RECLAMATION

Managing Water in the West

Draft Environmental Assessment

Controlling Quagga Mussels in the Cooling Water System at Davis Dam Using Zequanox^{TM} (MOI-401)
Laughlin, Nevada and Bullhead City, Arizona

U.S. Department of the Interior
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada

April 2011

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Laughlin, Nevada and Bullhead City, Arizona

Prepared by:

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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List of Acronyms

Term	Acronym or Abbreviation
Arizona Department of Environmental Quality	ADEQ
Arizona Game and Fish Department	AGFD
Biological Assessment	BA
Biological Opinion	BO
Bureau of Land Management	BLM
Bureau of Reclamation	Reclamation
Corps of Engineers	Corps
Council on Environmental Quality	CEQ
Cooperative Research and Development Agreement	CRADA
Endangered Species Act	ESA
Environmental Assessment	EA
Environmental Protection Agency	EPA
Federal Insecticide, Fungicide, Rodenticide Act	FIFRA
Greenhouse Gas	GHG
Indian Trust Asset	ITA
Intergovernmental Panel on Climate Change	IPCC
Invasive Mussel	Refers to both Zebra and Quagga Mussels
Isolated Objects	IO
Lower Colorado River	LCR
Migratory Bird Treaty Act of 1918 as amended	MBTA
Multi-Species Conservation Program	MSCP
National Ambient Air Quality Standard	NAAQS
National Environmental Policy Act of 1969 as amended	NEPA
Pseudomonas fluorescens	*P. fluorescens*
Reasonable and Prudent Alternative	RPA
Recreational Vehicle	RV
River Miles	RM
Technical active grade ingredient	TGAI
Threatened and Endangered	T&E
U. S. Fish and Wildlife Service	FWS
cubic feet per second	cfs
Marrone Bio Innovations	MBI
Marrone Organic Innovations	MOI

1.0 Introduction

This Environmental Assessment (EA) was prepared in compliance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA. The purpose of this EA is to evaluate the potential impacts of the proposed project and its alternatives on the physical and human environment and determine if the impacts would be significant warranting the preparation of an Environmental Impact Statement.

The Bureau of Reclamation (Reclamation) is proposing to control quagga mussels (*Dreissena bugensis*) in the cooling water system at Davis Dam using the product Zequanox **™** (MOI-401). Zequanox **™** is composed of dead cells of a specific strain of bacteria, *Pseudomonas fluorescens* CL 145A (*P. fluorescens* CL 145A), which has been demonstrated to be effective in killing invasive zebra and quagga mussels. The proposed project would be conducted within the facility of Davis Dam. Davis Dam is located on the Arizona and Nevada border 2 miles north (upstream) of Bullhead City, Arizona and Laughlin, Nevada (Figure 1).

1.1 Background

General Mussel Background
The zebra mussel (*Dreissena polymorpha*) and the quagga mussel are invasive species which were introduced into North America from Europe in the 1980s. Zebra and quagga mussels are closely related and are often referred to collectively in discussions and research. They have negative impacts to both the economy and freshwater ecosystems with costs estimated in the billions to the economy as well as major negative impacts on freshwater ecosystems. Currently, only the quagga mussel has been identified in the Colorado River system. This EA includes some discussions that include both zebra and quagga mussels. In those discussions, zebra and quagga mussels will be referred to as invasive mussels.

Invasive mussels are able to rapidly colonize hard surfaces and grow up to approximately one inch in length. Ten to twenty thousand individuals may be found in a square meter. They firmly attach to underwater surfaces using byssal threads. General information and fact sheets on quagga mussels can be accessed at the US Geological Survey website at http://nas.er.usgs.gov/ queries/FactSheet.aspx?speciesID=95.

Quagga mussels were discovered in Lake Mead in 2007. Since then, quagga mussels have established strong populations throughout the lower Colorado River system, downstream from and including Lake Mead. This includes Lakes Mohave and Havasu, as well as dams, other facilities, and distribution systems originating from the Colorado River.

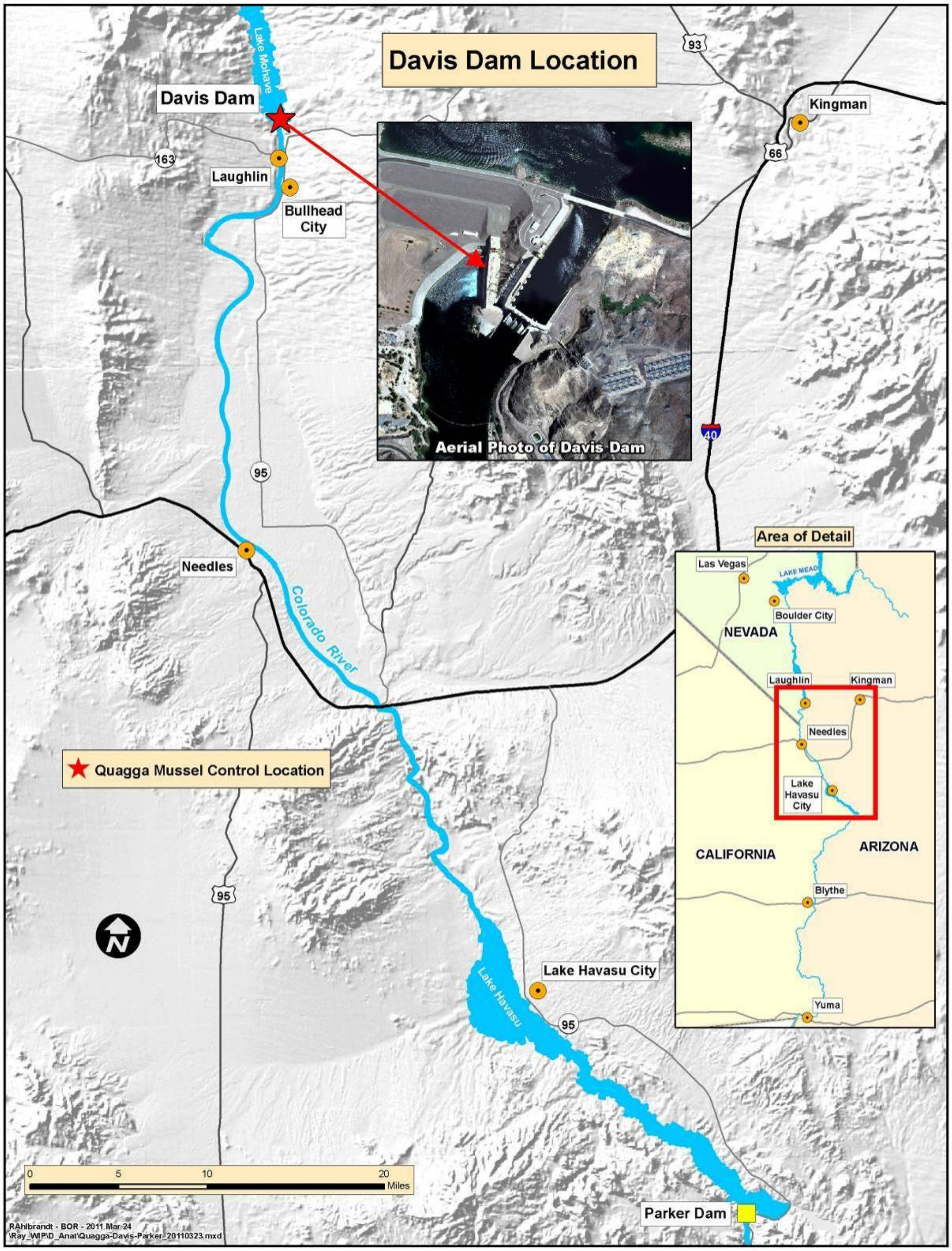

Figure 1. Davis Dam and Project Location Map.

Quagga mussels reproduce more often and grow faster in the Colorado River system compared to other areas in the United States. The Colorado River system is experiencing up to six breeding cycles per year, compared to up to two generations per year in the eastern United States. Water chemistry, abundance of food, and the warm water conditions within the Colorado River system are believed to be contributing to this previously unseen growth in quagga mussel populations.

Invasive mussels affect all submerged components, conduits and other structures such as trashracks, fish screens, raw water distribution systems for turbine cooling, fire suppression systems, water intakes (service, domestic, and irrigation), irrigation canals, gauging stations, weirs, gates, diffuser gratings, drains, and virtually all types of instrumentation in contact with raw water. It is often necessary to replace plugged equipment to avoid lengthy interruptions in operations.

Quagga mussels pose serious threats to Reclamation's infrastructure and operations and are impacting hydroelectric generation facilities at Hoover, Davis, and Parker Dams. Intake structures, pipes, and strainers are becoming clogged, reducing delivery capacities, pumping capabilities, and hydropower generation functions (Figure 2).

Figure 2. Pipe clogged with quagga mussels in a similar unit in Ontario, Canada.

Quagga mussel infestations are causing physical obstruction of water flow through hydroelectric cooling water systems. Flow obstruction from mussel settlement at Reclamation facilities has caused a significant increase in the frequency of high temperature alarms in cooling water systems, requiring unscheduled shut-downs for maintenance (see Figure 3). These impacts are increasing both in degree and frequency. Impacts from the mussels are expected to cause loss of function in power generation system components which could lead to failure of Reclamation's capability to maintain reliable power deliveries.

Zequanox™ Background

Reclamation has established an extensive program to address quagga mussel impacts on its lower Colorado River facilities. A wide range of treatment methods have been investigated, some of which are discussed in Section 2.3.

Figure 3. Dead invasive mussel debris in a cooling unit in Ontario, Canada similar to the cooling water system at Davis Dam.

In 2009, Reclamation entered into a Cooperative Research and Development Agreement (CRADA) with Marrone Bio Innovations, Inc. (MBI) to further develop and investigate the effectiveness of potential commercial formulations composed of *P. fluorescens* CL 145A bacterium. MBI is a research and development company that produces pest and disease management control products.

Zequanox™ is the trade name for the product being commercially developed by MBI for use as a quagga and zebra mussel pesticide; hereafter in this document, Zequanox™ will be referred to as Zequanox. The product is composed of *P. fluorescens* (Pf CL 145A), which have been killed. Zequanox contains natural compounds produced by *P. fluorescens* that, when ingested, destroy the invasive mussel's digestive system.

The Environmental Protection Agency (EPA) is the regulatory agency responsible for new pesticide product review and registration under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA). Section 18 of FIFRA authorizes EPA to allow states to use a pesticide for an unregistered use for a limited time if EPA determines that emergency conditions exist (EPA, 2011). Reclamation applied for and obtained a Section 18 Emergency exemption under FIFRA for the application of Zequanox. Under Section 18 a quarantine exemption is established, allowing the product to be applied to open water systems in accordance with the stipulations set forth by the EPA (see Appendix A). EPA is currently reviewing research on Zequanox for full product registration under Section 3 of FIFRA as a commercial molluscicide.

Successful closed system field trials have been performed by MBI using bioboxes which were fabricated and installed by Reclamation at Davis Dam (MBI 2009). These trials have shown that Zequanox treatments result in adult quagga mussel mortality rates greater than 90 percent (Dow, 2009). Other research has demonstrated that at lower doses the product is effective in treating juvenile mussel stages and preventing their settlement (see Appendix B; Section 18 Project File Docket ID number EPA–HQ–OPP–2009–0803-Appendix 2). Settlement prevention strategies are needed to protect the continued operation of dams and other facilities on the Colorado River.

1.2 Purpose and Need

The purpose of this action is to protect the cooling water system at Davis Dam through the removal of adult quagga mussels and prevention of future attachment of mussel larvae.
This action is needed at Davis Dam because quagga mussels are clogging intakes, cooling water lines, and associated equipment for the hydroelectric generating units. Davis Dam is an important hydroelectric facility, which is operated in concert with Hoover and Parker Dams to provide water and power on the lower Colorado River. Without corrective action, impacts from quagga mussels could reduce or stop cooling water from flowing to the power generating units. This could result in damage to or failure of components, loss of power generation capabilities, and extended outages for repairs. These impacts will significantly increase maintenance costs associated with Davis Dam.

Treatment of the cooling water system at Davis Dam will help to determine if Zequanox has the potential to be an effective invasive mussel control method that could be used to protect a wide range of facilities or waters that are threatened by quagga mussels.

1.3 Related Laws, Policies, and Planning Documents

In addition to fulfilling the requirements of NEPA, this EA will be used in compliance with all applicable environmental, natural resource, and cultural resource statutes, regulations, and guidelines. These additional statutes, regulations, and guidelines may require permits, approvals, consultations with outside agencies, or implementation of mitigation measures. These considerations are included in the analyses set in this EA. The additional statutes, regulations, and guidelines are listed below.

The following federal, state, and local statutes, regulations, management plans, and studies are relevant to the proposed project.

- National Environmental Policy Act of 1969 (42 USC 4321)
- Federal Insecticide, Fungicide, Rodenticide Act (P.L. 75-717)
- Environmental Planning Program Management Directive (MD; 02301).
- Clean Water Act (33 USC 1251 et esq.) Section 402
- Safe Drinking Water Act (42 USC 300f)
- Endangered Species Act of 1973 (P.L. 93-205)
- Indian Trust Responsibilities (512 DM Chapter 2)
- Executive Order 11514: Protection and Enhancement of Environmental Quality
- Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- Executive Order 13112: Invasive Species
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments
- Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661-667e) as amended

2.0 Description of Proposed Actions and Alternatives

This section of the EA provides a detailed description of the No Action Alternative, the Proposed Action Alternative, and the alternatives considered but eliminated.

2.1 The No Action Alternative

Under the No Action Alternative, Reclamation would not use Zequanox to control quagga mussels in the cooling water system at Davis Dam. Quagga mussels would continue to colonize the cooling water system at Davis Dam and impact powerplant operations and maintenance.

2.2 The Proposed Action Alternative

Reclamation is proposing to conduct cooling water system treatments to control quagga mussels at Davis Dam using Zequanox. This would be accomplished by injecting the product into the cooling water system.

Davis Dam is a zoned earthfill structure with a concrete spillway, intake structure, and powerplant. The powerplant, located on the Arizona side of the river, is immediately downstream from the dam embankment. There are five generators at Davis Dam with one cooling water system for each generator as shown in Figure 4.

Figure 4. Aerial photo of Davis Dam showing the 5 generators inside the red box.

Treatments would be applied to one generator that would be retrofitted with the treatment system. The treatments would be set up in two phases: the rehabilitation level treatment and the settlement maintenance level treatment. As specified in the Section 18 Permit, regardless of the treatment scenario employed, the concentration of the active ingredient during an application will not exceed 200 milligrams/liter (mg/L), continuously applied for no longer than 24 hours (hr) - not to exceed a combined (non-contiguous) total of 24-hrs per 4-week period. For comparison of the units used above, 1 million mg = 1L of water by weight, 1 mg/L = 1 part per million (ppm), and 1L = .26 gallons (gal).

Rehabilitation Level Treatment
The first phase is designed to treat adult quagga mussels that have accumulated in the cooling water system. This would be accomplished by treating the one designated generator for a 4-week period. Treatments would be applied to the designated generator until 80% mussel mortality is observed in the cooling water system. Each treatment would consist of injecting 200 mg/L continuously for up to 24 hr.

Settlement Maintenance Level Treatment
The second phase of the treatments would begin once greater than 80 percent mussel mortality is observed. Quagga mussel larvae settlement and growth would be controlled using pulsed doses of Zequanox. For this phase, a minimum of 10 mg/L would be applied into the cooling water systems for continuous durations of no more than 6 hr per day. Each 6-hr application would be repeated no more than 1 time per week, for a cumulative total of no more than 24-hrs of treatment within a 4-week period. This treatment would be applied to the designated generator.

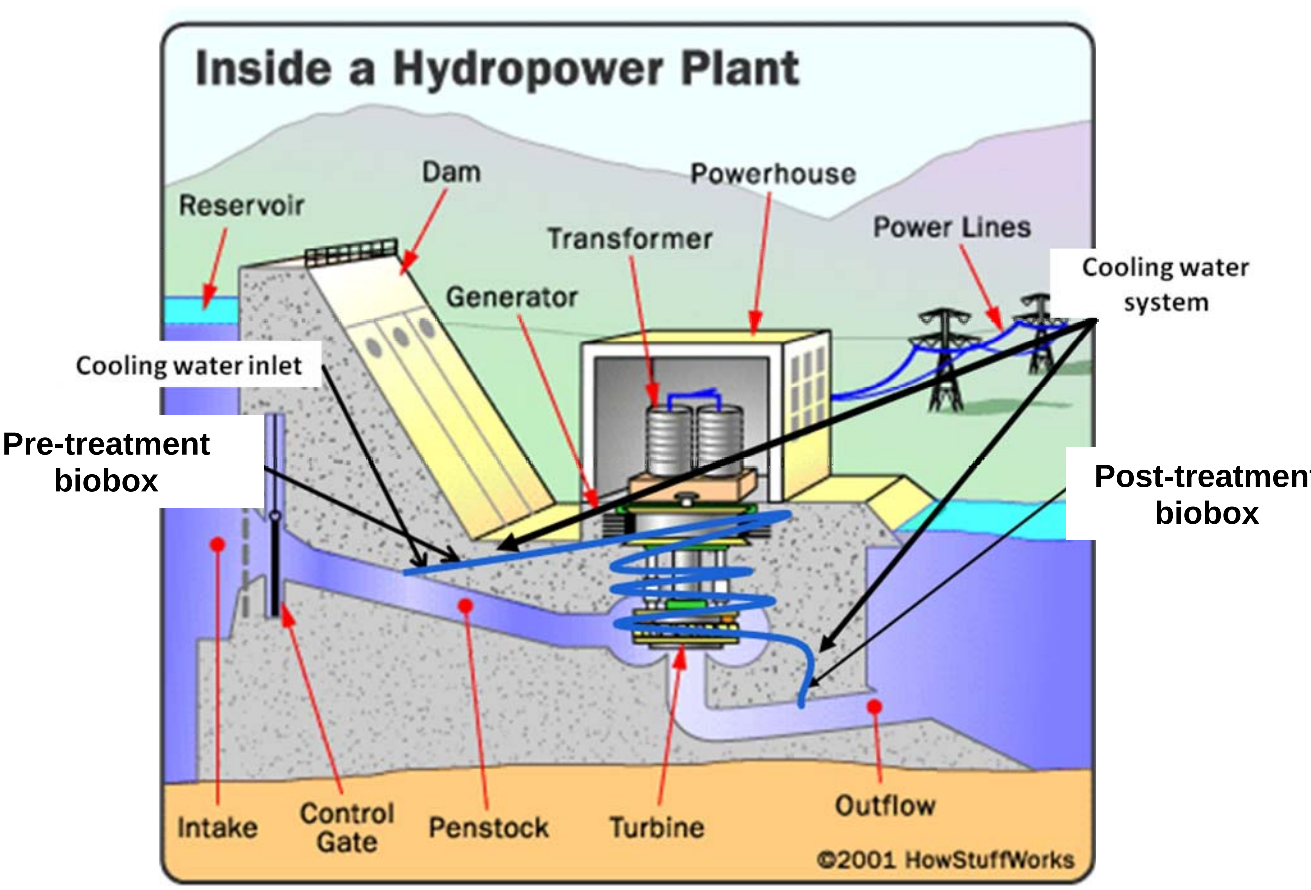

Figure 5. General Layout of a Hydropower plant showing the cooling water system and location of injection system.

Figure 5 is a drawing of a hydropower plant to illustrate where treatment would take place in the hydropower facility. The black arrows show the cooling water system and product injection site.

Zequanox would be applied at the cooling water inlet to treat as much of the cooling water system as possible. The treated water would be released to the outflow and mixed with water flowing out of the turbines. To verify the success of the treatments, bioboxes would be located at the inlet and the outlet of the cooling water system for pre and post treatment monitoring. Bioboxes will also be installed on an untreated cooling water system that will serve as a control unit to determine the overall effectiveness of the treatment. Only one unit would be retrofitted with the treatment system. More information on the proposed treatment evaluation methodology can be found in Appendix C.

The equipment necessary for product injection would include an injection port, a 55-gallon drum (or similar container) with secondary containment (plastic pallet), a flow meter for determining flow through the system, and a chemical injection pump mounted on the 55-gallon drum. The chemical injection systems and monitoring bioboxes would be situated to eliminate impact on all other dam activities, and to maximize safety. This equipment would be located in the power plant near the cooling water piping. These would be temporary and would not cause permanent alterations to existing structures. An injection port for product feed would be tapped into the basket strainer cover at the inlet of the cooling water systems (Figure 6).

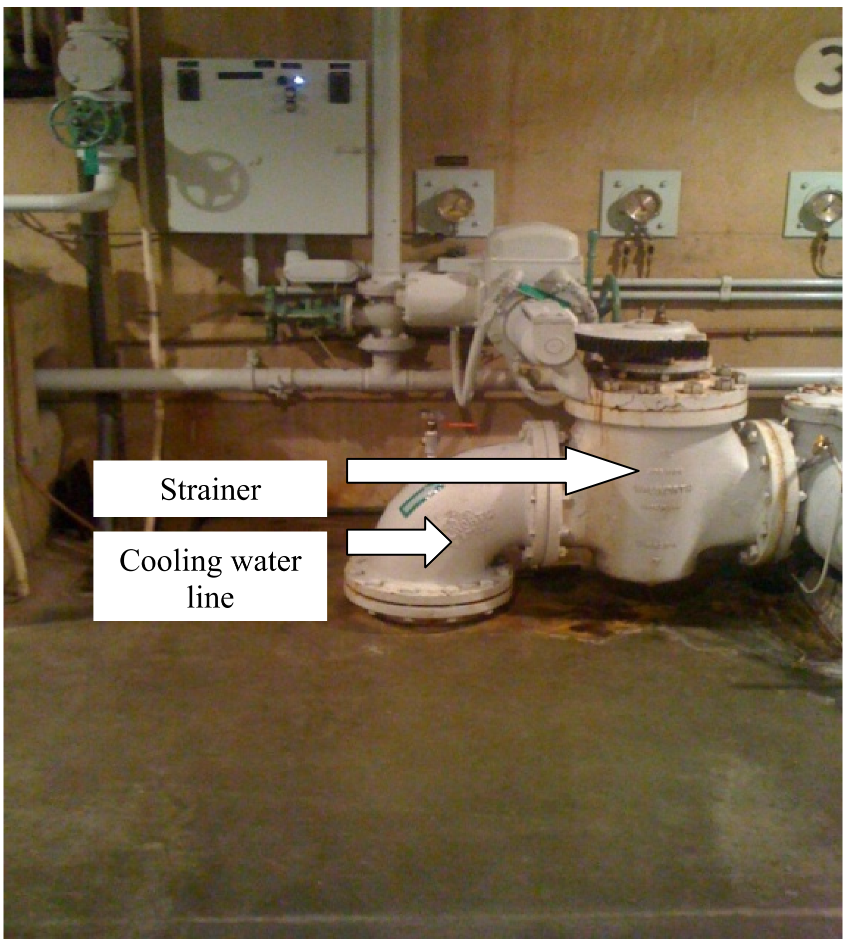

Figure 6. Davis Dam cooling water line with strainer basket site for product injection and monitoring bioboxes.

The proposed action would incorporate the following requirements and/or mitigation measures:

- All recommendations, stipulations, and conditions outlined in the FIFRA Section 18 permit must be met prior to, during, and after the implementation of the proposed project.

- A monitoring plan must be drafted and implemented to monitor for water quality properties, *P. fluorescens* levels, and quagga mussel larvae.

- All required permits under the Clean Water Act, FIFRA and other federal and state permits must be obtained prior to implementation of the proposed Project.

- All other formulations of the product other than the approved formulation identified in the FIRA Section 18 permit must be approved by the EPA under FIFRA Section 3 or Section 18.

- Any spilled MOI 401 EP or Zequanox will be disposed of in accordance with Material Safety Data Sheet (MSDS) (see Appendix E). There will be containment trays and absorbents available during applications.

2.3 Alternatives Considered but Eliminated from Detailed Analysis

Reclamation considered several alternative methods for control of quagga mussels. These methods, and the reasons for not considering them further in the EA, are given below.

Chemical Molluscicides
Available chemical molluscicides are designed to impact a broad range of organisms and could result in large-scale mortality of non-target species, including some threatened and endangered species. These compounds are acutely toxic to fish and other aquatic life, and the fate of these complex products in sediment is not well-documented (see Appendix B; Section 18 Project File Docket ID Number EPA–HQ–OPP–2009–0803 - Appendix 4). One of these methods, chlorination, has been employed as a temporary solution to the mussel problem at some eastern North American facilities. While effective for mussel control, chlorine has the additional risk of combining with organic compounds in open water systems, producing byproducts which are potentially carcinogenic.

Thermal Treatment
Reclamation considered thermal treatment but determined this method was most effective and practical for closed-loop cooling water systems. Davis Dam is a large volume, single pass system where thermal treatment would not be effective. Thermal treatment at Davis Dam would require excessive energy to heat the water to sufficient temperatures to kill the mussels. This would also be a warm water input that would alter the current thermal regime of the Colorado River. Due to the impractical nature of heat treatments to the proposed volume of water, thermal treatment has been eliminated from further analysis.

Water Jetting

Water jetting consists of running a high pressure water line with a jet nozzle through a pipe to dislodge attached mussels. This would be a regular or semi-regular maintenance activity that would create a flush of mussel debris in the system. While water jetting has limited application for temporary removal of mussels (as a reactive control strategy) in large diameter piping, it is not considered an option for powerplant cooling water systems which are intricate and comprised of small diameter piping, valves, and heat exchangers. Because of the time intensive nature of water jetting and the design of the cooling system at Davis Dam, water jetting to remove mussels would impose a large maintenance burden on Davis Dam and would not contribute for a long-term solution to quagga mussel infestation.

Other Technologies in the Research Phase

Other technologies such as filtration and ultraviolet treatment are currently being evaluated by Reclamation. The effects of these treatments have not been fully evaluated; therefore they are not considered as viable alternatives at this time.

3.0 Affected Environment and Environmental Consequences

The following section presents a list of the impact topics of the human and natural environment that may or may not be affected by the No Action Alternative and the Proposed Action Alternative (see Table 1). This section provides a description of the affected environment and the existing condition for the selected resource areas being reviewed and analyzed.

Table 1. Summary of Impact Topics.

Critical Element	Potential Effect		Critical Element	Potential Effect	
	Yes	No		Yes	No
Air Quality		X	Socioeconomic	X	
Water Quality	X		Human Health	X	
Cultural Resources		X	Environmental Justice		X
Biological Resources (T&E Species)	X		Indian Trust Assets	X	
Land Use and Recreation	X		Visual Resources		X
Noise		X	Floodplains		X
Sacred Sites		X			

Note: The table shows critical elements that may or may not be affected by the proposed action or alternatives.

This information will be used to describe and analyze the potential impacts of the no action and proposed action alternative described in Section 2 of this EA. Potential impacts are presented in the order in which the alternatives were discussed in Section 2 and are described for the specific resource areas listed below.

Lake Mohave will not be included in the impact analysis because Zequanox would be injected directly into the cooling water system of Davis Dam and would not enter the open water system of Lake Mohave.

Davis Dam

Davis Dam is a zoned earthfill structure with a concrete spillway, intake structure, and powerplant. The dam rises approximately 140 feet (ft) above the level of the Colorado River, has a crest length of 1,600 ft, and a top width of 50 ft. Reclamation owns and operates the dam, which was completed in 1951 (USDI 2006). The powerplant, located on the Arizona side of the river, is immediately downstream from the dam embankment. Lake Mohave is the reservoir formed by Davis Dam.

Releases from Davis Dam are scheduled on an hourly and daily basis, primarily to meet downstream water needs, although the hourly release pattern typically is determined to meet demand for power (Reclamation 2009). Releases can range from a maximum of 28,000 cubic feet per second (cfs; 793 cubic meters [m^3] per second [s]) to a minimum of approximately 1,000 cfs (29 m^3/s), the minimum flow needed to run one turbine at approximately half capacity. Such low flows are uncommon and usually associated with downstream flooding, construction, search and rescue, or other emergency conditions (USDI 2007).

Parker Dam

Parker Dam spans the Colorado River between Arizona and California 17 miles northeast of Parker, Arizona. Seventy-three percent of the dam's structural height of 320 ft is below the riverbed; only about 85 ft of it is visible (Reclamation, 2009). The crest is 856 ft long and 39.5 ft thick (Reclamation, 2009). Parker Dam's primary purpose is to provide reservoir storage from which water can be pumped into Metropolitan Water District of Southern California's (MWD) Colorado River Aqueduct and the Central Arizona Project (CAP) Aqueduct (see Figure 7). Lake Havasu, the reservoir behind Parker Dam, is about 45 miles long and covers nearly 20,390 acres (Reclamation, 2009). It can store 648,000 acre-feet (af) or nearly 211 billion gallons of water (Reclamation, 2009).

Designation of the Analysis Area

The Colorado River between Lake Powell and the Southerly International Boundaries of the US and Mexico is divided into reaches for Reclamation's purposes (Reclamation, 2004). The area between Davis Dam and Parker Dam is referred to as Reach 3.

Based on research, it has been determined that Zequanox degrades relatively quickly in well oxygenated bodies of water. Within a 24-hr time period the TGAI is no longer effective at treating invasive mussels and is considered biologically inactive (Malloy, 2009; see Appendix B; Section 18 Project File Docket-Appendix 10). The 24-hr decomposition time period for the TGAI was used to designate an area within Reach 3 as the analysis area for this EA. A maximum, average, and minimum flow scenario were used to determine the extent of flow of the Colorado River over a 24-hr period after its release from Davis Dam. The three scenarios are based on maximum, average, and minimum water releases out of Davis Dam during the time period of 2005-2010. The average March hourly and daily releases from 2009 were selected because they showed the greatest variation in flows. The scenarios are as follows:

1. Extremely high or maximum releases (5 hydroelectric generators operating for 24 hrs, an hourly and daily average flow of about 23,000 cfs)

2. An average March release pattern (varies from 1-5 hydroelectric generators operating throughout the day, daily average flow of about 14,600 cfs)

3. Extremely low or minimum releases (1 unit generating for 24 hrs, hourly and daily average flow of about 4,400 cfs)

Based on open channel flow calculations, estimated values for maximum, average, and minimum flows, the maximum distance water would travel from Davis Dam after 24 hours was calculated. During the high release (maximum) scenario, the distance is 63 miles, at the average release (average) scenario the distance is 62.6 miles, and at the low release (minimum) scenario the distance is 62 miles (see Figure 7). These parameters assume constant flow of water through Davis Dam for a 24-hr period. Evaporation and seepage were not taken in to consideration in the calculation. The average depth of Lake Havasu was assumed to be approximately 23 feet (seven

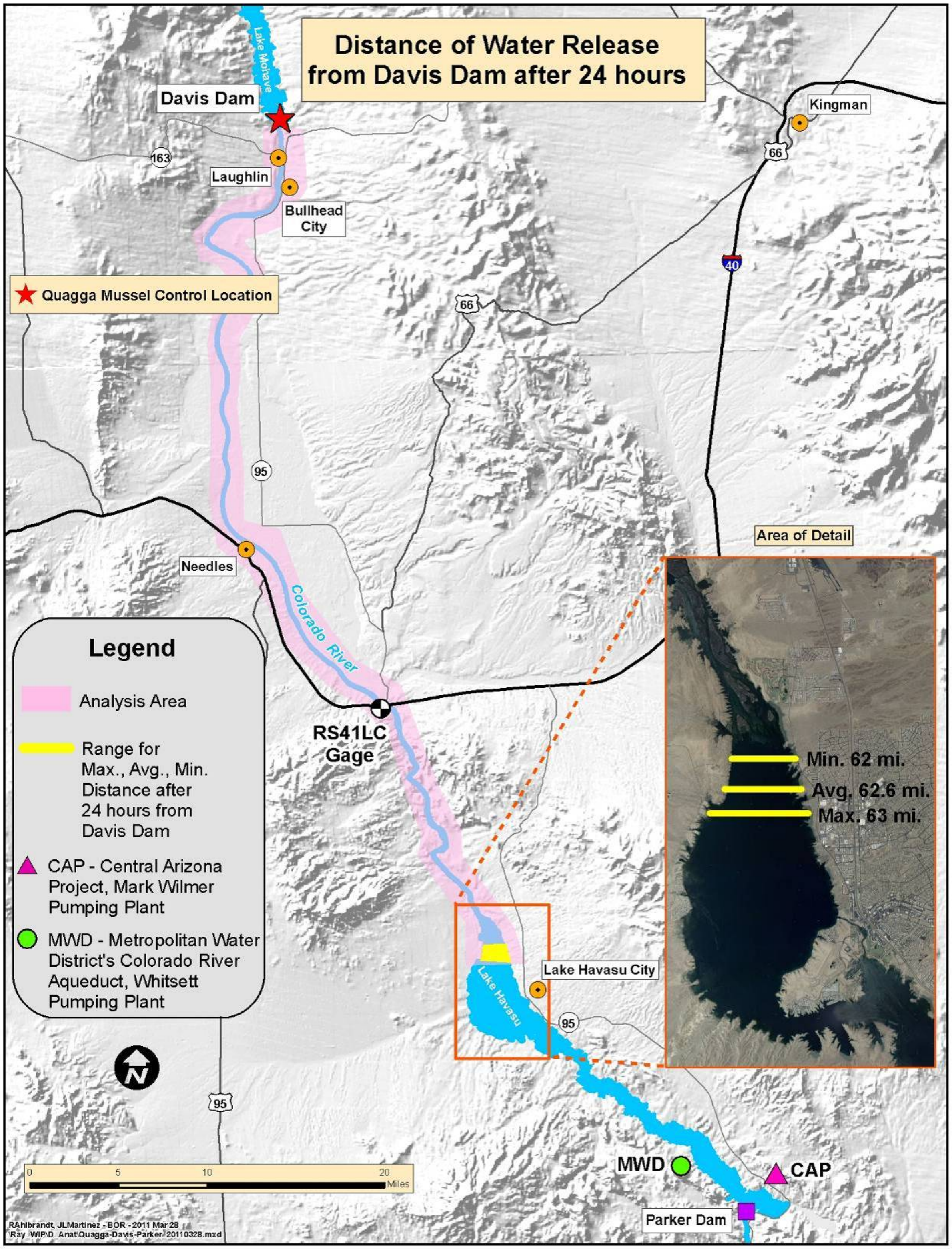

Figure 7. Estimated distance of water released from Davis Dam after 24 hrs.

meters). The residence time of water in Lake Havasu is approximately 14 days at maximum flow and 72 days at minimum flow (see Table 2).

The shaded areas shown in Figure 7 display the estimated range for the 24-hr decomposition period of Zequanox and sets the boundaries of the analysis area. Several communities are located within the analysis area including the cities of Laughlin, Nev., Needles, Calif,, and Bullhead City and Lake Havasu City in Arizona. The Fort Mojave and Chemehuevi Indian Reservations are also located within the analysis area. Other important features located within the analysis area are Topock Marsh and the Havasu National Wildlife Refuge (NWR), both managed by the U.S. Fish and Wildlife Service (FWS). Topock Marsh is located on the Arizona side of the Colorado River midway between Davis Dam and Parker Dam and is almost entirely within the Havasu NWR (Reclamation, 2011).

Table 2. Estimated 24-hr Release Parameters from Davis Dam

Scenario	Estimated Rate of Flow released from Davis Dam (cfs)	Estimated Time Traveled to River Gage RS41LC (hours)	Estimated Distance Traveled in 24-hours from Davis Dam (miles)	Estimated Residence time for water in Lake Havasu based on rate of flow released from Davis Dam (days)
Extreme High Releases or Maximum Flow	23,000	8	63	14.2
Average Releases	14,600	10	62.6	22.3
Extremely Low Releases or Minimum Flow	4,400	11-12	62	72

Note: These values are based on extremely high and low releases from Davis Dam taken from the hourly release data from 2005-2010. It is rare for Reclamation's River Operations Office to schedule the high and low hourly/daily releases. Open channel flow calculations are based on the theoretical values stated above and are estimates for the purposes of identifying the analysis area for this EA. The analysis area is based on the 24-hr decomposition period of Zequanox. No documented bathymetry was available for Reach 3 at the time of these calculations. (Source: Tighi, 2011 and Owen, 2011)

Impact Topics Removed from Further Analysis

The following topics were considered but are not further addressed in this document because they would not be impacted by the Proposed Action.

- **Air Quality** - The product would be stored in enclosed containers in a controlled environment and injected directly into the water system. There would be no releases into the air. There would be no impacts to air quality as a result of the proposed action.

- **Cultural Resources** – There would be no permanent alterations to the dam when installing equipment for the proposed action. There would be no impacts to any other cultural resources in the area as a result of the proposed action.

- **Noise** – There would be no increase in the amount of noise created by the dam facility from equipment associated with the cooling water subsystem treatment.

- **Sacred Sites** – There would be no impact to sacred sites from the proposed action.

- **Environmental Justice** – Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) directs federal agencies to determine whether their programs, policies, and activities have disproportionately high and adverse human health or environmental effects on minority and low-income populations. Zequanox would be directly injected into a specific area of Davis Dam (cooling water system). The water used for treatment would be discharged into the downstream open water channel of the Colorado River. No specific communities or groups would be solely impacted by the implementation of this project. Therefore, the proposed action would not have disproportionate human health or environmental effect on minority and low-income populations.

- **Visual Resources** – All equipment necessary for the cooling water subsystem treatment would be set up within the dam facilities and would not be visible to the public. There would be no impacts to visual resources as a result of the proposed action.

- **Floodplains** – There would be no impacts to floodplains from the proposed action.

Critical Element Topics Identified for Further Analysis

The following topics are discussed in Section 3.0.

- Water Quality
- Biological Resources (T&E Species)
- Recreation
- Socioeconomic
- Human Health
- Indian Trust Assets

3.1 Water Quality

3.1.1 Affected Environment

Water quality in the Colorado River south of Davis Dam is similar to water quality in Lakes Mead and Mohave, which are upstream of the proposed project area. In 2006, USGS published a report of the physical and chemical water quality data for Lake Mead collected from 2001-2004. The water properties collected by an automatic profiling system include depth, water temperature, specific conductance, pH, dissolved oxygen concentration, and turbidity (USGS, 2006). The monitoring systems used in the report were located in the Boulder Basin, including a station located near Sentinel Island that is the closest station to Hoover Dam.

The report stated that the overall water quality at the Sentinel Island showed variability of physical and chemical properties measured at this site (USGS, 2006). Table 3 shows the data quality ratings for the physical and chemical properties based on the measurements collected for the Sentinel Island station (USGS, 2006). Despite the variability of the water ratings for the Sentinel Island site, the report indicates that the raw water quality is generally good. Current water quality data for Lake Mead at the Sentinel Island station is available http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=95.

Table 3. Data quality ratings for physical and chemical water quality properties measured in profiles at Sentinel Island site, Lake Mead, Arizona and Nevada.

[Time, military format. E, excellent; G, good; F, fair; P, poor. See table 6 for quantitative definitions of these terms. Measurements made between 3 meters and 15 meters]

Period of measurement								
Start Date — Time (Pacific time)	End Date — Time (Pacific time)	Depth	Temperature	Specific conductance	pH	Dissolved-oxygen concentration	Turbidity
Sentinel Island site							
01/24/2002 — 0800	03/21/2002 — 1000	E	E	G	F	P	G
03/21/2002 — 1100	05/21/2002 — 1330	E	E	E	G	P	P
05/21/2002 — 1200	07/02/2002 — 0740	E	E	E	E	P	P
07/02/2002 — 0840	07/10/2002 — 1900	E	E	G	G	P	P
10/10/2002 — 1000	11/12/2002 — 0900	E	E	E	E	P	E
11/14/2002 — 1425	11/22/2002 — 1300	E	E	P	E	E	E
12/03/2002 — 1200	12/23/2002 — 1215	E	E	P	G	G	G
12/23/2002 — 1315	01/13/2003 — 1000	E	E	E	G	P	G
01/13/2003 — 1000	02/14/2003 — 1000	E	E	E	P	P	G
02/14/2003 — 1000	03/12/2003 — 0830	E	E	E	E	E	E
03/12/2003 — 0830	05/06/2003 — 1200	E	E	E	G	G	G
07/23/2003 — 1300	08/20/2003 — 1015	E	E	E	G	E	E
08/20/2003 — 1300	09/25/2002 — 0900	E	E	E	G	F	E
09/25/2003 — 0900	09/28/2003 — 1915	E	E	E	G	F	E
08/27/2004 — 1000[a]	09/16/2004 — 1200[a]	E	E	P	E	P	P
09/20/2004 — 1400[a]	10/14/2004 — 0900[a]	E	E	E	E	F	G

[a] Measurements made between 0.5 meter and 45 meters.

Note: The data above portrays only the Sentinel Island site water profile taken for Open-File Report 2006-1284. A complete table containing profiles for other sampling sites contained in the report can be found in Table 7 in the *Physical and Chemical Water-Quality Data from Automatic Profiling Systems, Lake Mead, Water Years 2001–04*, pp. 11-12. (Source: USGS, 2006).

MBI, in association with Reclamation, has been collecting water samples from points immediately upstream of Davis Dam, in the cooling water system of Davis Dam, and immediately downstream of Davis Dam. These samples are used to determine background levels of *Pseudomonas* spp. in the Colorado River in the vicinity of Davis Dam. Table 4 illustrates the naturally occurring background concentrations of *Pseudomonas* spp. in the areas that the samples are collected.

Through this sampling effort, it has been validated that *Pseudomonas* spp. are a natural component occurring in the Colorado River. The concentrations of *Pseudomonas* spp. are displayed in Colony Forming Units (CFU) per milliliter. CFU is a measurement of viable colony forming cells. Please note that the data enumerated in Table 4 is displayed for the *Pseudomonas* genus as a whole and does not identify to the species level. *Pseudomonas* spp. are an ubiquitous species in both aquatic and terrestrial habitats and are a very well studied group. Additional detailed information regarding *P. fluorescens* and other *Pseudomonas* spp. can be found in Appendix 10 of the attached Section 18 Project File Docket prepared for the EPA (see Appendix B).

Table 4. ***Pseudomonas*** **spp. concentrations at selected Colorado River locations, above Davis Dam, from the Davis Dam cooling water system, and below Davis Dam**

Colorado River, Katherine's Landing, Lake Mohave, AZ 35°12'58.10"N,-114°33'56.51"W			
Collection Date	**Water Surface Temperature °C**	**Concentration (cfu/mL) Average**	**Standard Deviation**
1/26/2010	-	1.38	1.26
2/25/2010	-	2.01	1.13
5/19/2010	20	0.91	0.59
6/24/2010	18	5.83	3.48
7/8/2010	20	0.61	0.65
7/27/10	25	6.67	3.71
8/17/10	27	1.20	1.30
9/28/10	20	2.56	0.98
10/19/10	20	1.83	2.28
11/16/10	16	2.00	1.11
1/3/11	10	12.6	3.08
Davis Dam Cooling Water System AZ 35°11’45.26”N,-114°34’12.87”W			
Collection Date	**Water Surface Temperature °C**	**Concentration (cfu/mL) Average**	**Standard Deviation**
1/26/10	-	0.34	0.41
2/25/10	-	0.93	0.70
3/25/10	-	37.28	39.39
5/19/210	20	0.25	0.34
6/24/2010	19	12.67	3.50
7/8/2010	20	10.67	6.58
7/27/10	16	3.70	3.83
9/28/10	19	2.00	2.11
10/19/10	20	4.00	2.75
11/16/10	17	2.87	1.33
1/3/11	12	6.5	3.12
Colorado River, Davis Camp, Bullhead City, AZ 35 ° 11’36.35”N,-114 ° 34’15.41”W			
Collection Date	**Water Surface Temperature °C**	**Concentration Average (cfu/mL)**	**Standard Deviation**
6/24/2010	19	0.76	0.83
7/8/2010	20	1.78	1.92
7/27/10	14	6.00	3.00
8/17/10	20	1.93	1.45
9/28/10	20	0.67	1.12
10/19/10	18	4.44	2.47
11/16/10	17	0.56	0.70
1/3/11	9	2.83	1

3.1.2 Environmental Consequences

3.1.2.1 No Action Alternative

The No Action Alternative would result in no change in water quality from what would occur under existing conditions described in Section 1.1 and 3.1.1.

3.1.2.2 Proposed Action Alternative

The Proposed Action Alternative would treat the raw cooling water with the specified dosage of Zequanox (200mg/L at the rehabilitation treatment level and a minimum of 10 mg/L at the settlement maintenance treatment level). The treated cooling water would be mixed with the water from the turbines in the tailrace downstream of the dam and would be comprised of a small fraction of the total water released from Davis Dam.

The estimated maximum concentration of Zequanox at the point of discharge (POD) in the Colorado River below Davis Dam if all five cooling water systems would be treated at the same time would be 1.47 mg/L or 1.47 parts per million (ppm). The maximum daily average POD concentration would be 0.84 mg/L (ppm). The maximum POD concentrations are based on calculations using the maximum treatment concentration of Zequanox in the cooling water system, maximum treated cooling water flow rates, and the maximum and minimum turbine flow rates for Davis Dam (see Table 5). The total discharge from Davis Dam will vary (through changes in turbine discharge) during the day and year depending on power demand and other requirements.

Table 5. Turbine discharges, cooling water flow rates, % cooling water flow rates to turbine charges, and maximum concentration of MOI-401 EP in the river at point of discharge at Davis Dam.

Dam	Min. turbine discharge (cfs)	Max. turbine discharge (cfs)	Min. daily avg. turbine discharge (cfs)	Total cooling water flow rate (cfs)	% treated cooling water flow rate to max. turbine discharge	% treated cooling water flow rate to min. turbine discharge	Min. POD[1] conc. (mg/L)	Max. POD conc. (mg/L)	Max. daily avg. POD conc. (mg/L)
	Q_{Tmin}	Q_{Tmax}	Q_{Tavg}	Q_C	Q_C/Q_{Tmax}	Q_C/Q_{Tmin}	C_{Dmin}	C_{Dmax}	C_{Davg}
Davis	4930	25000	8685	36.3	0.15	0.74	0.29	1.47	0.84

Note: This table was taken from Appendix 10 of the Section 18 Project File Docket. To view information on both Hoover and Parker Dam see Table 1 in Appendix 10 of the Section 18 Project File Docket. The min, avg., and max stated above are the overall values of turbine discharge from Davis Dam. The release rates used to calculate the 24-hr degradation period for Zequanox was the max, avg., and min for the month of March 2009, which showed the most variability from 2005-2010.

At the minimum POD concentration, if all five cooling water systems would be simultaneously treated, the diluted concentration produced would be 0.29 mg/L (ppm) in the river downstream of Davis Dam (see Appendix B; Project File Docket – Appendix 10). This would be equivalent to diluting less than a quart of Zequaox into a 650,000 gallon Olympic-sized swimming pool.

The Proposed Action Alternative proposes to only use one generator for treatment application of Zequanox with the treatment level of 200 mg/L (ppm) in a single unit (one generator) cooling water system. The treatment in one unit would produce diluted concentrations of 0.06 mg/L (ppm) in the river downstream after mixing with turbines discharges from all units. This would be similar to diluting less than ½ pint of product in an Olympic-sized swimming pool (containing approximately 650, 000 gallons of water).

Zequanox degrades within a 24-hr period (see Appendix B; Project File Docket – Appendix 10) (Molloy, 2009), and has not been found to be harmful to humans or fish at low concentrations (see Section 3.2 for the discussion on Biological Resources). Further dilutions would also occur downstream of Davis Dam during periods of no treatment because of the 24-hr decomposition period.

Based on the total treatment dosage during each treatment, the product would be expected to be undetectable downstream of Davis Dam because *Pseudomonas* spp. are already present in the Colorado River system.

P. fluorescens is naturally occurring and quite common in nature (Press et al. 2005, Samiguet et al. 1995, Corbell and Loper 1995, Swadling et al, 1996) and is present in the river. Minimal foaming could occur during the treatment, possibly persisting for a maximum of two hours after the treatment. The foaming would dissipate with further mixing downriver. There are no water quality or biological concerns related to the foaming, and this would likely be a transitory visual impact.

The project will have negligible or no effect on water quality based on the following points:

1. The dilution factors below the dam will result in measurements from 0.29 mg/L (ppm) to 0.06 mg/L (ppm)

2. The relatively rapid rate (24-hrs) of degradation of Zequanox. This conclusion was confirmed by an EPA review during the FIFRA Section 18 permit process and the granting of the Quarantine Exemption.

3.1.3 Mitigation

If foam is suspected to have a substantial visual impact, Reclamation will notify the appropriate agencies within the analysis area prior to the application to ensure that stakeholders are aware of the source of the foam.

3.2 Biological Resources

3.2.1 Affected Environment

This section describes the biological environment below Davis Dam within the analysis area. Table 5 lists species that are protected by the Endangered Species Act (ESA) and their state law protections. Nevada lists state protected species and Arizona list species of concern through the Natural Heritage Programs. California lists state Threatened or Endangered species through the California Natural Diversity Database. See Appendix B to review an extensive amount of biologically related and other information submitted to the EPA for approval of use for Zequanox.

Within the analysis area the Colorado River supports a wide variety of aquatic and terrestrial animals and plants. An exhaustive species list would be tedious and is not needed for the purposes of analysis of the proposed action. For the purposes of analysis in Section 3.2.2, with the exception of the ESA listed species in Table 6 below, species will be categorized as invertebrates, plants, fish, birds, and mammals. Potential exposure to Zequanox may occur for all types of invertebrates, fish, birds, mammals, and plants that come into direct contact with Colorado River water during treatment periods. For baseline information regarding water quality in the Colorado River and *Pseudomonas* spp. information please reference Sections 3.0 through 3.1.2.2.

Table 6. Federal protected species below Davis Dam and their associated Endangered Species Act and State status.

Common Name	Scientific Name	Listing Status
Fish		
Razorback sucker	*Xyrauchen texanus*	Endangered under ESA, with designated critical habitat; AZ species of concern, NV state protected, CA state listed as Endangered
Bonytail chub	*Gila elegans*	Endangered under ESA, with designated critical habitat; AZ species of concern, NV state protected, CA state listed as Endangered
Birds		
Yuma clapper rail	*Rallus longirostris yumaniensis*	Endangered under ESA; NV state protected, AZ species of concern, CA state listed as Threatened
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered under ESA; NV state protected, AZ species of concern, CA state listed as Endangered

Located within the affected environment as described in Section 3.0 are Topock Marsh and the Havasu National Wildlife Refuge (NWR), both managed by the FWS. Topock Marsh is located on the Arizona side of the Colorado River midway between Davis Dam and Parker Dam and is almost entirely within the Havasu NWR (Reclamation, 2011). These areas provide potential habitats for the species listed in Table 6. The razorback sucker and the bonytail chub occupy the Colorado River and backwater habitats below Davis Dam. The Southwestern willow flycatcher occupies riparian habitats associated with the Colorado River and its backwaters. The Yuma clapper rail occupies marsh systems associated with the Colorado River and its backwaters.

All the species listed in Table 6 are covered under Reclamation's Lower Colorado River Multi-Species Conservation Program (MSCP). Through the MSCP, Reclamation is engaging in active habitat creation and management for the species listed in Table 5. Due to the extensive amount of both species and habitat-specific information contained within the MSCP Habitat Conservation Plan, Biological Assessment, and the U.S. Fish and Wildlife Service Biological Opinion for the MSCP (File # AESO/SE 02-21-04-F-0161), the species specific information for the razorback sucker, bonytail chub, Yuma clapper rail, and the Southwestern willow flycatcher is hereby incorporated by reference. For further information on the MSCP, the activities that it is engaged in, and species specific information, visit http://www.lcrmscp.gov/.

3.2.2 Environmental Consequences

3.2.2.1 No Action Alternative

The No Action Alternative would result in no change from what would occur under existing conditions. Quagga mussels would continue to thrive in the lower Colorado River system and Reclamation facilities' operations would continue to be adversely impacted by quagga mussel colonization. The frequency of additional maintenance activities and temporary facility shutdowns for maintenance would be at an increased level.

3.2.2.2 Proposed Action Alternative

The *P. fluorescens* CL145A strain that is the basis for Zequanox has undergone extensive mammalian and environmental toxicity testing. The formulations used to control quagga and zebra mussels have been found to be of minimal to no-risk to humans and the environment. For the mammalian or environmental toxicity testing, live *P. fluorescence* CL 145A or MOI -401 TGAI or dead end product *P. fluorescence* CL 145A were used or MOI-401 EP.

Mammalian Toxicity Testing

For the mammalian toxicity studies, test animals were exposed to maximum doses of live cells of the *P. fluorescens* CL145A strain to ensure the safety of MOI-401 TGAI, even at an exaggerated exposure of the product (Table 6). These studies are required by the EPA to assess the safety of microbial pesticides, or biopesticides, when people can possibly be exposed to a pesticide or pesticide treated agricultural crop, water body or structure. The studies were completed with live cells, which represents a more conservative estimation of toxicity because dead bacterial cells experience more rapid natural decay when exposed to oxygenated water. A summary of mammalian toxicity studies can be found in Table 6. Based on the findings of these studies, the EPA determined that MOI-401 EP and Zequanox, when applied as stipulated by the pesticide product use label, are safe for people applying the pesticide and for the general public.

Ecological Toxicity Testing

Similar to mammalian toxicity testing requirements, the EPA also requires microbial pesticide testing at exaggerated rates (known as maximum hazard dose) to ensure the pesticide is safe for non-target animals that may be exposed to the product. In the case of the MOI-401 EP and Zequanox formulations, EPA regulations require that ecological testing be conducted on several aquatic species (Table 7). (A brief overview of the EPA ecological toxicity testing requirements can be found at http://ir4.rutgers.edu/biopesticides/RWP/BBelliveau-Mic%20Env%20As.htm)

Adverse effects in fish species associated with other strains of live *P. fluorescens* have been found in the literature and often appear to be linked to stress from transportation or cultivation of fish (OECD 1997). For example, some strains of *P. fluorescens* have been associated with disease in the cultivation of rainbow trout, *Oncorhynchus mykiss* (Barros et al., 1986), Atlantic salmon, *Salmo salar* (Carson and Schmidtke, 1993), chinook salmon, *Oncorhynchus tshawytscha* (Newbound et al., 1993), sea bream, *Evynnis japonica* (Kusuda et al., 1974), bighead carp, *Aristichthys nobilis*, and silver carp, *Hypophthalmichthys molitrix* (Petrinec et al., 1985), catfish and carp (Gatti and Nigelli, 1984), tench (Ahne et al., 1982), and tilapia species (Okaeme, 1989; Miyashita, 1984; Miyazaki et al., 1984). For this reason, MBI has chosen to develop formulations of MOI-401 that use only killed *P. fluorescens* strain CL 145A cells.

Reclamation and MBI are still conducting ecotoxicology testing with the live and dead end product *P. fluorescens* CL 145A, MOI-401 TGAI, and the MOI-401 EP respectively. Results have been encouraging regarding non-target impact to aquatic organisms. When the non-target animals are exposed to MOI-401 EP and Zequanox concentrations significantly above what would be present in the environment, all evidence indicates that the *P. fluorescens* CL 145A cellular byproduct that kills *Dreissena* spp. mussels is not harmful to other aquatic organisms.

When compared to experimental (untreated) controls, little to no mortality has been recorded among the following non-target organisms when treated at dosages that produced high *Dreissena* spp. mortality (76–100%):

- **Ciliates**: Trials with the common freshwater ciliate *Colpidium colpoda* indicated that the bacteria were not only nonlethal, but served as a food source permitting higher rates of ciliate reproduction than ciliates held in untreated stream water.
- **Freshwater shrimp**: The amphipod *Hyalella azteca appears to* be mildly sensitive to treatments with *P. fluorescens strain CL1*45A, and the MOI-401 EP formulation, but it appears that most, if not all, of the sensitivity can be attributed to the presence of the particulate bacterial cell matter itself rather than the bacterium's mussel-killing cellular byproduct.
- **Daphnids**: The microcrustacean *Daphnia magna* is an aquatic filter feeder that ingests small suspended particles including bacteria, making it a highly appropriate organism for non-target tests. Laboratory assays indicate that *P. fluorescens* is nonlethal to this species.
- **Fish**: No mortality from MOI-401 EP or Zequanox has been observed in the following three fish species tested: fathead minnows (*Pimephales promelas*), young-of-the-year brown trout (*Salmo trutta*), and juvenile bluegill sunfish (*Lepomis macrochirus*). Trials have indicated that fish cannot tolerate exposure to high levels of live bacteria. Fish trials conducted with dead bacteria, however, have indicated that applications of killed cells were harmless to fish, but were still highly lethal to the *Dreissena* spp. mussels.
- **Birds**: No mortality was observed after feeding mallards a 2,000 mg/kg dose of live *P. fluorescens* strain CL145A. The no observable effect limit (NOEL) was set at >2,000 mg/kg and classified Zequanox as "practically non-toxic to mallard."
- **Other Bivalve species**: Exposure to MOI-401 TGAI have caused no mortality to blue mussels (*Mytilus edulis*) or any of 6 native North American unionid clam species (*Pyganodon grandis, Lasmigona compressa, Strophitus undulatus, Lampsilis radiata, Pyganodon cataracta,* and *Elliptio complanata*).A summary of the ecological toxicity testing conducted to date is below.

Table 7. MOI-401 SDP Zequanox ™ (TGAI) Mammalian Toxicity Testing.

Test	Species	Dose Tested	Results
Acute oral toxicity	Rat	>5000 mg/kg	Non toxic Category IV
Acute dermal toxicity	Rat	>5050 mg/kg	Non toxic Category IV
Primary eye irritation	Rabbit	0.1 mL for 24 hours	Minimal irritant Category IV
Primary dermal irritation	Rabbit	0.5 mL for 4 hours	Slight irritant Category IV
Acute inhalation toxicity	Rat	>2.25mg/L aerosol for 4 hours	Non toxic Category IV
Acute intravenous toxicity / pathogenicity	Rat	10^6 to 10^7 CFU/mL	Non-pathogenic, mild to moderate toxicity, a few untreated controls and treated rats had possible Pseudomonad colonies in lymph nodes at study termination, 21 days. Category III
Acute pulmonary toxicity / pathogenicity	Rat	3.4 10^8 CFU/mL	Non-pathogenic, non-toxic, clearance at Day 21, no observable abnormalities during study Category IV
Acute inhalation toxicity	Rat	>2.25mg/L aerosol for 4 hours	Non toxic Category IV

Phytotoxicity (degree of toxic effects to plants) of microbial suspensions of Zequanox were tested on some of the most common aquatic and non-aquatic weed species, including common waterplantain (*Alisma plantago-aquatica*), small-flower umbrella sedge (*Cyperus difformis*), nightshade, bindweed, mallow, and curly dock (*Rumex crispis*; MBI 2009). Suspensions at 100 and 200 mg/L were prepared in distilled water and sprayed on the plant species. No phytotoxic symptoms were observed at either test concentration in any of the tested plants.

In an experiment designed to evaluate the persistence of the live CL145A strain of *P. fluorescens* toxicity to zebra mussels over time, results using dead bacterial cells after 24 hr of aeration in jars had virtually no toxicity when exposed to mussels (Figure 7; MBI 2009). These results could be of environmental benefit since once water is released from dam facilities, *P. fluorescens* CL145A cells are all the less likely to cause any non-target problems in open waters due to their tendency to rapidly lose toxicity when suspended in moving, oxygenated water.

Table 8. Summary of Non-Target Organism Studies.

Zequanox Aquatic Ecotoxicology Studies-

Summary Table on Non-target Organism Studies: Safety trials with aquatic nontarget organisms with **Zequanox** (killed *Pseudomonas fluorescens* CL145A) and, in some instances live *Pseudomonas fluorescens* CL145A or heat-treated/detoxified *Pseudomonas fluorescens* CL145A.. Unless otherwise indicated, all tests were single-dose acute toxicity treatments in closed container bioassays followed by a post-treatment observation period after which mean mortalities were determined.

Aquatic organism	Concentration of bacteria	Duration of exposure to bacteria	Treated with live or killed Pf?	Treatment Temperature	Post-treatment observation period	Mean control mortality (±SD)	Mean treatment mortality (±SD)	Notes
Ciliate *Colpidium colpoda*	100 ppm	72 hr	Live	23°C	0 days	0.0 ± 0.0%	0.0 ± 0.0%	No evidence of lethality. No evidence of impact on reproduction.
Amphipod *Hyalella azteca*	200 ppm	48 hr	Killed	22°C	12 days	0.0 ± 0.0%	26.7 ± 15.3%	No evidence of lethality to mussel-killing toxin. Evidence of sensitivity to bacterial cell matter. Detoxified cells (heat-treated) produced similar levels of mortality as toxic cells.
	200 ppm	48 hr	Killed	22°C	12 days	3.3 ± 5.8%	16.7 ± 11.5%	
	100 ppm	24 hr	Killed	22°C	13 days	3.3 ± 5.8%	16.7 ± 11.5%	
	100 ppm	48 hr	Killed	22°C	12 days	3.3 ± 5.8%	26.7 ± 30.6%	
	200 ppm	24 hr	Killed	22°C	13 days	3.3 ± 5.8%	3.3 ± 5.8%	
	200 ppm	48 hr	Killed	22°C	12 days	3.3 ± 5.8%	17.4 ± 15.5%	
	100 ppm	24 hr	Killed	22°C	13 days	0.0 ± 0.0%	16.7 ± 5.8%	
	50 ppm	24 hr	Killed	22°C	13 days	0.0 ± 0.0%	10.0 ± 17.3%	
	25 ppm	24 hr	Killed	22°C	13 days	0.0 ± 0.0%	6.7 ± 11.5%	
	200 ppm	48 hr	Heat Treated, Detoxified	22°C	13 days	3.3 ± 5.8%	23.3 ± 15.32%	
Microcrustacean *Daphnia magna*	200 ppm	48 hr	Killed	23°C	8 days	0.0 ± 0.0%	0.0 ± 0.0%	No evidence of lethality. Acute toxicity at 48-hr was 0.0 ± 0.0%.
	200 ppm	48 hr	Killed	23°C	8 days	15.5 ± 10.0%	10.0 ± 11.6%	
	200 ppm	48 hr	Killed	23°C	8 days	0.0 ± 0.0%	0.0 ± 0.0%	
	200 ppm	48 hr	Killed	23°C	8 days	10.0 ± 11.5%	10.0 ± 20.0%	
Fathead minnow *Pimephales promelas*	100 ppm	72 hr	Live	23°C	17 days	4.0%	2.7 ± 2.3%	No evidence of lethality.
	50 ppm*	24 hr	Killed	10°C	41 days	2.5 ± 3.5%	0.0 ± 0.0%	
	50 ppm*	24 hr	Killed	21°C	41 days	3.0 ± 1.4%	1.0 ± 1.4%	
Sunfish *Lepomis macrochirus*	100 ppm	72 hr	Killed	20°C	11 days	4.4 ± 3.9%	6.7 ± 6.7%	No evidence of lethality for killed Pf.

Table Continued.

Sunfish (cont.)	100 ppm	72 hr	Live	20°C	11 days	4.4 ± 3.9%	46.7 ± 0.0%	
Brown trout *Salmo trutta*	100 ppm	72 hr	Killed	6°C	39 days	1.3 ± 2.3%	2.7 ± 2.3%	No evidence of lethality for killed Pf.
	100 ppm	72 hr	Live	6°C	39 days	1.3 ± 2.3%	89.3 ± 10.1%	
Blue mussel (marine) *Mytilus edulis*	100 ppm	120 hr	Live	22°C	14 days	4.0%	1.3 ± 2.3%	No evidence of lethality.
Unionid clams								
Elliptio complanata	100 ppm	72 hr	Live	17°C	27 days	0.0%	0.0 ± 0.0%	
	100 ppm	24 hr	Live	23°C	36 days	0.0%	0.0 ± 0.0%	
	100 ppm	48 hr	Live	23°C	35 days	0.0%	0.0 ± 0.0%	
	200 ppm	24 hr	Live	23°C	36 days	0.0%	0.0 ± 0.0%	
	200 ppm	48 hr	Live	23°C	35 days	0.0%	0.0 ± 0.0%	
Lampsilis radiata	100 ppm	72 hr	Live	17°C	27 days	0.0%	0.0 ± 0.0%	
Lasmigona compressa	100 ppm	72 hr	Live	16°C	28 days	--***	0.0 ± 0.0%	No evidence of lethality.
Pyganodon grandis	100 ppm	72 hr	Live	16°C	28 days	0.0%	0.0 ± 0.0%	
Strophitus undulatus	100 ppm	72 hr	Live	16°C	28 days	0.0%	0.0 ± 0.0%	
Pyganodon cataracta	100 ppm	24 hr	Live	23°C	33 days	0.0%	0.0 ± 0.0%	
	100 ppm	48 hr	Live	23°C	32 days	0.0%	0.0 ± 0.0%	
	200 ppm	24 hr	Live	23°C	33 days	0.0%	0.0 ± 0.0%	
	200 ppm	48 hr	Live	23°C	32 days	0.0%	0.0 ± 0.0%	
	200 ppm	48 hr**	Live	21°C	28 days	0.0%	0.0 ± 0.0%	
Mallard *Anas platyrynchos*****	2000 mg/kg	14 days	Killed	19°C	14 days	0%	0%	NOEL > 2000 mg/kg Practically non-toxic designation

* These fish trials were conducted under flow-through conditions in service water at a coal-fired power station (Rochester Gas and Electric Russell Power Station).

** This unionid clam trial was an outdoor mesocosm trial.

*** Too few specimens of this unionid species to have an untreated control.

**** Study conducted by Genesis Midwest Laboratories. This study is a feeding study.

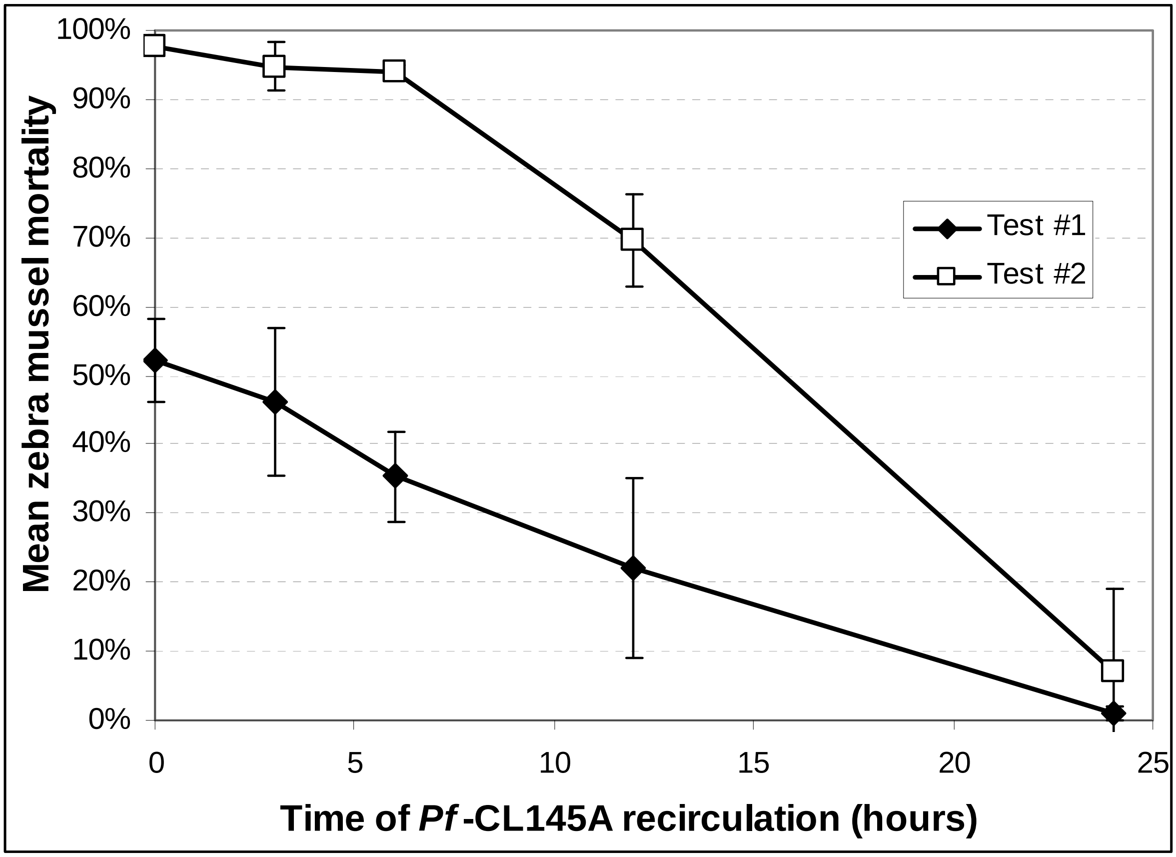

Figure 8. Toxicity of P fluorescens CL145A live cell material after re-circulating in testing jars to 0 to 24 hrs before exposing zebra mussels. Zebra mussel mortality at 23 C following treatment at 120 mg/L and 105 mg/L in Tests #1 and #2, respectively, for 24 hr exposure.

The study described in Figure 8 was completed with live *P. fluorescens* CL 145A, MOI-401 TGAI cells which represents a more conservative estimation on the efficacy because dead bacterial cells experience natural decay when exposed to oxygenated water in addition to the active compounds natural decomposition (see Appendix B; Section 18 Project File Docket-Appendix 10). The data from these tests suggest that the efficacy of treated water declines over time with treatments losing approximately 50% of their effectiveness after 12 hrs, and having virtually no impact on mortality after 24-hrs.

If the water in the cooling water subsystems of Davis Dam is treated with MOI-401 EP and Zequanox and discharged into the Colorado River, the final concentrations after mixing with the untreated total amount of water flowing through Davis Dam would be significantly lower than the original applied amount. The concentrations after mixing would be approximately 0.06 mg/L for the treatment of one generator coolling water system (the proposed project design). This dilute concentration would only occur in the River for a total of 24 hours per 28 days. Factoring in the treatment time and degradation time (24 hrs) that it takes for the active ingredient in Zeqaunox to decompose, Dilute concentrations of Zequanox (at 0.06 mg/L or less due to product decomposition) could be found in the Colorado River for a total time period of approximately 48 hrs per 28 day cycle.

After careful scrutiny of the information provided on the pesticide Zequanox; the associated mammalian and ecotoxicity studies; the decomposition time in water; the consideration that *Pseudomonas* spp. are already present in the Colorado River system (alive) in concentrations that approximate or are higher than the final concentrations of Zequanox after mixing with total water flows through Davis Dam; the fact that only dead bacteria will be utilized to formulate Zequanox; the fact that the EPA has exempted the species *P. fluorescens* from a human food tolerance amount; the fact that *P. fluorescens* has been approved by the EPA and utilized as a plant pesticide without any negative observations to non-target organisms; and the fact that the application rates will be controlled through the stipulations of the EPA letter granting emergency exemption to the open water use of Zequanox (see Appendix A), Reclamation has determined that the product Zequanox, when used in accordance to the manufactures label and the stipulation set forth by the EPA, is not likely to cause unforeseen impacts to the aquatic ecology of the Colorado River and is not likely to have detrimental impacts to non-target organisms. Zequanox has been tested and utilized in Ontario, Canada in 2009 and no impacts to non-target organisms were reported (see Appendix F).

Through the application of Zequanox, only killed bacteria would be used to treat quagga mussels in the cooling water system of Davis Dam. By treating quagga mussels with dead bacteria there would be no increase in *P. florescens* (live) populations in the Colorado River below Davis Dam. To review background levels of *Pseudomonas* spp. currently found in the Colorado River reference Table 4 in Section 3.1.1. Additionally, concentrations of Zequanox in the Colorado River downstream of Davis Dam would be diluted to 0.06 mg/L or less and would only be present for a short duration each 28-day cycle. At these dilute levels, the addition of Zequanox would be undetectable through sampling efforts because of the currently present *Pseudomonas* spp. in the lower Colorado River system.

Through all of the systematic research and testing that has occurred on Zequanox to prove its effective and non-target organism safe nature, if the product proves to be as effective at treating the cooling water system at Davis Dam as research has indicated, Zequanox would prove to be a much less environmentally damaging mussel control option for quagga and zebra mussels than the currently available alternatives (see Appendix B; Sections 18 Project File Docket- Appendix 4 for information on other moluscicides that are currently available). Zequanox is currently under final review by the EPA for Section 3 authorization under FIFRA. Section 3 authorization would grant full approval for use as directed on the manufacturer's label in aquatic systems.

The razorback sucker and bonytail chub occupy the Colorado River below Davis Dam. Based on the ecotoxicity studies presented in this section Reclamation can, with relative certainty, determine that applying Zequanox in accordance with the manufacturer's label instructions and within the Section 18 permit guidelines from the EPA would not have an effect on razorback sucker and bonytail chub. Due to the fact that ecotoxicity studies were not specifically conducted on these two species of fish, and the fact that they spend all of their lifecycle in the waters of the Colorado River, Reclamation is informally consulting with the FWS under Section 7 of the ESA with a "may affect, not likely to adversely affect" determination.

The Southwestern willow flycatcher is a riparian bird species that forages for insects that may originate from aquatic systems. The Yuma clapper rail is a marsh bird that forages for food in marsh systems that may come into contact with Colorado River water. After analyzing the ecotoxicity studies presented in this section, Reclamation has made a determination under Section 7 of the ESA of "no effect" to the Southwestern willow flycatcher and the Yuma clapper rail. The no effect call is based on no impacts to the forage base or habitat structure (plants) of these birds.

3.2.3 Mitigation

By incorporating all stipulations set forth through the FIFRA Section 18 Emergency Exemption granted by EPA it has been determined that no additional mitigation requirements are needed to avoid any potential impacts from the application of Zequanox.

3.3 Recreation

3.3.1 Affected Environment

Recreation is a major industry on the Colorado River between Davis Dam and Lake Havasu. A wide variety of recreation opportunities have developed because of the riverfront, gaming industry, mild winter climate, and many visitors to the area. Davis Dam Camp is located directly below Davis Dam on the Arizona side of the river and includes a campground, day use area, and boat launching facilities. Directly across from Davis Dam Camp and north of Laughlin, Nevada, Clark County and Reclamation have partnered to develop a new recreation trail area known as Laughlin Regional Greenway Heritage Trails. This development is under construction. The City of Laughlin is a popular resort/casino destination. Both Laughlin and Bullhead City, AZ, located directly across the Colorado River from each other, support parks and recreation areas. Boating, swimming, and fishing are all popular recreation activities on the Colorado River and Lake Havasu. Camping, hiking, and day use activities are popular on the public land adjacent to the Colorado River.

Colonization of water bodies by quagga mussels is known to impact docks, breakwaters, buoys, boats, and beaches (Benson 2010). Attached mussels can increase drag on the bottom of watercraft, reducing speed, wasting fuel, and requiring scraping and repainting the watercraft's hull. Mussels attached in and around the steering components can jam watercraft steering equipment, and mussels can block the cooling water system in engines, causing them to overheat. Degraded habitats and ecosystems caused by invasive mussel infestations also reduce sport-fishing opportunities. Shoreline activities such as swimming, hiking, and picnicking can be negatively impacted because of the excessive amounts of shell material that build-up along the edges of infested water bodies due to the natural lifecycle of invasive mussels. In the Colorado River, boats are currently being impacted by quagga mussels. Boats must be washed upon removal from the water, increasing the time and money that boaters expend.

3.3.2 Environmental Consequences

3.3.2.1 No Action Alternative

The No Action Alternative is not expected to have a direct impact on recreation because the treatment is proposed within the enclosed cooling water system of the dam. If the treatment does not take place, existing recreational activities would continue. Recreational activities would continue to be impacted by quagga mussels.

3.3.2.2 Proposed Action Alternative

The proposed action is not expected to have a direct impact on recreation as the treatment would be in the enclosed cooling water system of the dam. EPA has exempted *P. fluorescens* from human food tolerance restrictions (see Section 3.4.2 for discussion on human food tolerance exemptions). Negative impacts to recreation are not expected because there are no expected impacts to fisheries, wildlife, or human health. As discussed in Section 3.2.2.2, the concentration of Zequanox at the point of discharge from the dam would not be at levels that are lethal to fish (MBI 2009, Sutphin 2010). Therefore, no impacts to sport fishing would be expected.

The treatment within the cooling water system is not expected to kill quagga mussels downstream of Davis Dam and so would not address impacts from quagga mussels on the lower Colorado River as a whole. Indirectly, the proposed action may have a positive impact on recreation. Successful treatment at Davis Dam would demonstrate effectiveness of Zequanox, possibly leading to broader use, which may reduce mussels number overall and ensure that recreational activities are able to continue.

3.3.3 Mitigation

No mitigation measures are recommended for recreation.

3.4 Socioeconomic

3.4.1 Affected Environment

The electricity generated by the powerplant at Davis Dam is important to the economy of the region. The Parker-Davis Project, of which Davis Dam is a part of, provides electric service to 26 municipalities, cooperatives, federal and state agencies and irrigation districts in Nevada, Arizona and California (USBR, 2011).

Recreation activities between Davis Dam and Lake Havasu generate income for communities located along the Colorado River. The city of Laughlin attracts nearly 5 million visitors annually; many of these visitors enjoy water sports on the Colorado River (Laughlin Chamber of Commerce, 2011).

3.4.2 Environmental Consequences

3.4.2.1 No Action Alternative

The No Action Alternative would have a negative economic impact. As discussed under the Background and Purpose and Need in Section 1, quagga mussels are increasing maintenance costs at Davis Dam. Invasive mussels can clog water intake structures, such as pipes and screens, therefore reducing pumping capabilities for power and water treatment plants, which is an economic impact to industries, companies, and communities (Benson 2010). Unscheduled shutdowns for maintenance affect the efficient generation of power to meet the region's demand.

3.4.2.2 Proposed Action Alternative

The Proposed Action Alternative would have a positive socioeconomic impact if mussels are reduced or eliminated in the cooling water system. This would reduce maintenance costs and allow for more efficient power generation.

As discussed in Section 3.3, the project scope is limited to the cooling water system. No direct impacts to the tourism economy are expected. Indirectly, the proposed action may have a positive impact on the income generated from recreation. Successful treatment at Davis Dam would demonstrate effectiveness of Zequanox, possibly leading to broader use which may reduce mussels numbers overall and ensure that recreational activities continue to generate income.

3.4.3 Mitigation

No mitigation measures are recommended for socioeconomics.

3.5 Human Health

3.5.1 Affected Environment

Davis Dam is the northern boundary of Reach 3 of the Colorado River. Water flowing through Davis Dam originates from Lake Mohave and carries similar water quality properties and characteristics of Lake Mead (discussion on water quality can be found in Section 3.1.1).
In addition, Section 3.1.1 noted that *Pseudomonas* spp. are naturally occuring in the Colorado River. The TGAI, *P. fluorescens*, is a nonpathogenic saprophyte that colonizes soil, water, and plant surface environments as discussed in Section 1.1, 3.1, and 3.2. *P. fluorescens* is "noted for their metabolic diversity and are often isolated from enrichments designed to identify bacteria that degrade pollutants… such as styrene, TNT, and polycyclic aromatic hydrocarbons" (DOE, 2011). Research containing other form and formulations of *P. fluorescens* has been conducted to evaluate the effectiveness of *P. fluorescens* as a biocide/pesticide for land crops such as strawberries (Swalding et. al., 1996). Results have noted that *P. fluorescens* have been effective against grey mold development on strawberries (Swalding et. al., 2996). Strains of *P. fluorescens* would protect the seeds and roots and suppress plant diseases such as fungal infection (DOE, 2011).

As described in Sections 1.1, 3.0, 3.1, and 3.2, quagga mussels pose serious problems to facilities and structures along the Colorado River and reservoirs. Because of this, quagga mussels pose serious threats to Reclamation's infrastructure and operations and are impacting hydroelectric generation facilities at Hoover, Davis, and Parker Dams. Intake structures, pipes, and strainers are becoming clogged, reducing delivery capacities, pumping capabilities, and hydropower generation functions. Mussels have been known to physically obstruct water flow through hydroelectric cooling water systems. Flow obstruction from mussel settlement at Reclamation facilities has caused a significant increase in the frequency of high temperature alarms in cooling water systems, requiring unscheduled shut-downs for maintenance. These impacts are increasing both in degree and frequency.

3.5.2 Environmental Consequences

3.5.2.1 No Action Alternative

The No Action Alternative would result in no change from what would occur under existing conditions described in Section 3.1.1 and Section 3.5.1. There would be no injection of Zequanox into the cooling water system and Zequanox would not exist in the water downstream of Davis Dam.

The infestation of quagga mussels within the cooling water system of Davis Dam would continue and increase the risk of obstructing the pipes that would pose issues and concerns to the efficiency and safety of the facility for staff and nearby cities such as Laughlin and Bullhead City.

Impacts from the mussels have been noted to cause loss of function in power generation system components, which could lead to failure of Reclamation's capability to maintain reliable power deliveries. If the cooling water system fails to prevent the generators within Davis Dam from reaching high temperature, the increased risk of high temperature would yield serious safety concerns for Davis Dam.

3.5.2.2 Proposed Action Alternative

The Proposed Action Alternative would be implemented at Davis Dam for treatment of the cooling water system. Zequanox would be injected into the system where it would be diluted and mixed with raw cooling water and discharges from the turbines as discussed in Section 3.1.2.2. The discussion on the dilution concentration in Section 3.1.2.2 noted that the concentrations of one generator with the rehabilitation level treatment of 200 mg/L (ppm) dosage of Zequanox would produce dilution concentrations of 0.06 mg/L (ppm) in the river downstream after mixing with turbines discharges from all units.

This dilution concentration would also be influenced by the 24-hr decomposition period, which is estimated to reach 63 river miles downriver at the extremely high or maximum release rates from Davis Dam (see Figure 7 and Table 1). Further dilutions would also occur downstream of Davis Dam during periods of no treatment because of the 24-hr decomposition period.

In Section 1.1 and 3.2, the discussion and information presented on *P. fluorescens* noted that it is nonpathogenic and is highly researched as a biocide/pesticide and is naturally occurring in soil, water and plant environments (DOE, 2011). The TGAI, *P. fluorescens*, is naturally occurring and quite common in nature (Press et al. 2005, Samiguet et al. 1995, Corbell and Loper 1995) and is present in the Colorado River.

Early food safety evaluations have shown that proteins derived from *P. fluorescens* do not raise concern for human and animal health (Coats, 2009, JGIDOE, 2011). *P. fluorescens* has a long history of safe use in a wide variety of beneficial applications in agriculture, human health and bio-remediation (Coats, 2009, JGIDOE, 2011). The EPA has determined that the presence of *P.*

fluorescens is not expected to cause adverse health effects in humans, based on various studies that found no evidence of *P. fluorescens* being harmful to mammals (EPA, 2008). Mammalian toxicity tests illustrate that Zequanox has not been found to be harmful to humans at these very low concentrations (see Table 7).

The Proposed Action Alternative is centered in treating the cooling systems of Davis Dam for the purposes of controlling quagga mussel colonization. This would have little or no effect to human health based on the following points:

1. The dilution factors below the dam will result in measurements from 0.06 mg/L (ppm) with one generator being treated with the application and up to 0.29 mg/L (ppm) with all five generators being treated at one time.

2. The relatively rapid rate (24-hrs) of degradation of the dead TGAI in Zequanox (Molloy 2009).

3. *P. fluorescens* is a naturally occurring in soil, water, and plant environments and is nonpathogenic. It has been researched as a biocide/pesticide for land crops such as strawberries and protects seeds and roots from fungus and other plant diseases.

4. *P. fluorescens* has been used for a variety of purposes in agriculture, human health and bio-remediation and is known to have no adverse health effects on non-target organisms such as humans, animals and plants.

3.5.3 Mitigation

There are no mitigation measures identified for human health.

3.6 Indian Trust Assets

3.6.1 Affected Environment

Indian Trust Assets are legal interests in property held in trust by the United States for federally recognized Indian Tribes or individual Indians or for property the United States is charged to protect by law. Examples of resources that are Indian Trust Assets include lands, minerals, hunting and fishing rights, and water rights. Department of the Interior Order 3175 requires that:

1. Agencies consult with Indian tribes when trust property may be affected; and

2. Environmental and planning documents should “clearly state the rational for the recommended decision will be consistent with the Department’s trust responsibilities.

Ten tribal entities occupy Indian reservations with claimed or vested water rights to the Colorado River. These tribes have the senior water rights on the river (CRWUA, 2005). The Indian Reservations and tribal entities located within the established borders of the analysis area in Figure 7 are the Fort Mohave Indian Tribe and the Chemehuevi Tribe. The other eight tribal entities outside the analysis area are the Colorado River Indian Tribes, Fort Yuma Quechan

Tribe, Cocopah Indian Tribe, and the reservations of the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Luiseno Indians.

These Tribes have rights to or draw water from the mainstream Colorado River or its tributaries for irrigation and other water needs. The Bureau of Indian Affairs administers hydropower generated by Colorado River flows and supplies energy to various Tribes along the Colorado River.

3.6.2 Environmental Consequences

3.6.2.1 No Action Alternative

The No Action Alternative would result in no change from what would occur under existing conditions described in Sections 1.1, 3.1.1, and 3.5. There would be no application of Zequanox into the cooling water system and Zequanox would not exist in the water downstream of Davis Dam. The Tribes with claims or vested water rights to the Colorado River would continue drawing water or utilizing its resources under the existing conditions.

3.6.2.2 Proposed Action Alternative

The Proposed Action Alternative would be implemented at Davis Dam for treatment of the cooling water system. See Sections 2.2, 3.1, 3.2, and 3.5 for discussions on dosage of Zequanox, dilution concentrations once it would be injected into the cooling water system at Davis Dam, background information, and impacts of *P. fluorescens* on human health.

The project will have little or no effect to Indian Trust Assets (ITAs) based on the following points:

1. The dilution factors below the dam will result in measurements from 0.29 mg/L (ppm) to 0.06 mg/L (ppm).

2. The relatively rapid rate (24 to 72 hr) of degradation of the dead TGAI in Zequanox (Molloy 2009).

3. *P. fluorescens* is a naturally occurring in soils, water, and plant environments and is nonpathogenic. It has been researched as a biocide/pesticide for land crops such as strawberries and protects seeds and roots from fungus and other plant diseases.

3.6.3 Mitigation

There are no mitigation measures other than those included in the proposed action identified for ITAs.

3.7 Cumulative Effects

Cumulative impacts can result from individually minor, but collectively adverse, actions taking place over a period of time. Cumulative impacts are most likely to arise when a relationship exists between a proposed alternative and other actions that have, or are expected, to occur in a similar location, time period, or involving similar actions. Projects in close proximity to the proposed alternatives would be expected to have more potential for cumulative impacts than those more geographically separated. In this section, a list approach was used to identify projects closely related to the Proposed Action that would be analyzed for cumulative impacts (i.e., either located within or in the vicinity of the proposed project site and having the potential to impact common resources).

Actions considered to be "past" are projects that are complete, or currently ongoing but that would be completed before construction of the Proposed Action begins in mid 2011. Actions considered to be "present actions" are defined as projects/activities occurring at the time of this evaluation that would continue during construction and operation of the Proposed Action. Future actions are actions that are currently approved, but would not begin construction until after construction of proposed action would be completed or actions for which the NEPA process is in progress.

3.7.1 Past Actions

See 3.7.2 for projects that are currently being implemented but have also occurred in the past.

3.7.2 Present Actions

Multi-Species Conservation Plan – Programmatic Habitat Conservation Plan

The Lower Colorado River Multi-Species Conservation Program (MSCP) is a partnership of Federal and non-Federal stakeholders, created to respond to the need to balance the use of lower Colorado River water resources and the conservation of native species and their habitats in compliance with the ESA. This is a long-term (50-year) plan to conserve at least 26 species along the LCR from Lake Mead to the Southerly International Boundary with Mexico through implementation of a Habitat Conservation Plan (HCP) (Reclamation, 2004b).

The LCR MSCP projects located within the analysis area on Reach 3 include work in Lake Havasu National Wildlife Refuge (LHNWR) and Topock Marsh Water Infrastructure Improvement Project (TMWIIP). Efforts under the MSCP program are habitat conservation, recovery of listed fish, planning for current and future water diversions and power production and development (Reclamation, 2004b).

The Beal Lake Conservation Area (BLCA) is located on the LHNWR, approximately 30 miles northwest of Lake Havasu City. The BLCA is a construction and management effort that involves the improvement of habitat of backwaters for native fish species. The project includes clearing, blending dredge material with existing soils, leveling, and planting various native plants. The reclaimed area has been divided into cells or small fields with independent flood irrigation capabilities. The project allows for the testing of various planting and seeding methods while potentially creating habitat.

The TMWIIP, located in Mohave County, Arizona, is a multi-phased improvement project to control diversion and water distribution of water from LHNWR and manage riparian and water-dependent habitat (USFWS, 2009). This project includes the installation of two pumps at the existing inlet canal for Topock Marsh. The intent is to divert water along with supplemental pumping to maintain the water surface elevation, to help avoid negative effects on the groundwater elevation.

More information about this project can be accessed at www.lcrmscp.gov/workplans.html.

Swimmer Defense Testing at Davis Dam

The US Department of Homeland Security is conducting two year testing of a Swimmer Defense System (SDS) at Davis Dam under the "Underwater Surveillance: Dams and Tunnels Program." The project includes testing, at critical facilities, in-water SDS equipment including frequency detection sonars, an underwater loudhailer, and a subsurface non-lethal driver deterrent.

Laughlin Regional Greenway Heritage Trails Project

Reclamation has issued a long-term land use authorization to Clark County, Nevada to allow the construction, operation, and maintenance of a recreation area directly below Davis Dam. This recreation area, which will provide hiking, picnicking, and other day use facilities, is currently under construction.

Lake Havasu Fisheries Improvements

The Lake Havasu Fisheries Improvement program is a multi-agency effort that creates artificial habitats for fish by using various plant and man-made materials in 42 locations within Lake Havasu. This project is a ten-year program to improve and enhance about 875 acres of aquatic habitat to restore listed fish species and to enhance recreational activities such as sport fishing.

3.7.3 Future Actions

Davis-Kingman Tap 69-kV Transmission Line Rebuild

Western Area Power Administration is preparing an Environmental Assessment for rebuilding the Davis-Kingman 69-kV transmission line. The transmission line would be rebuilt within the existing alignment from Kingman Arizona to Davis Dam.

3.7.4 Cumulative Impacts by Resource

3.7.4.1 Water Quality

The potential implementation of the Proposed Action Alternative is not anticipated to have an impact on water quality during the application of Zequanox. The dilution concentration of 0.06mg/L and the 24-hour degradation period would not contribute to the background levels of *Pseudomonas* spp. already existing in the Colorado River because the *Pseudomonas* strain used to formulate Zequanox is dead. The Proposed Action Alternative, when considered in conjunction with the other identified actions, is not anticipated to have any cumulative impacts to water quality.

3.7.4.2 Biological Resources (T&E Species)

The potential implementation of the Proposed Action Alternative is not anticipated to have impacts to biological resources. Therefore, when considered in conjunction with the MSCP or Lake Havasu fisheries improvements, the action is not anticipated to have any cumulative impacts to biological resources.

3.7.4.3 Recreation

The potential implementation of the Proposed Action Alternative is not anticipated to lead to the disruption of established uses of the Colorado River below Davis Dam for recreation. The Proposed Action Alternative, when considered in conjunction with the other identified actions, is not anticipated to have any cumulative impacts to recreation.

3.7.4.4 Socioeconomic

The potential implementation of the Proposed Action Alternative is not anticipated to disrupt any established businesses in the adjacent area of Davis Dam that include Laughlin, NV and Bullhead City, AZ. The Proposed Action Alternative, when considered in conjunction with the other identified actions, is not anticipated to have any cumulative impacts to socioeconomics.

3.7.4.5 Human Health

The potential implementation of the Proposed Action Alternative is not anticipated to have impacts on water quality and human health when considered in light of the dilution concentration of 0.06mg/L and the 24-hour degradation period. The implementation of the Proposed Action Alternative would increase the efficiency and safety of Davis Dam and would minimize the safety risk of overheating generators. The Proposed Action Alternative, when considered in conjunction with the other identified actions, is not anticipated to have cumulative impacts to human health.

3.7.4.6 Indian Trust Assets

The potential implementation of the Proposed Action Alternative is not anticipated impacts on water quality and would have no impacts to ITAs. The Proposed Action Alternative, in conjunction with the other future actions, is not anticipated to have negative cumulative impacts to ITAs.

4.0 Coordination and Consultation

4.1 Persons/Agencies Consulted

Arizona Department of Environmental Quality
California Water Quality Control Board Colorado River Basin Region
Environmental Protection Agency
Marrone Bio Innovations Inc.
Nevada Division of Environmental Protection
US Fish and Wildlife Service

4.2 Scoping/Public Involvement

Since the establishment of the 2009 Cooperative Research and Development Agreement between Reclamation and MBI, presentations have been delivered by Reclamation at a variety of events, meetings, and conferences announcing plans to research Zequanox at Davis Dam as a potential control method for quagga mussels (see Table 9).

Reclamation is holding four public open houses in the area adjacent to Davis Dam and in Lake Havasu City, Arizona. A news release and paid advertisement will inform the public about the purpose, location, date, time, and reference resources regarding the Proposed Action Alternative and the NEPA process.

The open houses will provide the opportunity for interested parties to gather information on the concerns and potential impacts posed by quagga mussels at Davis Dam, product information on Zequanox, information on the NEPA process, and other pertinent information regarding the Proposed Action Alternative. Comment cards and Reclamation contact information for the proposed project will be provided.

The Tribes with claim or vested water rights to Colorado River water and interested parties were sent a letter informing them of the proposed Project, inviting them to the open houses, and requesting their comments on the Draft EA. Reclamation has also extended the opportunity to individually meet with Tribes residing within or directly south of the analysis area including the Chemehuevi Indian Tribe, Colorado River Indian Tribes and the Fort Mohave Indian Tribe.

Table 9. Events, meetings, and conferences where presentations were delivered announcing Reclamation's plans to research and test Zequanox at Davis Dam.

Date	Location	Name of Event, Meeting, or Conference	Delivered by:	Attendees
08/30/2010-09/03/2010	San Diego, California	International Conference of Invasive Species	Leonard Willet (Lower Colorado Region Dams Office)	International Group
09/9/2010	Henderson, Nevada	Lake Mead Interagency Quagga Mussel Task Force Quarterly Meeting	Leonard Willet (Lower Colorado Region Dams Office)	Various Federal, State, and Local entities.
10/5/2010-10/6/2010	Boise, Idaho	Western Regional Panel on Aquatic Nuisance Species Conference	Leonard Willet (Lower Colorado Region Dams Office)	Various Federal, State, and Local entities.
10/26/2010-10/28/2010	Laramie, Wyoming	Wyoming Water Users Association Meeting	Leonard Willet (Lower Colorado Region Dams Office)	Various Federal, State, and Local entities.
11/10/2010	Cibola National Wildlife Refuge, Cibola,	Colorado River Aquatic Nuisance Species Task Force Meeting	Fred Nibling (Denver)	Various Federal and State, entities.
12/15/2010-12/17/2010	Las Vegas, Nevada	Colorado River Water Users Association 2010 Annual Conference	Leonard Willet (Lower Colorado Region Dams Office)	Various Federal, State, and Local entities.
1/12/2011–1/13/2011	Laughlin, Nevada	Colorado River Aquatic Biologists Meeting	Marc Maynard (Lower Colorado Regional Office)	Various Federal, State, and Local entities.
03/14/2011-03/16/2011	St. George Utah	Utah Water Users Association Meeting	Leonard Willet (Lower Colorado Region Dams Office)	Various Federal, State, and Local entities.

4.3 Distribution List

The distribution list of entities who will be notified that the Draft and Final EA can be accessed for public review online at www.usbr.gov/lc/region/g2000/envdocs.html will include Arizona Game and Fish Department, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, California Department of Fish and Game, Nevada Department of Wildlife, U.S. Fish and Wildlife Service, the Quagga Mussel Interagency Group, and other interested parties. In addition, a paper copy of the EA will be available upon request.

5.0 Literature Cited

AFS-FHS (American Fisheries Society, Fish health Section). 1975. Suggested procedures for the detection and identification of certain infectious diseases. U.S. Fish and Wildlife Service, Washington, D.C., 99p.

Ahne, W., Popp, W. and Hoffman, R. 1982. Pseudomonas fluorescens as a pathogen for tench. Bulletin of the European Association of Fish Pathologists 2: 56-57.

Anderson, M. and Davey, R. 1994. Pseudobacteraemia with Pseudomonas fluorescens. Medical Journal Aust. 160: 233-234.

ANSTF (Aquatic Nuisance Species Task Force). 2009. Quagga-Zebra Mussel Action Plan for Western U.S. Water. Prepared by Western Regional Panel on Aquatic Nuisance Species. http://www.anstaskforce.gov/Meetings/2009_November/QZAP%20FINAL%20ANSTF%20OCT09%20%20Final.pdf.

Barros, G.C., Vianni, M.C.E. and Nogueira, Y.A. 1986. Outbreak of disease in rainbow trout attributed to Pseudomonas fluorescens. Revista da Faculdade de Medicina Veterinaria e Zootecnia da Universidade de Sao Paulo 23: 167-173.

Benson, A. J., M. M. Richerson, and E. Maynard. 2010. Dreissena rostriformis bugensis. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov/queries/ FactSheet.aspx?speciesID=95 accessed on 10 September 2010

California Incident Command. 2007. California's Response to the Zebra/Quagga Mussel Invasion in the West. Recommendations of the California Science Advisory Panel. Prepared for the California Incident Command: California Department of Fish and Game, California Department of Water Resources, US Fish and Wildlife Service, California Department of Food and Agriculture, California Department of Boating and Waterways.

Carson, J. and Schmidtke, L.M. 1993. Opportunistic infection by psychrotrophic bacteria of cold comprised Atlantic salmon. Bulletin of the European Association of Fish Pathologists 13: 49-52.

Claxton, W. T., A. B. Wilson, G. L. Mackie, and E. G. Boulding. 1998. A genetic and morphological comparison of shallow- and deep-water populations of the introduced dreissenid bivalve Dreissena bugensis. Can. J. Zool. 76(7):1269-1276.

Coats, Isabelle S. Ph.D. 2009. "Evaluation of the Food Safety of the Non-Pesticidal Protien p-hydroxphenylpyruvate dioxygenase (HPPD); Early Food Safety Evaluation Voluntary Submitted to the Federal Drug Administeration" Bayer CropScience. June 4, 2009. http://www.ingenta connect.com/content/tandf/cbst/ 996/00000006/00000001/art00012 accessed on 10 March 2011.

Corbell, N. and JE Loper. 1995. A global regulator of secondary metabolite production in Pseudomonas fluorescens Pf-5. Journal of Bacteriology, 177(21), 6230-6236.

Joint Genome Institute US Department of Energy Office of Science (JGIDOE). 2011. “Pseudomonas Fluorescens PfO-1.” http://genome.jgi-psf.org/psefl/psefl.home.html accessed on 11 March 2011.

Dow, S., 2009. Summary Report on Invasive Mussel Control Product Trials with Zequanox Conducted at Davis Dam by Marrone Bio Innovations. Davis, CA: Marrone Bio Innovations. Reviewed by Bureau of Reclamation.

Egusa, S. 1992. Infectious Diseases of Fish. A.A. Balkema Publishers, Bookfield, USA.

Foreman, N.K., Wang, W.C., Cullen, E.J., Stidham, G.L., Pearson, T.A. and Shenep, J.L. 1991. Endotoxic shock after transfusion of contaminated red blood cells in a child with sickle cell disease. Pediatric Infectious Disease Journal 10: 624-626.

Gatti, R. and Nigrelli, D. 1984. Haemorrhagic septicaemia in catfish. Pathogenicity of the strains isolated and reproducibility of the disease. Obbiettivi e Documenti Veterinari 5: 61-63.

Gottlieb, T, Funnell, G. and Gosbell, I. 1991. Pseudomonas fluorescens pseudobacteraemia. Med. J. Aust. 155: 854-855.

Kusuda, R., Toyoshima, T. and Nishioka, J. 1974. Properties of pathogenic Pseudomonas isolated from cultivated Evynnis japonica. Fish Pathology 9: 71-78.

MBI (Marrone Bio Innovations). 2009. Zequanox Ecological Testing. http://marronebioinnovations.com /products/zequanox/ecological_testing/ accessed on 9 September 2010.

Miyashita, T. 1984. Pseudomonas fluorescens and Edwardsiella tarda isolated from diseased tilapia. Fish Pathology 19: 45-50.

Miyazaki, T., Kubota, S.S. and Miyashita, T. 1984. A histopathological study of Pseudomonas fluorescens infection in tilapia. Fish Pathology 19: 161-166.

Molloy, Dan. 2009. Addendum to Ecological Toxicity Studies, Expression in Freshwater Environment, OPPTS No. 885.5300. http://marronebioinnovations.com/pdf/zeq/AddendumEcologicalToxicityStudies-PersistanceEnvironment.pdf accessed 13 October 2010.

Newbound, G.C., Speare, D.J., Hammell, K.L., Kent, M.L., Ostland, V.E. and Traxler, G.S. 1993. Chehalis River disease: a unique gill disease of salmonids. Canadian Journal of Fisheries and Aquatic Sciences 50: 1092-1100.

NPS (National Park Service). 1999. Lake Mead National Recreation Area Resource Management Plan. Boulder City, Nevada.

OECD (Organization for Economic Co-operation and Development). 1997. Consensus Document on Information Used in the Assessment of Environmental Applications Involving Pseudomonas. OECD/GD (97)22. http://www.oecd.org/officialdocuments/displaydoc umentpdf?cote=OCDE/GD(97)22&doclanguage=en accessed on 8 September 2010.

Okaeme, A.N. 1989. Bacteria associated with mortality in tilapias, Heterobranchus bidorsalis, and Clarias lazera, in indoor hatcheries and outdoor ponds. Journal of Aquaculture in the Tropics 4: 143-146.

Owen, Robert. 2011. Bureau of Reclamation (Reclamation); Engineering Services Office, Boulder City, Nevada. Personal Communication. March 22, 2011.

Palleroni, N.J. 1992a. Human and animal pathogenic pseudomonads. In: Balows, A., Truper, H.G., Dworkin, M., Harder, W. and Schleifer, K.H. (eds). The Prokaryotes, Chapter 161 (pp. 3086-3103) (2nd Edition), Vol. III. Springer-Verlag, New York.

Petrinec, Z., Naglic, T., Matasin Z. and Fijan, N. 1985. Pseudomonas fluorescens septicaemia in bighead (Aristichthys nobilis Rich) following handling. Veterinarski Arhiv. 55: 277-284.

Press, Caroline M., J. Ravel, D. .Y Kobayashi, G. S. A. Myers, D. V. Mavrodi, R. T. DeBoy, R. Seshadri, Q. Ren, R. Madupu, R. J. Dodson1, A. S. Durkin, L.M. Brinkac, S.C. Daugherty, S. A. Sullivan, M.J. Rosovitz, M. L. Gwinn, L. Zhou, D. J. Schneider, S. W. Cartinhour, W. C. Nelson, . Weidman, K. Watkins, K. Tran, H. Khouri, E. A. Pierson, L. S. Pierson & L. S. Thomashow. 2005. Complete genome sequence of the plant commensal Pseudomonas fluorescens Pf-5. Nature Biotechnology, 23, 873-878.

Roberts, R.J. and Horne, M.T. 1978. Bacterial meningitis in farmed rainbow trout, Salmo gairdneri Richardson, affected with chronic pancreatic necrosis. Journal of Fish Diseases 1: 157-164.

Rowe, M., D. Essig, and B. Jessup. 2003. Guide to Selection of Sediment Targets for Use in Idaho TMDLs. Idaho Department of Environmental Quality. http://www.deq.idaho.gov /water/data_reports/surface_water/monitoring/sediment_targets_guide.pdf

Scott, J., Boulton, F.E., Govan, J.R.W., Miles, R.S., McClelland, D.B.L. and Prowse, C.V. 1988. A fatal transfusion reaction associated with blood contaminated with Pseudomonas fluorescens. Vox Sang. 54:201-204.

Sarniguet, Alain, Jennifer Kraus, Marcella D. Henkels, Andrea M. Muehlchen and Joyce E. Loper. 1995. The Sigma Factor σs Affects Antibiotic Production and Biological Control Activity of Pseudomonas fluorescens Pf-5. Proceedings of the National Academy of Sciences of the United States of America, Vol. 92, No. 26, pp. 12255-12259.

Simor, A.E., Ricci, J., Lau, A., Bannatyne, R.M. and Ford-Jones, L. 1985. Pseudobacteremia due to Pseudomonas fluorescens. Pediatric Infectious Diseases 4: 508-512.

Smith, F. J., and J. L. Sykora. 1976. Early developmental effects of lime-neutralized iron hydroxide suspensions on brook trout and coho salmon. Transactions of the American Fisheries Society 105:308-312.

Snyder, F. L., M. B. Hilgendorf, and D. W. Garton. 1997. Zebra Mussels in North America: The invasion and its implications! Ohio Sea Grant, Ohio State University, Columbus, OH. http://www.sg.ohio-state.edu/f-search.html.

Stoskopf, M.K. 1993. Bacterial diseases of goldfish, koi, and carp. In: Stoskopf, M.K. Fish Medicine (pp. 473-475), Chapter 48. W.B. Saunders Co., Philadelphia, PA.

Sutphin, Z. 2010. Bureau of Reclamation, Fisheries and Wildlife Resources Group, Denver, Colorado. Personal communication.

Swadling I. R. and P. Jefferies. 1996. "Isolation of Microbial Antagonists for Biocontrol of Grey Mould Disease of Strawberries" in Biocontrol Science and Technology, Volume 6, Number 1, 1 March 1996 , pp. 125-136(12). http://www.ingentaconnect.com/content /tandf/cbst/996/00000006/00000001/art00012 accessed on 10 March 2011.

Thurston, R.V., R.C. Russo, and G.A. Vinogradov. 1981. Ammonia Toxicity to Fishes. Effect of pH on the Toxicity of the Un-ionized Ammonia Species. Environmental Science & Technology 15(7):837-840.

Thurston, R.V. and R.C. Russo. 1983. Acute Toxicity of Ammonia to Rainbow Trout. Transactions of the American Fisheries Society 112:696-704.

Tighi, Shana. 2011. Bureau of Reclamation (Reclamation), River Operations Office. Boulder City, Nevada. Personal communication. March 11, 2011.

Trebitz, A.S., J.C. Brazner, V.J. Brady, R. Axler, and D.K. Tanner. Turbidity Tolerances of Great Lakes Coastal Wetland Fishes. North American Journal of Fisheries Management; 27: 619-633.

United States Bureau of Reclamation (Reclamation). 2004. Draft Environmental Impact Statement, Colorado River Interim Guidelines for Lower Basin Shortages and Coordination Operations for Lake Powel and Lake Mead. February 4, 2004. http://www.usbr.gov/ projects/Facility.jsp?fac_Name=Davis+Dam&groupName=Overview accessed on 11 March 2011.

United States Bureau of Reclamation (Reclamation). 2004b. *Lower Colorado River Multi-Species Conservation Program; Final Habitat Conservation Plan.* Volume II. December 17, 2004.

United States Bureau of Reclamation (Reclamation). 2009. Parker Dam. http://www.usbr.gov/lc/hooverdam/parkerdam.html accessed on 11 January 2010.

United States Department of the Interior (USDI). 2006. Davis Dam and Powerplant. http://www.usbr.gov/lc/region/pao/brochures/davis.html accessed on 27 January 2010.

United States Department of the Interior (USDI). 2007. Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead Draft Environmental Impact Statement. Bureau of Reclamation, Boulder City, NV, p. 540.

United States Environmental Protection Agency (EPA). 2008. Frost-Preventing Bacteria: Pseudomonas fluorescens A506 (006438); Pseudomonas fluorescens 1629RS (006439); Pseudomonas syringae 742RS (006411) Products. http://www.epa.gov/pesticides/biopesticides/ingredients/product/prod 006438.htm accessed on 30 March 2011.

United States Environmental Protection Agency (EPA). 2011. "Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). http://www.epa.gov/agriculture/lfra.html#Registration%20of%20New%20Pesticides accessed on 11 January 2010.

United States Fish and Wildlife Service (USFWS). 2009. *Draft Environmental Assessemt for the Topock Marsh Water Infrastructure Improvements Project on the Havasu National Wildlife Refuge, Arizona."* November 2009.

United States Geological Survey (USGS), Southern Nevada Water Authority, Bureau of Reclamation. 2006. Physical and Chemical Water-Quality Data from Automatic Profiling Systems, Boulder Basin, Lake Mead, Arizona and Nevada, Water Years 2001–04. Open File Report 2006-1284. http://pubs.usgs.gov/of/2006/1284/ofr2006-1284.pdf accessed on 23 March 2011.

United States Geological Survey (USGS). 2010. NAS-Nonindigenous Aquatic Species; Dreissena rostriformis bugensis. http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=95 accessed on 26 February 2011.

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