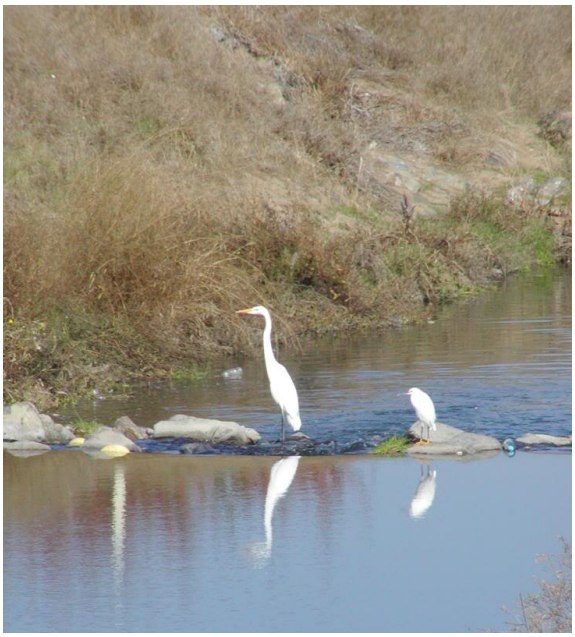
# The State of the Marsh Creek Watershed

## 2010 Annual Report

Data From 2001-2010



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**Acknowledgements:**
Funding for this report was generously provided by the CALFED Watershed Program in conjunction with the Department of Water Resources and the Department of Conservation, and the California Department of Conservation.

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# Executive Summary

Marsh Creek flows 30 miles from the eastern slope of Mount Diablo, through the cities of Brentwood and Oakley and into the San Francisco Bay Delta at Big Break. The Natural Heritage Institute (NHI) has been working to protect and restore the Marsh Creek Watershed since 2001. The Friends of Marsh Creek Watershed (FOMCW) is a local community group formed in the fall of 2004 to protect and restore the watershed and raise awareness about the creek. NHI and community volunteers have monitored salmon on Marsh Creek since 2002. Tom Lindemuth, a former teacher at Freedom High School, has monitored water quality with his students in partnership with NHI and the FOMCW between 2001 and 2007. This report summarizes data collected from 2001 to 2010, what is currently being done, and makes suggestions for what can be done to ensure the future protection and restoration of the Marsh Creek Watershed.

# Status and Trends

## Fish

Chinook Salmon

Over the last two seasons (2008-09 and 2009-10) no Chinook salmon have been observed in Marsh Creek despite increased monitoring efforts. This is consistent with the trend across California and the Delta.

Despite the lack of salmon the last two years, adult Chinook salmon have consistently been observed in Marsh Creek every year between 2001 and 2007. 114 live Chinook and 18 Chinook carcasses were observed in 2004-05, a season with exceptional water clarity and early rains. Adult salmon are typically present in Marsh Creek between late October and early January.

The presence of Chinook carcasses and juvenile salmon in the past suggest Chinook can successfully spawn in Marsh Creek.

Fish Kills

Three fish kills have occurred in Marsh Creek in 2005, 2007 and 2008. The exact causes of all three fish kills are unknown, but regulatory staff have concluded that low dissolved oxygen levels and the chemical acrolein (the active ingredient in the herbicide Magnicide) may have contributed to the kills. Magnacide was applied regularly to control algae in the East Contra Costa Irrigation District (ECCID) canals. The ECCID stopped using Magnacide after September 2007.

## Water Quality

Temperature

High water temperatures (>21.1°C) may be a limiting factor for salmon to migrate up Marsh Creek earlier in the season. Temperatures in November, December and January were all within 10-19.4°C, the suitable range for upstream migration, except for two samples taken in November 2001 and 2006. No water temperature data has been collected in October. Temperatures were higher than 21.1°C, the maximum temperature suitable for upstream migration, in September 2002, the only water quality sample taken in September.

Marsh Creek is currently too warm (>13°C) for steelhead to spawn. Data suggests temperatures are also high enough (>13°C) to be causing egg mortality in Chinook salmon from November through March, when eggs are incubating in the gravel.

Temperatures further upstream are consistently low enough for salmon eggs to successfully incubate and to support spawning populations of rainbow trout, or Steelhead. The construction of the fish ladder would allow salmon and steelhead to access these cooler waters upstream.

Turbidity

Turbidity data for Marsh Creek clearly shows there are times when there is over a 20% increase in turbidity in Marsh Creek, levels that exceed limits for the Central Valley Regional Water Quality Control Board (CVRWQCB).

Dissolved Oxygen

Data collected between 2001 and 2007 show Dissolved Oxygen (DO) levels often fell below 8mg/L in the water column (EPA's 1-day minimum to protect the early life stages of coldwater fishes) and were low in November and December when the salmon were swimming up Marsh Creek to spawn.

Nitrate Nitrogen

Nitrate-nitrogen levels in 2006 were between 19 and 31 mg/L, significantly above 10 mg/L, the Environmental Protection Agencies maximum contaminant level standards for nitrate-nitrogen for regulated public water systems. There was a significant increase in nitrate-nitrogen between 2002 and 2006. The nitrate-nitrogen levels measured in Marsh Creek from 2002 to 2005 were between 0 and 5mg/L, all well below 10 mg/L.

Benthic Macroinvertebrates

Of the 7 locations monitored for benthic macroinvertebrates (BMI) in the upper and lower Marsh Creek Watershed, 2 locations had a low relative BMI site health ranking, 3 locations had a medium relative BMI site health ranking, and 2 had a high relative BMI site health ranking. The locations with the high site health ranking were in the upper watershed. The locations with the low health site ranking were closest to the mouth of Marsh Creek and at the intersection of Morgan Territory Road and Marsh Creek Road.

# What is Being Done

## Fish

Chinook Salmon
The FOMCW in partnership with NHI and the East Bay Regional Park District have conducted 4 train-the trainer events for 50 volunteers between 2006 and 2009 on how to follow Department of Fish and Game protocol to monitor salmon in Marsh Creek. Approximately 300 community members have attended over 44 salmon monitoring walks between 2002 and 2010 to observe and count spawning salmon. The FOMCW, in partnership with NHI and EBRPD, plan to hold a training event in fall 2010 and lead walks in 2010-11 to continue collecting data on salmon in Marsh Creek.

Fish Passage
The FOMCW and NHI, in partnership with American Rivers and the Contra Costa County Flood Control District, are planning to construct a fish ladder over the drop structure so salmon can access an additional 7 miles of spawning habitat. Final construction drawings for the fish ladder have been approved, all permits have been secured and American Rivers is putting the project out to bid in spring 2010. Funding is still tight, but construction of the fish ladder is planned for fall 2010.

Fish Kills
The CVRWQCB, in partnership with the FOMCW and NHI, wrote a Monitoring Plan and an associated Quality Assurance Project Plan (QAPP) to collect water quality data recognized by the CVRWQCB to help determine the cause of fish kills in Marsh Creek. Water quality data will be collected in May and September each year and after a fish kill event. The first monitoring event is planned for May 2010.

## Water Quality

Field Measurements
The FOMCW Monitoring Program and associated QAPP will monitor pH, conductivity, dissolved oxygen and temperature every May and September.

The CVRWQCB has recently proposed revising the 303(d) list of impaired water bodies for the Central Valley Region, which includes Marsh Creek. Currently only mercury and metals are lists as a potential pollutant source in Marsh Creek (Dunn Creek to Marsh Creek Reservoir). The revised 303(d) list includes listing Diazanon, E. Coli, Sediment Toxicity and Unknown Toxicity in Marsh Creek (Marsh Creek Reservoir to San Joaquin River). The revised list also covers Sand Creek (tributary to Marsh Creek) and listing Chlorpyrifos, DDE, DDT, Dieldrin, E. Coli, Salinity and Unknown Toxicity.

Trash

Between 2004 and 2009, the cities of Oakley and Brentwood hosted 9 clean up events on Marsh Creek and collected over 22 tons of trash. Over 3,000 volunteers participated in the creek clean up events. The number of people volunteering to clean up trash in Marsh Creek increased between 2004 and 2009 from 350 people to 690 people while the trash collected from Marsh Creek each year decreased from 6 tons to approximately 1.5 tons.

The cities of Brentwood and Oakley in partnership with the FOMCW and East Bay Regional Park District hold annual creek clean up events on Marsh Creek the third Saturday of September in association with the Coastal Commission's California Coastal Cleanup Day.

# What You Can Do

- Participate in the FOMCW train the trainer event in the fall, learn how to identify and count salmon and lead salmon monitoring walks for the public.
- Look for live and dead salmon in Marsh Creek from October to January between the drop structure and the mouth of Marsh Creek in Oakley. Visit www.fomcw.org to report salmon sightings in the creek or call NHI at (415) 693-3000 x113.
- Report salmon poaching or spear fishing in Marsh Creek to the California Department of Fish and Game at 1-888-DFG-CAL Tip (1-888-334-2258).
- Help raise awareness and funding for the Marsh Creek fish ladder.
- Report multiple dead fish (fish kills) or other animals in Marsh Creek as soon as possible to the Friends of Marsh Creek Watershed at (925) 325-2908 and the California Department of Fish and Game at 1-888-DFG-CAL Tip (1-888-334-2258).
- Participate in water quality monitoring events in May and September to help determine the cause of fish kills in Marsh Creek.
- Collect water temperature data in October, when salmon are beginning to migrate through the Delta and into tributaries.
- Install a data logger or sensor that continuously monitors water temperature. With a continuous monitor, temperature data can be collected at night, when salmon typically migrate upstream.
- Plant riparian vegetation along Marsh Creek to shade water in Marsh Creek to decrease water temperatures for fish and other aquatic species.
- Watch to see if the water in Marsh Creek turns suddenly or unnaturally (not related to storm events) muddy or brown, an indicator of increased turbidity. Immediately monitor turbidity levels at the source and alert the CVRWQCB and FOMCW when turbidity levels increase by 20%. Investigate the source causing increased turbidity levels and take photos if possible.
- Do not dump harmful materials (i.e. chlorinated water from your swimming pool, toxic lawn products) into the stormdrains, which drain straight to Marsh Creek.
- Do not use excessive fertilizer on your lawns or agricultural fields. Consider planting native pants that require less water and fertilizer.
- Report any noticeable changes in Marsh creek, such as fish kills, increased turbidity, excess runoff, to the Friends of Marsh Creek Watershed (www.fomcw.org).
- To report illegal dumping or a spill, call 1-800-NoDumping (1-800-663-8674).

- Carry a trash bag with you when you use the trail and pick up trash you see in and along the creek.
- Participate in the annual Marsh Creek clean up event the third Saturday of September in association with the Coastal Commission's California Coastal Cleanup Day, the City of Oakley, City of Brentwood and FOMCW.

# Chapter 1: Fish

## Status and Trends

Over the last two seasons (2008-09 and 2009-10) no Chinook salmon have been observed in Marsh Creek despite increased monitoring efforts. This is consistent with the trend across California and the Delta.

Despite the lack of salmon in the last two years, adult Chinook salmon have been observed consistently in Marsh Creek every year between 2001 and 2007. 114 live Chinook and 18 Chinook carcasses were observed in 2004-05, a season with exceptional water clarity and early rains. Adult salmon are typically present in Marsh Creek between late October and early January.

The presence of Chinook carcasses and juvenile salmon suggest Chinook can successfully spawn in Marsh Creek.

## Data and General Observations

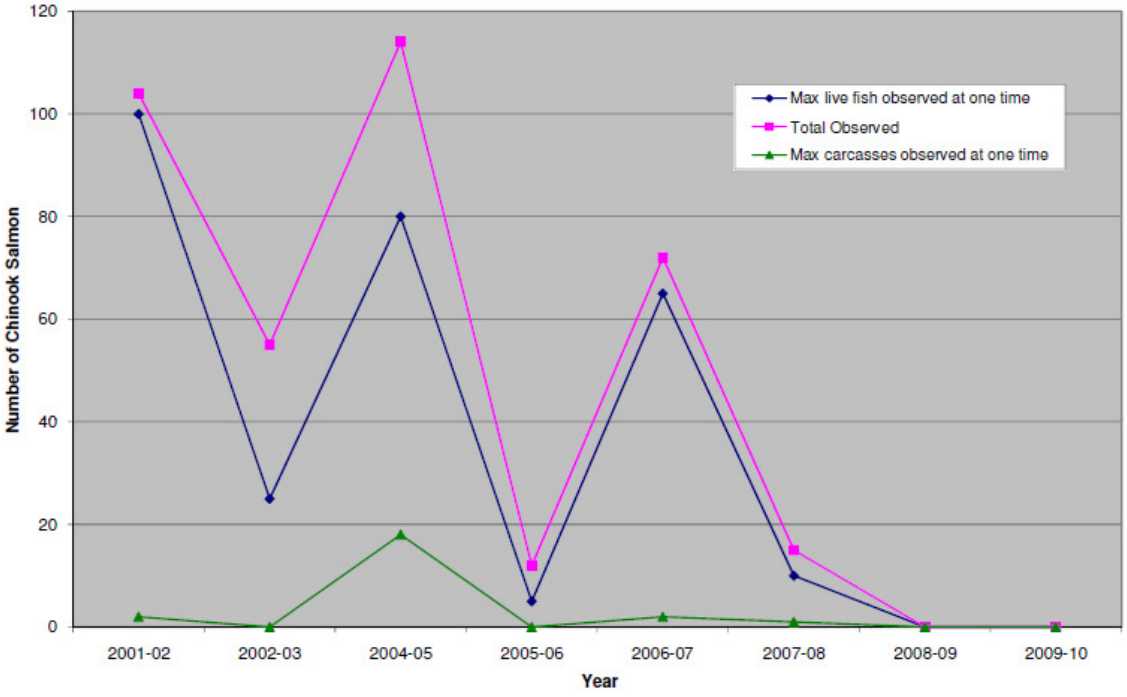
### Chinook Salmon

Historically, the Central Valley supported over a million spawning Central Valley fall-run Chinook salmon in some years (Moyle 2002). Between 1967 and 1997 the average annual number of Chinook in the San Joaquin River ranged from 1,100 to 77,500 fish. Runs are heavily supplemented with fish from hatcheries (10-65% depending on run, year and who is counting) on Battle Creek and the Feather, American, Mokelumne, and Merced Rivers (Moyle 2002).

The presence of juvenile salmon in Marsh Creek suggests there have been successful populations of spawning adult salmon. Darrel Slotton, California Department of Fish and Game (DFG), found five juvenile salmon below the drop structure between Oakley and Brentwood in 1995, when he sampled for mercury concentrations in 1995, 1996 and 1997 during the spring following the major rainfall and runoff of the year (approximately between March and May). In April 2002, Erica Cleugh, also at DFG, identified 13 juvenile Chinook salmon between 60 and 80mm downstream of the drop structure.

Students from Tom Lindemuth's Freedom High School chemistry class were the first to document adult Chinook salmon spawning in Marsh Creek while sampling for water quality in 2001. The Natural Heritage Institute (NHI) first observed salmon in Marsh Creek in 2001 and began organizing creek walks to observe spawning salmon in 2002. Data from each year was compiled in an Excel spreadsheet and is summarized in Figure 1. Note that no data were collected in 2003-04.

Figure 1. Chinook Observed in Marsh Creek 2001-2010




More data needs to be collected to make conclusions about the status of salmon in Marsh Creek over time. Monitoring should take place the same time each year, from October through January. In addition, it is important to record all monitoring activity, including when no fish were observed.

The following provides a summary of the Chinook salmon data collected from 2001 through 2010.

2009-2010

| | |
|---|---|
| First day fish observed: | no fish observed |
| Last day fish observed: | no fish observed |
| Maximum live fish observed at one time: | 0 |
| Maximum carcasses observed at one time: | 0 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 0 |

General observations: 8 volunteers participated in a “train the trainer” event on November 13, 2009. 23 community members attended 3 volunteer-led salmon monitoring events in December. There were heavy rains in October 2009, and not again until January 2010. The California Department of Fish and Game Salmon Spawner Survey protocol was used to collect data.

2008-2009

| | |
|---|---|
| First day fish observed: | no fish observed |
| Last day fish observed: | no fish observed |
| Maximum live fish observed at one time: | 0 |
| Maximum carcasses observed at one time: | 0 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 0 |

General observations: 16 FOMCW volunteers participated in a "train the trainer" event on November 15, 2008. 62 community members attended 10 FOMCW-led salmon monitoring events. 10 FOMCW volunteers led 14 total walks (10 walks for the public and 4 salmon observation walks) every Saturday from November 29 through February 28. There was a small amount of rain at the very end of December. January was one of the hottest and driest on record. Heavy rains occurred in February 2009, but it may have been too late for the salmon. Two carcass heads, which may or may not have been salmon, were observed in Marsh Creek in a plastic bag on the bank. They were too badly decomposed to be identified. The California Department of Fish and Game Salmon Spawner Survey protocol was used to collect data.

2007-2008

| | |
|---|---|
| First day fish observed: | December 6, 2007 |
| Last day fish observed: | January 27, 2008 |
| Maximum live fish observed at one time: | 10 |
| Maximum carcasses observed at one time: | 1 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 15 |

General observations: 19 volunteers from the FOMCW participated in the second annual "train the trainer" event on November 3, 2007. 72 community members attended 19 FOMCW-led salmon monitoring events led by 12 volunteers every Saturday and Sunday November 17, 2007 through January 27, 2008. Scarcity of salmon reported throughout Sacramento-San Joaquin Delta and along coastal California. Major oil spill occurred in San Francisco Bay on November 7. First heavy rains didn't occur until beginning of January. The California Department of Fish and Game Salmon Spawner Survey protocol was used to collect data.

2006-2007

| | |
|---|---|
| First day fish observed: | December 16, 2006 |
| Last day fish observed: | January 7, 2007 |
| Maximum live fish observed at one time: | 65 |
| Maximum carcasses observed at one time: | 2 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 72 |

General observations: The FOMCW participated in a "train the trainer" event this season. 64 community members attended 5 FOMCW-led salmon monitoring events. Heavy rains

in late November brought a significant number of Chinook upstream to spawn. Three white sturgeon carcasses were also observed in Marsh Creek. The California Department of Fish and Game Salmon Spawner Survey protocol was used to collect data.

2005- 2006

| | |
|---|---|
| First day fish observed: | November 13, 2005 |
| Last day fish observed: | December 2, 2005 |
| Maximum live fish observed at one time: | 5 |
| Maximum carcasses observed at one time: | 0 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 12 |

General observations: There was a small number of adult Chinook salmon identified in 2005-06 due to the delayed onset of rains until late December. The large storm events in December and January created muddy conditions, which made it difficult to view salmon and created poor conditions for spawning during this time. Together, the groups observed approximately 12 total salmon between November 13 and December 2, 2005.

2004 - 2005

| | |
|---|---|
| First day fish observed: | November 21, 2004 |
| Last day fish observed: | December 19, 2004 |
| Maximum live fish observed at one time: | 80 |
| Maximum carcasses observed at one time: | 18 |
| Number of redds observed: | 2 |
| Total fish observed over season: | 114 |

General observations: This was an excellent year to observe salmon in Marsh Creek because the water was so clear. The large groups of salmon were all observed in the pools directly downstream of the drop structure. The FOMCW observed what appeared to be two redds in the second and third pools that were approximately 3 feet by 6 feet. The exceptional water clarity allowed the FOMCW to see specific details about the salmon: they were green, black, red, pink, and covered with white fungus and small black spots. All of the fish observed with binoculars had their adipose fins.

On December 19, the FOMCW counted 5 live salmon and 18 carcasses. One carcass missing its adipose fin was sent into the Department of Fish and Game to recover a coded wire tag (CWT) inside its head. The CWT revealed that the salmon was a fall run Chinook raised in the Mokulmne River Hatchery and released in 2001 (so it was at least 3 years old).

2002 -2003

| | |
|---|---|
| First day fish observed: | November 6, 2002 |
| Last day fish observed: | January 9, 2003 |
| Maximum live fish observed at one time: | 25 |
| Maximum carcasses observed at one time: | 0 |
| Number of redds observed: | 0 |
| Total fish observed over season: | 55 |

General observations: Lots of salmon were observed in Marsh Creek this year. 2002-03 was the first year NHI, the Delta Science Center and the East Bay Regional Park District led salmon walks for the public.

2001 - 2002

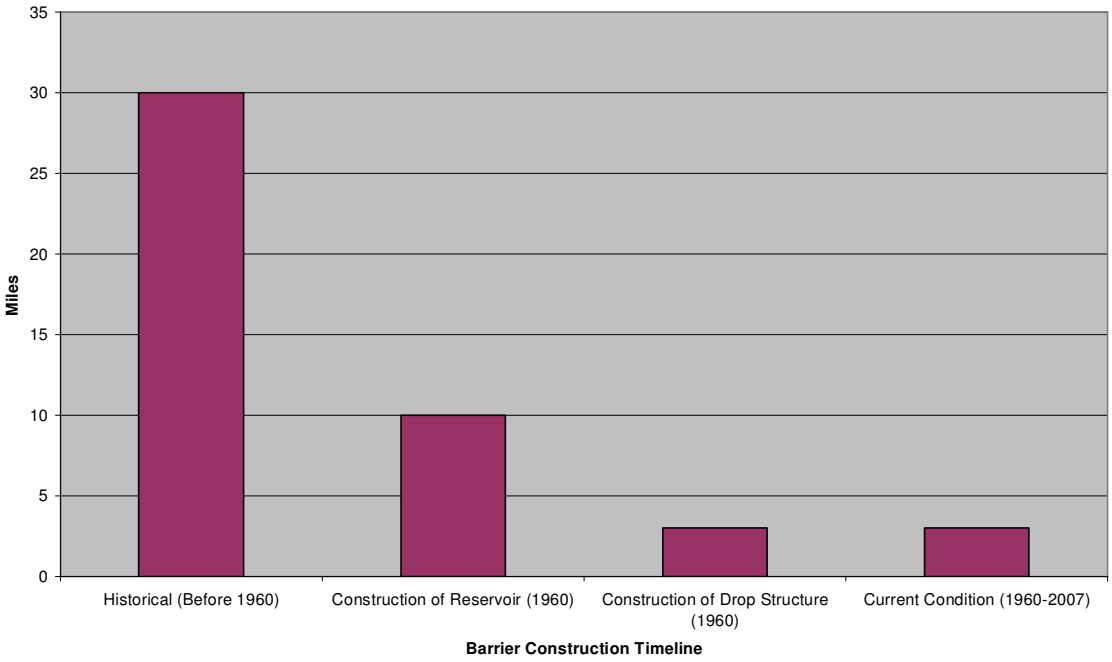
| | |
|---|---|
| First day fish observed: | late October |
| Last day fish observed: | early November |
| Maximum live fish observed at one time: | 100+ |
| Maximum carcasses observed at one time: | 2 |
| Number of redds observed: | observation of attempt to dig redds |
| Total fish observed over season: | 100+ |

General observations: Late October and early November 2001 significant numbers of salmon migrated up Marsh Creek and attempted to spawn. A knowledgeable fisherman who John Cain, Restoration Direct at the Natural Heritage Institute, spoke with claimed to have caught a 45 pound fish and to have observed "over 100" salmon pulled from the creek by fisherman during a two week period when he fished in the evenings. He thought the run was several 100 to 1,000 fish. This fisherman said salmon have been running for each of the last five years, which is the length of time he has been visiting the creek. He also claimed that salmon were attempting to dig redds. NHI heard from two separate sources - a fisherman and a Contra Costa Water District employee - that other fish were backing up at a downstream barrier below the railroad tracks in Oakley. Other reliable observers from Ironhouse and East Bay Regional Park District have reported similar sightings from previous years.

## Fish Passage

Prior to 1960, Chinook salmon and other anadromous fish such as Steelhead, had access to 30 miles of Marsh Creek (Figure 2). Today Chinook can swim 3 miles before they are stopped by a 6-foot high concrete barrier known as the “drop structure”. With the construction of a fish ladder over the drop structure, salmon can access an additional 7 miles of Marsh Creek downstream of the Marsh Creek Reservoir. The Contra Costa County Flood Control District is planning to expand the Marsh Creek Reservoir, which may provide another opportunity to increase access.

**Figure 2. Miles of Marsh Creek Open to Anadromous Fish**




# Fish Kills

Three fish kills have occurred in Marsh Creek in 2005, 2007 and 2008. The exact cause of all three fish kills are unknown, but regulatory staff have concluded that low dissolved oxygen levels and the chemical acrolein (the active ingredient in Magnicide) may have contributed to the kills. Magnacide was applied regularly to control algae in the East Contra Costa Irrigation District (ECCID) canals. The ECCID stopped using Magnacide after September 2007.

**September 14, 2005**

On the morning (approximately 7:00am) of September 14, 2005 members of the public and construction crew members working on the construction of East Cypress Road Bridge, reported a large number of dead fish floating downstream. Mike Moran, naturalist at the East Bay Regional Park District reported thousands of dead fish. He counted 13 dead fish between the drop structure and Delta Road and hundreds of dead fish between Delta Road and Cypress. On 14 and 15 September 2005, Regional Board and Department of Fish and Game (DFG) staff found approximately 500 dead fish in Marsh Creek. The dead fish were found just downstream from the Brentwood Wastewater Treatment Plant and the East Contra Costa Irrigation District discharge points into Marsh Creek. Mike Moran and Hanson Environmental, Inc, reported the fish species were mainly, but not limited to, bluegill, carp, bass and catfish.

Investigation

Sycamore Associates sent their fisheries biologist with Hanson Environmental Inc, and a hydrologist with Balance Hydraulics to investigate Marsh Creek on September 14. The

City of Brentwood Wastewater Treatment Plant monitored the creek downstream of their discharge on the evening of September 14 for pH, chlorine residual and dissolved oxygen, and did not find any problems. On the morning of September 15, the City conducted toxicity testing of its effluent and a sample of creek water downstream and the results came back with 100% survival in the effluent and 95 % survival in the creek water. DFG and the Central Valley RWQCB both took water quality and fish samples on September 15th to analyze back at their labs. The CVRWQCB sampled for organophosphorus pesticides (Diazanon, Chlorpyrifos, Methyl parathion, Ronnel, and Stirophoa), organochlorine pesticides, acrolein (the active ingredient in Magnacide), and acrylonitrilem. All samples were non-detect.

Potential Cause

DFG ruled the cause of the fish kill to low Dissolved Oxygen (DO) based on sampling at the time of the fish kill. DFG lab staff thought the oxygen levels were low due to warm water and combined with a legal release either from the treatment plant or something else may have caused enough stress in the fish to kill them. A DO sample of the water column taken by Balance Hydraulics at the Cypress Grove Project was 1.79mg/L. Staff from the Brentwood Waste Water Treatment Plant took 4 DO samples the evening of September 14th between the Delta Road Bridge and the WWTP that ranged from 6.2mg/L to 6.9mg/L. US EPA's National Recommended Water Quality Criteria 1-day minimum for dissolved oxygen to protect freshwater aquatic life is 8mg/L in the water column for the early life stages of coldwater fishes, and 3mg/L for other life stages.

The CVRWQCB noted the possibility of an herbicide discharge from the irrigation district. The Department of Fish and Game warden received an anonymous complaint of nearby magnicide use and that a cherry orchard was sprayed for pesticides earlier that week. DFG reported that Magnicide, and organochlorine pesticides samples taken by DFG were both non-detect.

Sycamore Associate's biologist report suggested that "Marsh Creek had undergone a temporary change in turbidity and/or water elevation between Tuesday evening (September 13th) and Wednesday morning (September 14th), when the first dead fish were observed. The USGS flow gauge upstream of the treatment plant indicated the flow spiked from 4cfs to 8cfs late on September 12 or early on the 13th and then dropped to 1cfs on September 13th and early on the 14th.

On September 5th, a truck carrying ethanol tipped over and ethanol spilled into the City stormdrain. DFG heard the County hazardous material team put a successful sand plug in the stormdrain that flows from downtown Brentwood to Marsh Creek to stop the ethanol spill. Brentwood staff said fish were swimming at the outfall after the spill.

**September 5, 2007**

The fish kill that occurred on September 5th extended from just downstream of the shared drainpipe used by the East Contra Costa Irrigation District and Brentwood Stormwater (near Sand Creek Road) to the Brentwood Waste Water Treatment outfall.

Potential Cause

Using the information gathered from interviews and field investigations, staff at the Central Valley Regional Water Quality Control Board (CVRWQCB) think the chemical acrolein (the active ingredient in Magnicide) may have caused the fish kill. A representative CVRWQCB conducted 2 field investigations after the incident. The CVRWQCB found the East Contra Costa Irrigation District (ECCID) recently treated the canals with Magnacide (a substance applied regularly to control algae in the canals). ECCID's normal procedure is to close the canal gates to prevent this treated water from reaching Marsh Creek. However, one of the gates leading to Marsh Creek reportedly was not completely shut, allowing the chemically treated water to flow into the creek. The results from water samples taken several days after the fish-kill did not detect the suspected aquatic herbicide since Marsh Creek is flowing and Magnacide is highly volatile. The ECCID told the CVRWQCB that it is taking steps with its customer to prevent any future discharges of treated water to Marsh Creek. The ECCID stopped using Magnacide after September 2007. DO levels were slightly low at some locations on Marsh Creek: 3.35mg/L and 4.41mg/L at Sunset Road.

**May 2, 2008**

The fish kill that occurred on May 2nd extended from the Brentwood Waste Water Treatment Plant to just downstream of Delta Road. Most of the dead fish were carp, black bass and some squaw fish. There was also a dead duck/drake mallard. According to an e-mail from Chris Jimmerson, Environmental Scientist with the CVRWQCB, staff from the Irrigated Lands Regulatory Program unit conducted a site visit on May 2nd to document the observed range of the fish kill and walk sections of the creek to look for any potential agricultural inputs to the creek. No agricultural inputs could be found. The CVRWQCB also contacted the Department of Fish and Game and the Contra Costa Agricultural Commissioner. DFG biologist took samples of fish carcasses the day of the fish kill and a necropsy was performed, but the carcasses were badly decomposed and the results were inconclusive. The Brentwood wastewater treatment plant collected water samples the same day and found DO levels were above 7mg/L.

# What is Being Done

The Friends of Marsh Creek Watershed in partnership with the Natural Heritage Institute and the East Bay Regional Park District have conducted 4 train-the trainer events for 50 volunteers between 2006 and 2009 on how to follow Department of Fish and Game protocol to monitor salmon in Marsh Creek. Approximately 300 community members have attended over 44 salmon monitoring walks between 2002 and 2010 to observe and count spawning salmon.The FOMCW in partnership with NHI and EBRPD plan to hold a training event in fall 2010 and lead walks in 2010-11 to continue to collect data on salmon in Marsh Creek.

The FOMCW and NHI, in partnership with American Rivers and the Contra Costa County Flood Control District, are planning to construct a fish ladder over the drop structure so salmon can access an additional 7 miles of spawning habitat. Final construction drawings for the fish ladder have been approved, all permits have been

secured and American Rivers is putting the project out to bid in Spring 2010. Funding is still tight, but construction of the fish ladder is planned for fall 2010.

The CVRWQCB, in partnership with the FOMCW and NHI, wrote a Monitoring Plan and an associated Quality Assurance Project Plan (QAPP) to collect water quality data recognized by the CVRWQCB to help determine the cause of fish kills in Marsh Creek. Water quality data will be collected in May and September each year and after a fish kill event. The first monitoring event is planned for May 2010.

# What You Can Do

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- Help raise awareness and funding for the Marsh Creek fish ladder.
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- Participate in water quality monitoring events in May and September to help determine the cause of fish kills in Marsh Creek.

# Chapter 2: Water Quality

Plants, animals and humans are all directly affected by the quality of water in Marsh Creek. Marsh Creek flows directly into the San Francisco Bay-Delta, the drinking water source for 20 million Californians.

## Status and Trends

Temperature

High water temperatures (>21.1°C) may be a limiting factor for salmon to migrate up Marsh Creek earlier in the season. Temperatures in November, December and January were all within 10-19.4°C (50-67°F), the suitable range for upstream migration, except for two samples taken at sampling location 4 in November 2001 and 2006. No water temperature data has been collected in October. Temperatures were higher than 21.1°C, the maximum temperature suitable for upstream migration, in September 2002, the only water quality sample taken in September.

Marsh Creek is currently too warm (>13°C) at sampling locations 4 and 5 (the only stretch of creek salmon can currently access) for steelhead to spawn. Data suggests temperatures at sampling locations 4 and 5 are also high enough (>13°C) to be causing egg mortality in Chinook salmon from November through March, when eggs are incubating in the gravel.

Temperatures further upstream at sampling locations 1-3 are consistently low enough for salmon eggs to successfully incubate and to support spawning populations of rainbow trout, or Steelhead. The construction of the fish ladder would allow salmon and steelhead to access these cooler waters upstream.

Turbidity

Turbidity data for Marsh Creek clearly shows there are times when there is over a 20% increase in turbidity in Marsh Creek, levels that exceed limits for the Central Valley RWQCB.

Dissolved Oxygen

Data collected between 2001 and 2007 show Dissolved Oxygen (DO) levels often fell below 8mg/L in the water column (EPA's 1-day minimum to protect the early life stages of coldwater fishes) and were low in November and December at sampling locations 4 and 5 when the salmon were swimming up Marsh Creek to spawn.

Nitrate Nitrogen

Nitrate-nitrogen levels in 2006 were between 19 and 31 mg/L, significantly above 10 mg/L, the Environmental Protection Agencies maximum contaminant level standards for nitrate-nitrogen for regulated public water systems. There was a significant increase in nitrate-nitrogen between 2002 and 2006. The nitrate-nitrogen levels measured in Marsh Creek from 2002 to 2005 were between 0 and 5mg/L, all well below 10 mg/L.

Benthic Macroinvertebrates

Of the 7 locations monitored for benthic macroinvertebrates (BMI) in the upper and lower Marsh Creek Watershed, 2 locations had a low relative BMI site health ranking, 3 locations had a medium relative BMI site health ranking, and 2 had a high relative BMI site health ranking. The locations with the high site health ranking were in the upper watershed. The locations with the low health site ranking were closest to the mouth of Marsh Creek and at the intersection of Morgan Territory Road and Marsh Creek Road.

# Data and General Observations

Tom Lindemuth, Chair of the Science Department and teacher at Freedom High School (FHS), and his environmental science and chemistry students, collected water quality data in partnership with NHI and the FOMCW between 2001 and 2007.

NHI, with funding from the California Bay Delta Authority and in partnership with the State Coastal Conservancy, hired Stellar Environmental, a consulting firm, to sample water quality in Marsh Creek in 2007.

Table 1 and Figure 3 describe the locations selected on Marsh Creek by Lindemuth and Stellar to sample water quality in order to collect consistent data.

**Table 1. Description of Marsh Creek water quality monitoring locations.**

| | |
|---|---|
| 1 | Downstream from bridge across Marsh Creek within Creekside Park in Brentwood. ("Creekside Park", Lindemuth*) |
| 2 | Upstream of confluence of Marsh Creek with Sand and Deer Creeks in Brentwood. (CF-2, Lindemuth*) |
| 3 | Downstream of confluence of Marsh Creek with Sand and Deer Creeks in Brentwood. (CF-1, Lindemuth*) |
| 3a | Marsh Creek, upstream of effluent from City of Brentwood Wastewater Treatment Plant (ST-2, Lindemuth*) |
| 4 | Marsh Creek, downstream of effluent from City of Brentwood Wastewater Treatment Plant (ST-1, Lindemuth*) |
| 5 | Cypress Road Bridge over Marsh Creek in Oakley |

*Sampling location names originally given by Lindemuth and the Freedom High School Team.

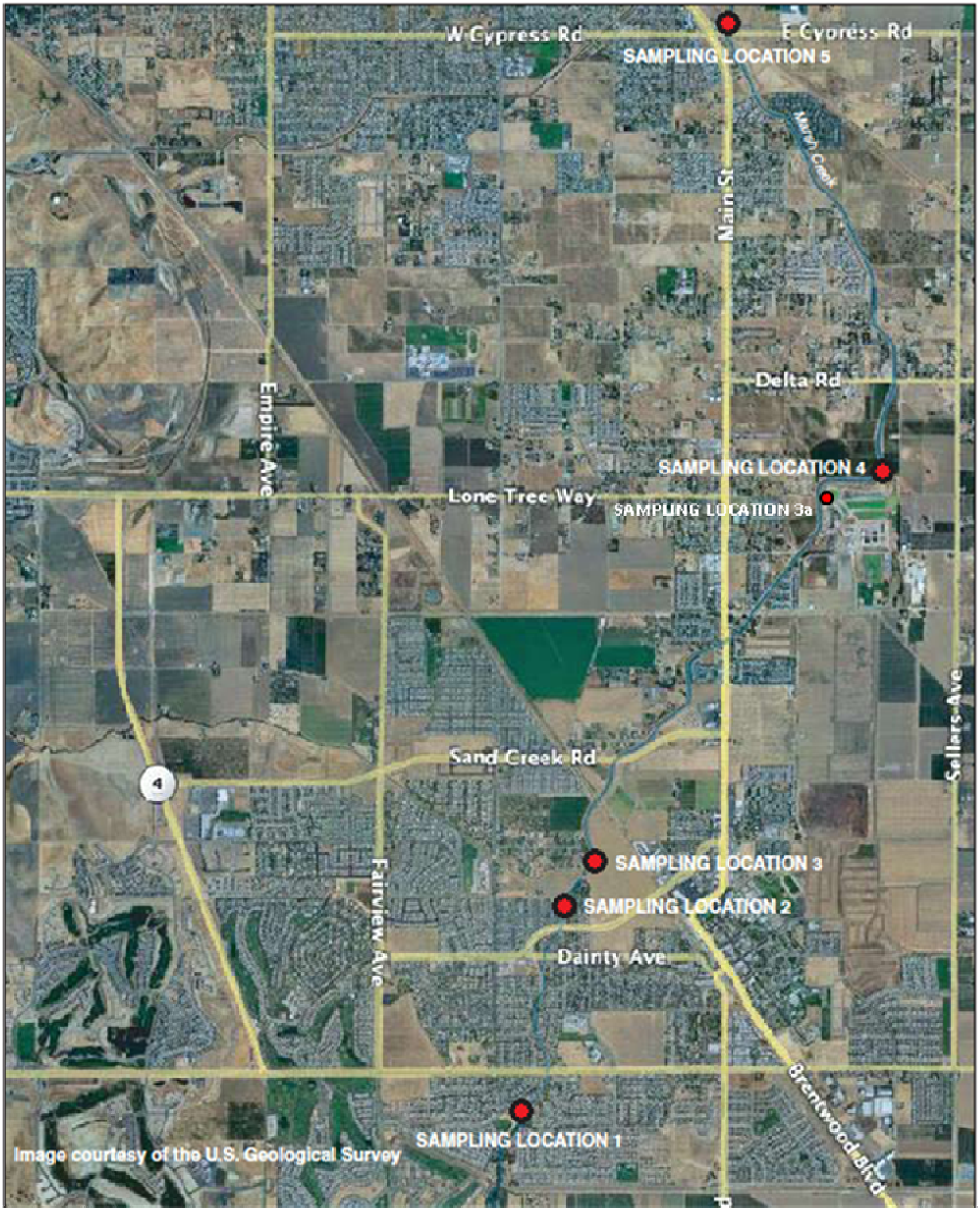


Figure 3. Map of water quality monitoring locations.

## Field Measurements

**Temperature**

Temperature is one of the most important water quality parameters (CWT 2004). The health and function of aquatic organisms is dependent on certain temperature ranges. And some species, such as Chinook salmon, Steelhead trout and benthic macroinvertebrtaes are especially sensitive to temperature.

Temperature influences the amount of oxygen that can be dissolved in water (oxygen levels become lower as temperature increases), the rate of photosynthesis by algae and other aquatic plants, metabolic rates of organisms, sensitivity of organisms, and timing of reproduction and migration of aquatic organisms. (CWT 2004 and USEPA 2007).

Acceptable Ranges

Acceptable temperature ranges depend on the species that live in the water. And for fish, there are two kinds of limiting temperatures: maximum temperature for short exposure, and a weekly average temperature that varies according to the time of year and life cycle stage of the fish species (EPA 2007). The reproductive stages (spawning and embryo development) are the most sensitive stages (EPA 2007). Table 2 shows the maximum temperatures for Chinook salmon and Table 3 shows the temperature criteria for other fish species that live in or could live in Marsh Creek.

**Table 2. Maximum temperatures for migration and egg mortality for Chinook salmon (°C and °F).** Numbers from Bell, 1986; Bell, 1973 in USFWS, 1995; and Bell 1991 in Oroville.

| Species | Suitable for upstream migration | Max temp for upstream migration | Max temp for egg mortality and incubation |
|---|---|---|---|
| Chinook Salmon | 10-19.4°C (50-67°F) | 21.1°C (70°F) | 13°C (56°F) |

**Table 3. Maximum average temperatures for growth and short-term maximum temperatures for selected fish species (°C and °F).** Adapted from USEPA 2007 from Brungs and Jones 1977.

| Species | Max weekly average temp. for growth (juveniles) | Max temp for survival of short exposure (juveniles) | Max weekly avg. temp for spanwing | Max temp. for embryo (spanwing) |
|---|---|---|---|---|
| Bluegill | 32°C (68°F) | 35°C (95°F) | 25°C (77°F) | 34°C (93°F) |
| Common carp | --- | --- | 21°C (70°F) | 33°C (91°F) |
| Channel catfish | 32°C (68°F) | 35°C (95°F) | 27°C (81°F) | 29°C (84°F) |
| Largemouth bass | 32°C (68°F) | 34°C (93°F) | 21°C (70°F) | 27°C (81°F) |
| Rainbow trout | 19°C (66°F) | 24°C (75°F) | 9°C (48°F) | 13°C (55°F) |
| Sockeye salmon | 18°C (64°F) | 22°C (72°F) | 10°C (50°F) | 13°C (55°F) |

Water Quality Objectives

The water quality objectives in the Sacramento-San Joaquin Basin Plan for freshwater ecosystems states waters that support coldwater ("COLD") or warmwater ("WARM") fishes cannot be increased by more than 5°F above natural receiving water temperature.

Data and Analysis: Temperature and Salmon

Temperature data collected between November 2001 and August 2007 are in Table 4. The only stretch of Marsh Creek salmon can currently access is downstream of the drop structure, where temperature data were collected at sampling locations 4 and 5. Shaded rows are samples taken during the window when Chinook could migrate up Marsh Creek, between October and early January.

Research has shown that fall-run Chinook salmon headed for the San Joaquin tributaries typically leave the Pacific Ocean and enter the Delta in September near Jersey Island (Jersey Point), near the mouth of Marsh Creek. And Fall-run Chinook migrate slowly (up to two months) upstream and enter the San Joaquin tributaries in late October or early November (Hallock et al. 1970, CADFG 1993 and 1997, and Carl Mesick Consultants 1998a in CMARP).

Salmon may be ready to enter Marsh Creek earlier than other San Joaquin tributaries because Marsh Creek is one of the first San Joaquin tributaries salmon reach on their migration upstream. However, high water temperatures (>21.1°C) may be a limiting factor for salmon to migrate up Marsh Creek earlier in the season.

Since 2001, the earliest salmon have been observed in Marsh Creek is late October. No water temperature data has been collected in October. Temperatures were higher than 21.1°C, the maximum temperature suitable for upstream migration, in September 2002, the only water quality sample taken in September. Temperatures in November, December and January were all within 10-19.4°C (50-67°F), the suitable range for upstream migration, except for two samples taken at sampling location 4 in November 2001 and 2006.

Marsh Creek is currently too warm (>13°C) at sampling locations 4 and 5 for steelhead to spawn.

Data suggests temperatures at sampling locations 4 and 5 are also high enough (>13°C) to be causing egg mortality in Chinook salmon from November through March, when eggs are incubating in the gravel.

Temperatures further upstream at sampling locations 1-3 are consistently low enough for salmon eggs to successfully incubate and to support spawning populations of rainbow trout, or Steelhead. The construction of the fish ladder would allow salmon and steelhead to access these cooler waters upstream.

Temperature data should be collected in October, when salmon are beginning to migrate through the Delta and into tributaries. It would also be beneficial to install a data logger

or sensor that continuously monitors water temperature. With a continuous monitor, temperature data can be collected at night, when salmon typically migrate upstream. The U.S. Geological Survey commonly uses continuous water-quality monitors to collect temperature, specific conductance, dissolved oxygen, and pH data.

Riparian vegetation planted close to the water and canopy trees along Marsh Creek can decrease water temperatures and provide shade for fish and other aquatic species.

**Table 4. Temperature Data for Marsh Creek 2001 – 2007 (°C)**

| | 1 | 2 | 3 | 3a | 4 | 5 | Data |
|---|---|---|---|---|---|---|---|
| 11-17-01 | - | 17.2 | 16.6 | 19 | 20 | - | FHS |
| 3-2-02 | - | 16 | 15 | 16 | 15 | - | FHS |
| 3-16-02 | - | 23 | 22 | 17.5 | 17 | - | FHS |
| 9-21-02 | - | 23.9 | 22.6 | 22.9 | 23.3 | - | FHS |
| 12-8-02 | - | 12.6 | 9.6 | 12.2 | 17.8 | - | FHS |
| 3-1-03 | - | 14.9 | 14.5 | 13.9 | 15.9 | - | FHS |
| 5-3-03 | 15.9 | 13.9 | 14.5 | - | 14.9 | - | FHS |
| 11-20-04 | - | 14.6 | 11.3 | 12.7 | 17.3 | - | FHS |
| 3-5-05 | 12.2 | 13 | 13 | - | 14 | - | FHS |
| 11-1-06 | 11 | 12.6 | 13.3 | - | 19.9 | 18.9 | Stellar |
| 12-2-06 | 8 | - | 7.9 | - | 18.9 | - | FHS |
| 1-5-07 | 6 | 5.1 | 5.6 | - | 14.6 | 10.5 | Stellar |
| 2-14-07 | 11.8 | 13.3 | 14.4 | - | 17.4 | 16.9 | Stellar |
| 4-16-07 | 16 | - | 17.2 | - | - | - | FHS |
| 5-4-07 | 13.9 | 14.7 | 14.8 | - | 18.6 | 17.6 | Stellar |
| 8-8-07 | 17.9 | 20.1 | 21.1 | - | 24.6 | 25 | Stellar |

## Turbidity

Turbidity, or suspended solids, is a measure of the amount of suspended particles in the water. Algae, suspended sediment, organic matter and some pollutants can cloud the water making it more turbid. Suspended particles diffuse sunlight and absorb heat. This can increase temperature and reduce light available for algal photosynthesis. Suspended solids typically come from runoff from roads, construction sites, logging and agricultural operations and erosion, either natural or man-made. High sediment loads can clog the gills of fish and interfere with the respiration of invertebrates. Once the sediment settles, it can smother fish eggs and benthic insects. The sediment can also carry pathogens, pollutants and nutrients (Katznelson 2001).

The Central Valley Regional Water Quality Control Board Basin Plan, which regulates the waters in Marsh Creek, states that increases in turbidity shall not exceed the limits in Table 5.

**Table 5. Central Valley Regional Water Quality Control Board turbidity limits.**

| Natural Turbidity | Maximum Increase |
|---|---|
| 0 -5 NTU | 1 NTU |
| 5 – 50 NTU | 20% |
| 50 – 100 NTU<br>>100 NTU | 10 NTU<br>10% |

Turbidity data for Marsh Creek (Table 6) clearly shows there are times (11-1-06 and 8-8-07) when there is over a 20% increase in turbidity in Marsh Creek. These levels exceed limits for the Central Valley RWQCB. Stakeholder groups should try to investigate the source causing these events and alert the CVRWQCB when turbidity levels increase above 20% in Marsh Creek.

**Table 6. Turbidity (NTU) in the Marsh Creek Watershed.**

| | **1** | **2** | **3** | **3a** | **4** | **5** | **Data** |
|---|---|---|---|---|---|---|---|
| 11-20-04 | - | 10 | 10 | 10 | 5 | - | FHS |
| 3-5-05 | 43 | 29 | 46 | - | 36 | - | FHS |
| 11-1-06 | 1.61 | 46 | 284 | - | 13 | 44 | Stellar |
| 12-2-06 | 28 | - | 26 | - | 22 | - | FHS |
| 1-5-07 | 10 | 10 | 10 | - | 10 | 10 | Stellar |
| 2-14-07 | 17 | 10 | 10 | - | 10 | 10 | Stellar |
| 4-16-07 | 6 | - | 28 | - | - | - | FHS |
| 5-4-07 | 40 | 10 | 9 | - | 6 | 6 | Stellar |
| 8-8-07 | 10 | 7.09 | 571.6 | - | 30.39 | 17.97 | Stellar |

**Dissolved Oxygen**

Dissolved oxygen (DO) is the amount of oxygen dissolved in water. Most aquatic organisms need oxygen to survive and grow. Some species, such as salmon and stoneflies, need more DO than others, such as catfish, worms and dragonflies (Katznelson 2001).

The US EPA's National Recommended Water Quality Criteria 1-day minimum for dissolved oxygen to protect freshwater aquatic life is 5mg/L in the gravel and 8mg/L in the water column for the early life stages of coldwater fishes, and 3mg/L for other life stages. The Marsh Creek Watershed supports cold water fish, including Chinook salmon.

Data collected between 2001 and 2007 in table 7 show DO levels often fell below 8mg/L in the water column and were low in November (11/17/01, 11/20/04 and 11/1/06) and December (12/8/02) when the salmon were swimming up Marsh Creek to spawn in sampling locations 4 and 5.

**Table 7. Dissolved Oxygen (mg/l) in Marsh Creek Watershed.**

| | 1 | 2 | 3 | 3a | 4 | 5 | Data |
|---|---|---|---|---|---|---|---|
| 11-17-01 | - | 1.9 | 2.1 | 7.7 | 7.7 | - | FHS |
| 3-2-02 | - | 15.1* | 18.2* | 10.9 | 8 | - | FHS |
| 5-16-02 | - | 6.8 | 7.8 | 5.4 | 6.2 | - | FHS |
| 9-21-02 (measured in ppm) | - | 6.5 | 5.9 | 8.1 | 7.5 | - | FHS |
| 12-8-02 | - | 11.7 | - | 6.8 | 7.9 | - | FHS |
| 3-1-03 | - | 10.6 | 11.8 | 7.4 | 6 | - | FHS |
| 5-3-03 | 6 | 7.4 | 11.8 | - | 10.6 | - | FHS |
| 11-20-04 | - | 11.8 | 12.5 | 6.44 | 7.8 | - | FHS |
| 3-5-05 | 7.85 | 8.95 | 10.5 | - | 7.65 | - | FHS |
| 11-1-06 | 8.43 | 7.59 | 9.01 | - | 7.02 | 7.97 | Stellar |
| 12-2-06 | 7.8 | - | 12.1 | - | 8.3 | - | FHS |
| 1-5-07 | 10.95 | 13.22 | 13.82 | - | 8.41 | 11.26 | Stellar |
| 2-14-07 | 11.25 | 11.61 | 10.7 | - | 10.48 | 9.72 | Stellar |
| 4-16-07 | 5.4 | - | 7 | - | - | - | FHS |
| 5-4-07 | 10.45 | 9.96 | 9.9 | - | 8.14 | 8.54 | Stellar |
| 8-8-07 | 8.86 | 8.01 | 7.65 | - | 6.46 | 13.26 | Stellar |

*These DO values are above saturation.

## Inorganic Ions

**Nitrate Nitrogen**

Nitrogen exists naturally in the environment in many forms and, in limited amounts, is necessary to support plant growth. Nitrogen is the nutrient applied in the largest quantities as fertilizer for lawn and garden care and crop production. Nitrogen occurs naturally in the soil in organic forms from decaying plant and animal residues. In the soil, bacteria convert various forms of nitrogen to nitrate, which is absorbed and used by plants. However, nitrate is highly leachable and readily moves with water through the soil profile. If there is excessive rainfall or over-irrigation, nitrate will be leached below the plant's root zone and may eventually reach groundwater. When testing water quality, nitrates are reported as nitrate-nitrogen ($NO_3$-N), which is the amount of nitrogen in the nitrate form.

Excessive concentrations of nitrate-nitrogen in drinking water can be hazardous to human health, especially for infants and pregnant women. Nitrate-nitrogen may reach groundwater from point sources such as sewage disposal systems and livestock facilities, non-point sources such as fertilized cropland, parks, golf courses, lawns, and gardens, or naturally occurring sources of nitrogen. The Environmental Protection Agency (EPA) has adopted a standard of 10 mg/L as the maximum contaminant level (MCL) for nitrate-nitrogen for regulated public water systems. 10 mg/L nitrate-nitrogen ($NO_3$-N) = 44.3 mg/L nitrate ($NO_3$-) and 1 mg/L = 1 ppm (http://www.water-research.net/nitrate.htm).

The U.S. Public Health Service recommended limit of 10 mg/L $NO_3$-N in drinking water, which the EPA also uses as the maximum contaminant level for public water systems. Public water systems are legally defined as those that have 15 or more connections or regularly serve more than 25 persons. If a test indicates that the nitrate-nitrogen concentration of the delivered water exceeds the standard, the public must be notified and treatment must be performed. Often, the treatment may be as simple as blending the water that exceeds the standard with water that has a nitrate-nitrogen concentration less than 10 mg/L such that the average concentration of the delivered water is below the EPA standard (http://www.water-research.net/nitrate.htm).

The nitrate-nitrogen levels measured in Marsh Creek from 2002-2005 were all below 10 mg/L. However, there is a significant increase in nitrate-nitrogen in 2006. Nitrate-nitorigen levels in 2006 were far above the EPA maximum contaminant level standards for nitrate-nitrogen for regulated public water systems.

**Table 8. Nitrate Nitrogen (mg/l) in Marsh Creek Watershed.**

| | **1** | **2** | **3** | **3a** | **4** | **5** | **Data** |
|---|---|---|---|---|---|---|---|
| 9-21-02 (measured in ppm) | - | 0 | 0 | 1 | 1 | - | FHS |
| 12-8-02 | - | 2 | 1 | 2 | 5 | **-** | FHS |
| 11-20-04 | - | 0 | 0 | 0 | 0 | - | FHS |
| 3-5-05 | 1.5 | 1.5 | 2 | - | 1.5 | - | FHS |
| 12-2-06 | **19** | **-** | **23** | **-** | **31** | **-** | FHS |
| 4-16-07 | 3.7 | - | 1 | - | - | - | FHS |

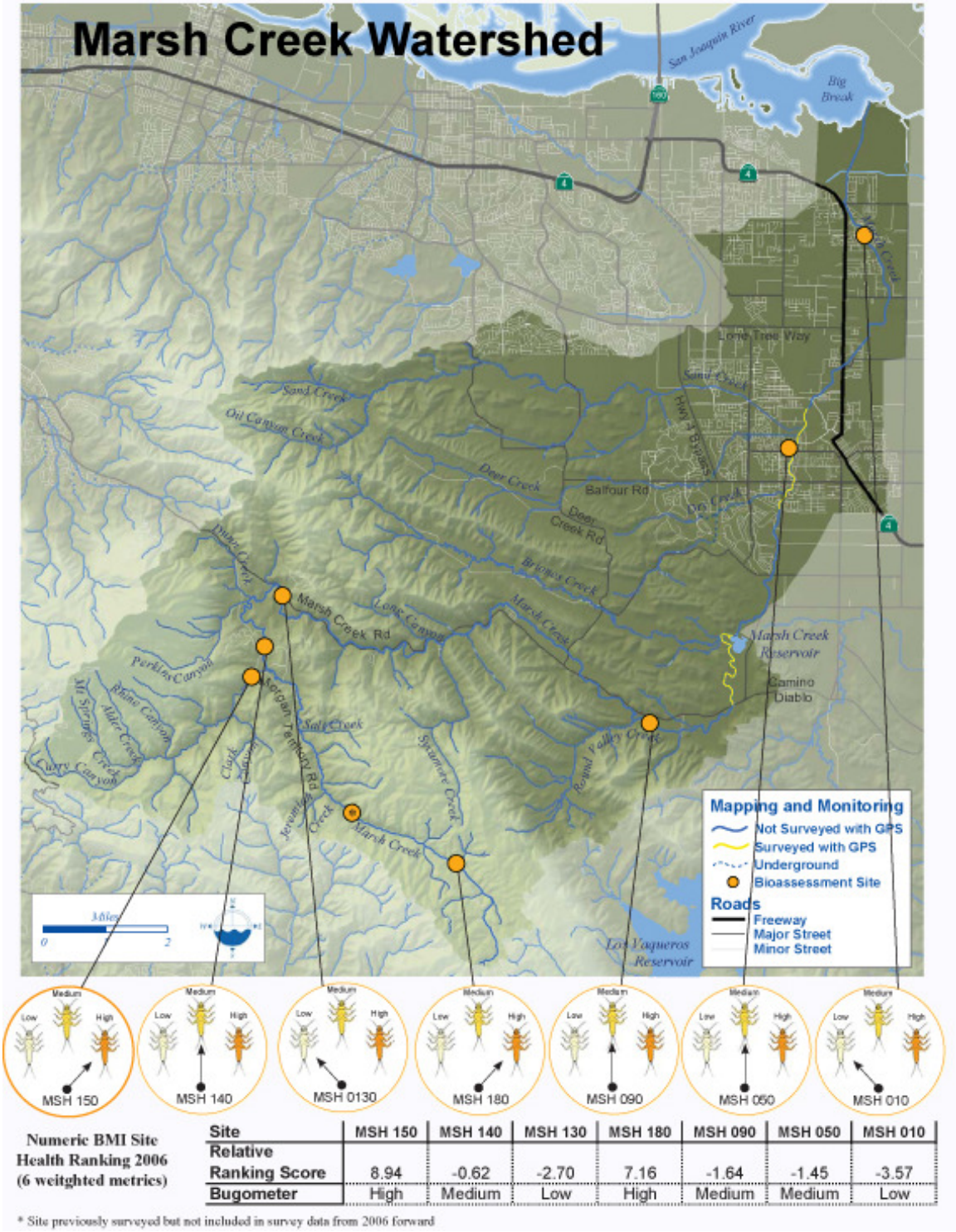
## Benthic Macroinvertebrates

Benthic macroinvertebrates (BMI) are animals (bugs) without backbones that live in creeks and are a good indicator of creek health. Some BMI, such as worms, can tolerate living in poor water quality. While other BMI, such as stonefly nymphs, can only survive in the best water quality. Identifying BMI that live in creeks provides a good indication if the water quality is good or poor.

BMI data on Marsh Creek was collected by volunteers from the FOMCW in coordination with Contra Costa County's Volunteer Creek Monitoring Program. The Monitoring Program is a partnership between the Contra Costa Watershed Forum, Contra Costa Clean Water Program, and the Contra Costa County Community Development Department. Monitoring events were organized in partnership by the NHI, FOMCW coordinator, and RCD watershed coordinator.

BMI data was collected in the upper Marsh Creek Watershed in 2005 and collected in the upper and lower watershed in 2006 and 2007. Of the 7 locations monitored for benthic macroinvertebrates (BMI) in the upper and lower Marsh Creek Watershed (Figure 4), 2 locations had a low relative BMI site health ranking, 3 locations had a medium relative BMI site health ranking, and 2 had a high relative BMI site health ranking. The locations with the high site health ranking were in the upper watershed. The locations with the low

health site ranking were closest to the mouth of Marsh Creek and at the intersection of Morgan Territory Road and Marsh Creek Road.




**Numeric BMI Site Health Ranking 2006 (6 weitghted metrics)**

| Site | MSH 150 | MSH 140 | MSH 130 | MSH 180 | MSH 090 | MSH 050 | MSH 010 |
|---|---|---|---|---|---|---|---|
| Relative Ranking Score | 8.94 | -0.62 | -2.70 | 7.16 | -1.64 | -1.45 | -3.57 |
| Bugometer | High | Medium | Low | High | Medium | Medium | Low |

* Site previously surveyed but not included in survey data from 2006 forward

Figure 4. Relative BMI rankings for data collected in 2006.

## Trash

Between 2004 and 2009, the cities of Oakley and Brentwood hosted 9 clean up events on Marsh Creek and collected over 22 tons of trash. Over 3,000 volunteers participated in the creek clean up events. The number of people volunteering to clean up trash in Marsh Creek increased between 2004 and 2009 from 350 people to 690 people (Figure 5) while the trash collected from Marsh Creek each year decreased (Figure 6) from 6 tons to approximately 1.5 tons.

2009
City of Brentwood and City of Oakley Joint Cleanup event, September 19
Tons of trash collected = 1.5 tons (3,000 lbs)
# of volunteers at clean up = 640 + 50 volunteers to staff event
Miles of Creek=14

2008
City of Brentwood and City of Oakley Joint Cleanup event, September 20
Tons of trash collected = 3.7 tons (7,370 lbs)
Recyclables=0.5 tons (1000 lbs)
# of volunteers at clean up = 646
Miles of Creek=11.9

2007
City of Brentwood, September 15
Tons of trash collected = over 1.9
# of volunteers at clean up = 455

City of Oakley, May 19
Tons of trash collected =Not available
# of volunteers at clean up = 70

2006
City of Brentwood, September 16
Tons of trash collected = over 4
# of volunteers at clean up = 504

City of Oakley, June 3
Tons of trash collected =Not available
# of volunteers at clean up = Not available

2005
City of Brentwood, September 17
Tons of trash collected = 5
# of volunteers at clean up = 300

City of Oakley, May 21
# of volunteers at clean up = 70
# of volunteers at clean up = Not available

<u>2004</u>
City of Brentwood, September 18
Tons of trash collected = 6
# of volunteers at clean up = 350

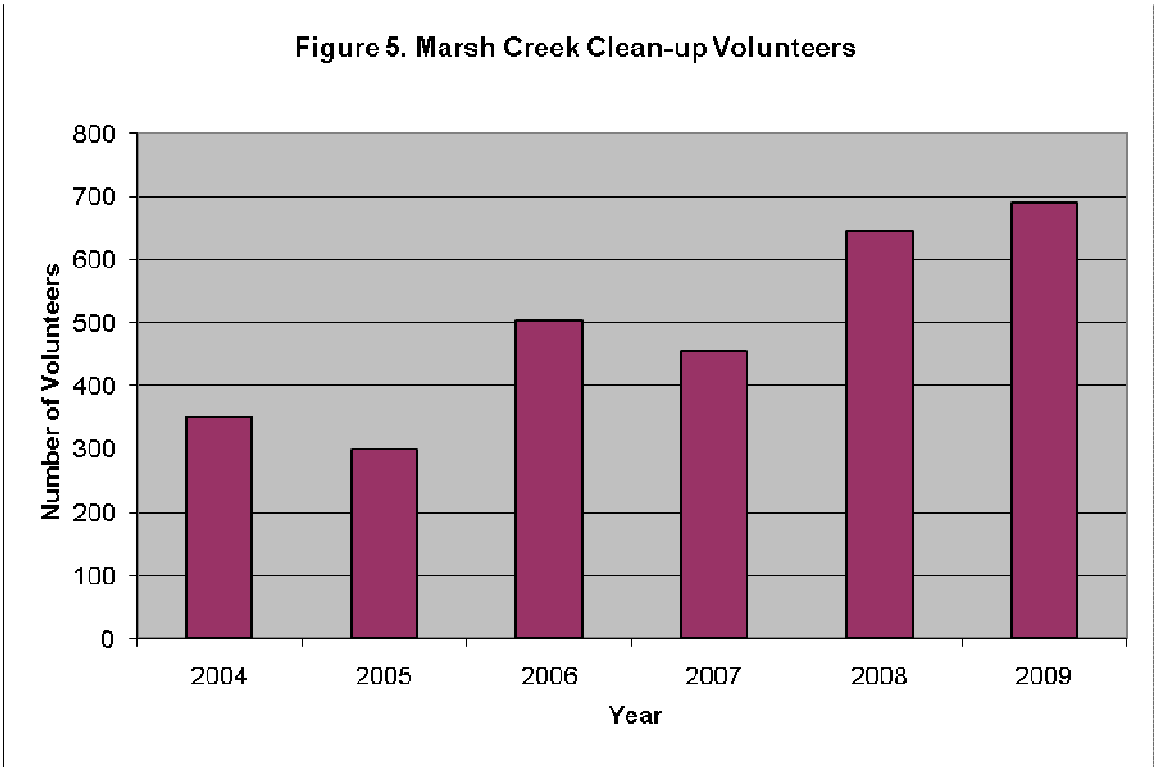
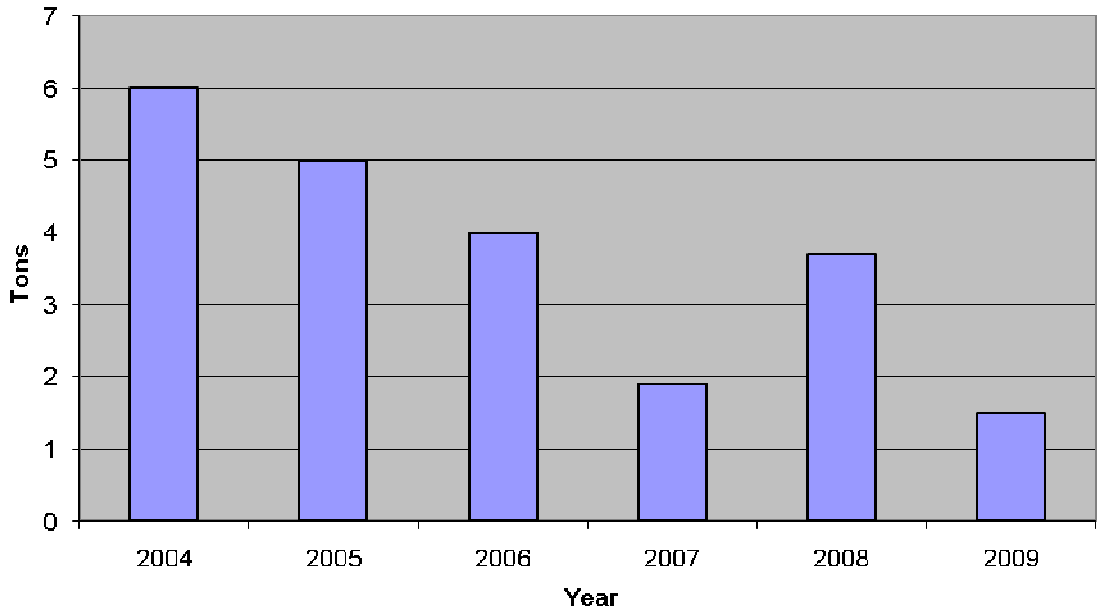


Figure 6. Trash Removed From Marsh Creek




# What is Being Done

The Central Valley Regional Water Quality Control Board, NHI and the Friends of Marsh Creek Watershed have partnered to create a Monitoring Plan for the FOMCW Monitoring Program and associated Quality Assurance Project Plan (QAPP) to monitor pH, conductivity, dissolved oxygen and temperature.

The CVRWQCB has recently proposed revising the 303(d) list of impaired water bodies for the Central Valley Region, which includes Marsh Creek. Currently only mercury and metals are lists as a potential pollutant source in Marsh Creek (Dunn Creek to Marsh Creek Reservoir). The revised 303(d) list includes listing Diazanon, E. Coli, Sediment Toxicity and Unknown Toxicity in Marsh Creek (Marsh Creek Reservoir to San Joaquin River). The revised list also covers Sand Creek (tributary to Marsh Creek) and listing Chlorpyrifos, DDE, DDT, Dieldrin, E. Coli, Salinity and Unknown Toxicity.

The cities of Brentwood and Oakley in partnership with the FOMCW and East Bay Regional Park District hold annual creek clean up events on Marsh Creek the third Saturday of September in association with the Coastal Commission's California Coastal Cleanup Day.

# What You Can Do

- Collect water temperature data in October, when salmon are beginning to migrate through the Delta and into tributaries.

- Install a data logger or sensor that continuously monitors water temperature. With a continuous monitor, temperature data can be collected at night, when salmon typically migrate upstream.
- Plant riparian vegetation along Marsh Creek to shade water in Marsh Creek to decrease water temperatures for fish and other aquatic species.
- Watch to see if the water in Marsh Creek turns suddenly or unnaturally (not related to storm events) muddy or brown, an indicator of increased turbidity. Immediately monitor turbidity levels at the source and alert the CVRWQCB and FOMCW when turbidity levels increase by 20%. Investigate the source causing increased turbidity levels and take photos if possible.
- Do not dump harmful materials (i.e. chlorinated water from your swimming pool, toxic lawn products) into the stormdrains, which drain straight to Marsh Creek.
- Do not use excessive fertilizer on your lawns or agricultural fields. Consider planting native pants that require less water and fertilizer.
- Report any noticeable changes in Marsh creek, such as fish kills, increased turbidity, excess runoff, to the Friends of Marsh Creek Watershed (www.fomcw.org).
- To report illegal dumping or a spill, call 1-800-NoDumping (1-800-663-8674).
- Carry a trash bag with you when you use the trail and pick up trash you see in and along the creek.
- Participate in the annual Marsh Creek clean up event the third Saturday of September in association with the Coastal Commission's California Coastal Cleanup Day, the City of Oakley, City of Brentwood and FOMCW.

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