Chapter 8 *Water Quality*

8.0 Introduction

Stakeholders in the Yuba County IRWMP region share a common concern for water quality protection. The Yuba County IRWMP region typically meets and exceeds state and federal regulatory standards, with a few critical exceptions. However, accumulating salts and nitrates in the Central Valley, sediment, mercury, water temperature, and aquatic invasive species require monitoring and intervention to ensure continued high-quality water in the future. This chapter describes water quality problem areas, especially locations with extensive historic mining, which caused degradation in the foothill elevations. Specific strategies for addressing water quality issues are discussed in Chapter 12 *Goals, Objectives, Issues, and Conflicts*.

8.1 Water Quality Regulatory Framework

The Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins establishes the standards and guidelines for water quality protection in the Yuba County IRWMP region. The following section provides an overview of the Basin Plan, Central Valley Salinity Coalition, Irrigated Lands Regulatory Program (ILRP), and DWR watershed management initiatives that guide water quality protection measures described in this IRWMP. The section also provides a brief summary of water projects in the region that match water quality with water use.

8.1.1 Basin Plan for the Sacramento River Basin[1]

Congress delegated the primary responsibility for implementing the Clean Water Act (CWA) of 1970, as amended, to the US Environmental Protection Agency (EPA), and the EPA has designated the State Water Resources Control Board (SWRCB) as the water pollution control agency with authority to implement the CWA in California (see Water Code Section 13160). The SWRCB and the state's nine Regional Water Quality Control Boards (RWQCBs) work in a coordinated manner to implement and enforce the CWA, as provided for in the state's Porter-Cologne Water Quality Act. The Yuba County IRWMP region is within the jurisdiction of the Central Valley RWQCB.

The CWA requires that the US EPA adopt water quality standards for surface waters within the United States, and that these standards be reviewed and revised, if necessary, at least every three years. The SWRCB carries out its water quality protection authority through the application of specific Regional Water Quality Control Plans, formulated and adopted by the RWQCBs, which submit these plans to the SWRCB for review. The SWRCB revises them as necessary and approves them (Water Code Section 13245).

8.1.1.1 Basin Plan Goals and Objectives Related to Yuba IRWMP

State water quality standards "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses" [33 USC Section 1313(C)(2)(A)]. RWQCB

[1] Excerpted from Yuba County Water Agency Pre-application Document (2009).

basin plans provide standards through: 1) designation of existing and potential beneficial uses, 2) water quality objectives to protect those beneficial uses, and 3) programs of implementation needed to achieve those objectives. The RWQCBs are required to consider a number of items when establishing water quality standards, including: 1) past, present, and probable future beneficial uses; 2) environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto; 3) water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area; and 4) economic considerations.

SWRCB's management goals are specified in the Central Valley RWQCB's Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers, the fourth edition of which was initially adopted in 1998 and which was most recently revised in 2009 (Central Valley RWQCB 1998). The Basin Plan formally sets forth designated existing and potential beneficial uses and water quality objectives for the region, including the Yuba River and the entire Yuba County IRWMP region.

The Basin Plan divides the Yuba River into two Hydro Units (HUs): 1) HU 517, which includes the Yuba River and its tributaries upstream of the US Army Corps of Engineers' (USACE) Englebright Reservoir; and 2) HU 515.3, which includes the Yuba River from USACE's Englebright Dam to the Feather River.

Beneficial Uses

The Basin Plan identifies the following beneficial uses:

- Municipal and domestic supply
- Agricultural supply
- Industrial service supply
- Industrial process supply
- Groundwater recharge
- Freshwater replenishment
- Navigation
- Hydropower generation
- Water contact recreation
- Non-contact water recreation
- Commercial and sport fishing
- Aquaculture
- Warm freshwater habitat
- Cold freshwater habitat
- Estuarine habitat
- Wildlife habitat
- Preservation of biological habitats of special significance
- Rare, Threatened, or Endangered species

Water quality objectives included in the Basin Plan set criteria for meeting the Plan's goals for several water quality parameters. Parameters identified in the Basin Plan for both surface waters and groundwater are listed below.

Water Quality Objectives to Protect Beneficial Uses

Water quality objectives included in the Basin Plan establish criteria for meeting the Plan's goals for several water quality parameters. Parameters identified in the Basin Plan for inland surface waters are as follows:

- Bacteria
- Biostimulatory substances
- Chemical constituents
- Color
- Dissolved oxygen
- Floating material
- Oil and grease
- pH
- Pesticides
- Radioactivity
- Salinity
- Sediment
- Settleable material
- Suspended material
- Tastes and odors
- Temperature
- Toxicity
- Turbidity

Parameters identified in the Basin Plan for groundwater are as follows:

- Bacteria
- Chemical constituents
- Radioactivity
- Tastes and odors
- Toxicity

8.1.2 Central Valley Salinity Coalition

Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS) is a multi-stakeholder process in the Central Valley to address the long-term build-up of salts and nitrates in the Central Valley. Through this collaborative process stakeholders, including the RWQCB, are developing a Central Valley Salt and Nutrient Management Plan (SNMP) and associated Basin Plan amendments to implement the SNMP.

The Statewide General Landscape Irrigation Permit for recycled water requires enrollees to participate in regional salt and nitrate planning. CV-SALTS has developed guidelines to allow entities to participate through membership agencies, such as Central Valley Clean Water Association (CVCWA), or as individual agencies. Participation includes active participation in meetings as well as contributions, either through the Central Valley Salinity Coalition, the funding arm of CV-SALTS, or in-kind services.

In December 2012, the CVCWA board established the CV-SALTS Special Project. The primary purposes of this special project are to support CVCWA's membership in CV-SALTS and the Central Valley Salinity Coalition (CVSC) and provide regulatory credit for "active participation in CV-SALTS" through CVCWA to agencies participating in this special project.

8.1.3 Irrigated Lands Regulatory Program

California agriculture is extremely diverse and spans a wide array of growing conditions from northern to southern California. California's agriculture includes more than 400 commodities. The state produces nearly half of US-grown fruits, nuts, and vegetables, and many of the products are exported to markets throughout the United States and worldwide. Water discharges from agricultural operations in California include irrigation runoff, flows from tile drains, and stormwater runoff. These discharges can affect water quality by transporting pollutants, including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals from cultivated fields into surface waters. The state's groundwater bodies have suffered pesticide, nitrate, and salt contamination.

To prevent agricultural discharges from impairing receiving waters, the ILRP regulates discharges from irrigated agricultural lands, including Yuba County. This is done by issuing waste discharge requirements (WDRs) or conditional waivers of WDRs (Orders) to growers. These Orders contain conditions requiring water quality monitoring of receiving waters and corrective actions when impairments are found. About six million acres of agricultural land statewide are enrolled in the ILRP, controlled by about 40,000 growers.

In 2003, the Central Valley RWQCB decided on three options for growers to avoid pollution of rivers, streams, and creeks by pesticides, fertilizers, sediment, and other pollutants: 1) join a coalition group and apply for a group waiver, or 2) apply for an individual discharger waiver, or 3) submit a complete application for a permit. The coalition group waiver and the individual discharger waiver require owners and/or operators of irrigated lands to manage their operations so they do not cause or contribute to surface water pollution. The waivers contain conditions that require water quality monitoring, implementation of management practices to address water quality problems, and reporting to the RWQCB. In order to comply with the conditions of the waivers, coalition groups and individual growers will review the available data for their watershed, develop monitoring plans, and prioritize their efforts to address known problems or pollutants of concern, such as pesticides or nutrients.

Participating in a coalition group is the simplest and most economical way to comply with the requirements. A coalition group is any group receiving RWQCB approval to operate under the terms and conditions of the coalition group conditional waiver. Coalition groups organize growers to share best management practices, conduct monitoring of rivers and creeks, apply for grants, and work cooperatively toward improving water quality. In addition to growers, coalition groups may include representatives from the farm bureaus, county agricultural commissioners, resource conservation districts (RCDs), the Natural Resource Conservation Service, farm advisors, and water agencies. The Butte-Yuba-Sutter Water Quality Coalition (BYSWQC) is one of the 10 subwatersheds that comprise the Sacramento Valley Water Quality Coalition. More information about this main watershed coalition is available at www.svwqc.org.

As of December 2006, in order to join any coalition group, a grower must apply to the RWQCB for approval by filing a completed form ILRP 5.0 and paying a $50 application fee. Information on the ILRP from the RWQCB is available at www.waterboards.ca.gov/centralvalley/water_issues/ irrigated lands/.

After the grower has received board approval, he or she may then join the BYSWQC by submitting the required information and paying all current dues, as well as any past dues if appropriate. The BYSWQC is governed by a board of trustees comprised of three members from each county. After the grower has received board approval, the entity may then join the BYSWQC by submitting the required information and paying all requisite dues.

8.1.4 Watershed Management Initiative for the Sacramento Hydrologic Region (2003)

The Watershed Management Initiative (WMI) was approved as part of the 1995 SWRCB Strategic Plan and remains a part of the current Strategic Plan. The premise of watershed management is that water quality and ecosystem problems are best prioritized, addressed, and solved at the local watershed level rather than at the individual discharger, water body, or state agency level. The watershed approach has

opened the door to a more holistic method of solving environmental and resource management problems by using the energy, knowledge, and experience of locally based watershed partnerships. In turn, the state recognizes that it has an ongoing responsibility to help local stakeholders assess their watersheds, create watershed plans, and implement watershed management measures to address broad concerns, such as those involving water quality, riparian and wildlife habitat, water supply, flooding, and fires—the many issues that often cross political and regulatory boundaries and therefore require significant coordination in order to find solutions.

The WMI establishes a broad framework overlying the numerous federal- and state-mandated priorities. As such, the WMI helps the RWQCBs achieve water resource protection, enhancement, and restoration while balancing economic and environmental impacts.

8.1.4.1 WMI Goals and Objectives

The integrated approach of the WMI involves three main ideas:

1. Use water quality to identify and prioritize water resource problems within individual watersheds. Involve stakeholders to develop solutions.
2. Better coordinate point source and nonpoint source regulatory efforts. Establish working relationships between staff from different programs.
3. Better coordinate local, state, and federal activities and programs, especially those relating to regulations and funding, to assist local watershed groups.

The Yuba, Bear, and Feather watersheds are part of the Sacramento Hydrologic Region WMI. The Yuba County IRWMP region's water quality issues are compatible with the issues addressed in the Central Valley RWQCB's 2003 Watershed Management Initiative, Central Valley Reports.[2] These common issues include metals, sedimentation, and temperature.

8.2 Current Water Quality Conditions

Surface water quality for human consumption is considered good in the region. Water quality concerns for ecosystems, however, include sediment and mercury deposition from past mining; sediment from development, recreation, and road-building activity; temperature increases brought on by water storage and diversion, inadequate shading, and low flows; and impairment due to elevated levels of copper and zinc. These contaminants are not considered significant in the context of existing drinking water supplies or treatment.

Historic land use practices in the upper elevations, beginning with mining more than 150 years ago, compromised water quality in certain areas. Hydraulic and/or placer mining in some areas completely altered stream geomorphology and caused heavy metal contamination from mercury, copper, and zinc as a result of mine operations. Significant deposits of mining debris still persist in the Yuba County IRWMP region, especially below Englebright Reservoir along the Lower Yuba River.

[2] State Water Resources Control Board, Watershed Management, www.waterboards.ca.gov/water_issues/programs/watershed/#wmi.

8.2.1 Yuba County IRWMP Region Drinking Water Quality

The Yuba County IRWMP region watersheds and groundwater subbasins are a critical source of drinking water. The California Department of Public Health (CDPH) requires all surface water suppliers to conduct a watershed sanitary survey and update that study every five years. The watershed sanitation surveys conducted in the upper reaches of the Yuba County IRWMP region have found the watershed to have excellent drinking water quality.[3] YCWA's continuous monitoring of water treatment plants includes source water entering the treatment system, water in the treatment processes, and the treated water.

In a 2008 survey, no wells less than 200 feet deep exceeded drinking water Maximum Contaminant Levels (MCL) in the North subbasin. In the South subbasin, one well less than 200 feet exceeded the MCL for nitrate. Wells greater than 200 feet deep commonly approach or exceed the MCL for total dissolved solids. Further, most areas in the region show increasing trends for total dissolved solids (TDSs) and alkalinity. Elevated levels of TDSs are associated with deep groundwater pumping and can negatively impact irrigated agriculture and the taste of domestic drinking water. [4]

8.2.2 Clean Water Act Section 303(d) List

Table 8-1 lists the 303(d)-listed (2010 list) water bodies in the Plan area classified as impaired because they are unable to support certain designated beneficial ecosystem functions. Similar to the Cosumnes, American, Bear, Yuba (CABY) region and other foothill regions, the heavy metal pollution legacy (primarily mercury) is the most high-profile water quality contaminant in the region and poses significant risks to aquatic organisms and ecosystem health. **Figure 8-1** shows the 303(d)-listed water bodies in the Plan area. Mercury is introduced in this section in the context of 303(d) listings, while bioaccumulation of mercury is discussed below in the "mercury" section.

The Lower Yuba River watershed has seven water bodies (Deer Creek, Englebright Reservoir, Scotts Flat Reservoir, Yuba River, South Fork Yuba, Middle Fork Yuba, and North Fork Yuba) listed as impaired due to mercury, arsenic, copper, chlorpyrifos, diazinon, and/or temperature. The lower Bear watershed has six impaired water bodies (Lake Combie, Lower Bear River, and Camp Far West Reservoir), mostly due to mercury contamination but with secondary contamination from chlorpyrifos and diazinon.

The State of California identified the Bear River and South Fork Yuba River as Priority 1 Impaired Watersheds requiring restoration to improve water quality as a result of the large amounts of mercury.[5]

[3] Nevada Irrigation District and Placer County Water Agency, Watershed Sanitation Surveys (2012).

[4] YCWA Relicensing Studies (2010). http://www.ycwa-relicensing.com/FERCApproved%20Studies/Forms/AllItems.aspx

[5] California Regional Water Quality Control Board (2004, as amended). Fourth edition of the water quality control plan (basin plan) for the Sacramento River and San Joaquin River Basins. Sacramento, CA: California EPA. http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Table 8-1. 2010 Clean Water Act Section 303(d) List of Water Quality-Limited Segments Within the Yuba County IRWMP Region

Watershed	Water Body	Pollutant/Stressor	Potential Sources	Estimated Size Affected	Expected TMDL Completion Date
Yuba	Deer Creek (Yuba County)	pH/Mercury	Resource Extraction	4.3 miles	2019
	Englebright Reservoir	Mercury	Resource Extraction	754 acres	2016
	Scotts Flat Reservoir	Mercury	Resource Extraction	660 acres	2016
	Yuba River, Lower	Mercury	Resource Extraction	10 Miles	2021
	Kanaka Creek	Arsenic	Resource Extraction	9.7 miles	2020
	Yuba River, Middle Fork	Mercury	Resource Extraction	45 Miles	2021
	Yuba River, North Fork	Mercury	Resource Extraction	37 Miles	2021
	Yuba River, South Fork (Spaulding Reservoir to Englebright Reservoir)	Mercury/ Temperature	Resource Extraction	48 Miles	2021
Bear	Lake Combie	Mercury	Resource Extraction	362 acres	2015
	Bear River, Lower	Chlorpyrifos Copper Diazinon Mercury	Agriculture Source Unknown Agriculture Resource Extraction	21 Miles	2021 2021 2010 2015
	Camp Far West Reservoir	Mercury	Resource Extraction	1,945 acres	2015
	Wolf Creek	Fecal coliform	Source Unknown	23 Miles	2019
	French Ravine	Bacteria	Land Disposal	1.7 Miles	2019
	Humbug Creek	Copper Mercury Sedimentation/Siltation Zinc	Resource Extraction	2.2 Miles	2020 2021 2012 2020
	Rollins Reservoir	Mercury	Resource Extraction	774 Acres	2016

Feather	Feather River, Lower (Lake Oroville Dam to Confluence with Sacramento River)	Chlorpyrifos Group A Pesticides Mercury PCBs (Polychlorinated biphenyls) Unknown Toxicity	Agriculture Agriculture Resource Extraction Source Unknown	42 Miles	2019 2011 2012 2019 2021
	Simmerly Slough	Unknown toxicity	Source Unknown	5.5 Miles	2021
	Honcut Creek	Oxygen, Dissolved	Source Unknown	10 Miles	2021

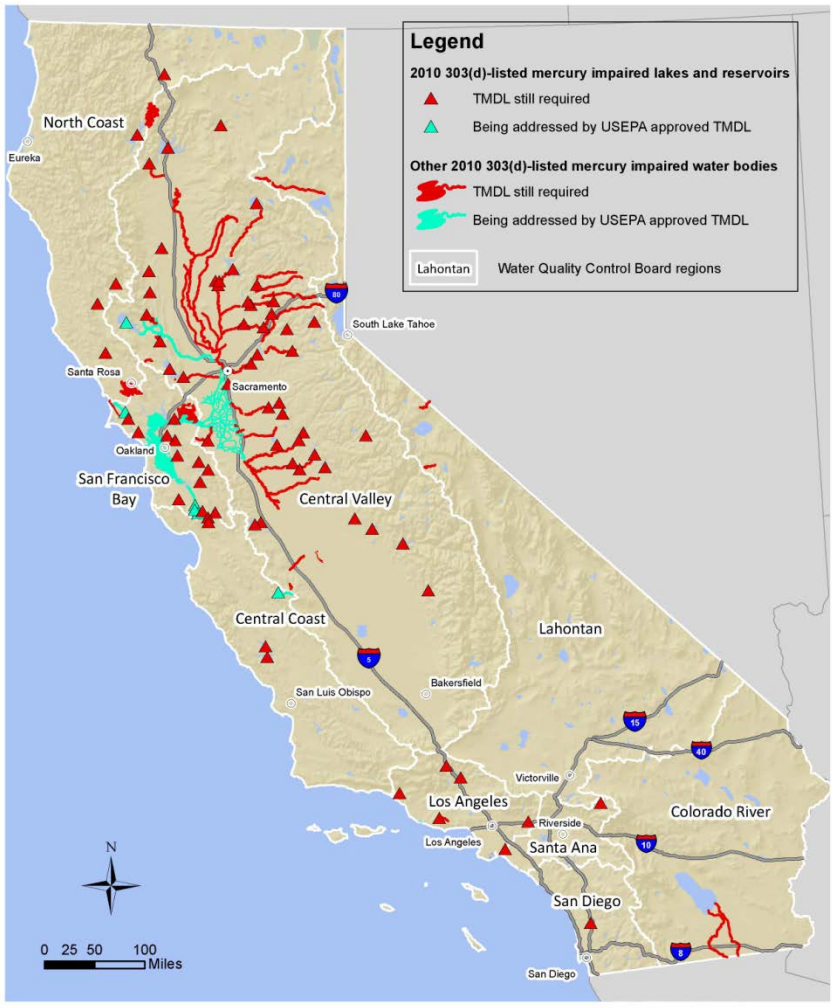

Figure 8-1: State Water Resources Control Board map of 303(d)-listed water bodies in California that may be addressed through the proposed Statewide Mercury Policy (SWRCB 2012)

As displayed in **Figure 8-1** above, the Yuba County IRWMP region includes a high concentration of listed water bodies compared to other regions in the state.

The following section is based largely on information included in the CABY IRWMP. As described in Chapter 6 *Region Description*, the two regions overlap in the upper watershed and the following discussion concerning mercury is directly relevant to both regions. In many places mercury concentrations violate federal water quality limits as well. The SWRCB and nine RWQCBs are currently in the process of developing a statewide policy to control mercury in California's waters. Key elements of the policy will include a control program for mercury in the state's reservoirs and new standards (objectives) for mercury in the tissues of certain species of fish.

Under this policy, reservoir operators, land managers, and others will be expected to design and implement sediment and mercury control programs to comply with the policy's requirements and reduce mercury contributions to the state water system. This policy will have serious cost implications for water managers as well as to rate payers from potential pass-through charges.

Table 8-2. Impaired Water Bodies and Fish Advisories Inside and Downstream of the Yuba County IRWMP Region

Streams listed as impaired	County	Pollutant	Fish Advisory	Species
Yuba River Watershed				
Englebright Reservoir	Yuba, Nevada	Mercury	Mercury, 3/18/09	Rainbow trout; bluegill or other sunfish; and largemouth, smallmouth, or spotted bass
Bear River Watershed				
Camp Far West Reservoir	Yuba, Nevada, Placer	Mercury	Mercury, 3/18/09	Bluegill or other sunfish; largemouth, smallmouth, or spotted bass, catfish
Feather River Watershed				
Feather River, Lower (Lake Oroville Dam to Confluence with Sacramento River)	Yuba, Butte, Sutter	Mercury or PCBs		Steelhead trout, American shad, Chinook salmon, bluegill or other sunfish; largemouth, smallmouth, or spotted bass, catfish

Sources: California Environmental Protection Agency, State Water Resources Control Board, Impaired Water Bodies, 2010 Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report), Statewide; 303(d) list, http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml; California Office of Environmental Health Hazard Assessment, Advisory Map, http://www.oehha.ca.gov/fish.html (2013)

Fish tested in tributaries of the Yuba River were among the highest in mercury in a statewide survey completed by the SWRCB's Surface Water Ambient Monitoring Program.[6] The findings from the most comprehensive survey of fish in the Yuba and Bear watersheds found that fish tissue levels meet and exceed California EPA (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) and Food and Drug Administration (FDA) levels (0.3ppm mercury in fish tissue):[7]

- Englebright Reservoir: all smallmouth and spotted bass that were >1 foot and >250 grams (1/2 lb) had levels >0.3 ppm; and
- Camp Far West: all spotted and largemouth bass and channel catfish >1 foot and >300 grams had levels >0.5 ppm, half of the spotted bass exceeded FDA level of 1.0 ppm.

In the summer of 2013, the State of California released comprehensive safe-eating guidelines for fish from all California's lakes and reservoirs that do not have location-specific guidelines issued. This means that there is now information available for any lake fished in the Sierra.

8.2.3 Water Quality Based on FERC Relicensing Studies

YCWA is currently conducting water quality studies and analyses as part of FERC relicensing efforts for its Yuba River Development Project (FERC No. 2246). The data collected as part of relicensing provides substantive detail on baseline water quality conditions, and associated ongoing water quality monitoring further increases the accuracy and specificity of the baseline data. As described below, the extraordinary research, data, and analyses have contributed significantly to understanding of water quality conditions within the Yuba River. Relicensing studies and analyses were recently completed for two additional hydroelectric projects in the upper reaches of the Yuba River: Drum-Spaulding Hydroelectric Project[8] and the Yuba-Bear Hydroelectric Project.[9]

Yuba's 2010 IRWMP planning grant application identified the studies conducted for relicensing as particularly relevant due to their focus on three of Yuba's primary issues: water quality, fish survival, and mercury levels and abatement.

8.2.4 Groundwater Quality, Imported Water Quality, and Water Quality from Storage Facilities

8.2.4.1 Groundwater Quality

Groundwater quality data have been collected in the Yuba County IRWMP region since 1965 in selected wells from both subbasins. In 2006, an extensive study of groundwater quality in the Middle Sacramento Valley was conducted by the US Geological Survey (USGS), as part of the California Groundwater Ambient Monitoring and Assessment (GAMA) program. The GAMA Priority Basin Assessment project

[6] Davis et al. , State Water Resources Control Board, Surface Water Monitoring Program (2010). http://www.waterboards.ca.gov/water_issues/programs/swamp/

[7] May et al. (1999). http://www.fda.gov/Food/FoodborneIllnessContaminants/ChemicalContaminants/ucm194482.htm

[8] PG&E, Draft Environmental Impact Statement for the Drum-Spaulding Project (P-2310-173) and Yuba-Bear Hydroelectric Project (P-2266-096) (2013). http://www.ferc.gov/industries/hydropower/enviro/eis/2013/05-17-13.asp

[9] Nevada Irrigation District, Draft Environmental Impact Statement for the Drum-Spaulding Project (P-2310-173) and Yuba-Bear Hydroelectric Project (P-2266-096) 2013. http://www.ferc.gov/industries/hydropower/enviro/eis/2013/05-17-13.asp

was developed in response to the Groundwater Quality Monitoring Act of 2001 and was conducted in cooperation with the SWRCB.

Samples were collected from 108 wells in Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba Counties. The groundwater samples were analyzed for a large number of synthetic organic constituents (volatile organic compounds [VOCs], gasoline oxygenates and degradates, pesticides and pesticide degradates, and pharmaceutical compounds), constituents of special interest, inorganic constituents (nutrients, major and minor ions, and trace elements), radioactive constituents, and microbial indicators. Most constituents that were detected in groundwater samples were found at concentrations below drinking-water thresholds. VOCs were detected in less than one-third, pesticides and pesticide degradates in just over one-half of the grid wells, and detections of these constituents from all wells of the Middle Sacramento Valley study unit were below health-based thresholds. All detections of trace elements in samples from Middle Sacramento Valley grid wells were below health-based thresholds, with the exceptions of arsenic and boron.

Arsenic was detected at concentrations greater than the regulatory MCL benchmark of 10 micrograms per liter in 22 percent of the primary aquifers in the Middle Sacramento Valley study unit, a higher proportion than what was observed in the Southern or Northern Sacramento Valley study units. High concentrations of arsenic were found in wells located along the Sacramento and Feather Rivers, likely because geochemical conditions in the sediments favor arsenic solubility. These trace and minor elements naturally occur in the region.[10]

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, or blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water served to the consumer, not to raw groundwater. However, to provide some context for the results, concentrations of constituents measured in the raw groundwater were compared with health-based thresholds established by the US EPA and CDPH, and thresholds established for aesthetic concerns (secondary MCLs) by CDPH.

8.2.4.2 Imported Water

No water is imported to the Yuba County IRWMP region from outside basins, although California relies on water exported from the Yuba watersheds. There are some interbasin transfers within the Yuba County IRWMP region, discussed in Chapter 7 *Water Supply*.

8.2.4.3 Water from Storage Facilities

Upper elevation reservoirs in the Yuba County IRWMP region are used for consumptive, irrigation, hydroelectric generation, environmental/beneficial uses, and recreation. Water quality in these storage reservoirs is considered good. The network of water supply and distribution is developed and maintained by various agencies including YCWA, PG&E, Nevada Irrigation District, Feather River Water and Power Authority, North Yuba Water District, and other smaller irrigation districts. Presently there are no known threats to water quality in the existing storage systems; however, as discussed above, there are a number of water bodies in the Plan area classified as impaired because they are unable to support certain designated beneficial ecosystem functions.

[10] US Geological Survey and California State Water Resources Control Board, Groundwater Quality in the Middle Sacramento Valley, California 2011 Fact Sheet by George L. Bennett, V, Miranda S. Fram, and Kenneth Belitz (2011).

8.2.5 Wastewater and Recycled Water Quality

Beale Air Force Base Wastewater Treatment Plant is a secondary bio-filtration process that treats an average of 330,000 gallons per day. Beale AFB no longer has a National Pollutant Discharge Elimination System permit for surface water discharge, and the effluent discharges via land to either the Base's 120-acre golf course, or its two irrigation fields. Beale AFB uses secondary-23 disinfected recycled water to irrigate the Base's golf course. The golf course is operated as a restricted-access golf course and historical irrigation demand is about 100 million gallons per year.

The City of Wheatland and Olivehurst Public Utility District (PUD) are interested in exploring the development of recycled water facilities, but they would require additional support staff and funding in order to determine if recycled water is a viable option.

8.3 Regulatory Compliance

8.3.1 Discharge and Basin Management Objectives

The Basin Plan water quality objectives for Yuba County IRWMP region beneficial uses establish the criteria for several water quality parameters. Both inland surface water and groundwater objectives are provided in Section 8.1.1. Beale AFB is currently treating several plumes from underground storage tanks. However, overall the water quality data collected for both surface and groundwater indicates the region is compliant with Basin Plan objectives.

8.3.2 Drinking Water Standards

The Yuba County IRWMP region sources for drinking water meet or exceed the CDPH MCLs.

8.3.3 Yuba County Groundwater Management Plan (2010) Goals and Objectives

The YCWA Groundwater Management Plan (GMP) states, "the goal of the YCWA GMP is to maintain a viable groundwater resource for the beneficial use of the people of Yuba County." The goals, objectives, and projects set forth in this IRWMP help promote the viability and maintenance of groundwater quality throughout the region.

8.4 Water Quality Protection and Improvement Needs in the Yuba County IRWMP Region

Sediment, mercury, bacterial contamination, water temperature, and prevention of aquatic invasive species are all areas of focus to ensure continued high-quality water in the Yuba County IRWMP region now and into the future. The following sections discuss these issues in further detail.

8.4.1 Future Water Quality Conditions

Population in the Yuba County IRWMP region is projected to increase over the next three decades by nearly twofold (see Chapter 7 *Water Supply* and Chapter 10 *Water and Land Use Planning*). Increased development can impact water quality both from a greater level of disturbance and general traffic, and from runoff from constructed surfaces and roads. Moreover, if the climate dries, as projected, less water will be available for dilution of pollutants and maintaining lower water temperatures, which could, in turn, increase the number of impaired water bodies. The Yuba County IRWMP region stakeholders are interested in programs that consider the link between natural resource management and protection of the region's water quality.

On the other hand, water quality concerns related to mercury should subside somewhat due to the state's new mercury control policy. Likewise, quality of agricultural return waters may improve from implementation of the ILRP.

8.4.2 Water Quality Monitoring

Current water quality monitoring activities in the Yuba County IRWMP region are conducted by DWR, local jurisdictions (e.g., water agencies, county environmental health departments), local watershed groups, conservation groups, and RCDs. The purpose and scope of these monitoring activities varies within watersheds and across the region. Governmental agencies are required to collect water quality information associated with a host of operational activities (e.g., raw water, treated water, wastewater discharge, FERC license requirements). These activities are conducted using strict protocols, and incorporate rigorous quality control and quality assurance standards.

Extensive water quality monitoring is currently performed by water purveyors in the Yuba County IRWMP region, as required by state and federal law and the FERC relicensing processes. As guided by regulations and permits, source waters, treated water, and areas near land use activities are periodically analyzed for pH, water and air temperature, dissolved oxygen, conductivity, turbidity, as well as bacterial constituents, inorganic chemical constituents, general chemical parameters, and organic chemicals, metals, and pesticides. Additionally, water purveyors are required to produce water quality reports to regulatory agencies at regular intervals. This information is available to the public as well as shared with stakeholder groups such as the Yuba RWMG.

Agricultural stakeholders in the Yuba County IRWMP region created water quality coalitions as a response to the Central Valley RWQCB's removal of an exemption for agricultural discharge in 2003. At that time, under the ILRP, the Placer/Nevada/South Sutter/North Sacramento Water Quality Coalition was formed. This coalition has spent over $1 million generated by landowner fees to perform monitoring activities and to report the analysis annually to the applicable water quality control board. The ILRP requires these agricultural coalitions to monitor discharges for legacy contaminants, metals, pesticides, and many other parameters. The areas in the Yuba County IRWMP region were found to be low-threat areas with zero exceedances found since 2003.[11, 12]

[11] Sacramento Valley Water Quality Coalition. 2011 Annual Report.
[12] Cosumnes, American, Bear Yuba, Integrated Regional Water Management Plan (2013).

8.4.3 Sedimentation and Erosion

Although sediment is a natural component of all river systems, it can present challenges to watershed management. Sedimentation can cause reduction in reservoir capacities and increased water treatment costs, and can adversely impact aquatic biota and habitat. Sedimentation is a natural process, but human activity has accelerated that process in some areas within the Yuba County IRWMP region. In general, sedimentation is increased when soil cover is reduced or eliminated. Historic mining activities, especially dredgers, created conditions where mercury-laden sediment continues to move within watersheds. High intensity forest wildfires and lack of management post-fire can result in landslides and accelerated erosion and sedimentation.

Some levels of erosion and sediment deposition are important for riverine processes, including providing substrate for spawning, and sediment for streambank and floodplain development. Active watershed stewardship is necessary to prevent sedimentation in the region from becoming problematic. Excessive sediment deposition moving through the riverine system into storage reservoirs can create high levels of turbidity, stress aquatic organisms, and reduce reservoir capacity.

8.4.3.1 Studies and Findings by Drainage

Yuba Watershed

Historic hydraulic mining involved directing high-pressure water cannons at exposures of Eocene gravel and washing the excavated sediment slurry through mercury-laden sluice boxes. Hydraulic mine tailings were conveyed into adjacent watercourses, leading to dramatic increases in sediment loads and severe aggradation. Gilbert (1917) estimated that hydraulic mining contributed approximately 682 million cubic yards of sediment to Yuba River channels. Extensive remobilization of stored hydraulic-mining sediment began as early as 1861 when severe winter storms delivered substantial volumes of sediment to the Central Valley.[13]

In 1941, the California Debris Commission built Englebright Dam to trap hydraulic-mining sediment mobilized in the Upper Yuba River watershed. The majority of the Middle Yuba River and South Yuba River channels have since recovered their pre-mining bed elevations; however, significant volumes of hydraulic-mining sediment remain stored in wide mainstem reaches and in smaller upland tributaries of these two rivers. Studies of the Yuba River and adjacent watersheds suggest that these smaller tributaries are asymptotically incising toward pre-mining channel-bed elevations; therefore, re-mobilization of hydraulic-mining sediment continues to affect sediment yields from impacted basins and contributes to lost water storage space in reservoirs.[14]

The Upper Yuba is considered a “priority watershed” for action by the state under the California Unified Watershed Assessment, due to impaired water quality. Yuba is a Category I watershed, which means it is a candidate for increased restoration activities due to impaired water quality or other impaired natural resource goals (emphasis on aquatic systems).[15] The high concentrations of suspended sediment in the

[13] James, A. Sustained storage and transport of hydraulic gold mining sediment in the Bear River. http://www.tandfonline.com/doi/abs/10.1111/j.1467-8306.1989.tb00277.x?journalCode=raag20#preview

[14] Curtis, J.A., L.E. Flint, C.N. Alpers, S.A. Wright, and N.P. Snyder, Sediment transport in the Upper Yuba River Watershed, California (2001–03), *US Geological Survey Scientific Investigations Report 2005-5246* (2006): http://pubs.usgs.gov/sir/2005/5246/.

[15] www.epa.gov/unified watershed assessment. (As reviewed September 3, 2014).

Humbug Creek watershed can be attributed to abandoned mines in the Malakoff Diggings Historical State Park, and clear-cuts on private lands.[16] Sediment loads in the Yuba watershed can also be attributed to other human activities such as past road construction associated with rural housing development, timber harvesting, and recreation.

Bear Watershed

The Bear River contains a large volume of mining sediment largely from two tributaries, Greenhorn and Steephollow Creeks. Sediment is stored in its main channel where three storage reservoirs are present. Due to its low-elevation headwaters (5,000 feet elevation), relatively low average annual discharge (around 273,000 af), and protracted sediment releases from water storage reservoirs, this sediment has not been flushed but continues to be a potential problem for fish habitat in the river.[17] The storage reservoirs have an infill of sediment which continues to increase in depth and reduce the storage capacity. In addition to sediment, the Bear River is a 303(d)-listed water body for mercury due to legacy mining practices. This high volume of mining sediment, in combination with restricting levees, has caused the Lower Bear channel to become deeply incised.[18] Additionally, the Bear River channel has not returned to pre-mining levels due to two main factors: 1) as mentioned, the Bear River headwaters are at relatively low elevations, resulting in discharges of low-to-moderate magnitude; and 2) hydraulic-mining sediment was of much larger magnitude than in other local watersheds.[19]

8.4.4 Mercury Methylation

The following section is based largely on information included in the CABY IRWMP 2014. As described in Chapter 6 *Region Description*, the two regions overlap in the upper watershed, and the following discussion concerning mercury is directly relevant to both.

Mercury contamination and attendant mercury methylation is a pervasive issue in the Yuba and Bear River watersheds.[20] Moreover, management and restoration of the Bay-Delta ecosystem is complicated by mercury contamination from historic mining sites in the Sacramento and San Joaquin River watersheds, the principal sources of fresh water for the Bay-Delta system. Mercury-laden sediment now contaminates downstream reaches of streams and rivers. A challenge to scientists and managers involved with restoration of this ecosystem is to avoid increasing exposure of biota to methylmercury, a toxic form of mercury. The methylation of mercury makes the pollutant “bio-available” and, if consumed, a neurotoxin. Methylmercury readily accumulates in organisms and biomagnifies (concentrates) in fish and wildlife at the top of aquatic food webs. Documented consequences of methylmercury pollution and consequent dietary exposure include: 1) direct adverse effects on the health of fish, wildlife, and humans; 2) contamination of fisheries resources that diminishes their nutritional, cultural, socioeconomic, and recreational benefits; and 3) socio-cultural damage to indigenous peoples who fish for subsistence.

[16] Schilling, F., State of the Yuba: an assessment of the Yuba River watershed, Nevada City: University of California (n.d.).

[17] James, L.A., Historical transport and storage of hydraulic mining sediment in the Bear River, California: A study of the timing, volume and character of hydraulic mining sediment production and channel responses to the sediment as well as present conditions, South Carolina Water Conference, University of South Carolina (1988).

[18] Eberhart, Allan, White Paper: Bear River Watershed Assessment, (2006): http://motherlode.sierraclub.org/4-BearRiver.htm.

[19] Ibid, James, L. A.

[20] Alpers, C.N., M.P. Hunerlach, J.T. May, R.L. Hothem, H.E. Taylor, R.C. Antweiler, J.F. De Wild, and D.A. Lawler (2005). Geochemical characterization of water, sediment, and biota affected by mercury contamination and acidic drainage from historical gold mining, Greenhorn Creek, Nevada County, California, 1999–2001. In *US Geological Survey Scientific Investigations Report 2004-5251, 278 p*. from http://pubs.usgs.gov/sir/2004/5251/

From 1900 to 1960, several billion cubic meters of alluvial material was dredged for gold, and millions of pounds of mercury was discharged. These alluvial "dredge fields" are generally downstream from dams on the major tributaries, including the Yuba and Bear Rivers, and are situated in floodplains that provide critical habitat to anadromous fish. Many of the dredge fields contain mercury-contaminated tailings from hydraulic-mining activities that took place further upstream before dams were constructed. Additional mercury was released in association with dredging processes at these alluvial sites. The release of mercury from gold mines in the Sierra, and the form of mercury in those mines has not been extensively studied; however, initial observations indicate that it may be more readily methylated. Elemental mercury and gold-mercury amalgam are often visible in streams draining hydraulically mined areas of the Sierra Nevada and in the dredged gold fields downstream, such as those on the Yuba River. Data concerning mercury and methylmercury in water, sediment, and biota from sites in the Bear River watershed are available online.[21, 22]

The USGS estimates that up to 8,000,000 of the 26,000,000 pounds of mercury used in the Sierra Nevada may have been "lost" during gold recovery, including during hydraulic mining. The mercury is present in the bottom of rivers and reservoirs, as well as in pits, sluices, and tunnels remaining in abandoned mine lands where it can be mobilized. It is transported by erosion and runoff as elemental mercury, in ionic form (i.e., Hg^{2+}), in dissolved form, adsorbed to particles, and as droplets of the metal.

8.4.4.1 Studies and Findings of Non-listed Sites

The following discussion is focused on watershed-level studies outside the 303(d)-listed sites.

The Nevada County RCD commissioned mercury studies through the USGS in 2001-2003 to track levels of mercury in fish on the Bear River. One of the findings is that "fish from reservoirs and streams in the Bear-Yuba watersheds [. . .] have bioaccumulated sufficient mercury to pose a risk to human health."[23] For example, Camp Far West has a "do not eat fish advisory" for bass and catfish (see http://oehha.ca.gov/fish/so_cal/campfarwest.html).

The USGS and others are conducting measurements of mercury and methylmercury in the biota, sediments, and waters in reservoirs and near/within abandoned mine lands of the Yuba and Bear systems. Currently, there are no direct measurements being conducted for the atmospheric deposition of mercury; however, mercury can originate from the atmosphere and this form of mercury can become bioavailable. Only a few measurements exist for the waters and sediments of the Upper Bear and Yuba Rivers and their tributaries. Though research is limited, it is known that mercury is leaking gradually from abandoned mine tunnels, sluice boxes, and pits. Dredge tailings are thought to be a potential hotspot, as is sediment disturbance during secondary mining near abandoned mine features, or in contaminated sediments. Mercury is assumed to be slowly migrating downstream in the creeks and rivers, temporarily lodging in the benthic sediments and pockets in the channel bedrock.[24]

[21] USGS, Bear-Yuba Watersheds Interagency Abandoned Mine Lands Project Bear-Yuba Watersheds Interagency Abandoned Mine Lands Project (2011). http://ca.water.usgs.gov/mercury/bear-yuba/

[22] J.G. Wiener, C.C. Gilmore, and D.P. Krabbenhoft, Mercury strategy for the Bay-Delta Ecosystem: a unifying framework for science, adaptive management, and ecological restoration. La Crosse, Wisconsin: University of Wisconsin (2003).

[23] Alpers, C.N., M.P. Hunerlach, J.T. May, and R.L. Hothem, Mercury Contamination from Historical Gold Mining in California, Fact Sheet #: 2005-3014 Version 1.1. US Geological Society, Sacramento, CA (2005): http://pubs.usgs.gov/fs/2005/3014/fs2005_3014_v1.1.pdf

[24] F. Schilling (n.d.), State of the Yuba: an assessment of the Yuba River watershed (Nevada City: University of California, Year to come).

8.4.5 Other Contamination

Non-sediment, non-mercury contaminants in the Yuba County IRWMP region potentially include microbes and biological contamination. Possible sources of these pollutants can include recreation, agricultural discharges and practices, stream and bank alterations, illegal dumping, timber harvest, and wildlife.[25]

Increasing development and the conversion of lands to impervious surfaces can also result in pollutant spikes during storm events.[26] Extreme runoff from urban areas results in unnatural flow surges and carries hydrocarbons, bacteria, lawn chemicals, and a host of other pollutants to the river systems.

8.4.5.1 Studies and Findings on Other Contaminants

Identifying sources and management strategies regarding biological contamination requires more research, especially as recreational use increases. Recently the Tahoe National Forest conducted environmental analyses to determine the effects of motorized vehicle use on National Forest System lands, and they developed guidelines for that use.[27, 28] Creating public awareness and providing education for land use best management practices can help prevent biological contamination.

8.4.6 Water Temperature

The following section is based in part on information included in the CABY IRWMP. As described in Chapter 6 *Region Description*, the two regions overlap in the upper watershed and some of the following general discussion concerning temperature holds true for both regions. The more specific information is based on relicensing data from the Yuba Development Project.[29]

Water temperature is an important water quality parameter in the Yuba County IRWMP region. Water temperatures can affect aquatic ecosystems by altering the water's ability to hold essential and beneficial dissolved gases (such as oxygen) in solution, as well as affecting mercury methylation, as mentioned above, and the hospitability of the water body to exotic species such as invasive mussels. Water temperatures may be influenced by dams, releases of surface water from reservoirs, water diversions and in-stream flows, riparian canopy, and could be affected by alterations of temperature and precipitation associated with climate change.

8.4.6.1 Studies and Findings on Temperature

In California, the timing and amounts of water released from reservoirs and diverted from streams are legally regulated with consideration of their effects on various native aquatic species, especially those listed as threatened or endangered under the Federal and California Endangered Species Acts, and

[25] Black & Veatch Corporation and Standish-Lee Consultants, Watershed sanitary survey update and source water assessment, Sacramento, CA, Black & Veatch Corporation (2002).

[26] Schmitt, J. and A. Michael, Rainfall infiltration under urban soil surface conditions – experiment and model results, 13th Annual Soil Conservation Organization Conference: Conserving Soil and Water for Society: Sharing Solutions (Brisbane: July 2004).

[27] Eldorado National Forest, Motorized Vehicle Use EIS (2008).

[28] Tahoe National Forest, Motorized Vehicle Use EIS (2010).

[29] Yuba County Water Agency, Relicensing Studies (2009). http://www.ycwa-relicensing.com/FERCApproved%20Studies/Forms/AllItems.aspx

additional designated species of regulatory concern. These include winter-run and spring-run Chinook salmon, Coho salmon, coastal and Central Valley forms of steelhead, and rainbow trout. Conversely, some amphibians require a different water temperature than those identified as ideal for salmon and steelhead. California constitutes the warm, southern end of the geographic range of most of these species. By 2100, climate change is expected to cause a considerable rise in average air temperature, raise water temperatures, greatly reduce snowpack volume, and shift the seasonal pattern of surface-water runoff to more in winter and less in spring and summer. These physical changes are likely to influence water temperatures and thus the ecology of aquatic life in the region. In many low- and middle-elevation California streams today, summer temperatures often come close to the upper tolerance limits for cold-water species, such as salmon and trout. Thus, anticipated climate change effects may be enough to raise water temperatures above the tolerance limits for salmon and trout in many streams, favoring instead non-native fishes such as carp and sunfish.[30] Chinook salmon and steelhead, for example, prefer temperatures of less than 68°F in mountain streams, although they may tolerate higher temperatures for short periods.[31]

On the South and Middle Yuba Rivers, low flows, high water temperatures, and sediment have contributed to problems for the cold-water adapted aquatic communities.[32] [33] SYRCL has over 20 temperature loggers established and takes monthly samples at 35 locations in the Yuba watershed. Additional samples are being collected by Sierra Streams Institute, Wolf Creek, and others. During spring and summer storm events, when water spills from the top of reservoirs in the Yuba River watershed, water temperatures have been shown to increase immediately downstream. Maps regarding temperature modeling along the Yuba River, completed by YCWA for its FERC relicensing process, are available in a final, and updated, report.[34] The maps completed as part of this data collection and reporting display the changes this hydropower system has had on lowering average summer temperatures due to reservoir releases. Reservoir operations can change the habitat suitability for endemic species in the area and are therefore considered in project management and licensing.

8.4.7 Aquatic Invasive Species

Aquatic invasive species (AIS) include water hyacinth and hydrilla, the bullfrog, New Zealand mudsnail, rock snot, giant reed, perennial pepperweed, parrotfeather, Eurasian watermilfoil, Brazilian waterweed, wild turkey, blue gill, crappie, yellow perch, largemouth bass, smallmouth bass, and striped bass. Additional invasion from quagga mussels, Asian clam, and other exotic species is anticipated without extreme vigilance from aquatic managers and the public. Threats from aquatic invasives are particularly insidious because of the interconnections between stream systems, and thus the ability for invasives to spread quickly.

[30] California Department of Water Resources, Progress on Incorporating Climate Change into Planning and Management of California's Water Resources; Technical Memorandum Report. Sacramento, CA, DWR (2006).
[31] Moyle, Inland fishes of California. Merced, CA, University of California Press (2002).
[32] Schilling, F., State of the Yuba: an assessment of the Yuba River watershed. Nevada City, CA, University of California (n.d.).
[33] Upper Yuba River Studies Program Study Team, for DWR, Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment (June 2006).
[34] YCWA. 2009. Relicensing Studies. http://www.ycwa-relicensing.com/FERCApproved%20Studies/Forms/AllItems.aspx

8.4.7.1 Studies and Findings on Invasive Species

AIS in the Yuba County IRWMP region

Parrotfeather milfoil (Myriophyllum aquaticum) is present in the lower Yuba[35] and water hyacinth and hydrilla remain persistent problems in certain areas.

AIS in California and Adjacent Watersheds

Hundreds of AIS have found their way into California waters via transoceanic ships, aquaculture, the aquarium trade, the bait industry, recreational activities, biological research, environmental restoration projects, and through freshwater deliveries up and down the state. Nationwide, non-native species have contributed to 68 percent of the fish extinctions in the past 100 years and the decline of 70 percent of the fish species listed under the Federal Endangered Species Act.[36]

8.4.8 Wildfire and Water Quality

Up to two-thirds of Yuba County is exposed to increased fire risk from May through October annually. Increased fire frequency and intensity can impact vegetative species composition, especially the size and extent of old-growth forest habitat and related fauna; threaten critical facilities located in fire-prone areas; and increase chances for human and economic loss due to development in fire-prone areas. Reservoir water quality could also be adversely affected by increased erosion post-fire.[37]

[35] South Yuba River Citizen's League, pers. comm. (2014).
[36] Wilcove, et al., Quantifying threats to imperiled species in the United States (1998).
[37] Matyac, Scott, pers. comm. with Karen Quidachay (December 2013).