

5.3.6 Aquatic Resources

5.3.6.1 Affected Environment

The LPP Project involves lands and waters in two states (Utah and Arizona) and crosses a variety of federal, state and privately managed property. The drainage basins include Lake Powell and the Colorado River, and the Virgin River tributary to Lake Mead. There are numerous seasonal, intermittent, and ephemeral washes, gulches and creeks that are potentially affected by the LPP Project. However, only the Paria and Virgin rivers and Kanab Creek near Fredonia carry perennial flows within the area of potential effect and can be expected to provide habitat for aquatic resources. A perennial stream is defined as a body of water flowing in a natural or man-made channel year-round, except during periods of severe drought. The term “water body with perennial flow” includes perennial streams, reservoirs and ponds that form the source of a perennial stream, or through which the perennial stream flows, are a part of the perennial stream. Generally, the water table is located above the streambed for most of the year and groundwater discharge could be the primary source or a significant portion of the stream flow. In the absence of chronic pollution or other man-made disturbances, a perennial stream is assumed to be capable of supporting aquatic resources for most, if not all, of the year on a continual basis. An intermittent or ephemeral drainage is defined as a body of water flowing in a natural or man-made channel that contains water for brief periods of the year. During the dry season and periods of drought, these streams do not exhibit surface flow. Geomorphological characteristics are not well defined and are often inconspicuous. In the absence of external limiting factors (pollution, thermal modifications, etc.), aquatic resources are scarce or nonexistent and must be adapted to the wet and dry conditions of the fluctuating water level or be able to migrate to more habitable areas when flows decline.

The immediate area around the water intake system screens in Lake Powell are considered part of the LPP Project study area for aquatic resources, because the intake screens could potentially entrain native fish from the lake and facilitate the transfer of invasive aquatic species to other drainages. The primary potential effects associated with the important stream and drainage areas for aquatic resources involve: 1) the effects of pipeline and penstock construction across or near perennial streams, 2) the accidental or occasional release of water from the pipeline to other drainages, and 3) the resultant potential transfer of aquatic invasive species from water releases.

5.3.6.1.1 Lake Powell and Colorado River.

The Colorado River below Glen Canyon Dam has been extensively studied and analyzed over the last 20+ years with regard to the discharge of water and the movement of sediments and settleable solids in the river. The effect of water withdrawal by the LPP Project has not been considered a major concern because of the relatively minor scope of the diversion in comparison to the normal daily, monthly, seasonal and annual variations. The effects on downstream flows and water quality were modeled by the Bureau of Reclamation (Reclamation) in 2015 (Reclamation 2015, and Reclamation 2016). The Reclamation hydrologic model evaluated the proposed LPP Project water withdrawal during the period from 2020 through 2060. The conclusion presented, based upon the model results, was that Lake Powell elevations and the flow in the Colorado below Glen Canyon Dam were essentially the same with or without the Project (Proposed Action vs. No Action Alternative) under the proposed annual withdrawal of 86,249 acre feet of water. The Reclamation model also showed that the water quality of Lake Powell with or without the LPP Project, in terms of dissolved oxygen and temperature downstream of the proposed diversion are so minimal as to be non-detectable using current field instrumentation.

Lake Powell is the second largest reservoir in the United States, encompassing over 160,000 acres at full pool. Table 5-71 shows the common and scientific names of fish species and their relative abundance in Lake Powell. There is no available information on distribution or species count for the variety of fish species occurring in the reservoir. The Utah Division of Wildlife Resources (UDWR) indicates that in 2008, 2009 and 2013 there was an attempt to introduce cutthroat trout in to the upper reservoir by planting fry (2-3 inch fish) (UDWR 2016a). No records of any fish planting in Lake Powell after 2013 are available.

Table 5-71
Common and Scientific Names of Fish Species and Relative Abundance in Lake Powell¹

Common Name	Scientific Name	Relative Abundance
Black crappie	<i>Pomoxis nigromaculatus</i>	Common
Bluegill	<i>Lepomis macrochirus</i>	Common
Channel catfish	<i>Ictalurus punctatus</i>	Abundant
Common carp	<i>Cyprinus carpio</i>	Common
Crappie	<i>Pomoxis annularis</i>	Abundant
Gizzard shad	<i>Dorosoma cepedianum</i>	Abundant
Green sunfish	<i>Lepomis cyanellus</i>	Common
Largemouth bass	<i>Micropterus salmoides</i>	Abundant
Rainbow trout	<i>Oncorhynchus mykiss</i>	Scarce
Smallmouth bass	<i>Micropterus dolomieu</i>	Abundant
Striped bass	<i>Morone saxatilis</i>	Abundant
Walleye	<i>Sander vitreus</i>	Common

¹Source: UDWR 2016b

The Reclamation water quality model simulated a number of important water quality parameters under the LPP Project water withdrawals and projected water quality changes during the period from 2043 through 2060 (full withdrawal of the LPP Project water). The model results indicated that there would be no measurable difference for downstream temperature profiles, TDS, DO, and nutrients between the Proposed Action and No Action alternative in the water released from Glen Canyon Dam.

The Reclamation modeling studies and other modeling results demonstrate the LPP Project would have no measurable effects on aquatic resources in Lake Powell or the aquatic resources and aquatic habitat downstream of Glen Canyon Dam.

5.3.6.1.2 Water Intake.

The proposed LPP Project intake would be located near the south end of the lake adjacent to Glen Canyon Dam (Figure 5-98). The current conceptual design has the intake site located at a nearly vertical cliff adjacent to the lake at a point where the water depth is approximately 510 feet. The intake would consist of two bored or excavated parallel vertical shafts with six horizontal valved lake intake tunnels spaced approximately 100 feet apart vertically, with the uppermost intakes stationed approximately 125 feet below the high water level (El. 3,700 ft). Each of the horizontal intakes would be fitted with screens, each with an intake fish screen approach velocity of less than 0.5 feet per second. Typically most healthy fish and actively motile aquatic species can avoid being entrained in an intake suction flow if the velocity is maintained below the escape velocity (swimming speed) of those organisms. For most fish, other aquatic vertebrates and many active motile larval stages and invertebrates, the escape velocity ranges from 0.5 to 0.6 feet per second (NMFS 2008). Non-motile or very small organisms are typically not able to escape the intake suction and would be collected in the incoming water and, as necessary, must be removed or inactivated by other methods prior to point of use, depending on the application of the water.



— LPP Alternative Alignment
— Intake Pump Station Facility
— Bureau of Reclamation Management Area

FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472

0 100 200 400 600 800 Feet

Lake Powell Pipeline Project
Spatial Reference: UTM Zone 12N, NAD-83



UDWRe Figure 5-98

MWH

Lake Powell Pipeline
Intake System

The proposed screening method and water intake preliminary design precautions to avoid fish collection and entrapment have generally been well defined and have been developed over years of study and practical application. If designed and operated properly to meet the conventional federal and state agency requirements for fish entrapment avoidance, then fish species in Lake Powell near the dam would not be entrapped or entrained by the fish screens.

The intake is to be fitted with six separate horizontal diversion tunnels (Figure 5-99) that would provide the option for diverting water at various depths. This would allow for operational water quality control as well as providing some level of management oversight to avoid regions of the water body that may contain concentration of species (invertebrates, algae, etc.), that can be avoided by varying the depth of the diversion intake depth.

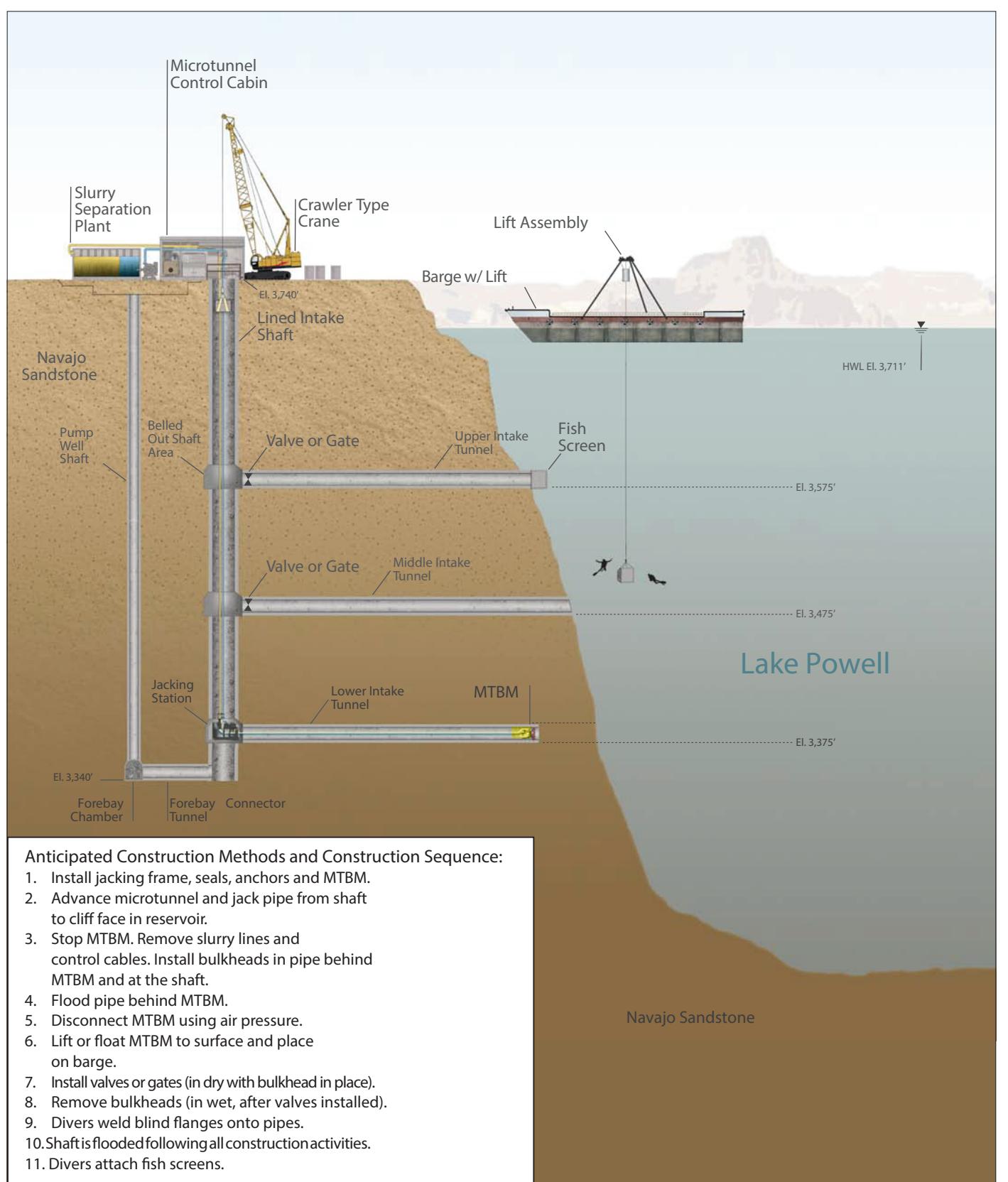
Construction of the intake would occur from the shore using deep vertical access shafts and horizontal tunnels drilled using microtunnel boring machines (MTBM). The spoil from the tunnel construction would be extracted from the landside and not deposited in the lake. Final installation of screens and appurtenances would be by divers working off construction barges. Geotechnical studies of the Navajo sandstone formation where the intake is to be constructed indicates the rock material is reasonably competent with a low permeability. Unusual construction problems have not been identified.

5.3.6.1.3 Pipeline and Penstock Crossings of Streams.

The potential direct effects of the LPP Project involve the alignment and construction of the pipeline and penstock, and to a minor extent, the supporting facilities (pump stations, regulating tank, hydro stations, etc.) as they cross the perennial drainages in the area of potential effect. The discharge of water for pipeline or penstock maintenance purposes or through drain valves (minor amounts) or from a pipe breach or accident are evaluated as a potential source of effect on the existing aquatic resources.

5.3.6.1.4 Aquatic Resources Habitat.

For this analysis, only those project components that would affect water resources or aquatic resources habitat were considered. The affected environment considered was limited to perennial streams and drainages that could sustain aquatic resources. Intermittent drainages and ephemeral channels were not considered as relevant to the project in terms of sustainable aquatic resources. The definitions of perennial streams and intermittent ephemeral drainages are included in Section 5.3.6.1.



FERC Project Number:

12966-001

BLM Serial Numbers:

AZA-34941

UTU-85472

1 inch = 80 feet

0 20 40 80 120 160
Feet

Lake Powell Pipeline Project

Spatial Reference: UTM Zone 12N, NAD-83

UDWRe Figure 5-99 **MWH**

**LPP IPS
Intake Underground
Features**

A subjective field protocol was developed for assessing the condition of each drainage that would be affected by the LPP Project components. The objective was to determine if a drainage was a perennial stream or an intermittent/ephemeral drainage. This protocol involved field reconnaissance observations to determine where potential construction effects could occur in or proximate to defined drainages, washes, gulches, canyons, rivers, streams, creeks, etc., that would be transected by the pipeline or penstock.

Existing drainages were identified on available mapping and aerial photographs. A project scientist and engineer reviewed the project pipeline and penstock alignments by vehicle and/or on foot to review each potential water body and to assess its condition. After observing each segment of a candidate drainage at different times during the 2007 through 2013 field seasons, investigators developed a representative understanding of perennial drainages that could provide habitat for aquatic resources.

The following criteria were used to evaluate drainages:

- Presence or absence of flowing water
- Presence of high groundwater seeps or springs
- Presence of leaf litter in stream bed that would indicate the hydraulic transport of plant material. In flowing streams, there is little or no leaf litter or only small accumulations at the high water mark.
- Sediment build-up that would indicate seasonal flows
- General geomorphological conditions including riffle-pool sequences, bank condition, soil features
- Vegetation established in a channel bottom that could not occur in flowing stream
- Benthic macroinvertebrate populations

These evaluation criteria were applied at each drainage crossing to determine if it possessed characteristics that would indicate perennial flow and related aquatic resources.

This was a subjective evaluation and may be subject to modification based on additional evidence; however, for this analysis, the drainages considered to have a potential for aquatic resources are limited to the following within the area of potential effect.

- Lake Powell (potential biota transfer, intake)
- Paria River
- Kanab Creek at Highway 89 Bridge in Fredonia, Arizona

5.3.6.1.5 LPP Intake Pump Station and Invasive Species Management.

The proposed LPP Project water diversion from Lake Powell increases the probability that invasive mussel species could be transferred (biota transfer) to other drainages. The concerns relating to the effect of the quagga mussel (*Dreissena bugensis*) and to a lesser concern the zebra mussel (*Dreissena polymorpha*) in Lake Mead are well documented and this problem has significantly affected operation of local domestic water intakes at the Lake, has resulted in the temporary closure of the Cold Water Fish Hatchery at Lake Mead, affected surface water withdrawals for the Central Arizona Project and the California water system, and has had a real effect on recreational use of the resources throughout the western United States and Canada.

As of 2012, Federal and State fish and wildlife agencies found definitive evidence of quagga mussels in Lake Powell. Quagga mussel veligers were detected at Antelope Point and near Glen Canyon Dam using DNA tests. Adult quagga mussels were found on boats and canyon walls near Wahweap Marina in 2013. The National Park

Service initiated a Quagga/Zebra Mussel Management Plan for Lake Powell in 2014 after thousands of adult quagga mussels were found on canyon walls, Glen Canyon Dam, boats, and other structures. Current efforts are being directed at controlling the spread of quagga mussels to other parts of the reservoir. Lake Powell is considered infested by *Dreissena* mussels as of October 2015.

Future project design efforts would include measures to protect and/or exclude invasive species from becoming an operational problem for the LPP Project or from being transported to other water bodies (biota transfer).

For this evaluation of the LPP Project, the implementation of future mitigation measures to avoid the effect of mussel infestation is considered as part of the proposed LPP Project. This is necessary to both protect the operation of the water supply system and prevent the biota transfer of these organisms to other water systems.

5.3.6.1.5.1 Invasive Species Management.

The use of any water intake and water supply system must consider the potential effects invasive aquatic species may have on the successful operation of the system. Water treatment plants can provide a number of opportunities and methods (settling, filtration, etc.) for removal of organisms prior to distribution for final use. However, the effect of these organisms prior to treatment or when “raw” water is conveyed must be considered with regard to operating water conveyance facilities and other appurtenant structures (valves, meters, hydro plants, etc.). Quagga and zebra mussels are aggressive structural and mechanical equipment bio-foulers. When present in a source water supply system, they potentially become a serious problem for operating municipal and industrial supply facilities. At a minimum, even the simplest colonization in a pipeline creates significant friction losses which limit pipeline discharge.

Larvae, juvenile and adult mussels can all move in the water column through a variety of active and passive transport methods. Control of *Dreissena* species in water conveyance systems is both an operational and environmental issue. For this analysis, of particular concern is the prevention of mussel entrainment at the LPP Project intake and into water conveyance facilities. Of significant interest for the LPP Project would be the potential bio-fouling effects on facilities such as the intake screen, water conveyance pipeline and initial pumping facilities which would primarily occur during the larval life-stage (gamete, veliger and post-veliger) when the organisms are most motile.

Invasive mussels are found in the area surrounding the proposed LPP Project intake. Provisions for removing and/or mitigating for the organisms would be incorporated into final design of the intake pump station for the LPP Project raw water supply. Best available technology for controlling aquatic invasive species at the water intake pump station would be implemented as part of the final design.

Colonization and transport are generally considered the two factors associated with the mussels and piping systems. It is essential that any facility that could experience mussel fouling be prepared to detail with both types. Chronic fouling occurs when juvenile quagga mussels attach themselves to external and internal structures. The juvenile mussels grow in place, develop into larger adult mussels, and reduce or cut off water flow through intakes and pipes. Acute fouling occurs when a large build-up of adult mussel shells, alive or dead, becomes detached from upstream locations and are carried by the water flow into piping systems. The large quantities of mussel shells quickly plug small diameter pipes, fixed strainers, filters and other equipment, or damage pumping equipment. Such events can occur at unexpected times and, if not anticipated, can have rapid and significant consequences.

The areas of concern for the LPP Project include, but are not limited to, the screened intake, pumping facilities, piping systems and support facilities (instrumentation, utility water, etc.).

Significant research has been performed and is ongoing to develop effective methods for mussel control because of the continued proliferation of quagga mussels throughout the major water supply systems in the western United States.

Various methods to remove, prevent attachment or reproductively inactivate mussel species have been attempted and/or proposed. The most common approach to date has been the application of chlorine solution or other chemicals to water entering intakes. This can destroy the larval forms but may not affect adults that can close their shells in response to toxic chemicals and survive for some time without additional raw water. Since the veligers can be the most motile, this treatment approach can be effective on this life stage in some cases. Other potential *Dreissena* species control methods include filtration, mechanical and electronic screening, anti-fouling coatings, UV irradiation, other chemicals including oxidants and molluscicides, the use of biological agents and others.

Control of *Dreissena* species at all life stages in the Water Intake System would be accomplished through the use of the most up-to-date, selective and environmentally compatible treatment available. In various parts of the country, a molluscicide approved by the EPA is used in closed systems. The active ingredient in the molluscicide is the dead cells of a strain of the soil bacteria *Pseudomonas fluorescens*, which *Dreissena* species filter out of dosed water and process as a food source. When *Dreissena* species digest the strain of dead *Pseudomonas fluorescens* cells, the epithelial cells lining the mussels' digestive system are disrupted causing mussel mortality. The dry bulk molluscicide would be stored, mixed with water, and injected by chemical metering pumps in the Water Intake Pump Station chemical room through pipes leading to dosing equipment in the operating intake tunnels. The mixed molluscicide would be dosed into the tunnel intake water immediately downstream from the fish screens at a concentration that would prevent settlement of juvenile and planktonic mussel life stages (veliger life stage) continuously throughout mussel spawning seasons. Site assessment monitoring would be performed to determine when mussels are preparing to spawn and molluscicide injection should begin. The molluscicide has been subjected to extensive toxicology studies demonstrating no bacteria-induced mortality to non-target aquatic organisms, including fish, native freshwater unionids, ciliates, daphnids, plants, algae, crustaceans, insects and birds. The fish screens in Lake Powell on each intake tunnel would require regular physical cleaning to remove adult mussels and other biological growth from the screen surfaces.

The current best available technology for quagga mussel control combines the use of molluscicides with filtration on pump discharge pipes. The filters involve using a 25-micron filter on each pump discharge pipe to remove biological materials (including residual dead mussel veligers) that pass through the fish screens and intake tunnels. The filters are equipped with automatic backwashing systems to remove the filtrate material for disposal. The filtrate material would be dewatered and landfilled off-site in an approved landfill. It should be noted that small quantities of filtrate material would be generated. Filters would be periodically inspected, serviced and replaced as necessary during operation by running a standby pump and filter. The molluscicide and filter combination is one aquatic invasive species control approach that could be applied at the Water Intake Pump Station.

5.3.6.1.6 Aquatic Resources in Perennial Drainages.

5.3.6.1.6.1 Lake Powell Drainage.

The intake structure and intake pump station construction would not directly or indirectly involve aquatic resources or aquatic resource habitat in Lake Powell tributary drainages. Construction of the pipeline and associated pump stations, tanks and hydroelectric facilities, would involve drainages with no aquatic resource value. The pipeline and penstock alignment and the location of ancillary facilities along Highway 89 involve land that does not sustain drainages with perennial flows. Numerous ephemeral washes draining directly to Lake Powell do not sustain perennial surface flows nor do they support any aquatic resource habitat.

5.3.6.1.6.2 Paria River Drainage.

The Paria River, which flows north to south from Utah to Arizona, maintains a perennial flow and it tributary to the Colorado River. The LPP Project Water Conveyance System would cross the Paria River drainage several times, once across the main Paria River immediately upstream of Highway 89 (Figure 5-100), three times across Sand Gulch which joins the Paria River at the Highway 89 crossing, and once across Buckskin Gulch (Figure 5-101), a tributary to the Paria River. These pipeline crossings would be in Utah. The Sand Gulch and Buckskin Gulch crossings are ephemeral and have no aquatic resource habitat.



Figure 5-100
Paria River at Highway 89 Pipeline Crossing



Figure 5-101
Buckskin Gulch Dry Streambed at Highway 89 Pipeline Crossing

The points where the LPP Project would cross the Paria River drainages are not in a wilderness study area and would be adjacent to existing Highway 89 bridge and culvert crossings. The Paria River maintains some flow (19.8 cubic feet per second annual average base flow) throughout each year; however, at the Highway 89 crossing, the river is dry throughout periods of each year. The Paria River is a “muddy” river and carries a significant suspended sediment load and fine sediment bedload. The flow is subject to flash flooding during periods of rainfall and seasonal runoff. The area of the water conveyance pipeline crossing of the Paria River can be characterized as a flat desert environment devoid of vegetation within the active channel and riparian vegetation (willows, tamarisk) growing in the surrounding floodplain. The proposed crossing area adjacent to the Highway 89 bridge is composed of fine silt, sand and small gravel and runoff debris on the surface.

The Paria River releases significant amounts of sediment to the Colorado River below Glen Canyon Dam each year that is carried further down into the Colorado River system by planned dam releases. Reaches of the river above the Paria Canyon wilderness (Primitive) areas are known to be impaired as a result of grazing and other human uses.

Five fish species are reported to be occasionally found in the lower Paria River, miles downstream from the LPP Project crossing adjacent to the Highway 89 bridge crossing.

Downstream reaches of the Paria River may provide habitat for flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus*), razorback sucker (*Xyrauchen texanus*), rainbow trout (*Oncorhynchus mykiss*) and speckled dace (*Rhinichthys osculus*). These fish, with the exception of rainbow trout and speckled dace, are considered sensitive by the State of Utah. The razorback sucker is federally listed as endangered and is discussed in further detail in the Special Status Aquatic Species and Habitats section of this chapter. The bluehead sucker feeds on algae from the bottom of stream substrate and typically inhabits large rivers and mountain streams with variable turbidity and temperature. The flannelmouth sucker also is a bottom feeder consuming algae, other fragmented vegetation, seeds and invertebrates. The species lives within moderate to large rivers and is typically affected by nonnative species, hybridization, habitat alteration and blockage of migration routes. The flannelmouth sucker and bluehead sucker are managed under a Conservation Agreement that has precluded

federal species listing (UDWR 2006). Rainbow trout is a game fish common in Utah reservoirs and rivers and can be found in water bodies associated with the LPP Project area. The speckled dace is a minnow common in many western waters. It is a bottom-dwelling species and is an important forage fish.

While a definitive assessment of the condition of these species in the Paria River near the area of potential effect for the LPP Project was not found in the literature, it is assumed that durability of the populations are dependent upon climate and the availability of flow from seasonal precipitation. There would be no proposed releases of LPP Project water into the Paria River.

Current proposed planning would have the crossing of the Paria River completed by open-cut excavation and fill during no or low-flow conditions. The pipeline crossing construction would involve a temporary diversion of any low stream flows to another portion of the broad river channel bottom (340 feet wide adjacent to the highway bridge). The Paria River crossing would be on private land and would be immediately upstream of the existing Highway 89 Bridge.

Buckskin Gulch is essentially dry during the majority of the year. It would be crossed using open cut and fill construction techniques.

5.3.6.1.6.3 Kanab Creek Drainage.

The penstock crossing alternatives of Kanab Creek and its associated drainages (Jacob Canyon, Bitter Seeps Wash) is the next westerly drainage along the proposed LPP Project alignment where a possible aquatic resource effect could occur. There are two alternative alignments for the penstock that could cross Kanab Creek. The Existing Highway alignment crossing site (Figure 5-102) is east of the Kaibab-Paiute Indian Reservation near Fredonia. The Proposed Action and Southeast Corner Alternative crossing site is approximately 0.5 mile south of the Reservation southern boundary (Figure 5-103).

Kanab Creek, located north of Kanab, has perennial flow through the narrow, rock canyon upstream of the LPP Project penstock alignment. Pools and groundwater seeps are present in some reaches south of Kanab. The alternative alignment penstock crossings of Kanab Creek and its principal drainages (Jacob Canyon and Bitter Seeps Wash) were dry on most occasions during the 2007 through 2013 field seasons. Kanab Creek near Fredonia supports no populations of sport or native fish because of the intermittent flows associated with this part of the drainage. Flannelmouth sucker, a sensitive species, may be present in Kanab Creek farther upstream and north of the pipeline alternative alignment. Speckled dace are present in Kanab Creek upstream from Kanab City. Upstream users of Kanab Creek in Utah divert flows for irrigation purposes, leaving it mostly dry in the summer season where any of the proposed LPP Project alternative alignments would cross the creek. Kanab Creek is a naturally intermittent stream. Water projects developed for irrigation prior to the beginning of the twentieth century have further altered the natural flow and have reduced or eliminated the aquatic habitat in downstream reaches.

Kanab Creek is the largest tributary canyon system to the Grand Canyon on the north side of the Colorado River. Upper Kanab Creek upstream of Kanab City passes areas with potential wilderness characteristics. The lower reach through the Kaibab-Paiute Indian Reservation is not considered to have the same recreational opportunities or support any aquatic resources.

Kanab Creek at the penstock crossing along the Existing Highway Alternative near Fredonia is characterized as a dry wash with little evidence of regular flow. The abundant vegetation includes willow and tamarisk which would indicate the presence of soil moisture but little surface flow. The penstock crossing reach is heavily grazed and trampled by livestock.



Figure 5-102
Existing Highway Alternative Penstock Crossing of Kanab Creek



Figure 5-103
Proposed Action and Southeast Corner Alternative Penstock Crossing of Kanab Creek

The Proposed Action, outside the south Reservation boundary, would cross Kanab Creek, Jacob Canyon and Bitter Seeps Wash. These drainages all show little evidence of regular surface flow. Remnant pools in Kanab Creek Canyon (Figure 5-104) are a result of storm water runoff entrapment and the vegetation development would indicate that actual water flow is limited in volume and duration. Jacob Canyon (Figure 5-105) and Bitter Seeps Wash (Figure 5-106) are dry washes with only one recorded surface flow in each during the LPP field studies from 2007 through 2012. The Jacob Canyon crossing is characterized by a channel bed comprised of particles ranging from small cobble to fine sand. The Bitter Seeps Wash crossing location is characterized by particles ranging from medium to fine sand. None of these crossings would need to be constructed during periods when measurable flow would be expected in Kanab Creek or its tributaries, therefore they all could be constructed by open cut techniques without having any measurable effect on potential aquatic resources.



Figure 5-104
Remnant Pools in Kanab Creek Canyon



Figure 5-105
Jacob Canyon at Proposed Action Penstock Crossing



Figure 5-106
Bitter Seeps Wash at Proposed Action Penstock Crossing

Sand Hollow Reservoir. Sand Hollow Reservoir is an off-stream reservoir constructed, owned, operated and maintained by WCWCD and would be the terminal reservoir for the WCWCD share of the LPP Project water. The reservoir was initially stocked with catchable sport fish following construction in 2002. The reservoir has a resident fishery that is self-sustaining.

A single quagga mussel was collected from the reservoir in 2010. Aggressive sampling has not found additional mussels since 2010. The reservoir has been removed from those water bodies considered to be infested. Subsequent tests and monitoring in 2013, 2014 and 2015 demonstrate no presence of quagga mussel in Sand Hollow Reservoir.

Sand Hollow Reservoir (1,300 acres surface area) would be the terminal delivery point for LPP water. Table 5-72 shows the common and scientific names of fish species and their relative abundance in Sand Hollow Reservoir. The reservoir opened for fishing in 2004 and has proven to be a popular sports fish site due to ease of access and location near a populated area. Utah Division of Wildlife Resources stocking records indicate no fish stocking of Sand Hollow Reservoir from 2002 through 2016 (UDWR 2016a).

Table 5-72 Common and Scientific Names of Fish Species and Relative Abundance in Sand Hollow Reservoir¹		
Common Name	Scientific Name	Relative Abundance
Bluegill	<i>Lepomis macrochirus</i>	Abundant
Largemouth bass	<i>Micropterus salmoides</i>	Abundant

¹Source: UDWR 2016b

Sand Hollow Reservoir would transfer LPP Project water to Quail Lake (Quail Lake or Quail Creek Reservoir). Quail Lake is one of the most popular bass (largemouth bass) fishing areas in Utah. In addition to bass species the reservoir contains rainbow trout, bluegill, catfish and a number of other warm water species. The Utah Division of Wildlife Resources actively stocks the reservoir with rainbow trout and have maintained a small “put and take” catchable (10-20 inch fish) program since 2003 according to Division stocking records (UDWR 2016a).

5.3.6.1.6.4 Virgin River Drainage.

The Virgin River is the most significant water resource Washington County. It is a perennial stream with wide variation in flow dependent on seasonal precipitation, climate and runoff throughout the year from its source in Utah to the Utah-Arizona state line.

The Virgin River in Utah provides habitat for various aquatic resources. The Virgin River Resource Management and Recovery Program has been established to help recover various sensitive and federally listed species within the river including woundfin (*Plagopterus argentissimus*) and Virgin River chub (*Gila seminuda*), which are both federally listed as endangered species and are discussed in further detail in the Special Status Aquatic Species and Habitats section of this chapter. Virgin spinedace is managed through a Conservation Strategy (UDWR 2002), and desert sucker is a special status aquatic species. The desert sucker and Virgin spinedace are discussed in further detail in the Special Status Aquatic Species and Habitats section of this chapter.

5.3.6.2 Environmental Effects

5.3.6.2.1 Significance Criteria.

The significance of potential effects on aquatic resources considers both context and intensity. Context includes the duration (short-term or long-term) of the effect and the consequence of direct or indirect actions. Intensity refers to the actual severity of an effect. Intensity can be beneficial and/or adverse, be unique or universal and have regulatory or local implications. Intensity assessment can be subjective with regard to certainty or potential of an effect and can be an objective assessment for other issues and concerns.

Key factors that influence significance of most effects can include:

- Magnitude (i.e., with this action element the value of resource)
- Duration or frequency (how long and how often)
- Global extent or areal implication
- Certainty or potential likelihood of actually occurring

These key factors, when not quantifiable, are typically rated using a subjective analysis similar to the following:

Magnitude:

- major
- moderate
- minor

Extent:

- large
- medium (localized)
- small (limited)

Duration:

- long-term
- medium term (intermittent)
- short-term

Likelihood:

- probable
- possible
- unlikely

This procedure was used to evaluate the potential effects of the Proposed Action and alternatives on aquatic resources.

The Proposed Action and other LPP Project alternatives would have no effects on aquatic resources in transected drainages from changes in existing water supply, use and diversions. The LPP Project water would only originate from the diversion at Lake Powell. Potential effects could occur on aquatic resources and their habitat in Sand Hollow Reservoir, which is currently managed as a put-and-take fishery and for M&I water supply storage.

The proposed LPP Project diversion of less than 0.6 percent of the current annual average flow withdrawn from Lake Powell would not have a significant effect on the availability of water for habitat conditions or aquatic resources or species.

Ephemeral streams, washes, gullies, etc. that do not measurably contribute to perennial streams within the area of potential effect are, by the earlier definition, not significant contributors to the available aquatic habitat or resources and are not considered further in this analysis.

Potential effects on LPP Project storage reservoirs, tanks and other artificial water supply structures were not considered because these facilities would be managed in a non-natural manner and would not contain any aquatic resources.

The effects of the Proposed Action and alternatives would not be considered significant adverse effects on the aquatic habitat unless invasive species were introduced that could escape into natural waters, which would have a very low probability of occurring.

5.3.6.2.2 Proposed Action.

The primary aquatic resource effects under the Proposed Action could occur at the Paria River pipeline crossing. The Proposed Action would have minimal to no short-term effects on aquatic habitat or aquatic species. Construction effects on aquatic habitat would be limited to the immediate area of excavation disturbance following stream diversion. The stream channel surface would be restored to preconstruction conditions following pipeline installation. Residual effects on aquatic species or aquatic habitat would be unlikely. Potential short-term effects on aquatic resources at the Paria River pipeline crossing would not be significant.

The Proposed Action would have no long-term effects on aquatic habitat or species at the Paria River. No planned LPP water releases would occur to the stream during operations. In the event water must be released from a pipeline drain valve to the stream, there would be no aquatic biota transfer because of biological and physical controls implemented at the water intake pump station and booster pump stations if necessary. The potential infrequent release of LPP water from a pipeline drain valve to the Paria River near the pipeline crossing would dilute sediment-laden water, which would have a short-term effect on local aquatic habitat. Potential long-term effects on aquatic resources at the Paria River pipeline crossing during operations would not be significant.

5.3.6.2.3 Existing Highway Alternative.

The aquatic resource effects of the Existing Highway Alternative would be the same as described for the Proposed Action in Section 5.2.6.2.2.

5.3.6.2.4 Southeast Corner Alternative.

The aquatic resource effects of the Southeast Corner Alternative would be the same as described for the Proposed Action in Section 5.2.6.2.2.

5.3.6.2.5 No Lake Powell Water Alternative.

The primary aquatic resource effects under the No Lake Powell Water Alternative would be long-term indirect effects resulting from eliminating residential outdoor watering with potable water, which would reduce groundwater recharge that currently flows subsurface to the Virgin River during the summer and fall months in the St. George metropolitan area. The Virgin River and tributary streams from Hurricane to the Utah-Arizona state line would have reduced non-sewered return flows to the Virgin River by 2052 ranging from 21.4 to 23.5 cfs (77 to 80 percent reduction) resulting from eliminating residential outdoor watering during the summer and fall months (UDWRe 2016). The reduced streamflows would potentially reduce aquatic resource habitat area, increase water temperature during the summer months, change aquatic resource food supplies, and diminish the areal extent and functions of riparian areas along the streams. These could be significant long-term indirect effects on aquatic species and habitats in the St. George metropolitan area under the No Lake Powell Water Alternative.

5.3.6.2.6 No Action Alternative.

The No Action Alternative no effects resulting on aquatic resources in the LPP Project study area.

5.3.6.3 Protection, Mitigation and Enhancement Measures

Aquatic resource protection and mitigation measures would be focused on avoiding construction activities in ephemeral drainages during periods of high runoff and ensuring that all construction areas are suitably reclaimed prior to seasonal runoff periods. This is both a safety issue (flash flooding) and to protect the local and downstream aquatic resources. Construction in and around perennial streams in the area of potential effect would be performed using open cut trench excavation and fill techniques, with temporary diversions of active flow around the pipeline crossing sites. At perennial streams, BMPs would be implemented to avoid or minimize effects on water quality, aquatic resources and habitat. BMPs would include the following:

- Construction of pipeline crossings of perennial or intermittent flowing streams (e.g., Paria River and Kanab Creek) would be performed when the streams are either at low flows or are dry.
- Silt fences and/or straw bales would be temporarily installed upstream or up-gradient of riparian areas to filter suspended sediments and bedload sediments to avoid sedimentation effects during construction. If necessary, silt fences and/or straw bales would be installed in series to control sediments and turbidity generated by construction activities.
- Temporary coffer dams would be constructed upstream of pipeline crossings for diversion of Paria River flows during construction. Stream flows would be diverted around in-channel work and excavation areas to control turbidity during construction of the pipeline crossings. Temporary coffer dams would be removed from the stream following completion of the pipeline construction crossing and the aquatic habitat would be restored to preconstruction conditions.
- Equipment usage and operation within temporarily dewatered reaches of stream channels would be minimized to protect stream bed substrates.
- Construction equipment working within the temporarily dewatered reaches of stream channels would be checked and regularly monitored for leaking hydraulic fluid, oil, grease, and fuel. Any visible leaks would result in immediate removal of the leaking equipment from the stream channel work area and containment of the leakage within a containment pad in an upland area to isolate potential contaminants and prevent spills on soil. Relevant land management agencies should be notified of any spills or leaks detected.
- All construction equipment refueling would be performed on upland areas within spill containment berms or pads to prevent fuel spills from contaminating stream substrates and temporarily dewatered stream reaches.
- Construction trenches within dewatered stream reaches would be pumped as necessary to remove subsurface water. The water would be pumped into portable tanks for settling, and then land applied away from the streams for disposal.

Silt fences would be installed across the stream channels within the dewatered construction areas downstream of the pipeline crossing excavation to capture sediments that may be mobilized by precipitation events during construction activities. The silt fence toe would be anchored into the stream bed with native material. The silt fence would be removed following completion of the pipeline crossing construction and native material used to anchor the silt fence toe would be returned to pre-construction conditions. The silt fence that is removed would be disposed of in approved landfills. Sediment trapped by the silt fence would be incorporated into the backfill and spoil material and distributed across the ROW as part of surface restoration operations.

The effects of these BMPs on aquatic resources in perennial drainages would be short-term throughout the duration of construction and aquatic habitat restoration activities.

Monitoring would include both construction-related and long-term monitoring to utilize an adaptive management approach for assessing any future issues or effects and provide for operational modifications. Monitoring of flow, water quality and benthic macroinvertebrates prior to and following any instream construction would be performed on perennial stream crossings. Pre-construction electroshocking or clearing of portions of the channel to be temporarily dewatered would be performed to remove any fish prior to diverting the flow into a diversion channel. Post-construction electroshocking or clearing of the diversion channel would be performed to remove any fish prior to returning the flow to the original channel and closing off the diversion channel.

Long-term monitoring would include routine visual inspection of pipeline stream crossings and construction areas. Flow and pressure measurement provisions, to assess any pipeline leakage, would be included in the project design. It is unlikely that the pipeline and penstock operation would result in any measureable unregulated discharges. Periodic pipeline and penstock maintenance or other inspection activities would require draining

specific segments at low points in the hydraulic grade line during January each year. The infrequent pipeline or penstock segment water releases on receiving drainages would be monitored and drain valves adjusted to avoid or minimize potential erosion and sediment recruitment. Incidental discharges from drain valves would flow onto rock riprap aprons placed around the discharge to dissipate the flow energy and avoid erosion of stream bed and bank particles.

Under the No Lake Powell Water Alternative, long-term monitoring could be performed to document the potential decline of aquatic resources and habitat in the indirectly affected waters. No protection, mitigation, or enhancement measures would be undertaken as part of the No Action Alternative.

5.3.6.4 Cumulative Effects

5.3.6.4.1 Proposed Action.

The Proposed Action would have no measurable short-term or long-term effects on aquatic resources and therefore would have no measurable short-term or long-term cumulative effects on aquatic resources when combined with past, present and reasonably foreseeable future interrelated actions.

5.3.6.4.2 Existing Highway Alternative.

The Existing Highway Alternative would have the same cumulative effects as the Proposed Action described in Section 5.3.6.4.1.

5.3.6.4.3 Southeast Corner Alternative.

The Southeast Corner Alternative would have the same cumulative effects as the Proposed Action described in Section 5.3.6.4.1.

5.3.6.4.4 No Lake Powell Water Alternative.

The No Lake Powell Water Alternative would have no measurable short-term cumulative effects on aquatic resources when combined with past, present and reasonably foreseeable future interrelated actions. The reduced return flows from eliminating residential outdoor irrigation could have significant long-term indirect cumulative effects on aquatic resources in the Virgin River when combined with the past, present and reasonably foreseeable effects of water diversion throughout the St. George metropolitan area.

5.3.6.4.5 No Action Alternative.

The No Action Alternative would have no measurable cumulative effects on aquatic resources in the LPP Project study area.

5.3.6.5 Unavoidable Adverse Effects

5.3.6.5.1 Proposed Action.

The Proposed Action would not have any measurable unavoidable adverse construction effects on aquatic resources. Mitigation measures implemented as described for pipeline crossings of perennial streams would avoid or minimize effects on water quality, aquatic resources and aquatic habitats. The residual effects on aquatic resources after applying mitigation measures would not be measurable.

The Proposed Action would not have any measurable long-term unavoidable adverse effects on aquatic resources. Operations activities involving incidental draining of the pipeline or penstock segments to perennial streams or dry washes would not transfer aquatic biota from Lake Powell water. The biological treatment with EPA-approved molluscicide at the water intake pump station and intake tunnels, combined with filtration at the pumps,

would cause invasive non-native *Dreissena* species mortality at all life stages and prevent their transport through the Water Conveyance and Hydro systems.

5.3.6.5.2 Existing Highway Alternative.

The Existing Highway Alternative would have the same unavoidable adverse effects as the Proposed Action described in Section 5.3.6.5.1.

5.3.6.5.3 Southeast Corner Alternative.

The Southeast Corner Alternative would have the same unavoidable adverse effects as the Proposed Action described in Section 5.3.6.5.1.

5.3.6.5.4 No Lake Powell Water Alternative.

The No Lake Powell Water Alternative would not have any unavoidable adverse construction effects on aquatic resources.

The No Lake Powell Water Alternative could have long-term unavoidable adverse effects on the aquatic resources resulting from the indirect action of eliminating residential outdoor irrigation, which would reduce groundwater recharge in the St. George metropolitan area that flows subsurface to the river during the summer and fall months. The Virgin River could experience reduced non-sewered return flows by 77 to 80 percent (ranging from 21.4 to 23.5 cfs by 2052) through the St. George metropolitan area during the summer months (UDWRe 2016). This indirect unavoidable adverse effect could result in reducing Virgin River flows, reducing habitat, increasing water temperatures, decreasing DO concentrations, changing the food supply for aquatic resources, and diminishing the areal extent and functions of the riparian corridor from Hurricane to the Utah-Arizona state line. These could be significant long-term unavoidable adverse effects on Virgin River aquatic resources and its connected ecosystem.

5.3.6.5.5 No Action Alternative.

The Action Water Alternative would not have any unavoidable adverse construction effects on aquatic resources in the LPP project study area.

5.3.6.6 References

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