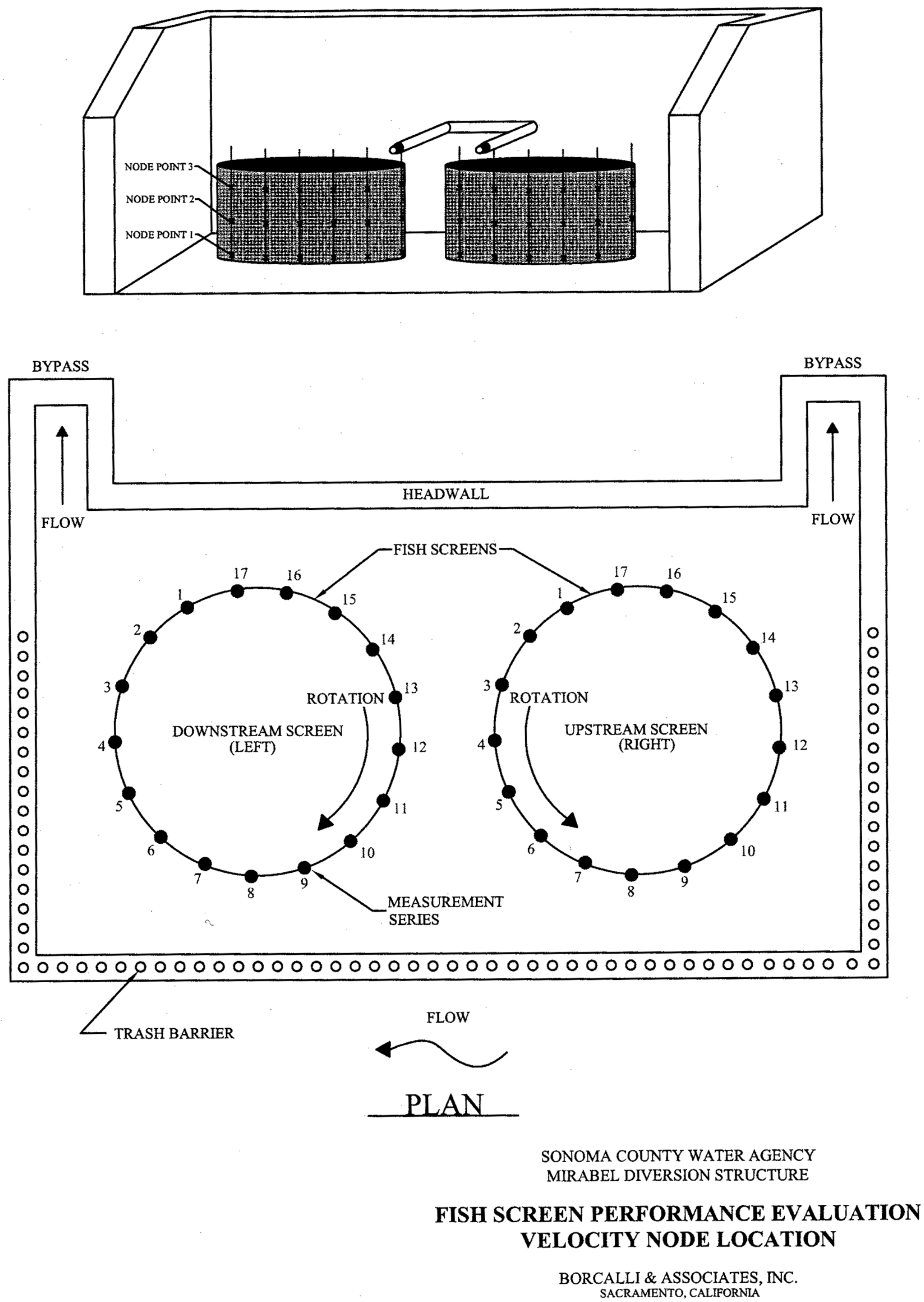

Figure 3-1 Fish Screen Performance Evaluation - Velocity Node Location

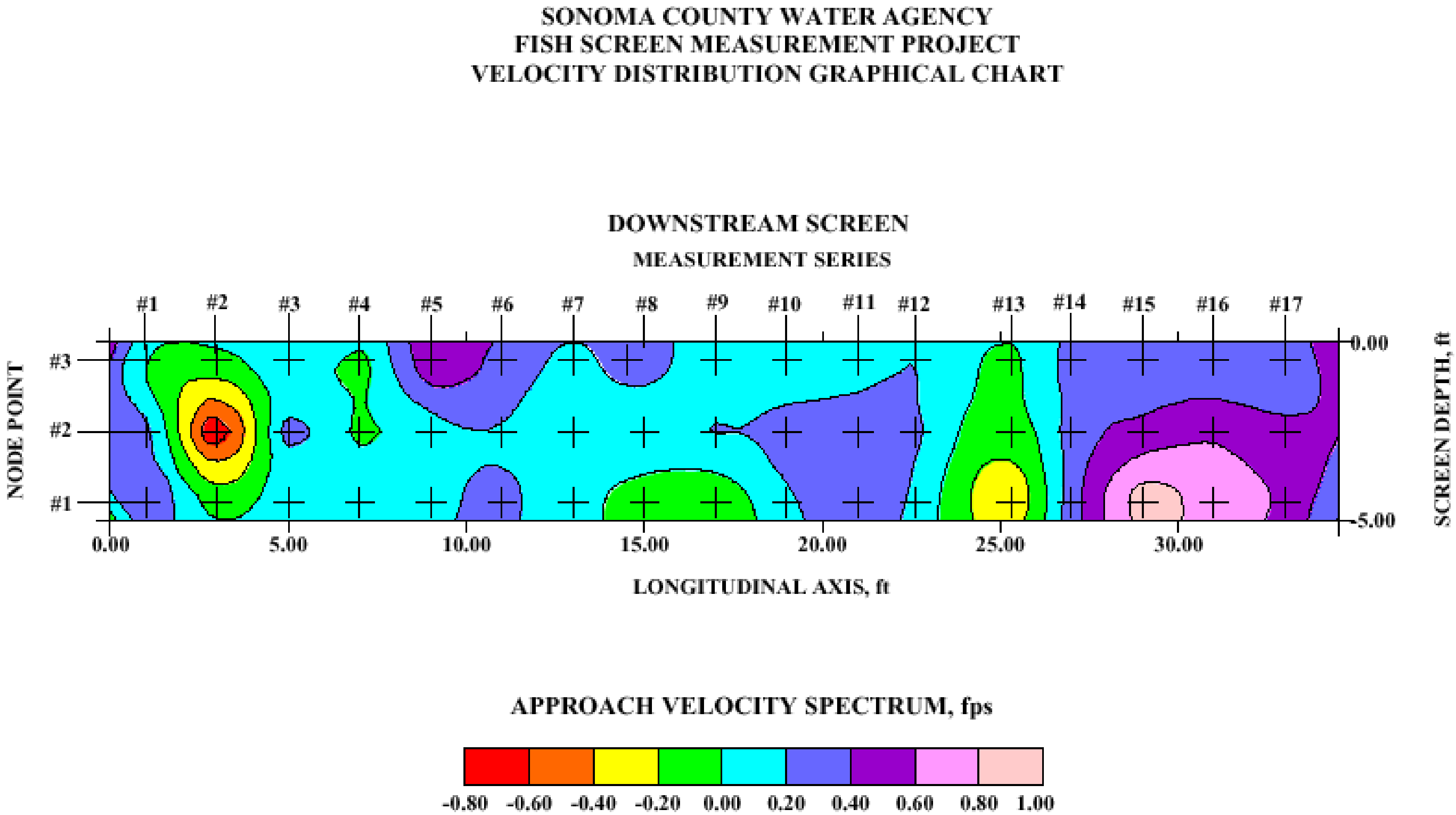

FIGURE 2

Figure 3-2 Mirabel Diversion Structure Velocity Distribution Graphical Chart – Downstream Screen

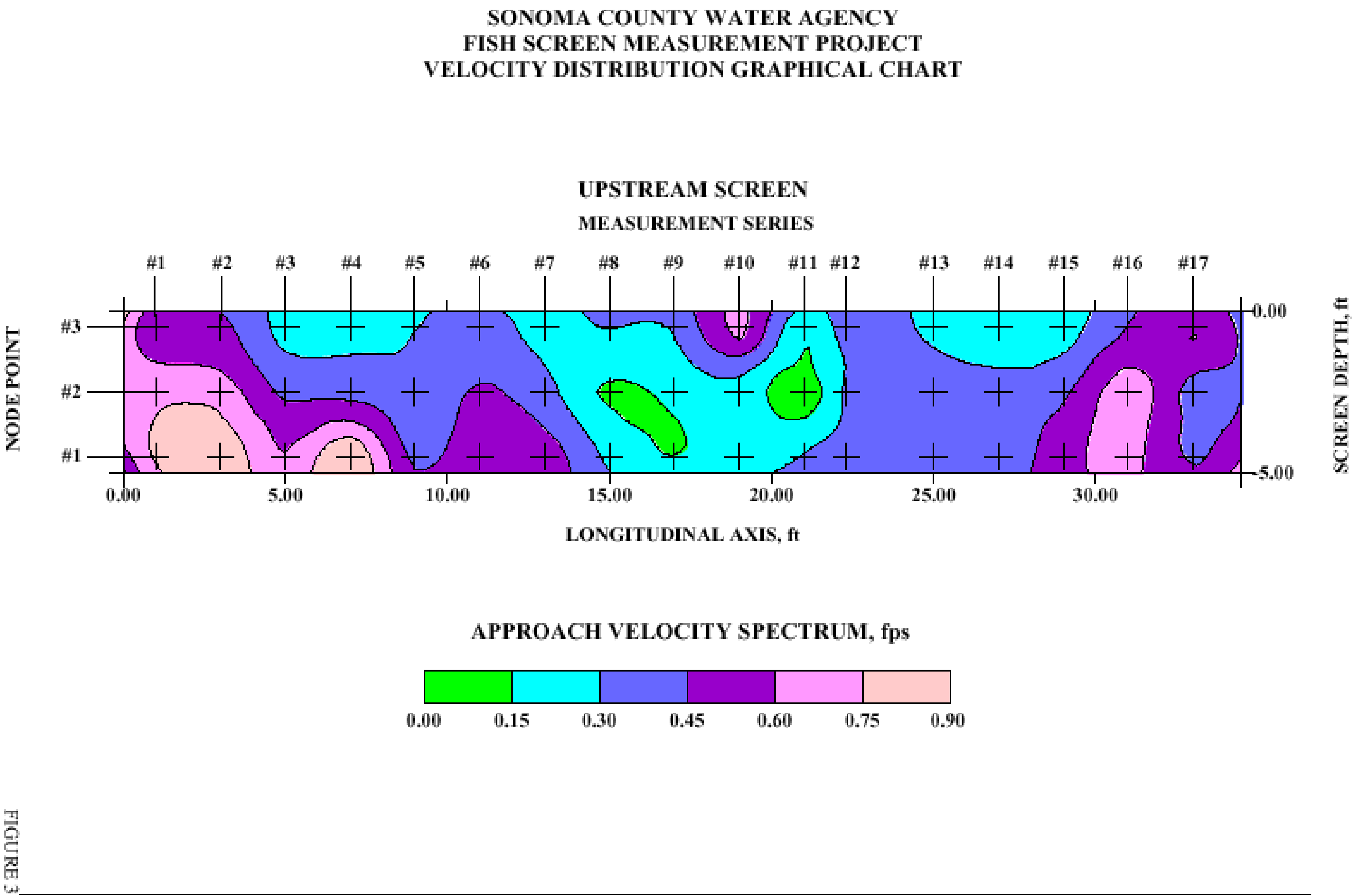

Figure 3-3 Mirabel Diversion Structure Velocity Distribution Graphical Chart – Upstream Screen

the duration of potential impingement would be approximately five seconds maximum at the downstream screen, but greater for the upstream screen. Results indicate that the majority of flow is pulled through the upstream screen. Sweeping velocity is low along the Mirabel fish screens, but in general approach velocities are low as well. Some sweeping velocity is created as the screens turn.

Other critical operating parameters appear to meet the NMFS criteria for juvenile salmonids. A vertical fixed brush keeps the screens free of silt and other debris and a trash rack is provided on three sides of the intake structure. Field examinations of the bypass system were not conducted. Since the hydrologic conditions at the screens have little variability due to location and a consistent pool elevation, operation can be assumed to be relatively consistent at the flow ranges within the side structure where they are located. Since there is not total compliance with NMFS design criteria, the score for passing juveniles of all three species is a 4 (Table 3-6). Because the Mirabel pumped diversion screen design and operation are generally within NMFS criteria for juvenile salmonids, the fish screens are likely to safely pass juveniles of the three threatened salmonid species past the diversion.

Several NMFS fish screen criteria for salmonid fry are more stringent than criteria for juveniles (see Section 2.2.1.2). These include: approach velocity not to exceed 0.33 fps, perforated plate screen opening not to exceed 3/32 inches in diameter, and a minimum of 27 percent open area on the screen for fry (Table 3-5). Twenty percent of the downstream Mirabel fish screen and 60 percent of the upstream screen areas have approach velocity values that exceed NMFS criteria for fry. Because the Mirabel fish screens do not meet these NMFS criteria, there is a high risk of injury for individual fry that may be present. The evaluation score is 2 (Table 3-6). If fry are swept downstream during high spring flows, they may be affected because the risk to fry that

may be present at the site is high. However, there is a low probability that large numbers of fry-sized anadromous salmonids rear at the site. It is also not clear whether fry present in the area would be able to rear successfully in the lower mainstem when summer water temperatures become high. There may be a risk to some fry, but there is a low risk to the populations of listed fish species as a whole.

The opportunity for impingement, entrainment or injury for salmonid juveniles and fry at the Mirabel diversion during low flows is evaluated with two components: 1) estimates of the amount of time surface water is diverted during the year and 2) the amount (%) of total surface water diverted through the fish screens for infiltration.

Table 1-2 (Inflatable Dam Operational History) indicates that between 1978 and 1997, the inflatable dam was in operation for an average of approximately 6.5 months per year. This is consistent with the analysis of the period when the dam is raised and surface water diversion (pumping) occurs in 1997 and 1998 (Table 3-1). Pumping occurred during the months of May through November, or water months. In general, the inflatable dam was in operation during the months of June, July, August, September and October. During the months when the dam was raised and lowered (May and November), operation was approximately 25% of each month. This is typically the end of May and the beginning of November. A comparison of past operation times and outmigration periods for the three species of concern (see *Section 1*) gives an

Table 3-5 Critical Operating Parameters for Mirabel Fish Screens

Parameter	Mirabel Fish Screens	NMFS Juvenile Criteria	NMFS Fry Criteria
Net equivalent submerged screen area	345.6 square feet		
Screen open area	40%[1]	40% open area	27% open area
Approach velocity	Upstream: Average 0.41 fps Downstream: Average 0.18 fps	≤ 0.8 fps	≤ 0.33 fps
Sweeping velocity	Upstream: Average 1.04 fps Downstream: Average 0.45 fps	Greater than approach velocity (sufficient to sweep debris away from screen face)	Greater than approach velocity (sufficient to sweep debris away from screen face)
Screen opening size (square openings)	5/32 inches	≤ ¼ (8/32) inches	≤ 3/32 inches

[1]Calculated from original construction drawing.

Table 3-6 Passage Scores for Fry and Juvenile Salmonids – Screen Design and Operation for the Mirabel Pump Diversion

Category Score	Evaluation Categories	Current Operations Score
5	Fish screens meet NMFS criteria and pass fish without injury or delay	
4	Facility provided with fish screens, but the facility has a low risk of entrainment, impingement or migration delay	Co, St, Ch juveniles
3	Facility provided with fish screens, but the facility has a moderate risk of entrainment, impingement, or migration delay, effective rescue or escape is provided.	
2	Facility provided with fish screens, but the facility has a high risk of entrainment, impingement, or migration delay, ineffective rescue or escape is provided.	Co, St, Ch fry
1	Facility not provided with fish screens, no rescue or escape is provided.	

* Co = Coho Salmon, Ch = Chinook Salmon, and St = Steelhead

estimate of the percentage of the juvenile migration period most likely to be affected (Table 3-7). Because the dam may be raised or lowered at any time of the year if drought conditions occur, there may be some years that a larger portion of a juvenile migration period may be affected. However, outmigration of juveniles is likely timed with increase in flows similar to those that prompt the lowering of the inflatable dam. In general, the diversion is not likely to be in operation during juvenile coho migration, and is likely to be in operation during about 1.5 months of steelhead migration and about 0.5 months (May) of chinook migration.

The screens at Mirabel are less effective for salmonid fry. Because growth of juvenile salmonids is dependent on water temperature and food availability, the transition from the fry size to the juvenile size will vary between tributaries and from year to year. To give a general idea of which species would have the most overlap, an estimate of time periods fry are most likely to be present is given by adding two months to the end of the emergence period (Table 3-7). If fry were to be present during the time that the diversion is likely to be in operation, steelhead fry are more likely to be present than coho or chinook, based on timing of their life history stages. However, there is a low probability that large numbers of fry are present in the area.

Table 3-7 Amount of overlap between Normal Periods of Mirabel Diversion (Mid-May to Mid-November) with Salmonid Life History Periods

Life Stage	Coho		Steelhead		Chinook	
	Period	Overlap (Months)	Period	Overlap (Months)	Period	Overlap (Months)
Juvenile	February to mid-May	None	March through June	1.5 (38%)	February through May	0.5 (13%)
Fry	February through May	0.5 + (13%)	March through July	2.5 + (50%)	February through May	0.5 + (13%)

The opportunity for entrainment during juvenile passage is scored for the Mirabel pumped diversion with two sets of criteria. The first set of criteria evaluates the risk based on the percentage of the migration period that the diversion facility is in operation. (Table 3-8). About 1.5 months of the steelhead emigration period corresponds with the time the diversion is usually in operation, or 25% of the time. The score for steelhead is therefore a 3. Coho migration periods do not overlap with normal periods of diversion, but since the diversion may be operated earlier or later in some years, there is a possibility that the diversion will operate during a larger portion of the of the coho migration period in the future. Therefore, the score for coho is 4. Chinook salmon emigration overlaps about 0.5 months (17%) with a score of 4. The diversion may be operated during about 13% of the time coho and chinook salmon fry may be present, for a score of 4. Steelhead may be affected up to 50% of the time, therefore the score for steelhead fry is 3. If fry were present, steelhead would likely have the greatest risk. However, large numbers of fry are not likely to be present in the area.

The second component for opportunity for entrapment, impingement or injury evaluates the risk to juvenile or fry salmonids by looking at the amount of water diverted when fish are present. The amount of water diverted from the river is variable and depends on water demand, aquifer levels, and instream flow requirements as set forth by decision 1610. Because underground diversion through the Raney collectors does not provide an opportunity for impingement or entrainment, only the pumped diversion at Mirabel is assessed. The 1997 and 1998 pumping records show the average amount of water diverted through the Mirabel pumped diversion, and indicate that the maximum amount diverted is less than 50% of the instream flow requirement below the inflatable dam during normal and dry years. Therefore, the amount diverted is about 33% of the total flow in the river (66% = minimum flows and 33% = diverted flow). During a critical year flow scenario, the diversion could exceed 50% since demand is likely to be high.

Table 3-8 Passage Scores for Fry and Juvenile Salmonids– Opportunity for Entrapment, Impingement or Injury at the Mirabel Pump Diversion – Time Water is Diverted

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect surface water flow during migration period.	
4	Facility operates less than 25% of migration period.	Co, Ch Fry and Juveniles
3	Facility operates between 25 and 50% of migration period.	St Fry and Juveniles
2	Facility operates between 50 and 75% of migration period.	
1	Facility operates during more than 75% of the migration period.	

* Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

For this analysis, we assume that diversion flows are less than 50% of the river flow but greater than 25%, as would be expected during a normal or dry year. The score for all three species is 3 (Table 3-9).

Table 3-9 Passage Scores for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury for the Mirabel Pump Diversion - Amount of Water Diverted

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect any surface flow.	
4	Facility diverts less than 25% of surface water flow	
3	Facility diverts 25-50% of surface water flow	Co, St, Ch
2	Facility diverts between 50-75% of surface water flow	
1	Facility diverts more than 75% of surface water flow	

* Co = Coho Salmon, St = Steelhead , Ch = Chinook Salmon

In summary, the diversion is normally operated during a very small portion of the coho and chinook salmon migration period, putting them at a very low risk of exposure, and a larger portion of the steelhead migration period, putting steelhead at a slightly higher (moderate) risk for entrapment, impingement or injury. Between 25-50% of total river flow is diverted, presenting a moderate risk when juvenile fish are present. Combining these two components, coho salmon and chinook salmon are at a low risk for entrapment, impingement or injury primarily because normally the Mirabel diversion operation does not overlap significantly with the juvenile outmigration period. The risk for steelhead entrapment, impingement or injury is slightly higher, based on a larger overlap with diversion operation and juvenile outmigration period. Even so, because the Mirabel diversion screen is basically designed and operated within NMFS screen criteria, the overall risk to juveniles of all three species is low.

Because the Mirabel screen design is not within NMFS criteria for salmonid fry, there is a high risk of entrapment, impingement, or injury for fry of any of the three species that may be present. The risk for steelhead fry is slightly higher because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, as discussed previously, large numbers of fry are not likely to be present because suitable spawning habitat does not exist in the area and fry are not present during the late summer when peak diversion is likely to occur. While some individual fry, particularly steelhead fry that may be swept downstream in the spring, may be at a high risk for entrapment, impingement or entrainment, the overall risk to the populations of listed species is likely to be low.

The Mirabel fish screen was constructed approximately 30 years ago without the benefit of extensive research and development or current criteria and guidelines. The fish screen structure would require modifications to alleviate the concern of impinging fry upon the screen face during SCWA's routine diversion operations (Borcalli & Associates, Inc. 2000).

Wohler

The Wohler diversion evaluation includes 1) fish screen design and operation and 2) opportunity for fish to be impinged, entrained, or injured at the facility. The evaluation includes fry and juvenile life history stages of all three salmonid species of concern. However, as discussed previously, large numbers of fry-sized anadromous salmonids are not likely to be present in the area.

Examination of the screen in the field and a review of screen design are used to evaluate how well the fish screens meet the NMFS criteria. The Wohler screen may be effective as a fish screen once the water levels in the river and the infiltration ponds have equalized. High velocities flowing through the inlet while the infiltration ponds are filling could impinge fish against the screen, or high velocities could erode a passageway around the screen and bypass its effectiveness. There is no mechanism to automatically clean the screen. The screen is placed a significant distance from the river in the canal and is not placed in the ditch at the confluence of the river. There is no structure that allows the fish to voluntarily return to the river near the screen.

Table 3-10 provides the current operations passage scores for Wohler canal diversion based on screen design and operation. The screens are not operating within NMFS screen criteria for juveniles or fry, and there is a high risk of potential injury to salmonids that are diverted to the canal. Therefore, passage scores based on screen design and operation for the Wohler Canal screens are 2 for both juvenile and fry of all three species.

The opportunity for impingement, entrainment or injury for salmonid juveniles and fry is evaluated with two components: 1) by estimating the amount of time surface water is diverted during the year and 2) the amount (%) of total surface water diverted.

Since the Wohler diversion is in operation only when the inflatable dam is raised, the same overlap in emigration periods of juvenile salmonids and diversion operation apply as for the Mirabel diversion facility. The Wohler ponds might be operated periodically throughout the time that the dam is raised, but are not consistently in operation. Generally, the ponds are filled

Table 3-10 Passage Scores for Fry and Juvenile Salmonids – Screen Design and Operation for the Wohler Canal Screens

Category Score	Evaluation Categories	Current Operations Score*
5	Fish screens meet NMFS criteria and pass fish without injury or delay.	
4	Facility provided with fish screens, but the facility has a low risk of entrainment, impingement, or migration delay.	
3	Facility provided with fish screens, but the facility has a moderate risk of entrainment, impingement or migration delay, effective rescue or escape is provided.	
2	Facility provided with fish screens, but the facility has a high risk of entrainment, impingement or migration delay, ineffective rescue or escape is provided.	Co, St, Ch
1	Facility not provided with fish screens, no rescue or escape is provided.	

* Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon,

and then drained a couple of weeks later, with a fish rescue. If fish were entrained, they would be entrapped for at least two weeks. Because the dam may be raised or lowered at any time of the year, particularly in response to drought, there may be some years that a larger portion of a juvenile migration period may be affected. Most years, however, the diversion is not likely to be in operation during juvenile coho migration, is likely to be in operation during about 1.5 months of steelhead migration and about 0.5 months (May) of chinook migration. The score for coho and chinook salmon is 4 and for steelhead is 3 (Table 3-11). If fry were present, steelhead would likely have the greatest risk because operation of the Wohler ponds would overlap the most with the steelhead fry rearing period (up to 2.5 months, or 50%). Operation of the Wohler ponds would overlap with coho and chinook salmon fry about 0.5 months. However, there is a low probability that large numbers of fry are present in the area.

Table 3-11 Passage Scores for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury at the Wohler Canal –Time Water is Diverted

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect surface water flow during migration period.	
4	Facility operates during less than 25% of migration period.	Co, Ch
3	Facility operates between 25-50% of migration period.	St
2	Facility operates between 50-75% of migration period.	
1	Facility operates during more than 75% of the migration period.	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

The second component of the risk for entrapment, impingement or injury is based on the amount of water diverted. Although there are no measurements of the amount of water diverted into the Wohler infiltration ponds, it is estimated that under normal operation conditions, about 5% of stream flow is diverted. This estimate is based on the small size of the ponds and ditch that transports the water and field observations of the amount of water entering the ponds (low velocities). Because less than 25% of total river flow is diverted, the score is 4 for all three species (Table 3-12).

Table 3-12 Current Operations Passage Scores by Species for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury for the Wohler Canal – Amount of Water Diverted

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect any surface flow	
4	Facility diverts less than 25% of surface water flow	Co, St, Ch,
3	Facility diverts 25-50% of surface water flow	
2	Facility diverts 50-75% of surface water flow	
1	Facility diverts more than 75% of surface water flow	

* Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon, and St = Steelhead

In summary, because the Wohler diversion screen design and operation are not within NMFS criteria for juvenile or fry, any young fish that are exposed to the facility have a high risk of entrapment, impingement, injury or migration delay. While in some years the diversion may be operated earlier or later than the May to November period, the diversion is normally operated during a very small portion of the coho and chinook salmon migration period, and a larger portion of the steelhead migration period (38%). It is estimated that about 5% of stream flow is diverted. Combining these two components, juvenile coho salmon and chinook salmon are at a low to moderate risk for entrapment, impingement, injury or migration delay, primarily because the Wohler diversion operation does not overlap significantly with the juvenile outmigration period and a small amount of the total river flow is diverted. The risk for steelhead entrapment, impingement or injury is higher, based on a larger overlap with diversion operation and juvenile outmigration period, and therefore steelhead juveniles are at a moderate risk. Because the Wohler ponds are not used continuously during the diversion period, and because fish rescues are conducted within two weeks when the ponds are filled, the risk may be reduced.

The risk for steelhead fry is slightly higher than for coho or chinook salmon fry because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, large numbers of fry are not likely to be present because suitable spawning habitat does not exist in the area. Therefore, while some individual fry, particularly steelhead, may be at a high risk for entrapment, impingement or entrainment, the overall risk to fry of the populations of listed species is likely to be low.

3.2.3.2 High Flows

Both the Mirabel and Wohler ponds are likely to flood during storm events. The ponds are isolated from the river by levees, and when floods overtop the levees, salmonids (and potential predators) may be trapped in the ponds as water levels recede. This may subject salmonids to increased risk of injury, predation, and migration delays. The potential effects of flooding the infiltration ponds during high flow events are evaluated based on the opportunity for entrainment, injury or migration delays. Two components for opportunity for salmonid juveniles or fry to be entrained, injured or subjected to migration delays at the facility are based on 1) the frequency in which the ponds flood on a yearly basis and 2) the time of year the ponds are flooded.

Mirabel

Table 3-13 provides estimates for the number of times the Mirabel ponds would have flooded from 1960 through 1995, based on a computer simulation using current demands. In the 35 water years, Mirabel ponds would have overtopped 32 days or about 0.3% of the days in those years (32 days ÷ 12,775 days = 0.003). The times the ponds would have flooded occurred during 14 of the 35 years (Table 3-14). The only months the ponds would have overtopped were December through March (Table 3-13). Coho and chinook salmon juvenile migration periods overlap approximately two months or 33% of the time (February and March). Steelhead migration potentially overlaps one month (March) or about 17%. Fry rearing periods also have some overlap.

Table 3-13 Total Number of Days per Month that Mirabel Infiltration Ponds were Overtopped from 1960 through 1995 (Computer Simulation)* and Juvenile Emigration Periods

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Frequency	14	9	4	0	0	0	0	0	0	0	0	5
Juvenile Emigration Periods												
Coho		■	■	■	▌							
Steelhead			■	■	■	■						
Chinook		■	■	■	■							

*The total days the ponds could potentially overtop is 35 years X 365 days/year = 12,775 days

The correlation between migration timing and potential entrainment in the Mirabel ponds during flooding is supported somewhat through preliminary data collected in fish rescue operations conducted in 1998 and 1999 (Table 3-15) (SCWA 1998 and 1999). Rescue efforts were not necessary in 1999 because the Mirabel infiltration ponds did not flood. In 1998, rescue efforts at Mirabel ponds captured a total of 12 juvenile chinook salmon out of a total of 3,595 fish. Of these, 10 chinook were released, two died. One chinook mortality was probably associated with high water temperatures, one with predation. No coho salmon or naturally spawned steelhead juveniles were captured. However, year to year variation in migration periods and storm events could result in the capture of naturally spawned steelhead or coho salmon in future years. While fry have not been captured in the ponds, it is likely that small fish would not survive for two weeks because cover is not available and large fish that could prey on them are present. Young-of-the-year steelhead were also generally not captured, although an unusually high number of young-of-the-year (approximately 200 individuals) were captured in Wohler pond 1 in 1998 after the hatchery had released approximately 150,000 juveniles (surplus production). The practice of releasing surplus production has been discontinued.

Adult steelhead were not captured in 1998 or 1999 and, in general, have been captured infrequently. Fishermen who fish the ponds have said that adults are frequently seen jumping in

Table 3-14 Number of days by Water Year that Mirabel Infiltration Ponds Would Have Overtopped for 1960 through 1995 (Computer Simulation)

Water Year Exceeded	Number of Days
WY 1960	0
WY 1961	0
WY 1962	0
WY 1963	1
WY 1964	0
WY 1965	3
WY 1966	1
WY 1967	0
WY 1968	0
WY 1969	1
WY 1970	3
WY 1971	1
WY 1972	0
WY 1973	1
WY 1974	2
WY 1975	1
WY 1976	0
WY 1977	0
WY 1978	2
WY 1979	0
WY 1980	1
WY 1981	1
WY 1982	3
WY 1983	4
WY 1984	0
WY 1985	0
WY 1986	6
WY 1987	0
WY 1988	0
WY 1989	0
WY 1990	0
WY 1991	0
WY 1992	0
WY 1993	0
WY 1994	0
WY 1995	1

Table 3-15 Summary of Salmonids captured in the SCWA Mirabel and Wohler Infiltration Ponds During Fish Rescue Efforts in 1998 and 1999

	1998*			1999		
Pond Number	**Chinook**	**Steelhead (hatchery)**	**Rescue Events**	**Steelhead (wild)**	**Steelhead (hatchery)**	**Rescue Events**
Mirabel Pond 1	6	0	1			none
Mirabel Pond 2	2	0	1			none
Mirabel Pond 3	1/1	0	1			none
Mirable Pond 4	1/1	0	1			none
Sedimentation Pond	0	0	1			none
Wohler Pond 1	0	50	2	17	29	2
Wohler Pond 2	0	16/13	2	15	0	2
Total	12	79		32	29	

*Two numbers indicate number rescued/number of mortalities.

the ponds (B. Coey, CDFG, pers. comm. 2000). However, fish rescues in recent years have recovered less than a dozen steelhead, and most of these were at Mirabel after significant flooding in 1997 (S. White, SCWA, pers. comm. 2000).

In 1999, structures were installed in the Mirabel ponds to reduce stress on fish, reduce residence time of fish trapped in the ponds, and facilitate rescue operations. Although fish rescues do not reduce the probability of entrapment, it is anticipated that returning trapped fish to the river reduces the mortality rate from flooding of the ponds, and therefore reduces the risk to the population. “V” ditches, and sumps installed in the ponds provide a refuge from predators and high water temperatures, and increase the efficiency of rescue operations by concentrating fish. Because the ponds did not overtop in 1999, fish rescues were not conducted. In 1998, ponds were monitored daily and rescue efforts were initiated when water levels dropped enough to allow seining, generally in about two weeks. Impounded fish were captured using beach seines. Captured fish were held in a large tub filled with water and sorted. ESA listed species were transferred into a 5-gallon bucket, counted and measured, and released into the river as rapidly as possible. Tissue and scale samples were collected from chinook and steelhead mortalities for analysis at the Bodega Bay Marine Lab.

The first component of the evaluation criteria for the risk of entrapment, impingement or injury is based on estimates of the amount of water entering the ponds during flooding. Although the portion of surface water that enters the Mirabel ponds during flooding has not been measured, it is reasonable to assume that it is less than 5% of the flow. Descriptions of flooding in the fish rescue reports suggest that within approximately five hours the ponds are full (SCWA 1998 and 1999). During that five hours, it is assumed that a small portion of the mainstem flood flows enter the ponds. Because less than 5% of the river flow enters the ponds, the score for all three species is a 4 (Table 3-16).

The second component of the opportunity for entrainment during high flows for the Mirabel infiltration ponds evaluates the overlap between the migration periods for each species and the

Table 3-16 Current High Flow Operations Passage Scores by Species for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury for High Flows at the Mirabel Infiltration Ponds – Amount of Water Entering Ponds

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect any surface flow during migration period	
4	Facility diverts less than 25% of surface water flow during migration period	Co, St, Ch
3	Facility diverts 25-50% of surface water flow during migration period	
2	Facility diverts 50-75% of surface water flow during migration period.	
1	Facility diverts more than 75% of surface water flow during migration period.	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

months the ponds may be subjected to overtopping. Table 3-13 indicates the months that the ponds are most likely to overtop, and Table 3-14 provides the number of days per year that the ponds would have flooded, based on a computer simulation. Because about 33% of coho salmon and chinook salmon juvenile migration periods overlap, a score of 3 is given for these two species. Steelhead migrate later in the year, so the steelhead migration period has an overlap of about 17% and, therefore, receives a score of 4 (Table 3-17).

Table 3-17 Current High Flow Operations Passage Scores for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury at the Mirabel Infiltration Ponds –Time Water Enters the Ponds

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect surface water flow during migration period.	
4	Facility operates during less than 25% of migration period.	St
3	Facility operates between 25-50% of migration period.	Co, Ch
2	Facility operates between 50-75% of migration period.	
1	Facility operates during more than 75% of the migration period.	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

In summary, less than 5% of streamflow during flood events enters the Mirabel ponds, and the ponds overtop during only a very small portion of the steelhead juvenile migration period. Therefore, steelhead are subject to a low risk. Coho and chinook salmon juveniles are more likely to be migrating through the area when the ponds overtop, subjecting them to a moderate risk of entrapment or migration delays when the ponds overtop. However, the ponds do not overtop very often, so that while individual fish may be affected, the overall risk to the populations is likely to be low. Chinook salmon were found in the Mirabel ponds during rescue operations in 1998. Modifications to the ponds were made in 1999 to reduce stress on fish and facilitate rescue operations. Although some fish may be lost to injury or stress during rescue operations, fish rescues conducted within two weeks help to reduce risks to listed species.

Wohler

Table 3-18 provides estimates of the number of times the Wohler ponds would have flooded from 1960 through 1995 based on the computer simulation. Of the 35 water years, Wohler pond 1 would have overtopped 533 days, or about 4% of the time, and Wohler 2 about 625 days (approximately 5%). The 533 times the pond 1 would have flooded occurred during 30 of the 35 years and pond 2 would have flooded 31 of the 35 total years (Table 3-19). In general, the months of flooding were concentrated from November through April. This falls within the potential outmigration of coho salmon, steelhead and chinook salmon. Coho and chinook salmon outmigration periods overlap with potential flooding and migration approximately three months or 50% (February, March and April) of the migration period. The steelhead migration period has a potential overlap of two months (March and April) or about 33% of the time

Fish rescue efforts at the Wohler infiltration ponds in 1998 and 1999 captured steelhead, but not coho or chinook salmon (Table 3-15) (SCWA 1998 and 1999). Chinook were captured in 2000. Year to year variation in migration periods and storm events could result in the capture of coho salmon in future years. A total of 79 juvenile hatchery steelhead (out of a total of 850 fish) were captured in 1998 during rescue efforts at the Wohler infiltration ponds. The steelhead captures in 1998 correlated with large releases of hatchery steelhead. Of these, there were 13 hatchery steelhead mortalities due to predation. In 1999, 29 hatchery steelhead and 32 naturally spawned steelhead were rescued from the Wohler ponds, out of a total of 539 fish. One adult steelhead mortality was found in the outlet culvert at Wohler pond 2 in March of 1999, and one unmarked adult steelhead was rescued in March of 1999. After December 1, 1999, pond 2 was modified by connecting the pond to the river to allow fish to return to the river on their own volition. This connection to the river was made by removing about 20 feet of terrace between the pond and the river. Ambient water quality and ready access to the river allows entrained fish to easily return to the river. This connection reduced the number of times fish rescues were needed for the rest

Table 3-18 Total Number of Days per Month that Wohler Ponds 1 and 2 were Overtopped from 1960 through 1995 (Computer Simulation)* and Juvenile Emigration Periods

Wohler Pond 1

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Frequency	169	135	100	30	0	0	0	0	0	0	25	74

Wohler Pond 2

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Frequency	188	161	120	36	0	0	0	0	0	2	28	90

Juvenile Emigration Periods

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coho		■	■	■	▌							
Steelhead			■	■	■	■						
Chinook		■	■	■	■							

*The total days the ponds could potentially overtop is 35 years X 365 days/year = 12,775 days.

of 1999. A fish rescue performed in the residual water at the end of the season produced very few fish. It is probable that fish could seek shelter in the pond during high flows and return to the river when conditions are suitable (S. White, SCWA, pers. comm. 2000). This connection was maintained in 2000 as well.

Although the portion of the mainstem flood flows that enters the pond during flooding has not been measured, it is reasonable to assume that it is less than 5% of the flow because the Wohler ponds are relatively small (1.4 acres). Table 3-18 provides the total number of days per month that the ponds would have overtopped over a 35 year period, as estimated with a computer simulation, compared to juvenile emigration periods. Table 3-19 provides the estimated number of days per year that the ponds would have flooded, based on a computer simulation.

Tables 3-20 and 3-21 give the current high flow operations passage scores for Wohler infiltration ponds concerning opportunity for entrainment. The first set of criteria evaluates the amount of water diverted and the second set of evaluation criteria evaluates the portion of the juvenile migration period that overlaps with the months that the ponds may be overtopped. Because less than 5% of the flood stream flow enters the Wohler ponds, the score for the amount of water entering the ponds is 4 for all three species (Table 3-20). Approximately 33% of coho salmon and chinook salmon migration periods overlap with the months that the ponds may flood, so a score of 3 is given (Table 3-21). About 17% of the steelhead migration period overlaps and therefore a score of 4 is given.

In summary, less than 5% of streamflow during flood events enters the Wohler ponds, and the ponds overtop during only a small portion of the steelhead juvenile migration period. However, the ponds overtop more frequently then they do at Mirabel. Fish rescues in 1998 and 1999 found only steelhead, but chinook were found in 2000. Although three years of fish rescue efforts did not find coho juveniles, this species is likely to be migrating through the area when the ponds overtop and, therefore, may be at risk. While fish rescue operations are likely to reduce the risk to protected species, they are conducted up to two weeks after the ponds overtop, when water levels recede. Our criteria suggest one week would be preferable. The modifications made to the Mirabel ponds have not been made at the Wohler ponds. Although 13 hatchery fish out of 29 steelhead (primarily hatchery fish) recovered during rescue operations in Wohler pond 2 in 1998 were dead, a connection from Wohler pond 2 to the river decreased the number of fish rescues needed in the 1998-1999 winter season and no mortalities were found. Because an effective, continual connection is maintained between the pond and the river, fish are able to return to the river at will, and the overall risk is likely reduced to a lower level. By providing an area of refuge from high flow events in the river, this connection may benefit some salmonids.

Table 3-19 Number of Days by Water Year that the Wohler Ponds Would Have Overtopped from 1960 through 1995 (Computer Simulation)

WOHLER POND 1		WOHLER POND 2	
Water Year	**Number of Days Exceeded**	**Water Year**	**Number of Days Exceeded**
WY 1960	10	WY 1960	11
WY 1961	7	WY 1961	11
WY 1962	15	WY 1962	17
WY 1963	20	WY 1963	28
WY 1964	3	WY 1964	4
WY 1965	23	WY 1965	25
WY 1966	10	WY 1966	14
WY 1967	21	WY 1967	22
WY 1968	7	WY 1968	8
WY 1969	35	WY 1969	43
WY 1970	32	WY 1970	34
WY 1971	16	WY 1971	21
WY 1972	0	WY 1972	0
WY 1973	30	WY 1973	32
WY 1974	35	WY 1974	38
WY 1975	17	WY 1975	21
WY 1976	0	WY 1976	0
WY 1977	0	WY 1977	0
WY 1978	30	WY 1978	31
WY 1979	7	WY 1979	9
WY 1980	25	WY 1980	28
WY 1981	6	WY 1981	6
WY 1982	36	WY 1982	42
WY 1983	63	WY 1983	71
WY 1984	20	WY 1984	21
WY 1985	3	WY 1985	4
WY 1986	28	WY 1986	30
WY 1987	2	WY 1987	3
WY 1988	3	WY 1988	6
WY 1989	1	WY 1989	4
WY 1990	0	WY 1990	0
WY 1991	2	WY 1991	5
WY 1992	0	WY 1992	2
WY 1993	7	WY 1993	10
WY 1994	0	WY 1994	0
WY 1995	19	WY 1995	24

Table 3-20 Current Operations Passage Scores by Species for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury for High Flows at the Wohler Infiltration Ponds – Amount of Water that Enters the Ponds

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect any surface flow during migration period	
4	Facility diverts less than 25% of surface water flow during migration period	Co, St, Ch,
3	Facility diverts 25-50% of surface water flow during migration period	
2	Facility diverts 50-75% of surface water flow during migration period.	
1	Facility diverts more than 75% of surface water flow during migration period.	

* Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

Table 3-21 Passage Scores for Juvenile Salmonids – Opportunity for Entrapment, Impingement or Injury for High Flow at the Wohler Infiltration Ponds – Amount of Time Water Enters the Ponds

Category Score	Evaluation Categories	Current Operations Score*
5	Facility does not affect surface water flow during migration period.	
4	Facility operates during less than 25% of migration period.	St
3	Facility operates between 25-50% of migration period.	Co, Ch
2	Facility operates between 50-75% of migration period.	
1	Facility operates during more than 75% of the migration period.	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook Salmon

3.2.4 Stranding or Displacement from Flow Fluctuation

When the inflatable dam is lowered, dewatering effects in two miles of river upstream could potentially result in the stranding or displacement of salmonids. Generally, the inflatable dam is lowered each fall as river flow increases. It can also be lowered in early spring in response to late storms. Juvenile coho salmon and steelhead are the two species most likely to be migrating during the early spring, but juvenile chinook salmon could also be present. Adults are not likely to be at risk during their spawning runs, because they are less susceptible than juveniles to stranding, especially considering the absence of side channels and large pools in the margins of this part of the river. Therefore, the risk of stranding is largely restricted to deflation of the dam in the spring.

Estimating the rate of change in water stage when the dam is lowered is simple. Since the dam is 11 feet in height when raised and it normally takes 24 hours to lower it, the stage change is approximately 0.46 feet per hour (11 feet divided by 24 hours = 0.46 feet per hour). This rate of stage change equates to a score of 3 for juveniles (Table 3-22) and 2 for fry (Table 3-23). Because the inflatable dam is lowered in response to increasing flows, the stage change is likely to be attenuated to some extent, resulting in actual rate of stage change that is less than 0.46 feet per hour.

Opportunity for stranding or displacement is directly related to the frequency that flow fluctuations or stage changes take place. The inflatable dam was lowered approximately 1.5 times per year on average between 1978 and 1998 (Table 1-2). In a normal year, the dam is lowered once during the year. If drought conditions require more water outside of the normal low flow period, or there is a need for dam maintenance, it could be lowered as many as three times in a year. When compared to flow fluctuations in other rivers, such as daily peaking operations from a hydroelectric project, the stage changes associated with lowering the inflatable dam are infrequent. The opportunity for stranding, based on the frequency of dam deflation, is scored a 5 for juveniles of all three listed species (Table 3-24).

As described in Section 2.3.2, opportunity for stranding or displacement is related to the type of habitat where the stage change or dewatering takes place. SCWA has mapped the habitat found in the area above the inflatable dam (SCWA 2000a). It is described generally as run habitat when the dam is not inflated. When the dam is not inflated, it is described as “swiftly flowing reaches with little surface agitation and no major flow obstructions,” and “often appears as flooded riffles.” When the dam is inflated, the area above the dam is primarily pool habitat. Typical substrate consists of gravel, cobble and boulders. Winzler and Kelly (1978) describe a similar habitat for the same general area but add that there are considerable amounts of fine sediments. Examination of aerial photographs (SCWA 1999) and field reconnaissance in the area in late 1999 indicate a single channel river that has a relatively straight trajectory with long sweeping oxbow characteristics through the area. It appears to have relatively few structural features that would create low areas outside of the main channel. The slopes of the river margins are relatively low gradient, but are sloped to the main channel. The wetted channel extends from bank to bank whether the dam is inflated or deflated, so it is unlikely that dewatering of the riverbed is a concern. Also, because the dam is only lowered when river flows are increasing, it is unlikely that stage changes above the dam would strand salmonids. The score for opportunity to be stranded during stage changes or dewatering based on habitat is a 4 for juveniles of all three listed species (Table 3-25).

Table 3-22 Current Operations Ramping and Stage Change Evaluation Scores by Species for Juvenile and Adult Salmon

Category Score	Evaluation Categories	Current Operations Score*
5	Meets 0.16 ft/hr maximum stage change	
4	Meet 0.32 ft/hr maximum stage change	
3	Meet 0.48 ft/hr maximum stage change	Co, St, Ch
2	Meet 1.4 ft/hr maximum stage change	
1	Greater than 1.4 ft/hr maximum stage change	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

Table 3-23 Current Operations Ramping and Stage Change Evaluation Scores by Species for Fry

Category Score	Evaluation Categories	Current Operations Score*
5	Meets 0.08 ft/hr maximum stage change	
4	Meets 0.16 ft/hr maximum stage change	
3	Meet 0.32 ft/hr maximum stage change	
2	Meet 0.48 ft/hr maximum stage change	Co, St, Ch
1	Greater than 0.48 ft/hr maximum stage change	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

Table 3-24 Flow Fluctuation Evaluation Scores Related to Opportunity for Stranding or Displacement for Fry, Juvenile and Adult Salmon - Frequency of Occurrence

Category Score	Evaluation Categories	Current Operations Score*
5	Less than two fluctuations per year in critical habitat	Co, St, Ch
4	Between 3 and 9 fluctuations per year in critical habitat	
3	Between 10 and 29 fluctuations per year in critical habitat	
2	Between 30 and 100 fluctuations per year in critical habitat	
1	More than 100 fluctuations per year in critical habitat	
0	Daily fluctuations in critical habitat	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

Table 3-25 Current Operations Flow Fluctuation Evaluation Scores Related to Opportunity for Stranding or Displacement by Species for Fry, Juvenile and Adult Salmon – Habitat Related

Category Score	Evaluation Categories	Current Operations Score*
5	Habitat features unlikely to induce stranding	
4	Few habitat features present to induce stranding	Co, St, Ch
3	Some habitat features that induce stranding, but area affected is small (<30%)	
2	Many habitat features that induce stranding, but area affected is small (>30%)	
1	Some habitat features that induce stranding, area affected is large (>30%)	
0	Many habitat features that induce stranding, area affected is large (>30%)	

*Co = Coho Salmon, St = Steelhead, Ch = Chinook

In summary, the risk of stranding is probably limited to spring deflation of the dam. The dam is generally lowered once in the late fall and infrequently in the spring, and stage changes above the dam are likely to be attenuated by increasing flows associated with storm events. Because of the distance of this area from spawning grounds, large numbers of fry are not expected to be present in the impoundment when the inflatable dam is deflated (see *Section 3.2.1 Utilization of* *the Mirabel and Wohler Areas by Juvenile Salmonids*). Generally, habitat in the two-mile reach that is affected by impounded water above the inflatable dam does not have characteristics that increase the potential for stranding. Therefore, there is a low risk of stranding for juvenile salmonids from the stage changes or dewatering of habitat associated with deflation of the inflatable dam.

3.2.5 Habitat in Wohler Pool

Habitat mapping surveys upstream and downstream of the inflatable dam were conducted by SCWA in 1998 and 1999 (SCWA 2000). Under free-flowing conditions, aquatic habitat upstream of the inflatable dam is dominated by run habitat, whereas a lower stream gradient dominated by relatively long, wide pools make up the habitat downstream of the dam. It was estimated that the impoundment of water at the inflatable dam will likely increase upstream pool habitat on an order of 30 to 70 percent over free-flowing conditions. This habitat alteration has the potential to affect rearing conditions and smolt emigration for salmonids by changing the pool/run/riffle ratio, channel geomorphology, water temperatures, and species (predator) composition.

Under free-flowing conditions, the two-mile stream reach at Wohler Pool may provide some rearing habitat for steelhead or chinook. When the dam is inflated, the amount of pool habitat is increased and riffle/run habitat is decreased, which likely results in a decrease in the amount of rearing habitat. Coho salmon rear in the tributaries to the Russian River rather than the mainstem, and young-of-the year coho have not been caught near the Wohler Pool. Steelhead rearing could occur during the spring in this part of the mainstem, when water temperatures are optimal for growth (see Section 3.2.1). Steelhead young-of-the-year were captured downstream of the inflatable dam in 1999 and 2000 in a rotary screw trap that was operated during the months of April through June (SCWA 2000). However, primary rearing habitat for steelhead is likely to be found elsewhere because high water temperatures during the late summer and early fall limit suitable rearing habitat in this part of the mainstem. Chinook are likely to have migrated through the area by the time water temperatures become high.

When salmonids rear in warm water, their metabolism is high and they require more food for maintenance and growth. Because transport of sufficient quantities of food (through fast water such as runs and riffles) is important to rearing salmonids in warmwater reaches, a change from run habitat to pool habitat in the impounded reach above the inflatable dam may reduce rearing habitat quality, particularly in the beginning of the summer when water temperatures increase. An increase in pool habitat above the inflatable dam may affect rearing habitat, particularly during the time water temperatures become warm and food transport is reduced. Some juvenile steelhead may have to leave the area sooner than they might otherwise have, but the overall risk to steelhead rearing habitat is likely to be low because only a small portion of the time (when water temperatures become high) is likely to be affected. SCWA's five-year monitoring effort will help determine the amount of rearing that occurs in this section of the mainstem.

Riparian vegetation could be weakened if the edges of the river become inundated, leading to bank erosion when flows increase. However, the width of the wetted channel is not generally different between the time the water is impounded and during the rainy season when the river flows freely.

Changes to water temperature in the Wohler Pool are discussed in Section 3.3.2. A change in habitat type could create conditions that are more favorable for predators, and the potential predation risk is discussed in section 3.7.

3.3 WATER QUALITY RELATED EFFECTS OF WATER STORAGE AND RELEASE FOR DIVERSION

Potential water quality effects due to water supply operations include changes to temperature, dissolved oxygen and turbidity from the operation of Warm Springs Dam, Coyote Valley Dam, and the inflatable dam. Water quality in the outflow of Warm Springs Dam is controlled by operations of the Don Clausen Fish Hatchery, and will be discussed in the final BA. A water quality model will be used to assess water quality effects from instream flow requirement, including temperature and dissolved oxygen, in *Interim Report 3: Instream Flow Requirements*.

3.3.1 COYOTE VALLEY DAM

3.3.1.1 Temperature

The single intake to the control tower at Coyote Valley Dam is in the cooler bottomwaters of Lake Mendocino, so the coolest water available is released. During flood control season, the temperature of the water released from Lake Mendocino is usually in the range of 48-59°F (8.9-15°C) (NMFS 1999). Figure 3-4 shows the stream temperature fluctuations at the USGS gauge 500 ft below the dam from water years 1987-1994. Water temperatures are relatively stable from year to year. However, late summer and fall temperatures can be high for salmonid rearing.

Mean daily temperature data from the USGS gauge 500 feet below the dam for 1987–1994 were used to develop scores for each life history stage in each species based on temperature evaluation criteria provided in Table 2-12. Most of those years were drought years and may not be representative of long-term trends. Effects due to water supply are not distinguished from those due to instream flow requirements or flood control. The frequencies with which mean daily temperatures fall within each scoring category are shown in Table 3-26.

For steelhead migration, scores of 3 or better are met 74% of the time, but a score of 1 occurs 18% of the time. Temperatures for spawning are scored as 4 or better, with 81% of the data scored 5. Incubation temperatures are also good, with most of the temperatures scored at 5, some at 4. Steelhead rearing scores are 3 or better 95% of the time.

Upstream migration temperatures for chinook salmon fall in scoring categories 3-4 for 69% of the time, but they are scored less than 3 for 31% of the time. Temperatures for spawning usually are suitable for chinook salmon, with most of the data scored as 4 or 5, but scores of less than 3 occur 16% of the time. Incubation temperatures are usually suitable, with most of the temperatures scored at 5, some at 4, but are sometimes scored less than 3 (11%). Suboptimal temperatures during incubation could be a concern because short periods at stressful or lethal levels could have an effect on the success of a particular year class if they are not limited to the early portion of the spawning season. Temperatures for rearing were scored greater than 3 at all times, and 4 for 90% of the time.

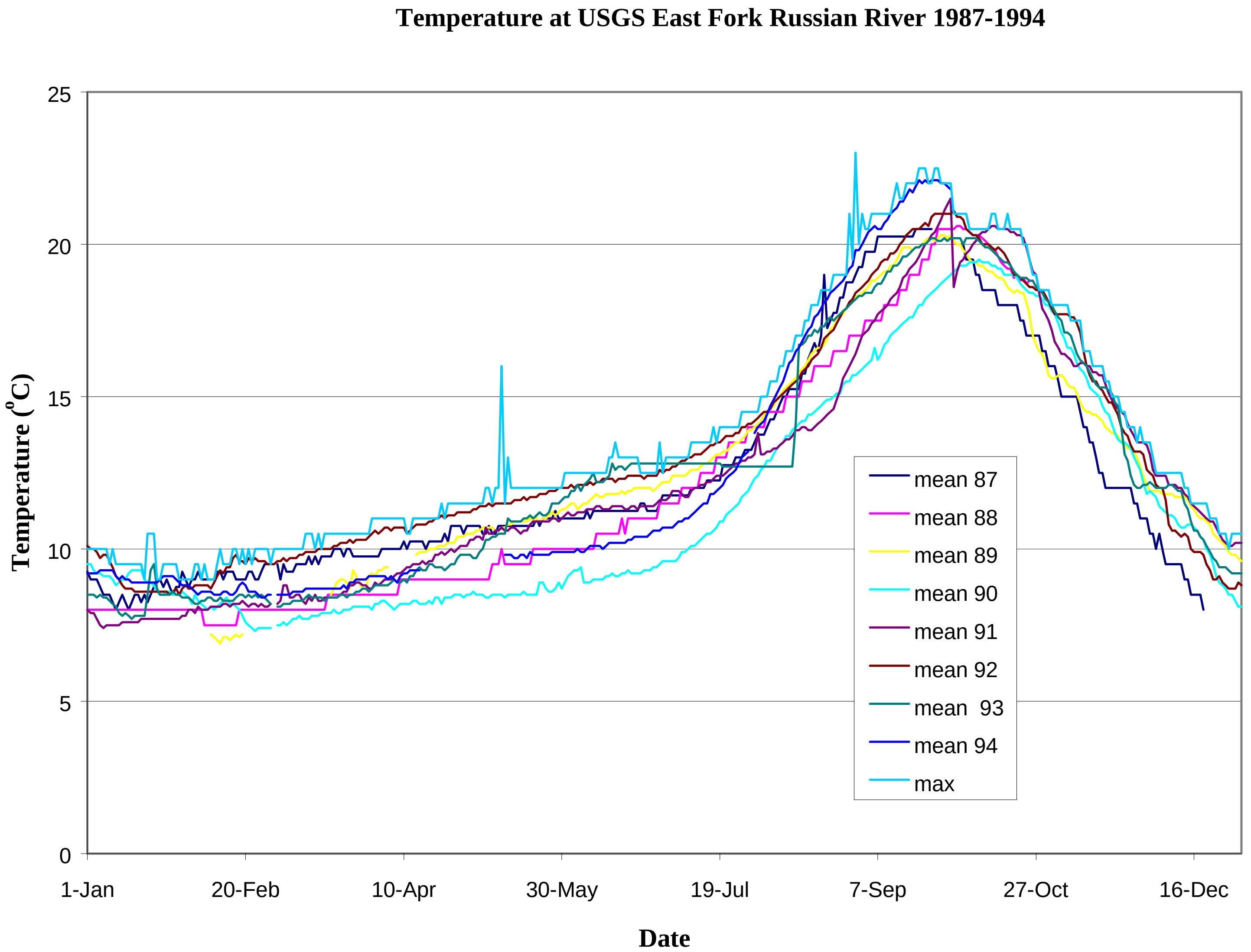

Figure 3-4 Daily Temperature below Coyote Valley Dam for 1987-1994

Daily temperature data from USGS gauge 500 feet below the dam for water years 1987-1994 show that temperature profiles are relatively stable from year to year. (USGS gauge East Fork Russian River near Ukiah, CA, ID 11462000)

Table 3-26 Coyote Valley Dam Temperature Score Frequencies (%)

The percent of the temperature data from the USGS gauge 500 feet below the dam (1987-1994) that falls within each scoring category, during the time each life history stage is present. High temperatures generally occur in the late summer and early fall, and decrease by late November.

Score	Coho	Steelhead	Chinook	Coho	Steelhead	Chinook
	Upstream Migration			**Spawning**		
5	67%	2%	27%	100%	81%	75%
4	8%	39%	27%		18%	4%
3	8%	33%	15%			4%
2	8%	8%	17%			8%
1	9%	18%	12%			2%
0		1%	2%			6%
	Incubation			**Rearing**		
5	100%	85%	81%	13%	11%	
4		15%	4%	55%	68%	90%
3			4%	10%	16%	10%
2			4%	17%	5%	
1			3%	5%		
0			4%			

Most of the warm temperatures that could potentially affect steelhead and chinook adult migration, and chinook spawning and incubation, occurred in the late summer and fall. Temperatures generally decreased in late November in all years (Figure 3-4). Peak chinook spawning generally occurs after this time, so suboptimal temperatures early in the spawning season are not likely to have much of an effect on the population. Peak steelhead spawning (January through April) also occurs when temperatures are cooler.

Temperatures are generally good for all life history stages of coho salmon except juvenile rearing, but coho adults have only rarely been found at Coyote Valley Dam. Coho salmon are not currently rearing in the East Fork Russian River because habitat types are not suitable (W. Jones, CDFG, pers. comm. 2000). Based on the recent temperature data, water temperatures below Coyote Valley Dam are usually scored at 3 or higher during the peak periods of use by all life history stages of chinook salmon and steelhead. Because water is drawn from the lower levels of Lake Mendocino, the coolest water available is released.

3.3.1.2 Dissolved Oxygen

When Lake Mendocino stratifies in the summer, dissolved oxygen levels could decrease in the bottom layer of the lake. The intake of the dam is located in these lower layers, and water with low dissolved oxygen levels could be drawn from the reservoir. Turbulence in the outflow, in runs and riffles below the dam, and in the hydroelectric facility restore dissolved oxygen to the water.

Dissolved oxygen has not been monitored at the outflow of the dam. However, the Coyote Valley Dam Hydroelectric Facility is located in the base of the dam. Federal Energy Regulatory Commission (FERC) permit guidelines (FERC 1982) set dissolved oxygen levels downstream of the CVD Hydroelectric Facility. The desired oxygen levels have been shown to be maintained by turbulence in the bypass valves of the piping system. Effects on life history stages of all three species are evaluated based upon compliance with minimum DO standards set by the FERC (1982) permit, specifically that a minimum level of 7.5 mg/l is maintained 90% of the time (Table 3-27). DO levels of above 7.5 mg/l would result in scores of 4 or 5, depending on species life history stage (see DO evaluation criteria in Table 2.13).

Table 3-27 Dissolved Oxygen Criteria Scores for Coyote Valley Dam Standards

Scores are based upon meeting DO standards set in the FERC license.

Lifestage	Current Operations Score Coho	Current Operations Score Steelhead	Current Operations Score Chinook
Upstream migration	5	5	5
Spawning/emergence	4[1]	5	4[2]
Rearing	4	4	4
Downstream migration	4	4	4

[1] Rainbow trout embryo development criteria for ≤ 15 °C were used. Temperatures below Coyote Valley Dam are generally in that range during the steelhead incubation period in January to May.

[2] Chinook, during egg and pre-emergent yolksac fry period, criteria for temperatures >5°C to ≤ 10°C were used. Temperatures below Coyote Valley Dam are generally within that range during the chinook incubation period in November to March.

As dissolved oxygen standards set in the FERC license issued to the City of Ukiah are met, scores for all life history stages of all three species are either 4 or 5. Because there is continuous compliance with FERC guidelines for DO, and because dissolved oxygen is likely to be restored in runs and riffles below the dam, operations at the Coyote Valley Dam are not likely to have a negative effect on DO.

3.3.1.3 Turbidity

Water quality data from the outflow of the degassing tower of the Coyote Valley Fish Facility from December through April from 1993 through 1998 were used to give an indication of turbidity and suspended solids concentrations in the outflow from Coyote Valley Dam. Generally, turbidity readings were taken once a month in December and twice a month from January to April. Figure 3-5 shows the turbidity levels near the outlet of the dam during these months. The data are not continuous for all years and all months. Migration periods for some species and/or life history stages are not covered by the range of data available. However, turbidity is likely to be highest after storm events rather than during the dry season (summer and fall).

Turbidity scores were evaluated by the frequency with which turbidity criteria are met in the period of record between January 1 1993 and December 15, 1998, based on turbidity evaluation criteria outlined in Table 2-15. Table 3-28 shows the percentage of the data that turbidity criteria were met for rearing and migration for each species.

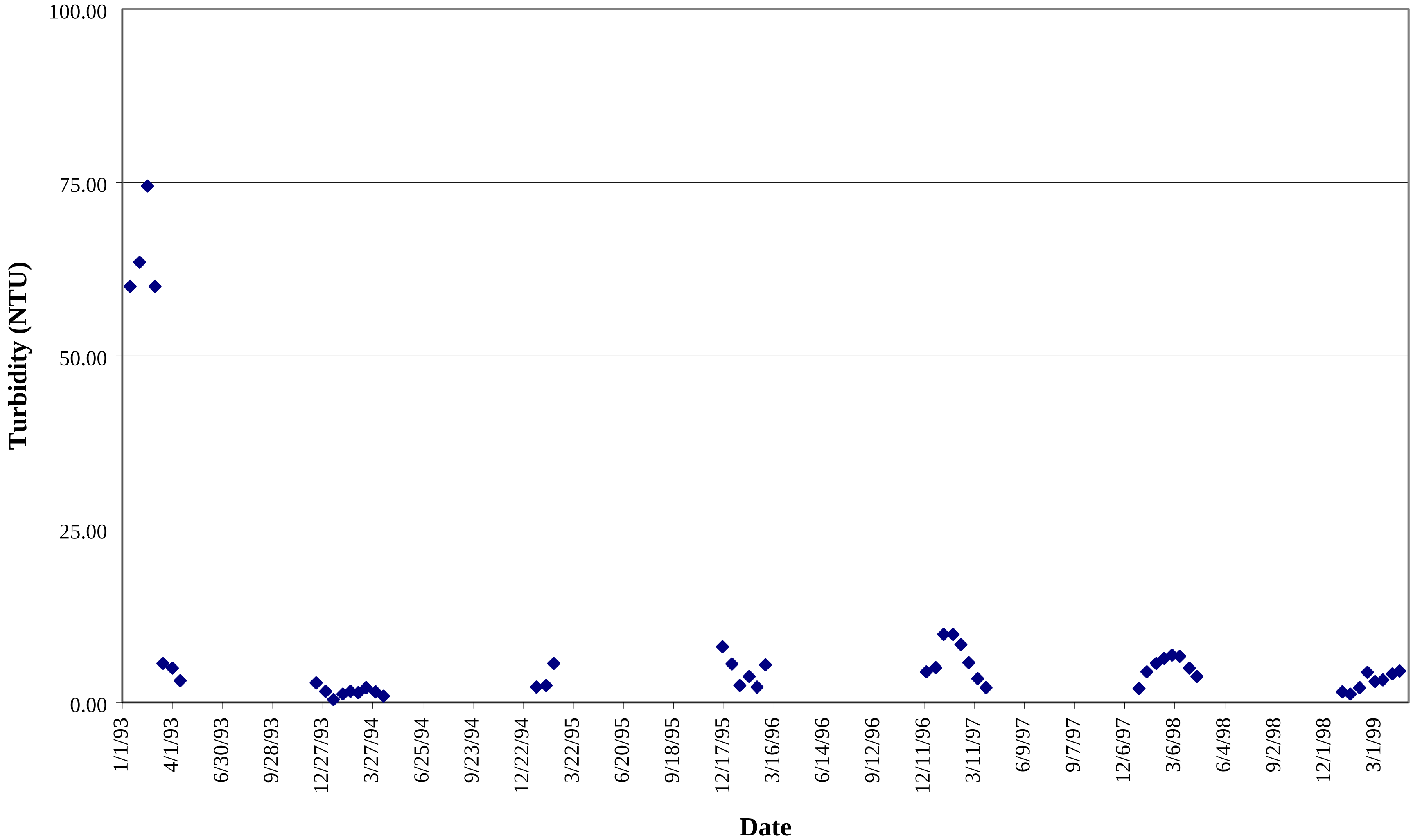

Figure 3-5 Turbidity at Coyote Valley Dam

Turbidity is monitored after the pack columns of the Coyote Valley Fish Facility about twice a month from December through April.

Table 3-28 Coyote Valley Dam Turbidity Score Frequencies (%)

The percent of the turbidity data from the Coyote Valley Fish Facility inflow that falls within each scoring category. Turbidity data were collected between December and April from 1993 through 1998.

Habitat Score	Coho	Steelhead	Chinook	Coho	Steelhead	Chinook
	Juvenile Emigration			Rearing		
5	91.2%	95.0%	91.2%	91.8%	91.8%	91.2%
4	0%	0%	0%	N/A	N/A	N/A
3	0%	5.0%	0%	0%	0%	0%
2	N/A	N/A	N/A	0%	0%	0%
1	2.9%	0%	2.9%	0%	0%	0%
0	5.9%	0%	5.9%	8.2%	8.2%	8.8%

N/A indicates that a category score was not defined for this life history stage, and therefore was not applied.

Turbidity scores based on the available data are generally 5 over 91% of the time for all species uring juvenile emigration and rearing. High turbidity values may have been produced by storm runoff events. During 1993 there were three very high values (60-74.5 NTUs) on 1/15, 2/1, and 2/15, but in all other years high values were not recorded (0.4-9.8 NTUs). It is not clear from these data whether persistently high turbidity values may have occurred during 1993 for more than two weeks at any time, but they did not occur in the other years.

The turbidity in the East Fork above Lake Mendocino is influenced by the turbidity of the water imported from the Eel River. In a comprehensive survey of turbidity in the Russian River Basin, Ritter and Brown (1971) concluded that water in Lake Mendocino remains turbid about as long as the water entering the reservoir remains turbid. Water released from Lake Mendocino remains turbid until the water flowing into the lake becomes clear. The persistence of turbidity during the winter and spring runoff has been attributed to the diversion of turbid water from the Eel River, which does not permit the East Fork to become clear between rainstorms. Turbidity effects due to flood control operations are discussed in *Report 1: Flood Control Operations*. Based upon the available turbidity data, turbidity does not appear to be increased to harmful levels due to water supply operations of the Coyote Valley Dam.

3.3.2 Mirabel and Wohler Facilities, Inflatable Dam

During the five year study at Wohler and Mirabel facilities. water quality (water temperature, dissolved oxygen, and conductivity) will be monitored at five stations from approximately 6.5 km upstream of the dam, to approximately 1.6 km downstream of the dam, (SCWA 2000b). Although the 1999 data collected in a reconnaissance sampling program and presented in the draft report are subject to revision, they were used in general terms in this section (SCWA 2000a). The results of this sampling program will produce additional and more focused data on water quality in the future.

3.3.2.1 Temperature

When the inflatable dam impounds water, it subjects the water to increased residence time and surface area, resulting in greater solar heating compared to free-flowing riverine conditions.

Higher temperatures could potentially affect salmonid rearing and migration during the time the dam is inflated.

In 1999, a series of three water temperature monitoring stations above and within the Wohler Pool Reach recorded water temperatures every 1.5 hours between June 10 and September 16. One data logger was located in a relatively shallow glide above the upstream extent of the Wohler Pool, and it served as a control site. A second data logger was located near the mid-point of the impoundment at a depth of 3.0 meters. At a third site at the downstream end of the impoundment, temperature was recorded at a depth of 0.5 m and 3.0 m.

At the control site, daily average surface water temperatures ranged from 18.7 to 24.3°C between 10 June and 16 September, with a maximum hourly temperature of 27.1°C. The average daily water temperature at the downstream end of the impoundment ranged from 19.4 to 25.2°C, with a maximum hourly temperature of 25.9°C. The average daily water temperature (at a depth of 0.5 m) at the inflatable dam was 0.5°C warmer than at the upstream control site, suggesting that as water passed through the Wohler Pool it warmed on average 0.5°C. The change in the daily water temperature ranged from 0.0 to 1.1°C over the length of the impoundment (approximately two river miles).

A few steelhead may potentially rear in the area all year, but chinook and coho salmon have not been observed rearing through the summer near the Wohler Pool. As salmonid smolts have generally migrated out by the end of June, increased temperatures are not likely to affect smolt migration. Applying scoring criteria for rearing, the temperatures at the control site would receive scores between 3 to 0 for coho salmon, and 2 to 0 for steelhead during the study period. An average change of 0.5°C could result in lower scores for some of that time, particularly in the hot summer months of July and August, when temperatures are already close to suboptimal levels. As the temperatures at the control site are sometimes high for coho and steelhead rearing, it is likely that rearing would already be limited in this part of the mainstem during the hottest part of the summer.

A small increase in temperature (0.5°C) is not likely to affect smolt migrating through the area, but may result in a slight reduction in the quality of rearing habitat here, particularly in the warmest summer months.

3.3.2.2 Dissolved Oxygen

Preliminary dissolved oxygen data from the water quality profile monitoring in 1999 are available. While DO levels at the upstream control site were slightly higher, the site at the inflatable dam had DO levels that ranged from a low of 6.7 mg/l to a high of 9.0 mg/l. Applying DO criteria for rearing (Table 2-13), scores for all three species are 4 for levels greater than 6.5 mg/l and 5 for levels greater than 8.0 mg/l. Since scores of 4 or 5 were achieved during this preliminary monitoring period, it appears that DO levels are not adversely affected by operations at the inflatable dam. Continued monitoring over the five year study period will produce data to assess any potential effect.

3.3.2.3 Turbidity

Turbidity effects of gravel bar grading operations are addressed in Section 3.5 *Critical Habitat Alteration and Fish Injury from Operation and Maintenance Activities*.

3.4 WATER QUALITY EFFECTS FROM WATER TREATMENT ADDITIVES AND FACILITY MAINTENANCE SUBSTANCES

Substances used to treat water include chlorine, an ortho-polyphosphate compound, and caustic soda (sodium hydroxide). Each substance is contained in accordance with strict regulations, and would not be released under normal conditions. Any significant risk to protected species would be due to accidental spills. For the substances discussed below, the risk of an accidental spill and subsequent exposure to fish in the river is minimized by in-place and up-to-date Spill Prevention, Containment and Control (SPCC) plans.

3.4.1 CHLORINE

Chlorine is normally delivered to SCWA's chlorine buildings in pressurized cylinders that are constructed in accordance with strict regulations and that are capable of withstanding severe shock if they are dropped. SCWA buildings that house chlorine are equipped with leak detection alarm systems and are located at a considerable distance from the river (about 250 yards). These measures are likely to reduce the likelihood of accidental releases of concentrated chlorine to the river.

Minor amounts of chlorinated water are discharged from the Ranney collector wells and other nearby facilities. Water from motor cooling lines is discharged at an estimated rate of about 5 gallons per minute when the pump motors are running. This discharge water flows into the settling and infiltration ponds at the Mirabel facilities, and into the Russian River at Wohler. These incidental discharges and the pipeline discharges are covered under a waiver issued by the NCRWQCB. SCWA is looking into other options for cooling to alleviate this discharge.

Maintenance of the water storage tanks requires that the tanks be emptied periodically. A portion of the water is released to surface water drainage. SCWA maintenance staff adds a dechlorinating chemical to eliminate any chlorine residue in the discharge. If water levels in the tank unexpectedly rise too high, overflows may occur. In this case, water with a chlorine level of approximately 0.6-ppm may be discharged to surface water drainage.

In general, normal operation and maintenance activities are performed with trained personnel and under stipulations and regulations provided by permits. Normal operations do not appear to present a significant risk to the threatened fish species of the area. Since chlorine would be in the form of a gas, if spilled, the likelihood of it entering the water in severe concentrations is limited. A catastrophic spill in the water from storage tanks could have severe consequences but would be limited in area. The SPCC plan minimizes this to nearly no risk.

3.4.2 CAUSTIC SODA

Caustic soda is delivered by tanker trucks as a solution of 50% water and 50% caustic soda. Storage facilities are designed to keep the substance contained. The Wohler pH control building is located approximately 250 yards from the river, and the River Road pH control building is approximately 200 yards from Mark West Creek. The concrete masonry walls of the pH control buildings are designed to provide secondary containment in the event a leak occurs. Although a catastrophic spill that entered the river would be serious, the SPCC measures should be adequate to minimize the risk of an accidental spill to near nothing, and distance from the river further minimizes the risk to salmonids.

3.4.3 Ortho-polyphosphate

A pilot treatment system is in place at the Todd Road well that adds a small dose of an ortho-polyphosphate compound to the well water. This treatment is used to eliminate the hydrogen sulfide odor that occurs at all three wells. The SPCC plan provides maximum protection from an accidental spill and the risk is little to none.

3.4.4 Vegetation Control

Vegetation control along access roads to the levees associated with water supply operations involves the use of Rodeo, approved for aquatic applications. Improper use of this herbicide could result in contamination of the water and harmful effects on protected species. However, with proper training of maintenance workers and prescribed use, this risk is minimal. This is evaluated for specific activities below under Section 3.5.3, *Vegetation Removal.*

3.4.5 Hydrocarbons

The only significant potential effect related to hydrocarbons is diesel fuel storage. A catastrophic spill into the Russian River would have serious effects. Because of the adherence to local and federal regulations and guidelines (i.e., SPCC plans), it appears highly unlikely that a major spill would occur. Approximately 31,000 gallons of diesel fuel are stored adjacent to the standby generators at the Wohler and Mirabel for use in powering standby generators. Both diesel storage locations are approximately 250-300 yards from the Russian River and are in above-ground, double-containment tanks, which would indicate that if a spill did occur it would be unlikely to enter the Russian River. Concrete block walls around fuel tanks provide additional containment capability. Fuel tanks are designed, manufactured, and constructed in accordance with the Uniform Fire Code, the Uniform Building Code, and applicable local codes and ordinances. Spill prevention and response is outlined in the SPCC plan, which is kept updated per state and federal regulations.

3.5 Critical Habitat Alteration and Fish Injury from Operation and Maintenance Activities.

3.5.1 Critical Habitat Alteration and Fish Injury from Scraping of Gravel Bars

Gravel bar grading operations have the potential to affect protected species directly through disturbance, injury or degradation of habitat. Indirect effects can be related to sediment input into the stream and increased turbidity. The following examination of risk to fish related to scraping of gravel bars includes 1) opportunity for direct injury to fish during gravel bar scraping activities, 2) critical habitat degradation from sediment input to the stream, and 3) opportunity for habitat disturbance and/or injury related to the magnitude of the activity. Potential effects to the geomorphology of the river channel are also discussed.

Gravel scraping activities currently take place at three gravel bars upstream of the inflatable dam (McMurray, Wohler, and Bridge bars) and one location downstream of the inflatable dam near the Mirabel infiltration ponds (Mirabel Bar). Work in other gravel bars may be required in the future if the pattern of gravel bar formation in the river changes, particularly between the proposed Caisson 6 and Caisson 3. Gravel bars are recontoured once a year when flows are low. At the upstream sites, gravel bar scraping operations take place in the spring outside of the active low flow channel and before the inflatable dam is raised and submerges those areas. The time this work is performed varies, depending on the flow in the river and demands on the water system, but in general, the work takes place between March and July. The Mirabel bar is scraped between July and October of each year.

SCWA's gravel bar grading operations include several BMPs to control sediment input and turbidity in the river. Agency biologists inspect the gravel bars prior to the maintenance activity to evaluate the need for silt fences and to identify environmentally sensitive areas. Furthermore, permanent vegetation is not removed. The five-year monitoring plan is assessing the effectiveness of the BMPs (SCWA 2000).

Salmonid spawning does not occur in these sections of the mainstem Russian River. Gravel bar grading operations at the Mirabel Bar do not normally occur during peak spawning migrations, but may occur during juvenile outmigration. At the upstream sites, the opportunity for injury to migrating juvenile salmonids due to scraping activities is minimal, since scraping occurs outside of the wetted channel.

At the Mirabel Bar, gravel is scraped to a low level, creating a depression in which fish may become trapped. The gravel scraping activity normally occurs after the coho and chinook salmon outmigration periods, although in some years it may occur during the later portion of the outmigration. There is a greater risk to steelhead juveniles, which are more likely to be present during gravel bar scraping activities. Fish rescue is provided for fish trapped at the Mirabel Bar. Fish rescues on June 24 and July 29, 1999 resulted in the capture of 797 fish, although none of the fish were salmonids. No salmonids were captured during fish sampling in September at the Mirabel Bar.

Table 3-29 provides current operations scores for the gravel scraping operations in relation to opportunity for injury at the gravel bars. The scores for the Wohler, Bridge and McMurray bars are 5 largely because gravel bar scraping is done outside of the wetted channel. The score at the Mirabel Bar is 3 because although the area is excavated below the low flow water level, the project area is isolated from the stream, and fish rescue is provided.

The gravel bar grading operations upstream of the inflatable dam are limited to areas outside the active low flow channel. Therefore, no instream sediment control measures are necessary at the Wohler, Bridge and McMurray bars.

Table 3-29 Opportunity for Injury Evaluation Scores for Gravel Bar Grading

Category Score	Evaluation Category	Current Operations Score
5	Project area is not within flood plain or below maximum water surface elevation (WSEL), and requires no isolation from flow.	Wohler, Bridge, McMurray
4	Project area is within dry part of channel, or construction and maintenance activity scheduled when species of concern is not present.	
3	Appropriate BMPs are applied; *e.g.* project area survey, escape or rescue provided, project area isolated from flow (if appropriate).	Mirabel
2	Limited ability to apply appropriate BMPs.	
1	Appropriate BMPs are not applied.	

At the Mirabel Bar, gravel is removed to an elevation below the low-flow water surface elevation of the river. A berm is first constructed to prevent water from flowing through the area to control sediment. In addition, sediment fences are used to prevent the input of sediment into the river, and heavy equipment activity in the active stream channel is limited to moving equipment to and from the mid-channel gravel bars. Operation of equipment is kept to the minimum necessary. The sediment removed from the streambeds (spoils at the Wohler and Mirabel areas) is stored about 200 feet from the channel and is normally removed shortly after storage by local parties.

Turbidity was monitored in 1999 during the gravel bar grading operation at the Mirabel Bar. Background turbidity levels above the bar measured 3.4 NTUs. During construction activities, the upstream and downstream ends of the gravel bar were closed from the river. The highest peak of turbidity was 4.2 NTUs and this event lasted less than 30 minutes. This would have resulted in a turbidity criteria score of 5 (Table 2-15). When the grading operation was completed, the outflow channel from the Mirabel Bar was breached at the downstream end of the gravel bar. Turbidity levels reached 37.6 (2 hours after breaching), but levels had declined to 7.3 NTUs after 3.5 hours, and 4.3 NTUs after 5.75 hours. While this turbidity spike would have resulted in a score of 2, the event was of a short duration that would not be expected to have had a significant effect on juvenile salmonids. While there was this short turbidity spike, the score during the majority of the gravel bar scraping operation for migrating salmonids was not less than a 5.

Because gravel bar scraping operations occur during a limited time, and BMPs are in place to minimize sediment input into the river, it is likely that gravel bar grading operations would have only very limited, short-term effects on turbidity levels during juvenile rearing or migration. Turbidity is monitored continuously at two sites (upstream and downstream of the bar grading operation) at the Mirabel Bar to determine project-related effects associated with increased turbidity levels.

Sediment control was scored for instream and up-slope practices (Table 3-30). The instream component for the Wohler, Bridge and McMurray bars scored a 5 because the project area is generally dry. Gravel bar grading operations at the Mirabel Bar scored a 3 because the berm generally provides effective instream sediment control. The up-slope component was used to evaluate spoils storage, with all gravel bar grading operations receiving a score of 3.

Table 3-30 Sediment Containment Evaluation Scores for Gravel Bar Grading

Category Score	Evaluation Category	Current Operations Score
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	Wohler, Bridge, McMurray
4	Clean bypass or similar method used	
3	Effective instream sediment control (e.g., berm/fence)	Mirabel
2	Limited sediment control	
1	No sediment control	
	Component 2: Up-slope sediment control (spoils storage)	
5	No up-slope disturbance, or increase in up-slope stability	
4	Limited disturbance with effective erosion control measures	
3	Moderate to high level of disturbance with effective erosion control measures	Wohler, Bridge, McMurray, Mirabel
2	Action likely to result in increase in sediment input into stream	
1	Action likely to result in slope failure, bank erosion an uncontrolled sediment input to the channel or major changes in channel morphology	

The magnitude of the activity is examined at the sites in relation to bankfull widths in the respective areas. The McMurray Bar is approximately 1000 feet long and 75 feet wide, and the Bridge and Wohler bars are 500 feet long and 100 feet wide (Table 3-31). The Mirabel Bar is approximately 1000 feet long and 200 feet wide. An estimate of bankfull width from aerial photographs is approximately 200 feet at Wohler and 300 feet at Mirabel.

Table 3-31 Approximate Sizes of Gravel Bars

Gravel Bar	Length	Width	Bankfull Width	Lineal Distance in Bankfull Widths	Width of Activity (% of Bankfull Widths)
McMurray	1000	200	75	5	38 %
Wohler	500	100	200	2.5	50 %
Bridge	500	100	200	2.5	50 %
Mirabel	1000	200	300	3.3	67 %

Table 3-32 estimates the magnitude of the action based on bankfull widths where the gravel bar scraping takes place. There are two components. Lineal distance of the disturbance is rated a 5 for the Mirabel, Wohler, and Bridge bars and 4 for the McMurray bar because the length of the bars are approximately equal to 5 bankfull widths. The width of the activity for Mirabel, Wohler and Bridge bars are rated as 2 and for McMurray Bar as 3. Scraping at the upstream gravel bars generally occurs outside of the wetted channel and is not as likely to have direct effects. Gravel bar grading at in Mirabel area, based on the moderate size of the wetted area affected, is may have a larger effect.

Table 3-32 Magnitude of the Action Evaluation Scores for Gravel Bar Grading

Category Score	Evaluation Category	Current Operations Score
	Component 1: Lineal Distance Estimated in Bankfull Widths	
5	<5 bankfull widths	Mirabel, Wohler, Bridge
4	5-10	McMurray
3	10-20	
2	20-30	
1	> 30	
	Component 2: Activity Width as a Percent of Bankfull Widths	
5	<10% of bankfull width	
4	10-25%	
3	25-50%	McMurray
2	50-75%	Mirabel, Wohler, Bridge
1	75-100%	

Gravel removal has the potential to increase stranding of juvenile fish, and to affect the geomorphology of the river channel. When gravel bars are scraped to improve infiltration, the result is a flatter streambed. Improper grading of streambanks could create large, flat, shallow areas along the stream margin or large depressions along the stream margin that become dewatered at low flows. Juvenile fish that take refuge in these areas can be stranded when these areas become dewatered at low flows. After gravel bar grading operations are completed, SCWA contours gravel bars to an approximately 2 percent grade to reduce the potential for stranding. While it would be preferable to have a grade steeper than 6% (Bradford, *et al*. 1995), this grading probably helps somewhat.

Given the characteristics of the river in the area, gravel bar scraping activities are not likely to significantly change the geomorphology of the channel and therefore habitat types are not likely to be different. The two mile reach above the inflatable dam was surveyed to determine if the impoundment altered the habitat type (SCWA 2000). This reach is generally run habitat when the dam is not inflated and primarily pool habitat when the dam is inflated. Aerial photographs (SCWA 1999), and brief field reconnaissance in the area in late 1999, indicate a single channel river that has a relatively straight trajectory with long sweeping oxbow characteristics through the area. It appears to have relatively few structural features that would create low areas outside of the main channel. The slopes of the river margins are relatively low gradient, but are sloped to the main channel. Bank stability has not been affected by gravel bar grading activities.

In summary, the risk to migrating juvenile salmonids from gravel bar scraping activities related to potential injury to fish (type of operation and magnitude of activity) is none at the Wohler, Bridge and McMurray bars (upstream of the inflatable dam) and low risk at the Mirabel area operation. Since work at the upstream gravel bars is done outside of the wetted channel, it is not expected that fish would be trapped, or that there would be additional sediment input to the river. The potential to injure juvenile steelhead at Mirabel is greater than at the upstream bars because there is a possibility steelhead may be trapped in the Mirabel Bar. Fish rescues reduce the risk. Gravel bar grading at the Mirabel Bar normally occurs later in the summer, and during fish rescues in the 1999 portion of the monitoring study, no salmonids were found. Additional monitoring will give information in upcoming years.

The potential risk to juvenile salmonids is greatly reduced for the Mirabel area because the timing of the operation does not normally coincide with migration of the salmonids. The potential to alter habitat with sediment input from instream activities is addressed through implementation of best management practices (BMPs). The use of BMPs during gravel bar are scraping activities reduces the potential for juvenile fish stranding. Spawning does not occur in this area. Effects from gravel bar grading operations are restricted to immediate, short-term effects, including a low risk of entrapment of migrating juveniles and short-term turbidity spikes. Therefore, the overall risk for injury and habitat degradation is low. If additional bars form in the future that may need grading, particularly between Caisson 6 and Caisson 3, the same BMPs would be applied to minimize the risk to salmonids and their habitat.

3.5.2 Inflatable Dam Maintenance

Before the dam is raised, it may be necessary to remove gravel that has accumulated during the winter on top of the dam and in the fish ladders. Although it has not been necessary to do this in recent years, it may be necessary at some time in the future. This activity has the potential to increase sediment input to the river. A portable suction dredge removes accumulated gravel and the dredge discharge is routed to a temporary siltation (settling) pond to prevent turbid water from reaching the river. The water is allowed to re-enter the river after the sediment has settled, and spoils are removed or stored out of the flood plain. It is expected that this practice is sufficient to reduce the risk of increasing suspended sediment concentrations in the vicinity. Because suspended sediments are allowed to settle in settling pond, the score for component 1 for sediment containment is a 3 (Table 3-33). Spoils storage is offsite, so the score for the second component is a 5. This practice is most likely to occur in the spring, would not be likely to put juvenile salmonids at risk. As part of the five year monitoring study, turbidity information will be collected in the future to help assess the risk.

Table 3-33 Sediment Containment Evaluation Scores for Inflatable Dam Maintenance

Category Score	Evaluation Category	Current Operations Score
	Component 1: Instream sediment control	
5	Project area does not require rerouting streamflow	
4	Clean bypass or similar method used	
3	Effective instream sediment control (e.g., berm/fence)	Co, St, Ch
2	Limited sediment control	
1	No sediment control	
	Component 2: Up-slope sediment control (spoils storage)	
5	No up-slope disturbance, or increase in up-slope stability	Co, St, Ch
4	Limited disturbance with effective erosion control measures	
3	Moderate to high level of disturbance with effective erosion control measures	
2	Action likely to result in increase in sediment input into stream	
1	Action likely to result in slope failure, bank erosion an uncontrolled sediment input to the channel or major changes in channel morphology	

3.5.3 VEGETATION REMOVAL

Vegetation is removed along access roads to levees associated with water supply operations with the use of Rodeo (an herbicide approved for aquatic use) and by hand. Levee roads are mowed in the late spring each year. As vegetation removal related to water supply projects does not occur on the streambank, but rather on roads up-slope of the river, the practice is not likely to affect the riparian corridor on the streambanks. Effects of vegetation control are scored to evaluate the use of an herbicide (Table 3-34). (Vegetation removal activities are discussed in greater detail in *Interim Report 5: Channel Maintenance).* Juvenile emigration for all three species would be occurring. A score of 4 indicates that significant short-term effects from the use of this herbicide are not likely to occur. As the active component of this herbicide is short-lived, application in up-slope areas away from the stream may not even result in any contact with the stream.

Table 3-34 Vegetation Control Scores for Levee Roads

Category Score	Evaluation Category for Herbicide Use	Current Operations Score*
5	No chemical release	
4	Limited use of herbicide approved for aquatic use	Co, Ch, St
3	Moderate to heavy use of herbicide approved for aquatic use	
2	Use of herbicide not consistent with instructions	
1	Herbicide not approved for aquatic use	

*Co = Coho, St = Steelhead, Ch = Chinook

3.6 REMAINING AUTHORIZED CONSTRUCTION OF COLLECTOR NO. 6

Collector No. 6 will be located in the Wohler area, adjacent to the Russian River, north of Wohler Bridge. An Environmental Analysis for Collector No. 6 and associated facilities has described the potential effects to the listed species and mitigation to avoid significant harm (SCWA 1999). An informal Section 7 consultation has taken place separately, resulting in the conclusion that Collector 6 will not likely adversely affect listed fish species (NMFS 2000b).

3.7 PREDATION RISK FROM MAINTENANCE AND OPERATION ACTIVITIES

Reservoirs or smaller impoundments can provide habitat for introduced and native predators of salmonids. In the Russian River the primary predators are likely to be the Sacramento pikeminnow and smallmouth bass (S. Chase, SCWA, pers. comm., 1999). Striped bass have been stocked in Lake Mendocino, and have been known to come into the Russian River from the ocean as far as Oddfellows Bridge upstream of Guerneville. The following subsection evaluates the potential for increased predation related to the water supply operation of two reservoirs (Warm Springs Dam and associated Lake Sonoma, Coyote Valley Dam and associated Lake Mendocino), and the inflatable dam.

3.7.1 WARM SPRINGS DAM

Lake Sonoma becomes thermally stratified during the summer. Dissolved oxygen in the hypolimnion is gradually depleted until little remains. The surface layer is generally about 30-35 feet deep (B. Cox, CDFG, pers. comm., 2000). A non-native warmwater fishery exists in the reservoir and includes largemouth bass, smallmouth bass and redear sunfish. Sacramento pikeminnow have been part of the native community and are self-sustaining in the reservoir. Fish in Lake Sonoma may pass through the Warm Springs Dam outlet.

Evaluation criteria for predation risk are divided into three components. The first component assesses the extent to which a structure concentrates prey in an area where predators are present. (Table 3-35). There are no structures below Warm Springs Dam that are likely to concentrate salmonid juveniles or fry. Furthermore, predators are not known to be present in large numbers in Dry Creek, but they are present in the reservoir (B. Cox, CDFG, pers. comm., 2000). Therefore, a score of 4 is given.

The second component assesses predation access (Table 3-36). Because water is drawn from the deeper, cooler depths of the reservoir, it is possible that bass and pikeminnow are less likely to be entrained, at least during the summer months, when they occupy warmer surface layers. The reservoir is not stratified during the winter. These predators are members of the warmwater fish community, but coldwater conditions are found below the dam. Although limited sampling data exist, it is not expected that large populations of predators would be present in Dry Creek. Allowing for the possibility of some predator passage, a score of 2 is given.

The third component assesses whether temperatures are suitable for predator habitat (Table 3-37). Water temperatures at the outlet of Warm Springs Dam vary throughout the year from about 9-17°C (Figure 3-6). This would result in scores of 4 to 5 throughout the year. While there is a possibility that predators could be introduced from the reservoir, they would most likely be concentrated in the warmer reaches of the Russian River. Therefore, the effect of predator introduction would probably be low on coho and steelhead rearing that occurs in the cooler reaches of Dry Creek. However, introduction of predators that may survive in the mainstem Russian River could have an effect on steelhead and coho salmon migrating smolts, and possibly juvenile chinook salmon that may rear in the lower reaches of the river. However, warmwater predators were already established in the mainstem of the Russian River. Therefore, the possible introduction of predators from the operations of the Warm Springs Dam is not likely to introduce a risk of predation on protected species.

Table 3-35 Predation Evaluation Scores for Warm Springs Dam – Structural Component

Category Score	Evaluation Criteria	Current Operations Score*
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.	
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.	Co, Ch, St
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.	
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.	
1	Features that concentrate salmonids, predators abundant locally.	

Table 3-36 Predation Evaluation Scores for Warm Springs Dam – Access Component

Category Score	Evaluation Category	Current Operations Score*
5	Structure does not allow passage of predators, predators not present near structure.	
4	Structure does not allow passage of predators, predators present near structure.	
3	Structure provides limited passage of predators or limited passage to areas they are already well established, predators not present near structure,	
2	Structure provides limited passage of predators to areas they have historically not been found or have been found in limited numbers, predators present in limited numbers near structure.	Co, St, Ch
1	Structure provides passage of predators to areas they have historically not been found or found in limited numbers, predators present or migrate to structure	
0	Structure provides passage of predators; predators present or migrate to structure.	

Table 3-37 Predation Evaluation Scores for Warm Springs Dam – Water Temperature for Warmwater Predators

Category Score	Evaluation Category	Current Operation Score*
5	Water temperatures <13°C	Co, St, Ch
4	Water temperatures 13-18°C	Co, St, Ch
3	Water temperatures 18-20°C	
2	Water temperatures 20-24°C	
1	Water temperatures ≥24°C	

*Co = Coho, St = Steelhead, Ch = Chinook

3.7.2 Coyote Valley Dam

Coho salmon adults have only rarely been caught at Coyote Valley Dam, and coho salmon are not generally thought to utilize the East Fork Russian River. Chinook salmon are not thought to use the East Fork Russian River, but do spawn in the mainstem above Asti. Steelhead utilize the East Fork Russian River and the upper mainstem. Therefore, predation effects from Coyote Valley Dam were evaluated for steelhead in the East Fork, and for steelhead and chinook salmon in the mainstem.

The inlet tower pipes at Coyote Valley Dam are not screened to prevent fish in Lake Mendocino from passing through. As with Warm Springs Dam, it is possible that predators could pass through the dam and establish themselves in the warmer reaches of the mainstem Russian River. However, predators are already present in the mainstem of the Russian River. Therefore, introduction of predators from current operations of the Coyote Valley Dam is not likely to affect listed species.

Striped bass are also stocked on an irregular basis in Lake Mendocino, and they were stocked in 1999. It is possible some may escape into the Russian River. No juveniles have been found in the river, and suitable spawning conditions do not exist in the upper river, so it is not likely that they have spawned successfully. Although fish smaller than those that were stocked were found once in Lake Mendocino, it is not believed that spawning is generally successful in the reservoir because adequate spawning conditions do not exist above the dam (B. Cox, CDFG, June 14, 2000).

The potential for striped bass to escape from Lake Mendocino does exist. As there are no self-sustaining populations of striped bass in the upper river, introduction of this predator could contribute to an increase in predation on protected salmonids. Passage of these would be limited when the reservoir becomes stratified in the summer because low dissolved oxygen levels at the intake system of the dam near the bottom of the lake would make it unlikely that fish are passed through. While striped bass are sometimes found in the lower river, they are not generally found below Coyote Valley Dam. Although the potential does exist, the risk to protected species is likely to be very low. Table 3-38 presents the category scores for Coyote Valley Dam.

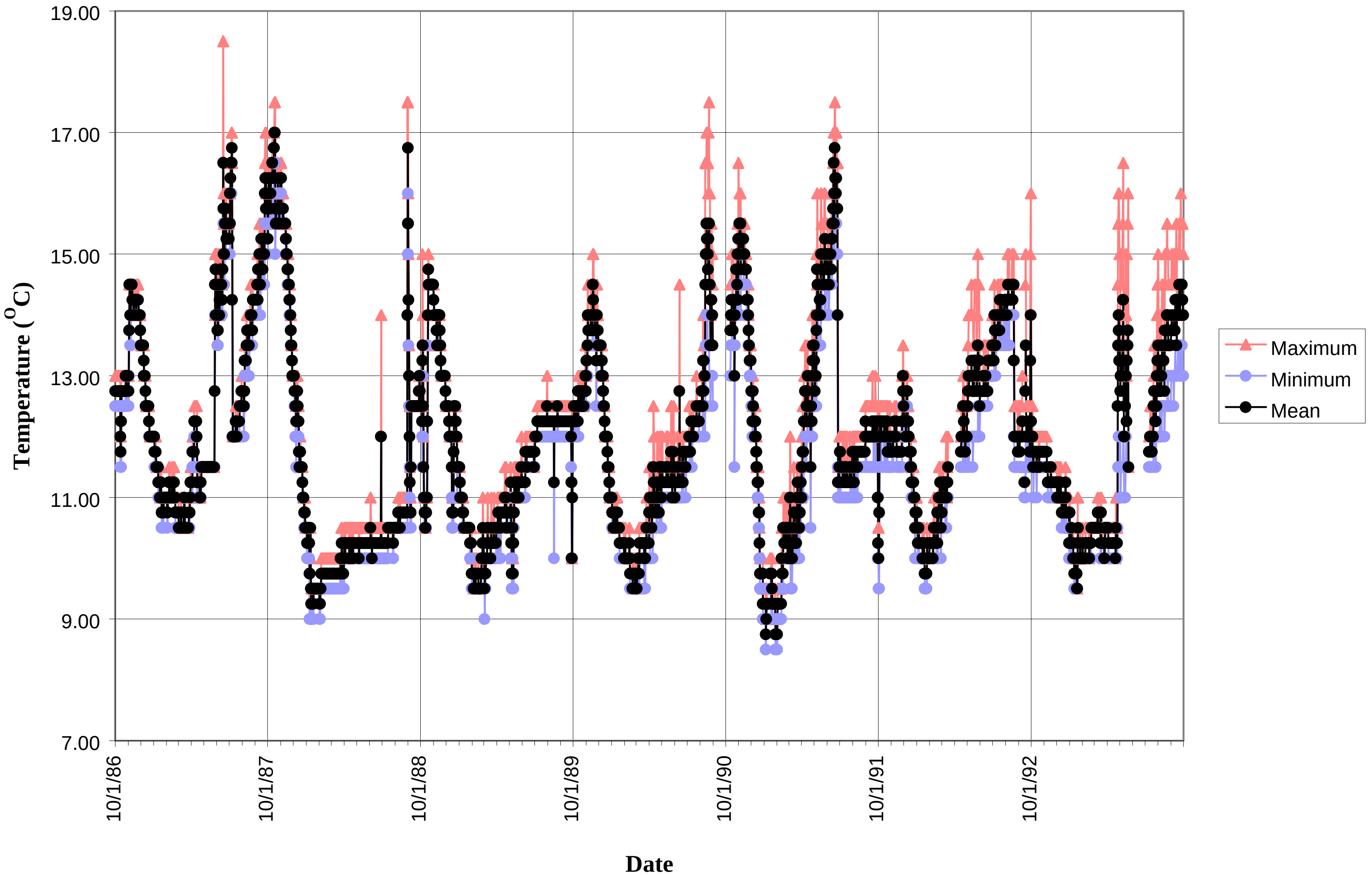

Figure 3-6 Daily Temperatures on Dry Creek below Warm Springs Dam for 1986-1993

Daily temperature data from USGS gauge 500 feet below the dam for water years 1986-1993 show that temperature profiles vary from year to year, particularly in the spring and summer months. (USGS gauge Dry Creek below Warm Springs Dam near Geyserville CA, ID 11465000)

Table 3-38 Predation Evaluation Scores for Coyote Valley Dam

Category Score	Evaluation Criteria	Current Operations Score*
	Component 1: Structural Criteria	
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.	
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.	St, Ch
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.	
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.	
1	Features that concentrate salmonids, predators abundant locally.	
	Component 2: Access Criteria	
5	Structure does not allow passage of predators, predators not present near structure.	
4	Structure does not allow passage of predators, predators present near structure.	
3	Structure provides limited passage of predators or limited passage to areas they are already well established, predators not present near structure,	
2	Structure provides limited passage of predators to areas they have historically not been found or have been found in limited numbers, predators present in limited numbers near structure.	St, Ch
1	Structure provides passage of predators to areas they have historically not been found or found in limited numbers, predators present or migrate to structure	
	Component 3: Water Temperature Criteria for Warmwater Species	
5	Water temperatures < 13^{O}C	St, Ch
4	Water temperatures 13 - 18^{O}C	St, Ch
3	Water temperatures 18 - 20^{O}C	St, Ch
2	Water temperatures 20-24^{O}C	St, Ch
1	Water temperatures ≥24^{O}C	

*St = Steelhead, Ch = Chinook

3.7.3 INFLATABLE DAM

Since adult salmonids are generally not preyed on by species found in the Russian River, fry and juvenile salmonids are the life history stage of concern. While some steelhead rearing may occur in the area of the inflatable dam in the spring, primary rearing is likely to occur in the upper mainstem and tributaries because water temperatures, particularly in the late summer, and habitat types are more suitable there. Juveniles that are migrating down the river are the life stage most likely to be affected.

The first component of evaluation criteria for predation assesses the extent to which a structure concentrates prey in an area where predators are present (Table 3-40). The inflatable dam impounds water, turning approximately two miles of upstream habitat from a combination of riffle/run/pool to primarily pool. This would increase habitat favorable for the predator species.

SCWA electrofished two sites in the inflatable dam pool and two reference sites upstream, between River Mile (RM) 22.75 and RM 26.75, for a total of approximately four miles of habitat sampled over three nights in August 1999 (SCWA 2000). Because of a malfunctioning timing device, and differences in the amount of sampling effort between reaches (the impounded pool sites were samples more), no catch per unit of effort was available, and therefore, a quantitative comparison of the impounded area and the reference areas can not be made. Predators, such as smallmouth bass and Sacramento pikeminnow, were present in all areas sampled (Table 3-39).

Two of the most important issues are abundance and size of the predators. Small predators would find it difficult to prey on salmonid smolts. Zimmerman (1999) found that the maximum length of salmonids consumed by adult smallmouth bass and northern pikeminnow was linearly related to predator length (the northern pikeminnow and Sacramento pikeminnow are closely related), and that smallmouth bass consumed smaller juvenile salmonids than pikeminnow. The mean maximum length of salmonids consumed in the Zimmerman (1999) study was 119 mm FL (40% of predator length) for smallmouth bass and 167 mm (43% of predator length). Based on his regression, a 200 mm smallmouth bass can consume a 100 mm salmon, and a 383 mm smallmouth bass (largest captured in the SCWA 999 screw trap sampling) can consume a 134 mm salmon. Similarly, a pikeminnow between 250 to 530 mm (largest captured) can consume salmon ranging from 116 to 220 mm. Moyle (1976) reports that Sacramento pikeminnow feed primarily on fish greater than approximately 200 mm FL. Chinook salmon emigrate through the Wohler Pool at an average of 90 mm FL (range 65 to 106 mm), and steelhead at 175 mm (range 145 to 250) (SCWA 2000). Therefore, chinook salmon emigrating in the spring would potentially be most vulnerable. Young-of-the-year steelhead rearing in the impounded area in the spring may also be at a greater risk. The average size of young-of-the-year steelhead increased from 44 to 84 mm between April and June of 2000.

SCWA electrofishing in 1999 showed that the smallmouth bass and pikeminnow populations were predominantly composed of juveniles, and that very few adults were present, despite an increase in pool habitat (Table 3-39). For example, smallmouth bass captured at the two stations upstream of the impounded area included about 79 age 0+ and age 1+ fish, and 8 age 2+ and 3+. The two stations in the impounded water had about 151 age 0+ and age 1+ fish and 4 age 2+ and 3+ fish. Smallmouth bass averaged 85 mm FL in August of their first year and 179 mm in August of their second year. If growth rate of smallmouth bass is determined by backcalculating length at age to see when this predator becomes large enough to feed on chinook salmon smolts, it is estimated that 50% of the smallmouth bass greater than 150 mm fall into the age 1+ category. It is estimated that 15% (24 of 162) of the bass in the impounded area and 16% (14 of 87) of the bass in the upstream areas are capable of predation on chinook smolts. Of 13 pikeminnow captured, 3 were large enough to prey on salmonid smolts. This preliminary data suggests that while juvenile predators, particularly smallmouth bass, may be relatively abundant, predators that are large enough to prey on steelhead or salmon smolts are not. Therefore, the score for concentrating predators at the inflatable dam is a 4 (Table 3-40). As part of a five year monitoring study assessing the effects of the inflatable dam, data will be collected to assesses the relative predator concentrations between the impounded area and free-flowing reaches, including a reach below the inflatable dam if suitable sites and access points can be located.

Table 3-39 Size and Age of Smallmouth Bass in the 1999 Mirabel Study Area

Age*	Number	Avg. Length (mm)	Length Range (mm)
Riverine Reach			
0+	39	89	70-115
1+	2	184	182-185
2+	2	255	240-270
3+	2	318	310-325
Benoist Reach			
0+	34	80	60-110
1+	4	172	160-186
2+	2	270	260-280
3+	2	316	315-317
Upper Wohler			
0+	104	84	55-120
1+	7	176	150-210
2+	5	261	250-275
3+	2	363	350-375
Lower Wohler			
0+	33	91	60-120
1+	7	187	170-210
2+	2	274	252-295
3+	2	359	335-382

*Ages based on length-frequency histogram and scale analysis.
Because catch effort was not equal between sites, a comparison of relative abundances can not be made.
Upper and Lower Wohler are in the impounded reach.

It is not known why large numbers of smallmouth bass are not found in the impounded reaches despite the large numbers of juveniles. It is possible that the seasonal nature of the impoundment limits success of the juvenile bass population. Perhaps juvenile bass can be successfully produced when the dam is inflated and a return to free-flowing riverine conditions in the wet season makes it difficult for the young fish to survive.

The second component assesses predator access. The inflatable dam is basically a run of the river operation. Because the operation of the inflatable dam does not improve access for predators, this component of the evaluation criteria does not apply. Predators are able to pass through normal river flows when the dam is deflated, and may still pass through the fish ladder when the dam is inflated. Native and introduced warmwater predators were already established in the mainstem of the Russian River prior to use of the inflatable dam. Therefore, passage of predators through the fish ladder not likely to introduce a new risk.

The third component assesses habitat conditions and in particular, the suitability of temperatures for warmwater predators (Table 3-41). SCWA monitored the temperatures in the impounded area of inflatable dam and reaches above and below (see temperature discussion for inflatable dam above). The average daily water temperature at the Wohler site was from 19.4 to 25.2°C, which results in scores of 3 to 1. The control point, upstream of the influence of the inflatable dam, had daily average surface water temperatures ranging from 18.7 to 24.3°C and would also have scores of 3 to 1. While the inflatable dam does not appear to significantly increase water temperatures favorable to warmwater predators, it does increase the amount of predator habitat by significantly increasing the percentage of pool habitat above the inflatable dam.

Table 3-40 Predation Evaluation Scores for the Inflatable Dam - Structural Component

Category Score	Evaluation Criteria	Current Operations Score*
5	No features that concentrate salmonids or provide cover for predators, concentrations of predators not found.	
4	No features that concentrate salmonids, predator cover near, predators in low abundance locally.	Co, St, Ch,
3	Features that concentrate salmonids, no predator cover nearby, predators in medium to low abundance locally.	
2	Features that concentrate salmonids, predator cover nearby, predators in medium to low abundance locally.	
1	Features that concentrate salmonids, predators abundant locally.	

*Co = Coho, St = Steelhead, Ch = Chinook

Table 3-41 Predation Evaluation Scores for the Inflatable Dam – Water Temperature for Warmwater Species

5	Water temperatures < 13^{O}C	
4	Water temperatures 13 - 18^{O}C	
3	Water temperatures 18 - 20^{O}C	Co, St, Ch
2	Water temperatures 20 - 24^{O}C	Co, St, Ch
1	Water temperatures $\geq 24^{O}$C	Co, St, Ch

*Co = Coho, St = Steelhead, Ch = Chinook

The inflatable dam does not concentrate salmonids. Pool habitat that would favor warmwater predator communities is created above the inflatable dam, but predators have been found in only limited numbers, and results from one year of sampling indicate that most of the predators sampled in this habitat are small enough to not be a significant threat to juvenile salmonids. The operation of this dam does not introduce new predators to an area where they have not traditionally been. Water temperatures are suitable for warmwater predators (score of 3 to 1), but operation of the inflatable dam increases water temperatures only slightly above water temperatures documented in a control site. Therefore, the inflatable dam may slightly increase the risk of predation on protected salmonid juveniles by increasing the amount of predator habitat, but the actual risk is likely to be low.

The potential effects of operation and maintenance of the SCWA water supply and transmission system were evaluated for the three threatened species of salmonids and their designated critical habitat in the Russian River. The potential effects (direct, habitat related, and indirect) are summarized as follows:

1) Potential direct effects on listed fish species;
   a) Passage past project facilities for adult and juvenile salmonid migration and salmonid rearing,
   b) Stranding potential from deflation of the inflatable dam, and
   c) Injury to listed species from construction and maintenance activities,
2) Potential to alter critical habitat;
   a) Alteration of critical habitat from inflatable dam inflation, deflation,
   b) Water quality related effects of water storage and release for diversion
   c) Water quality effects from accidental releases of water additives and facility maintenance substances, and
   d) Alteration of critical habitat from operation and maintenance activities,
3) Potential Indirect Effects;
   a) Increase in predation risk from maintenance and operation activities.

Key findings from this investigation are provided in the following sections.

4.1 ADULT MIGRATION EFFECTS

Potential effects from operation of the inflatable dam located at Mirabel on the Russian River on adult salmonid upstream migration were evaluated. The dam has two fish ladders. Two factors that influence the success of adult migration through the fish ladders were analyzed, including 1) fish ladder design and 2) operation and attraction flows.

Examination of the engineering drawings indicates that the ladders are built within the basic guidelines of published criteria. Data from video monitoring of adult migration through the ladder indicate successful passage by adult salmonids, and even less proficient swimmers, such as Pacific lamprey. Attraction flows at the ladders are suitable to attract upstream migrants to the ladders. A hydrologic computer simulation indicated there are sufficient attraction flows for the majority of the time, and inadequate attraction flows (during storm events) are infrequent and short in duration.

In addition, the normal timing of the operations of the inflatable dam avoids peak upstream migration periods for all three species, although the dam could be operated earlier or later. Because steelhead spawning migrations do not generally occur during the normal operating period of the inflatable dam, the risk for steelhead is very low. There is a slight potential overlap with coho salmon migrations in November of some years. However, coho salmon migrations are usually correlated with increasing river flow and the time when the inflatable dam is lowered, so they are also at a low risk. Adult chinook salmon depend the most on successful passage using the fish ladders at the inflatable dam because the early portion of their spawning run overlaps with the normal operating period of the dam. However, even their peak spawning runs occur after November when the inflatable dam is normally lowered.

All three protected species are likely to have successful upstream passage since the fish ladder is designed and operated to pass them, attraction flow is provided under nearly all conditions, and peak upstream migration upstream is likely correlated with the time when the inflatable dam is lowered (when river flows are increasing).

4.2 JUVENILE EMIGRATION AND REARING EFFECTS

The effects of diversion facilities on young salmonids were examined at both the Mirabel and Wohler diversion facilities. The potential for the inflatable dam to cause juvenile emigration delays was evaluated. The risk of impingement, entrainment or injury to fish on fish screens at diversion facilities was evaluated, both at high (flooding) and low (summer) flows. The risk of stranding or displacement of young salmonids was evaluated for when the inflatable dam is lowered, about once or twice a year.

4.2.1 JUVENILE EMIGRATION DELAY AT THE INFLATABLE DAM

When inflated, the dam at Mirabel impounds water for approximately two miles upstream. This impoundment decreases current velocity, which has the potential to delay emigrating smolts. As part of the five year monitoring program, data was collected in 2000 to assess juvenile steelhead passage, and the analysis of this first year's data will be completed in February 2001. The effects of the inflatable dam on juvenile migration will be assessed in the BA.

4.2.2 IMPINGEMENT, ENTRAINMENT, OR INJURY AT DIVERSION FACILITIES

The inflatable dam raises the water level in the river and submerges the intakes to three diversion pumps that transport water to the Mirabel infiltration ponds. Canals provide gravity-fed water to the two Wohler infiltration ponds when the dam is in operation. A slide gate is opened to fill the Wohler ponds. Water diversion intakes at Mirabel and Wohler have the potential to injure or kill juvenile salmonids. Entrainment of fish in the infiltration ponds at Mirabel and Wohler may have potential detrimental effects on both juvenile and adult salmonids that migrate through the area.

Potential effects from the diversions were evaluated by examining the effectiveness of fish screen design and operation and by assessing the opportunity for fish to be impinged, entrained, or injured at the diversion facilities. The potential for fish to be impinged, entrained or injured was roughly evaluated with two components, including the percentage of the migration period that the diversion facility is in operation and the percentage of the total surface water diverted. Effects were evaluated for juvenile and fry life stages of all three protected fish species.

4.2.2.1 Operations during Low Flows

Mirabel

Engineering design and critical operating parameters for the fish screen at Mirabel appear to meet most of the NMFS criteria for juvenile salmonids. While there are some small areas on the screens with approach velocities that are higher than NMFS criteria, particularly on the upstream screen, the risk to juvenile salmonids is small. When juvenile fish are present, the opportunity for entrainment based on the proportion of flow diverted is moderate, as between 25-50% of water flow is diverted. Coho salmon and chinook salmon are at a low risk for entrapment, impingement or injury primarily because the Mirabel diversion operation normally does not overlap significantly with the juvenile outmigration period. The risk for juvenile steelhead is slightly higher based on a larger overlap with diversion operation and juvenile outmigration period. However, because the Mirabel diversion screen design and operation is mostly within NMFS screen criteria for juvenile salmonids, the overall risk to migrating juveniles of all three species is low.

Because the Mirabel screen design is not within NMFS criteria for salmonid fry (fish less than 60 mm long), there is a higher risk of entrapment, impingement, or injury for fry of any of the three species that may be present. The risk for steelhead fry is slightly higher than for the other two species because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, there is a low probability that large numbers of fry would be found here because suitable spawning habitat does not exist in the area and rearing habitat is limited during the warm summer months. Therefore, while some individual fry, particularly steelhead fry that may be swept downstream in the spring, may be at a high risk for entrapment, impingement or entrainment, the overall risk to the populations of listed species is likely to be low.

Wohler

The Wohler diversion screen design and operation are not within NMFS criteria for either juvenile or fry. Young fish that are exposed to the facility have a high risk of entrapment, impingement, injury or migration delay.

While in some years the diversion may be operated earlier or later than the May to November period, the diversion is normally operated during a small portion of the coho salmon and chinook salmon outmigration period, and a larger portion of the steelhead outmigration period (about 40% overlap). It is estimated that about 5% of total river flow is diverted at Wohler. Combining these two components, juvenile coho salmon and chinook salmon are at a low to moderate risk for entrapment, impingement, injury or migration delay, primarily because the Wohler diversion operation does not overlap significantly with the juvenile outmigration period. The risk for steelhead entrapment, impingement or injury is higher, based on a greater overlap with diversion operation and juvenile outmigration period, and therefore steelhead juveniles are at a moderate risk. Because the Wohler ponds are not used continuously during the diversion period, and because fish rescues are conducted within two weeks when the ponds are filled, the risk may be reduced. However, rescue efforts appear to be delayed (longer than a week) and difficult to achieve in a manner that would insure safe recovery of fish from the Wohler ponds.

The risk for steelhead fry is slightly higher than for coho or chinook salmon fry because the diversion operation period is most likely to overlap with the steelhead fry rearing period. However, large numbers of fry are not likely to be present. Therefore, while some individual fry, particularly steelhead, may be at a high risk for entrapment, impingement or entrainment, the overall risk to fry of the populations of listed species is likely to be low.

4.2.2.2 Operations during High Flows

The opportunity for fish to be entrained or injured at the facility was assessed during high flows, when the Mirabel and Wohler infiltration ponds can be flooded. Analysis included computer simulations to estimate 1) the frequency in which the ponds would have flooded on a yearly basis and 2) the time of year the ponds would have flooded.

Mirabel

Of the 35 water years modeled, Mirabel ponds would have overtopped 28 days or about 0.1% of the time. The months the ponds would have overtopped were December through March. Because the ponds at Mirabel do not overtop often, the opportunity for entrainment at Mirabel during high flows is small. Although the portion of surface water that enters the Mirabel infiltration ponds during flooding has not been measured, it is estimated as less than 5% of the flow.

Because less than 5% of streamflow during flood events enters the Mirabel ponds, and the ponds overtop during only a very small portion of the steelhead juvenile migration period, steelhead are subject to a low risk. Coho and chinook salmon juveniles are more likely to be migrating through the area when the ponds overtop, subjecting them to a moderate risk of entrapment or migration delays when the ponds overtop. However, the ponds do not overtop very often, so that while individual fish may be affected, the overall risk to the populations is likely to be low. Chinook salmon were found in the Mirabel ponds during rescue operations in 1998. Although some fish may be lost to injury or stress during rescue operations, recently modified rescue operations at the Mirabel infiltration ponds significantly minimize the overall risk at Mirabel.

Wohler

Wohler ponds are at greater risk of being overtopped and flooded from the river than Mirabel ponds. Computer simulations estimated that Wohler pond 1 would have overtopped 533 days during the 35 years modeled or about 4% of the time, and Wohler pond 2 would have overtopped about 625 days (approximately 5% of the time). The Wohler ponds overtop almost every year. In general, the months of flooding were concentrated from November through April. Although the portion of the surface water that enters the pond during flooding has not been measured, it is estimated as less than 5% of the flow. The Wohler ponds are relatively small (1.4 acres) so it is assumed that a small portion of the mainstem flood flows enter the ponds.

Fish rescues in 1998 and 1999 found steelhead, and chinook salmon were found in 2000. Although data from two years of fish rescue operations did not find coho salmon juveniles, they are likely to be migrating through the area when the ponds overtop and could be at risk as well. Juvenile steelhead have been lost to injury or stress during rescue operations in the past, but current practices and fish rescue operations may reduce the risk to protected species. Although 13 out of 29 steelhead (primarily hatchery fish) recovered during rescue operations in Wohler pond 2 in 1998 were dead, a connection from Wohler pond 2 to the river decreased the number of fish rescues needed in the 1998-1999 winter season and no mortalities were found. Because an effective, continual connection is maintained between the pond and the river, fish are able to return to the river at will, and the overall risk is likely reduced to a lower level.

4.2.3 Stranding or Displacement from Flow Fluctuation

When the inflatable dam is lowered, stranding or displacement of salmonids could occur due to dewatering effects in two miles of river upstream. Evaluation of the risk is based on the change in water stage in the river when the dam is lowered, the number of times per year habitat is dewatered, the habitat characteristics of the channel that may affect the potential for stranding, and species and life history stages present.

The risk of stranding is highest during spring deflation of the dam because juvenile fish are more likely to be present. Because summer temperatures limit rearing habitat, and this area is far from spawning grounds, large numbers of fry are not expected to be present in the impoundment when the inflatable dam is deflated. The inflatable dam was lowered on average 1.5 times per year over a recent 20-year period. The stage change is estimated at about 0.46 feet per hour, but because the dam is lowered in response to increasing flows associated with storm events, this stage change is likely to be attenuated.

Generally, habitat in the two-mile reach that is affected by impounded water above the inflatable dam does not have characteristics that increase the potential for stranding. Before the inflatable dam is raised, the channel upstream of the dam is primarily run habitat with fine gravel, cobble, and boulder substrates. It appears to be a single channel river that has a relatively straight trajectory through the area and relatively few structural features that would create low areas outside of the main channel. The slopes of the river margins have a low gradient, but are sloped to the main channel. The wetted channel extends from bank to bank whether the dam is inflated or deflated, so it is unlikely that dewatering of the riverbed is a concern.

The attenuated stage change within the impoundment behind the inflatable dam is small enough that there is a low risk of stranding for juvenile salmonids. The dam is not lowered frequently, (on average of less than two times per year), the channel shape presents little risk of stranding, and dewatering of the riverbed is unlikely. Therefore, deflation of the inflatable dam presents a low risk of stranding to juvenile salmonids.

4.3 Habitat in Wohler Pool

When the inflatable dam impounds water, the two-mile stream reach behind the inflatable dam is changed from a combination of run/riffle/pool habitat to primarily pool habitat; pool habitat is likely to increase on an order of 30 to 70 percent over free-flowing conditions. This reach may provide some rearing habitat in the spring for steelhead or chinook, but summer water temperatures limit rearing habitat. An increase in pool habitat above the dam may affect food transport and slightly increase water temperatures. However, with limited rearing conditions available during the summer in this reach, primary rearing habitat is likely to be found elsewhere, and the overall risk to salmonid populations is likely to be low.

4.4 WATER QUALITY RELATED EFFECTS OF WATER STORAGE AND RELEASE FOR DIVERSION

Water supply operations at Coyote Valley Dam and the Mirabel and Wohler facilities have the potential to affect temperature, dissolved oxygen, and turbidity. Water quality in the outflow of Warm Springs Dam is determined by operations of the Don Clausen Fish Hatchery, and will be assessed in the draft and final BA.

4.4.1 COYOTE VALLEY DAM

Temperature

The intake to the control tower at Coyote Valley Dam is in the cooler bottom waters of Lake Mendocino, so the coolest water available is released. Mean daily temperature data from below the dam were used to assess the effect on each life history stage of each species based on published temperature criteria. As there is only limited use of the East Fork Russian by coho salmon, it is steelhead and chinook salmon that are most likely to be affected. Water temperatures are relatively stable from year to year, but late summer and fall water temperatures can be high for salmonid egg incubation and juvenile rearing. Most of the suboptimal temperatures occur in the late summer and fall, which could affect the early part of chinook salmon spawning and incubation periods. However, peak chinook spawning occurs after November, and temperatures are usually lower by this time. Water temperatures are generally suitable for all coho life history stages except for rearing in the late summer and early fall, but coho are not currently rearing in the East Fork Russian River.

Dissolved Oxygen

Because Lake Mendocino is stratified in the summer, water drawn from the lower depths of the lake may be low in dissolved oxygen. Turbulence in the outflow channel and in runs and riffles below the dam are likely to help restore dissolved oxygen levels. Dissolved oxygen levels are not monitored at the outflow to the dam, but they are monitored at the hydroelectric power plant. Continuous compliance with FERC guidelines for DO has been maintained in the hydroelectric facility, and the outflow from the hydroelectric facility would help to maintain dissolved oxygen in the water below Coyote Valley Dam.

Turbidity

Data from water quality monitoring at the Coyote Valley Fish Facility at the base of Lake Mendocino show that turbidity criteria are generally met for rearing and migration for each species. Infrequent, high turbidity values are probably related to storm runoff events that result in releases that are more turbid. Persistence of turbidity during the winter and spring runoff has been attributed to the diversion of turbid water from the Eel river which does not permit the East

Fork to become clear between rainstorms. Based upon the available turbidity data from the fish facility, turbidity is not generally increased to harmful levels due to operations of the Coyote Valley Dam for water supply purposes.

4.4.2 Mirabel and Wohler Facilities, Inflatable Dam

Temperature

When the inflatable dam impounds water, water temperatures may increase. Similar effects may occur related to deepening areas of gravel bars downstream of the dam. The inflatable dam operation is basically a run-of-the-river operation, and preliminary data from 1999 suggest there is only a slight increase in water temperature through the Wohler Pool (0.5°C). A five-year monitoring study will produce data to assess any potential effect. Limited steelhead rearing may occur in the area, but chinook and coho are thought to use the area primarily for passage. No spawning occurs in the area. By summer, temperatures in the inflatable dam impounded area, as well as free-flowing areas above and below the dam, are warmer than recommended in published water temperature criteria for salmonids. This small increase in temperature (0.5°C) is not likely to affect smolts migrating through the area, but may slightly reduce the quality of rearing habitat here during the early summer.

Dissolved Oxygen

Preliminary dissolved oxygen data collected in 1999 indicate DO levels meet criteria for rearing habitat for all three species. DO levels are not thought to be adversely affected by operations in the inflatable dam area.

4.5 Water Quality Related Effects from Water Treatment Additives and Facility Maintenance Substances

Potential risks related to the use of toxic materials as water treatment additives and facility maintenance substance are assessed. Chlorine, NaOH and Ortho-Phosphate are used, or have been used and stored to treat water for safe human consumption. Petroleum products are used and stored for operation and maintenance of water supply facilities. These substances can have deleterious or lethal effects on salmonid species if they enter water bodies in high concentrations. Normal operations and maintenance activities are structured to avoid adverse effects on aquatic habitats or salmonids, because they are carried out under specified permits and restrictions, and by trained personnel. A catastrophic spill has the potential to have serious, but fairly localized effects on salmonid populations. Spill prevention, containment and control measures significantly decrease the risk of injury or death from an accident. Adult and juvenile life stages of the three threatened salmonid species are at a low risk from a potential spill.

4.6 Critical Habitat Alteration and Fish Injury from Operation and Maintenance Activities

4.6.1 Scraping of Gravel Bars

Infiltration capacity at the Wohler and Mirabel diversion facilities is augmented by periodically scraping three gravel bars in the Russian River upstream of the inflatable dam (Wohler, McMurray and Bridge bars) and one location downstream of the inflatable dam near the Mirabel infiltration ponds (Mirabel Bar). Work in other gravel bars may be required in the future if the pattern of gravel bar formation in the river changes. At the Mirabel Bar, gravel is removed to an elevation below the low-flow water surface elevation of the river, and fish could potentially become trapped in the excavated area at low flows. At the upstream areas, gravel bar scraping operations take place in the spring outside of the active low flow channel and before the inflatable dam is raised and submerges those areas. The gravel scraping activity at the Wohler, McMurray and Bridge bars normally occurs after the coho salmon and chinook salmon outmigration periods, although in some years it may occur during the later portion of the outmigration. There is a greater risk to steelhead juveniles, which are more likely to be present during gravel bar scraping activities. The McMurray and Mirabel bars are approximately 1,000 feet long and 200 feet wide. The other two bars are smaller, about 500 feet long and 100 feet wide.

There is no risk to migrating juvenile salmonids from gravel bar scraping activities related to potential injury to fish (type of operation and magnitude of activity) at the Wohler, McMurray and Bridge bars. Since work at the upstream sites is done outside of the wetted channel, it is not expected that fish would be trapped or that there would be additional sediment input to the river.

The potential to injure juvenile steelhead at the Mirabel Bar is greater than at the other sites because there is a possibility steelhead may be trapped in the excavated area. BMPs reduce the risk. Gravel bar grading at Mirabel normally occurs in late summer, and does not normally coincide with migration of salmonids. Fish rescues are conducted, and no salmonids were found in fish rescues in 1999. Additional monitoring will provide more data in upcoming years. Spawning does not occur in this area. Sediment input from instream activities is reduced with the use of gravel berms.

After gravel bar grading operations are completed, SCWA contours the bars to an approximately 2 percent grade to reduce the potential for stranding. The two-mile reach above the inflatable dam has relatively few structural features that would create low areas outside of the main channel, and given the characteristics of the river, gravel bar scraping activities are not likely to significantly change the geomorphology of the channel. Bank stability has not been affected by gravel bar grading activities.

Effects from gravel bar grading operations are restricted to immediate, short-term effects, including a low risk of entrapment of migrating juveniles and short-term turbidity spikes, particularly at the Mirabel bar. Therefore, the overall risk for injury and habitat degradation is low. If additional bars form in the future that may need grading, particularly between Caisson 6 and Caisson 3, the same BMPs would be applied to minimize the risk to salmonids and their habitat.

4.6.2 Maintenance of the Inflatable Dam

Before the inflatable dam is raised in the spring, it may be necessary to remove gravel that has accumulated during the winter on top of the dam and in the fish ladders. This activity could potentially increase suspended sediment concentrations that could affect juvenile salmonids. Sediment would be removed with a suction dredge and the discharge diverted to a temporary siltation pond to prevent turbid water from reaching the river. Spoils are stored offsite. These practices are likely to limit the risk of sediment input to the stream. SCWA's five year monitoring plan will produce turbidity data in the future if this activity occurs.

4.6.3 Vegetation Removal

Vegetation is removed with herbicide approved for aquatic use (Rodeo) and by hand along access roads to levees associated with water supply operations. Levee roads are mowed in the late spring. Vegetation removal related to water supply projects does not occur on the streambank. Because there is only limited use of an herbicide approved for aquatic use, and application is in up-slope areas away from the stream, there are not likely to be direct effects on protected fish species or on the riparian corridor.

4.6.4 Predation Risk from Maintenance and Operation Activities

Reservoirs or smaller impoundments can provide habitat for introduced and native predators for salmonids. The risk of predation was evaluated for operations at Warm Springs Dam, Coyote Valley Dam, and the inflatable dam.

4.6.4.1 Warm Springs Dam

Lake Sonoma has a non-native warmwater fishery. Juvenile salmonids are not concentrated directly below the dam and predators are not present in large numbers in Dry Creek. Because water is drawn from the deeper and cooler depths of the reservoir in the summer, warmwater predators are less likely to be entrained and introduced to the river. Furthermore, cool temperatures reduce the suitability of the habitat for these predators. Introduction of predators that may survive in the warmer reaches of the mainstem Russian River could affect migrating steelhead and coho salmon smolts, and possibly juvenile chinook salmon that may rear in the lower reaches of the river. However, warmwater predators were already established in the mainstem of the Russian River. Therefore, the possible introduction of predators from operations of Warm Springs Dam is not likely to introduce a new predation risk, but may contribute to predator populations in downstream reaches.

4.6.4.2 Coyote Valley Dam

The inlet tower pipes at Coyote Valley Dam are not screened. As with Warm Springs Dam, it is possible that predators could pass through the dam and establish themselves in the warmer reaches of the mainstem Russian River. Because warmwater predators have already been established, operations of the dam are not likely to introduce a new risk.

However, striped bass have been stocked in Lake Mendocino, and they could escape into the stream. Suitable spawning conditions do not exist below the dam for striped bass, and striped bass are only rarely found in the upper mainstem or the East Fork. Therefore, the risk for predation on salmonids is probably low.

4.6.4.3 Inflatable Dam

The inflatable dam impounds water, resulting in an increase in pool habitat that has the potential to increase predator habitat in Wohler pool. This has the potential to increase predation on migrating juveniles. There is a low probability that fry-sized salmonids are in this area. Young-of-the year steelhead have been found in the area, but not young-of-the-year coho salmon. The ability of predators to eat fish depends on their size; larger predators are most likely to prey on young fish. Preliminary sampling in 1999 found predators (smallmouth bass) in vastly larger numbers in young age classes than older age classes. Older, larger predators that can prey on young salmonids were found in very low numbers in Wohler Pool. The age distribution was nearly the same for predators in the impoundment and in free-flowing river reaches. Preliminary temperature monitoring in both the impounded area and in the free-flowing river areas found favorable temperatures for warmwater predator populations, but that impoundment of water behind the dam increases water temperature only slightly (about 0.5°C).

Operation of the inflatable dam may slightly increase the risk of predation on migrating chinook or a few rearing steelhead. Additional pool habitat favorable to predators is created for a portion of the year, but actual numbers of large predators found during preliminary sampling in 1999 have been low.

4.7 SYNTHESIS OF EFFECTS

Examination of current operational and maintenance practices and the substantial improvements implemented by SCWA in recent years reflect a clear commitment to the prevention and minimization of adverse effects to protected populations. Table 4-1 provides a summary of 1) the risk of an adverse effect on an individual species/life stage of threatened species, and 2) the risk of an adverse effect to critical habitat.

Many operations have no risk or a low risk to protected fish species. The inflatable dam does not impede adult salmonid passage while lowered, and when in operation the fish ladders are effective at passing all species without delay. Salmonids are at a very low risk of stranding when the inflatable dam is deflated. Standard water quality parameters, especially cooler water released from the reservoirs, could have a positive effect overall. The normal use of chemicals or petroleum products for maintenance and operation activities are done under state and federal regulations by trained personnel. While a catastrophic spill (i.e., diesel fuel) could have significant effects over a local area, it is highly unlikely with spill prevention and control measures in place. Water supply operations at Warm Springs and Coyote Valley dams are not likely to increase the risk of predation on protected species, while operations at the inflatable dam may slightly increase the risk of predation.

Maintenance activities (particularly sediment input to the stream during gravel bar grading operations) have short-term effects on habitat quality, but are limited in area and duration. Juvenile fish may be trapped in the Mirabel Bar during gravel bar scraping activities, but the timing of the activity and fish rescues minimize the risk. Gravel bar grading operations are not likely to change channel morphology or increase the risk of stranding of juvenile salmonids. Therefore, gravel bar grading operations are not likely to have significant effects on salmonids.

The diversion and infiltration systems at the Mirabel facilities conform to most established screening criteria for protecting juvenile life stages of salmonid species, but not for fry. Steelhead fry that may be present are at a high risk. However, there is a low probability that large numbers of fry are present, so the overall risk to the populations of protected species is low. Recent improvements in fish rescue efforts at Mirabel after the ponds overtop are likely to minimize risks to migrating juvenile salmonids.

The most significant effects are related to operations at the Mirabel and Wohler diversion facilities. The Wohler diversion system, although considerably smaller than the one at Mirabel and with less opportunity for injury to fish, is ineffectively screened, and presents a moderate risk to fry and juvenile salmonids that are rearing or migrating through the area when the infiltration ponds are filled. Because limited steelhead rearing occurs in this area, the overall effect to the rearing life history stage (fry or juveniles) is likely to be low, but migrating juveniles of all three protected species, particularly steelhead, are likely to be affected. When floods overtop the infiltration ponds at Mirabel and Wohler, juvenile fish can be entrained. Because the Mirabel ponds overtop infrequently, migrating salmonids are at a low risk, and recent modifications for more effective fish rescue efforts minimize this risk. Because the Wohler ponds overtop more frequently, migrating salmonids are at a moderate risk of entrainment. While fish rescue operations may reduce the risk, some juvenile steelhead have been lost to injury or stress during rescue operations. A continual connection from Wohler pond 2 provides effective passage back to the river during the flood season, and this has reduced the need for fish rescues in the pond.

The current operations of the SCWA water supply and transmission system are likely to adversely affect the listed fish species primarily because the Wohler diversion facility is ineffectively screened, because migrating juveniles may be trapped in the Wohler or Mirabel infiltration ponds when they overtop during flood events, and because the Mirabel diversion is ineffectively screened for fry. Juvenile salmonids that pass through the Wohler area during diversion operations or periods when the ponds overtop are likely to be at a moderate risk, but since only a portion of migration periods are affected, the overall effect on populations of the protected species is likely to be low to moderate. Recent improvements in fish rescue operations at the Mirabel ponds reduce the risk to the few salmonids that may be entrained, so the overall risk to the population is likely to be low. Because large numbers of fry are not likely to be present in the Mirabel area, the risk to the populations of protected species from the Mirabel screens is likely to be low.

The current operations of the SCWA water supply and transmission system are likely to adversely affect the designated critical habitat of the listed fish species because gravel bar grading operations in a wetted channel may introduce short-term spikes of suspended sediment concentrations. However, because only a few individual fish may be affected, the overall effect to populations is likely to be very low.

It may seem to the reader that it is contradictory to state that there is a low risk of adverse effects to protected populations, along with the statement that the proposed project is likely to adversely affect the listed species. However, the first statement is a general assessment of the risk to the larger population of the protected fish species, while the second statement reflects the possibility that one or more fish might be harmed by certain activities. These conclusions will assist NMFS with preparing a BO which may include an incidental take statement (with regard to the individual fish that may be harmed by the proposed action), as well as a determination of whether the proposed action is likely to jeopardize the continued existence of the species.

Table 4-1 Summary of Risk Level for Fish Injury and Alteration of Critical Habitat by Threatened Salmonid Species and Life Stage for Major Project Components

Project Component	Risk Level for Fish Injury by Species and Life Stage*			Risk Level for Alteration of Critical Habitat by Species and Life Stage		
	Low to None	Mod-erate	High	Low to None	Mod-erate	High
Adult Migration at Fish Ladders	CO, ST, CH					
Juvenile Emigration at Diversion Facilities						
low-flow at Mirabel	Co, St, Ch					
low-flow at Wohler		Co, St, Ch,				
high-flow at Mirabel	Co, St, Ch					
high-flow at Wohler		Co, St, Ch				
Fry at Diversion Facilities						
Mirabel		co, st, ch				
Wohler		co, st, ch				
Stranding from Water Level Fluctuation when Inflatable Dam is Lowered	St, Ch					
Injury from Gravel Bar Scraping	St, Ch					
Injury from Vegetation Control	CO/Co, ST/St, CH/Ch					
Water Quality Effects of Water Storage and Release for Diversion				CO/Co, ST/St, CH/Ch		
Water Quality Effects from Facility Maintenance Substances				Co/CO, ST/St, CH/Ch		
Habitat Alteration from Impoundment at Inflatable Dam				St, Ch		
Critical Habitat Alteration from Gravel Bar Scraping.				Co, St, Ch		
Critical Habitat Alteration from Vegetation Removal				CO/Co, ST/St, CH/Ch		
Increased Predation through Alteration of Critical Habitat				CO/Co, ST/St, CH/Ch		

* Co = Juvenile Coho Salmon, St = Juvenile Steelhead, Ch = Juvenile Chinook Salmon
CO = Adult Coho Salmon, ST = Adult Steelhead, CH = Adult Chinook Salmon
co = Coho Fry, st = Steelhead Fry, ch = Chinook Fry

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