This document includes extended narratives for all resources, please see the 20190118 Comments Table to determine which narrative applies to a specific resource.

Extended Narratives

NPS Comment No. 27

A revised noise analysis is incorporated setting a sound volume within GLCA at the IPS and BPS-1 boundary fences of no more than 45dBA, and for BPS-2, BPS-3(Alt.) and BPS-4(Alt.) outside the GCLA, setting the volume at the boundary fence at no more than 60dBA. The second paragraph in Section 3.1.3.1.7, Chapter 3, Exhibit E of the License Application is revised to read: **The Water Intake Pumping Station (IPS) and Booster Pump Station – 1 (BPS-1) proposed for operation on NPS administered lands would be enclosed and utilize design features (e.g., acoustical louvers, noise absorbing panels and interior baffling) to minimize operational noise levels. The proposed IPS and BPS-1 would be designed with features incorporated to minimize normal operational sound levels with an objective of a sound level of 45 A-weighted decibels (dBA) at each pump station inner boundary fence, or 50 feet from the facility, whichever is closer. The 45 dBA sound level at the IPS and BPS-1 boundary fences is consistent with the research findings of Blickley, J.L. et al. (2012), which is cited in Shannon, G. et al. (2016).**

The new third paragraph in Section 3.1.3.1.7 is revised to read: **BPS-2, BPS-3 (Alt.), BPS-4 (Alt.) and the hydroelectric generating stations would be enclosed and utilize design features (e.g., acoustical louvers and noise absorbing panels) to minimize operational sound levels. Pressure reducing station valves at the hydroelectric generating stations would be fully enclosed in vaults. Potential facility sound levels would be estimated during facility design, and features would be incorporated to minimize normal operational sound levels with an objective of 60 dBA or less at the boundary of each facility.**

Section 3.7, Chapter 3, Exhibit E of the License Application is revised to include the following two references:

Blickley, J.L., D. Blackwood, and G.L. Patricelli. 2012. Experimental Evidence for the Effects of Chronic Anthropogenic Noise on Abundance of Greater Sage-Grouse at Leks. Conservation Biology 26(3):461-471.

Shannon, G., M.F. McKenna, L.M. Angeloni, K.R. Crooks, K.M. Fristrup, E. Brown, K.A. Warner, M.D. Nelson, C. White, C. Briggs, S. McFarland, and G. Wittemyer. 2016. A synthesis of two decades of research documenting the effects of noise on wildlife. Biological Reviews 91:982-1005.

The three paragraphs comprising Section 5.3.18.2.1.3, Chapter 5, Exhibit E of the License Application, are revised to read:

Recent studies of noise effects on wildlife summarized in the literature review by Shannon, G., et al. (2016) indicates 45 dBA is the lowest sound level at which construction noise effects on wildlife are demonstrated to occur in natural rural habitats such as those in GLCA. Construction noise effects for the IPS and BPS-1 would occur over a longer period of time (up to 2 years) than the pipeline construction that would occur over one month per mile of construction. The 45 dBA noise level at the IPS and BPS-1 construction sites is considered an appropriate significance threshold for chronic construction noise in GLCA, based on the research results of Blickley, J.L., et al. (2012). The research results published by Blickley, J.L., et al. (2012) included construction traffic noise, for which wildlife demonstrated a biological response of changes in abundance, distribution and

occupancy at and above 45 dBA sound levels in natural rural habitats. The 45 dBA sound level as a significance threshold for pipeline construction is consistent with the American National Standards Institute (ANSI) and Acoustical Society of America (ASA) S12.9 Part 5 (ASA 1998) and ANSI/ASA S12.100-2014 (ASA 2014).

Recent studies of noise effects on wildlife are summarized in a literature review by Shannon, G., et al. (2016), which cites specific research by Blickley, J.L., et al. (2012) demonstrating adverse effects on wildlife occupancy and abundance at chronic anthropogenic noise levels of 45 dBA and above in natural rural habitats. The chronic anthropogenic noise level of 45 dBA is considered appropriate as a significance threshold at and above which adverse effects could occur on wildlife in natural rural habitats within GLCA. The 45 dBA sound level at the boundary of the IPS would decay to GLCA ambient sound levels of 35 to 38 dBA in GLCA within approximately 150 feet. The 45 dBA sound level at the boundary of the BPS-1 would decay to GLCA ambient sound levels of 35 to 38 dBA in GLCA within approximately 200 feet. The 45 dBA sound level at the IPS and BPS-1 boundaries is consistent with the American National Standards Institute (ANSI) and Acoustical Society of America (ASA) S12.9 Part 5 and ANSI/ASA S12.100-2014 (ASA 2014).

Section 5.3.18.6, Chapter 5, Exhibit E of the License Application is revised to include the following four references:

American National Standards Institute (ANSI) and Acoustical Society of America (ASA). 1998. Quantities and Procedures for Description and Measurement of Environmental Sound – Part 5: Sound Level Descriptors for Determination of Compatible Land Use. ANSI/ASA S12.9 – 1998/Part 5. New York, NY.

_____. 2014. Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas. ANSI/ASA S12.100-2014. Melville, NY.

Blickley, J.L., D. Blackwood, and G.L. Patricelli. 2012. Experimental Evidence for the Effects of Chronic Anthropogenic Noise on Abundance of Greater Sage-Grouse at Leks. Conservation Biology 26(3):461-471.

Shannon, G., M.F. McKenna, L.M. Angeloni, K.R. Crooks, K.M. Fristrup, E. Brown, K.A. Warner, M.D. Nelson, C. White, C. Briggs, S. McFarland, and G. Wittemyer. 2016. A synthesis of two decades of research documenting the effects of noise on wildlife. Biological Reviews 91:982-1005.

NPS Comment No. 47

The requested changes regarding cumulative effects are incorporated into Chapter 5, Exhibit E of the License Application. This comment response addresses the types of actions that are included in the cumulative effects analysis. Please see the response to NPS Comment No. 59 in this revised Narrative Response document for changes to the cumulative effects analysis.

The following new sections are added to Chapter 5, Exhibit E of the License Application in Section 5.2.3.11.

5.2.3.11.5 Global Climate Change/Regional Drought Conditions. UDWRe contracted Reclamation to prepare an analysis of climate change effects on the Virgin River basin, incorporating Reclamation's work on the Colorado River Basin Water Supply and Demand Study (Reclamation 2012) and the SECURE Water Act Section 9503(c) Report to Congress (Reclamation 2016). The Virgin River basin report prepared by Reclamation projects a 3 percent decrease in Virgin River streamflow resulting from climate change during the period 2025 through 2054, which translates to a potentially larger decrease in WCWCD water system yield via diversions from the Virgin River (Reclamation 2014). This result demonstrates the vulnerability of diverting existing water supplies from the Virgin River for population in the St. George metropolitan area and the WCWCD need to diversify their water supply with the LPP to make sure future water supplies meet future population demands. The SECURE Water Act Section 9503(c) Report to Congress projects a 5 to 7 percent chance that Upper Basin shortages in coming decades could exceed 25 percent of the requested depletion in any one year Reclamation 2016). These results are incorporated into the CRSS modeling with climate change inflow hydrology performed by Reclamation on the LPP under a contract with UDWRe. Therefore, the climate change modeling results presented in Section 5.3.3.2.2.1, Chapter 5, Exhibit E of the License Application and in Final Study Report 18, Surface Water Resources, Section 4.3.1.1 and Appendix 2 Reclamation Colorado River Model Report represent the conditions projected to occur under climate change/regional drought conditions in Lake Powell and the Virgin River basin diversions serving the St. George metropolitan area population. The climate change conditions in Lake Powell could combine with other interrelated actions on the Colorado River and LPP diversions to result in cumulative effects on the following resources:

- **Air Quality**
- **Aquatic Resources**
- **Archaeological and Historic-Era Resources**
- **Land Use Plans and Conflicts (Floodplains)**
- **Recreation Resources**
- **Special Status Aquatic Species**
- **Socioeconomic Resources (Energy Resources)**
- **Surface Water Quality**
- **Surface Water Resources**
- **Visual Resources**
- **Wetlands and Riparian Resources**

5.2.3.11.6 Utah Department of Transportation (UDOT) Projects. UDOT has long range plans to widen portions of Highway 89 from the Utah-Arizona state line to Kanab, Utah within the LPP study area. The widening would involve adding one lane in multiple segments to build a 2+1 corridor (two lanes in one direction, one lane in the other direction). Some widened highway

segment construction would occur during LPP construction pending available funding, with potential short-term cumulative effects on the following resources:

- **Air Quality**
- **Archaeological and Historic-Era Resources**
- **Ethnographic Resources**
- **Noise**
- **Paleontological Resources**
- **Recreation Resources (including visitor use and experience)**
- **Socioeconomics (Energy Resources)**
- **Special Status Plant Species**
- **Special Status Wildlife Species**
- **Transportation**
- **Vegetative Communities**
- **Visual Resources**
- **Wetlands and Riparian Resources**
- **Wildlife Resources**

5.2.3.11.7 GLCA Off-road Vehicle Management Plan. NPS completed an Off-road Vehicle (ORV) Management Plan and Final EIS in 2017 for Glen Canyon National Recreation Area, and a Record of Decision is pending. The plan and FEIS describe five alternatives for managing off-road use and on-road use of off-highway vehicles (OHVs) and street-legal all-terrain vehicles (ATVs) and assesses impacts that could result from continuing current management (the no action alternative) or implementation of any of the action alternatives within Glen Canyon National Recreation Area (GLCA). Under the NPS preferred alternative involving mixed use, resources would be protected and visitor experience enhanced by identifying and designating specific areas capable of supporting off-road use while prohibiting such uses in areas where resources and values may be at risk. Proposed designated ORV routes and GMP roads that would overlap with LPP construction include routes near Glen Canyon substation, northwest of the Page Port of Entry, south/southwest of Greenehaven, west of Greenehaven, southwest of Stud Horse Point, and south of Blue Pool Wash, all accessed from Highway 89. The following resources potentially affected by the proposed ORV routes and GMP roads have the potential for cumulative effects on resources with the LPP construction:

- **Archaeological and Historic-Era Resources**
- **Geology and Soil Resources**
- **Ethnographic Resources**
- **Noise**
- **Paleontological Resources**
- **Recreation Resources (including visitor use and experience)**
- **Socioeconomics**
- **Special Status Plant Species**
- **Special Status Wildlife Species**
- **Vegetative Communities**
- **Wildlife Resources**

5.2.3.11.8 South Central Communications Fiber Optic Project. This recently completed project resulted in placement of a fiber optic cable along the south side of Highway 89 between Kanab and Page. The cable is generally located five feet from the fence line toward Highway 89 and has

approximately 40 inches of cover. The cable alignment was adjusted in specific locations to avoid sensitive plant species. The cable has an overhead crossing over one drainage and is buried immediately adjacent to the existing roadway in other locations to cross drainage features. The following resources affected by the fiber optic cable project have the potential for cumulative effects on resources with the LPP:

- **Archaeological and Historic-Era Resources**
- **Ethnographic Resources**
- **Paleontological Resources**
- **Special Status Plant Species**
- **Special Status Wildlife Species**
- **Vegetative Communities**
- **Wetlands and Riparian Resources**
- **Wildlife Resources**

The following new section is added to Chapter 5, Exhibit E of the License Application following Section 5.2.3.11:

5.2.3.12 Other Considered Actions

5.2.3.12.1 Non-Native Quagga Mussel Infestation in Lake Powell.
The presence of nonnative quagga mussel (*Dreissena bugensis*) in Lake Powell was first confirmed in 2013 and infestation was documented near Glen Canyon Dam in 2014. Average veliger density in southern Lake Powell ranged from 2 to 38 per liter in 2016, with veliger density at Glen Canyon Dam ranging from 1 to 45 per liter in 2016 (NPS 2017). Section 3.1.1.1.2 in Chapter 3, Exhibit E of the License Application presents that water entering the intake system would be dosed with a molluscicide (operations conducted in compliance with NPS Management Policies for pesticide use) and passed through a 25-50 micron self-cleaning filter on the pump discharge line to remove aquatic invasive species parts and eggs. This would remove aquatic invasive species from the LPP and prevent distribution of aquatic invasive species by the LPP, resulting in no environmental effects from non-native species in other waters. Therefore, the LPP would not have potential cumulative effects with non-native quagga mussel infestation in Lake Powell.

5.2.3.12.2 Central Arizona Water Pipeline Project.
The Bureau of Reclamation (Reclamation) was leading a planning study for a water pipeline from the Colorado River to serve Page, Flagstaff, Coconino County, Navajo Nation and the Hopi Tribe when Congress cut the federal budget in 2014 and the non-federal partners were recommended to fund at least 30 percent of the study. The City of Flagstaff decided to not fund their share of the study and Reclamation put the study completion on hold in 2014. The City of Flagstaff also has no rights to Colorado River water and would have to purchase rights from another entity to receive water from a pipeline diverting water from the Colorado River. Therefore, the proposed project would not be implemented in the reasonably foreseeable future and there would be no cumulative effects with the LPP.

5.2.3.12.3 Arizona Department of Transportation (ADOT) Projects
ADOT has three projects planned, under construction, or recently completed near Page involving Highway 89 and Highway 89A. These include the completed landslide repair 25 miles south of Page, culvert extension along Highway 89 near Bitter Springs 25 miles south of Page, and culvert

extension along Highway 89A between Marble Canyon and Jacob Lake. These projects would not combine with LPP effects to result in potential cumulative effects on resources. Therefore, there would be no potential cumulative effects resulting from ADOT planned projects in the LPP area.

NPS Comment No. 51

The State of Utah (State) contracted with the U.S. Bureau of Reclamation (Reclamation) to have Reclamation perform Lake Powell Pipeline (LPP) simulations using the Colorado River System Simulation (CRSS) model. The model simulates impacts on Lake Powell storage levels and streamflow effects on the Colorado River downstream of Lake Powell with a monthly time step. For additional information on CRSS modeling of Lake Powell and Glen Canyon Dam releases see Appendix 2, Reclamation Colorado River Modeling Report, in the April 2016 Final Surface Water Resources Study Report; and Section 5.3.3.2.3.1, Chapter 5, Exhibit E of the License Application.

This comment response addresses the following:

- Effects on Lake Powell water levels from LPP operations under natural flow and climate change conditions
- Sensitivity of Lake Powell water level effects regarding assumption that under the No Action Alternative the State would not use its water right elsewhere

Lake Powell Lake Levels for the No Action Alternative and Proposed Action – CRSS Direct Natural Flow

The CRSS model runs assume under No Action that the State's water is not diverted and remains in Lake Powell, with all other reasonably foreseeable diversions held constant at 2015 quantities. Under the No Action, State water gradually accumulates in Lake Powell, similar to other unused Upper Basin allocations under the assumed operations, whereas under the Proposed Action, the CRSS model diverts the State's water through the Lake Powell Pipeline (LPP). The No Action Alternative assumption isolates the effect of adding a new project (LPP) to the mix of existing and reasonably foreseeable depletions in the Colorado River system. This assumption and associated CRSS modeling was used to evaluate impacts on all other resources, such as water quality and aquatic species.

Average Lake Powell elevations differences that would be experienced under the full CRSS simulation period (2015-2060) and under full LPP diversions (2048-2060) are shown in Table 1 in this response. Elevation changes shown in Table 1 in this response reflect the No Action Alternative assumption that the State of Utah would not use its water right.

Table 1 (NPS Comment No. 51). Average End-of-Year Changes in Lake Powell Reservoir Elevation Under Natural Inflows

Percentile	Changes in Reservoir Elevation Under Natural Inflows (feet)[1]					
	Entire CRSS Simulation Period (2015-2060)			CRSS Simulation Period Under Full LPP Diversions (2048-2060)[2]		
	No Action Alternative	Proposed Action	Difference	No Action Alternative	Proposed Action	Difference
90th Percentile	3680.6	3680.4	-0.2	3683.9	3683.6	-0.3
50th Percentile	3638.5	3637.1	-1.4	3646.4	3643.3	-3.1
10th Percentile	3563.6	3559.9	-3.7	3575.5	3567.2	-8.2

Note:
[1] Elevation differences in Lake Powell would be on an average annual basis and would not be absolute or instantaneous. Figure 5-91 and Table 5-25 in Exhibit E of the License Application show additional information on lake elevation differences in CRSS simulations between LPP diversions and the No Action Alternative.
[2] Percentiles calculated from 2048 through 2060 under a full diversion of UBWR water (86,249 acre-feet) in Proposed Action only. The full delivery of LPP water commences in 2048 under direct natural flow conditions (see April 2016 Water Resources Final Study Report in the License Application). Changes in reservoir elevation between 2015 and 2047, when Proposed Action would not be at capacity, would be less.

All elevations for the three percentiles under the Action and No Action Alternatives would be within Lake Powell's normal operating range (elevations 3,490 to 3,700 feet mean sea level) as established by Reclamation. Even under other operational scenarios, the 50th and 90th percentile or 50 and 90 percent probability reservoir elevation differences would also be within anticipated operational ranges. Such scenarios include:

- reservoir elevation differences resulting from equalizing releases made by Reclamation to transfer water to Lake Mead
- reservoir elevation differences that occur when high flow releases from Glen Canyon Dam have been made during two to three day periods for sediment management downstream of Glen Canyon Dam

Lake Powell Lake Levels for the No Action Alternative and Proposed Action – CRSS Climate Change

The projected effects of climate change on Lake Powell reservoir elevations were also modeled in CRSS by Reclamation. In this analysis, the State's water is not used in the No Action Alternative and water gradually accumulates in Lake Powell. Average Lake Powell elevations differences that would occur under climate change conditions during the full CRSS simulation period (2015-2060) and under full LPP diversions (2048-2060) are shown in Table 2 in this response.

Table 2 (NPS Comment No. 51). Average End-of-Year Changes in Lake Powell Reservoir Elevation Under Climate Change

Percentile	Changes in Reservoir Elevation Under Climate Change (feet)[1]					
	Entire CRSS Simulation Period (2015-2060)			CRSS Simulation Period Under Full LPP Diversions (2049-2060)[2]		
	No Action Alternative	Proposed Action	Difference	No Action Alternative	Proposed Action	Difference
90th Percentile	3677.4	3677.1	-0.3	3676.8	3675.9	-0.9
50th Percentile	3610.3	3608.4	-2.0	3601.7	3597.3	-4.4
10th Percentile	3430.7	3429.8	-0.9	3411.4	3409.7	-1.7

Note:
[1] Elevation differences in Lake Powell would be on an average annual basis and would not be absolute or instantaneous. Figure 5-92 and Table 5-25 in Exhibit E shows the lake elevation differences under climate change in CRSS simulations between LPP diversions and the No Action Alternative.
[2] Percentiles calculated from 2049 through 2060 under a full diversion of UBWR water (86,249 acre-feet) in Proposed Action only. The full delivery of LPP water commences in 2049 under climate change conditions (see April 2016 Water Resources Final Study Report in the License Application). Changes in reservoir elevation between 2015 and 2048, when Proposed Action would not be at capacity, would be less.

Elevations for the 90th and 50th percentiles would be within Lake Powell's normal operating range (elevations 3,490 to 3,700 feet mean sea level). Full LPP depletions under climate change at the 10th percentile for both the No Action Alternative and proposed action would cause average reservoir elevations to be below Lake Powell's normal operating range. The overriding cause of the low reservoir elevations at the 10th percentile would be climate change as these elevations are not reached under natural inflow conditions (see Table 1 in this response).

No Action Alternative Sensitivity Analysis

As mentioned, the No Action alternative assumes that if the LPP is not developed, Utah's unallocated water would not be used by the State. In the absence of LPP, however, it is likely that the State of Utah would use its water right elsewhere, and the water would not revert back to the U.S. government and would not enter Lake Powell. Such a project upstream from Lake Powell has not been defined. A sensitivity analysis was completed to examine the effects of this assumption only on Lake Powell water levels. The results of this sensitivity analysis were not directly applied to impact analyses for other resources.

For the sensitivity analysis, CRSS model results for the No Action Alternative were adjusted to remove the 86,249 acre-feet per year from Lake Powell inflows. Lake elevation differences between LPP diversions (full diversion volume) and the No Action Alternative under this assumption would be -0.6, -0.7, and -1.1 feet for the 90th percentile, 50th percentile, and 10th percentile, respectively (see Table 3 in this response). Sensitivity analysis results under climate change conditions are shown in Table 4 in this response.

This analysis demonstrates that the LPP effects on Lake Powell water levels are sensitive to the assumption that the State's water right would not be used and would accumulate in Lake Powell. If the State uses its water right elsewhere in the No Action Alternative then effects of LPP on

Lake Powell water levels would be minimal under most conditions. Similar to the CRSS analysis, full LPP depletions under climate change at the 10th percentile under this sensitivity analysis (Table 4) for both the No Action Alternative and proposed action would cause average reservoir elevations to be below Lake Powell's normal operating range. The overriding cause of the low reservoir elevations at the 10th percentile would be climate change.

Table 3 (NPS Comment No. 51). Sensitivity Analysis Results – Average End-of-Year Changes in Lake Powell Reservoir Elevation Under Direct Natural Flow

Percentile	Changes in Reservoir Elevation Under Natural Inflows (feet)[1]					
	CRSS Analysis (Utah's Water Right Diverted Only in Proposed Action) – Simulation Period Under Full LPP Diversions (2048-2060)[2]			*Sensitivity Analysis (Utah's Water Right Diverted in Both No Action Alternative and Proposed Action)* – Simulation Period Under Full LPP Diversion (2048-2060)[2]		
	No Action Alternative	Proposed Action	Difference	No Action Alternative	Proposed Action	Difference
90th Percentile	3683.9	3683.6	-0.3	3684.2	3683.6	-0.6
50th Percentile	3646.4	3643.3	-3.1	3644.1	3643.3	-0.7
10th Percentile	3575.5	3567.2	-8.2	3568.3	3567.2	-1.1

Note:
[1] Elevation differences in Lake Powell would be on an average annual basis and would not be absolute or instantaneous.
[2] Percentiles calculated from 2048 through 2060 under a full diversion of UBWR water (86,249 acre-feet). The full delivery of LPP water commences in 2048 under direct natural flow conditions (see April 2016 Water Resources Final Study Report in the License Application). Changes in reservoir elevation between 2015 and 2047, when Proposed Action would not be at capacity, would be less.

Table 4 (NPS Comment No. 51). Sensitivity Analysis Results – Average End-of-Year Changes in Lake Powell Reservoir Elevation Under Climate Change

Percentile	Changes in Reservoir Elevation Under Climate Change (feet)[1]					
	CRSS Analysis (Utah's Water Right Diverted Only in Proposed Action) – Simulation Period Under Full LPP Diversions (2049-2060)[2]			*Sensitivity Analysis (Utah's Water Right Diverted in Both No Action Alternative and Proposed Action)* – Simulation Period Under Full LPP Diversion (2049-2060)[2]		
	No Action Alternative	Proposed Action	Difference	No Action Alternative	Proposed Action	Difference
90th Percentile	3676.8	3675.9	-0.9	3676.5	3675.9	-0.6
50th Percentile	3601.7	3597.3	-4.4	3598.2	3597.3	-0.9
10th Percentile	3411.4	3409.7	-1.7	3412.8	3409.7	-3.0

Note:
[1] Elevation differences in Lake Powell would be on an average annual basis and would not be absolute or instantaneous.
[2] Percentiles calculated from 2049 through 2060 under a full diversion of UBWR water (86,249 acre-feet. The full delivery of LPP water commences in 2049 under climate change conditions (see April 2016 Water Resources Final Study Report in the License Application). Changes in reservoir elevation between 2015 and 2048, when Proposed Action would not be at capacity, would be less.

NPS Comment No. 59

The following sections in Chapter 5, Exhibit E of the License Application are revised to incorporate cumulative effects of global climate change/regional drought conditions, Utah Department of Transportation (UDOT), GLCA Off-Road Vehicle Management Plan, and South Central Fiber Optic project/ROW with implementation of the LPP.

Surface Water Resources
A new paragraph is added after the third paragraph in Section 5.3.3.4.1, Chapter 5, Exhibit E of the License Application and reads:

Reclamation's updated CRSS model of the LPP prepared for UDWRe in 2015 incorporates climate change inflow hydrology. The climate change inflow hydrology simulation results show a 90 percent probability that Lake Powell elevation with LPP full depletion would average 3675.9 feet MSL in any one year between 2049 and 2060, 0.9 feet below the No Action CRSS modeled elevation. The climate change simulation results show a 50 percent probability that Lake Powell elevation with LPP full depletion would average 3597.3 feet MSL in any one year between 2049 and 2060, 4.4 feet below the No Action CRSS modeled elevation. The cumulative effects of climate change inflow hydrology and LPP full depletion at the 90th and 50th percentiles would not be significant on Lake Powell elevations and other associated resources.

The LPP Proposed Action could have cumulative effects on surface water resources under climate change conditions at the 10th percentile when combined with interrelated actions including:

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

The climate change simulation results show a 10 percent probability that Lake Powell elevation with LPP full depletion would average 3409.7 feet MSL in any one year between 2049 and 2060, 1.7 feet below the LPP No Action CRSS-modeled elevation. Elevations at the 10th percentile of climate change inflow hydrology conditions for both the No Action Alternation and Proposed Action would be below Lake Powell's normal operating range. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions could result in a significant cumulative effect.

Surface Water Quality
Cumulative effects on surface water quality at Lake Powell are discussed in the response to NPS Comment No. 113 in this revised Narrative Response document.

Aquatic Resources
The first paragraph in Section 5.3.6.4.1, Chapter 5, Exhibit E of the License Application is revised to read: **The Proposed Action would have no measurable long-term effects on aquatic resources and therefore would have no measurable long-term cumulative effects on aquatic resources when combined with past, present and reasonably foreseeable future interrelated actions. The LPP Proposed Action could have cumulative effects on aquatic resources in Lake Powell under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Indirect cumulative effects on aquatic resources and their habitat in Lake Powell would include increased water temperatures, decreased dissolved oxygen concentrations, and decreased usable habitat area. These cumulative effects could be significant.

Special Status Aquatic Species

The first paragraph in Section 5.3.7.4.1, Chapter 5, Exhibit E of the License Application is revised to read: **The Proposed Action would have no measurable long-term effects on special status aquatic resources and therefore would have no measurable long-term cumulative effects on special status aquatic resources when combined with past, present and reasonably foreseeable future interrelated actions. The LPP Proposed Action could have cumulative effects on special status aquatic resources in Lake Powell under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Indirect cumulative effects on special status aquatic resources and their habitat in Lake Powell would include increased water temperatures, decreased dissolved oxygen concentrations, and decreased usable habitat area. These cumulative effects could be significant.

Vegetation Resources

A new paragraph is inserted after the fourth paragraph in Section 5.3.8.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action would have direct cumulative effects on vegetative communities when combined with the direct effects of UDOT Highway 89 widening projects. Vegetation removed for LPP construction combined with vegetation permanently removed for UDOT Highway 89 widening construction would increase the disturbance of**

vegetation communities along the parallel corridors. These cumulative effects would not be significant because of the relatively large amount of surrounding vegetation communities that would not be disturbed by the construction activities. These cumulative effects would be long-term because revegetation of the LPP alignment with shrub species could take 20 to 30 years.

A new paragraph is inserted after the fourth paragraph in Section 5.3.8.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action would have direct cumulative effects on vegetative communities when combined with the direct effects of the South Central Communications Fiber Optic Project in the Highway 89 ROW from Kanab to Page. Vegetation removed for LPP construction combined with vegetation permanently removed for the South Central Communications Fiber Optic Project construction would increase the disturbance of vegetation communities along the parallel corridors. These cumulative effects would not be significant because of the relatively large amount of surrounding vegetation communities that would not be disturbed by the construction activities. These cumulative effects would be long-term because revegetation of the LPP alignment with shrub species could take 20 to 30 years.**

Wetland and Riparian Resources

The first paragraph in Section 5.3.9.4.1, Chapter 5, Exhibit E of the License Application is revised to read: **The Proposed Action could have unmeasurable cumulative effects on wetland and riparian resources when combined with past, present and reasonably foreseeable future actions involving operations of Glen Canyon Dam. These potential minor cumulative effects could occur on wetland and riparian resources in Lake Powell and the Colorado River downstream from Glen Canyon Dam. The Proposed Action could have unmeasurable cumulative effects when combined with the effects of climate change and past, present and reasonably foreseeable future actions involving operations of Glen Canyon Dam. These potential minor cumulative effects could occur on wetland and riparian resources in Lake Powell and the Colorado River downstream from Glen Canyon Dam.**

A new paragraph is inserted after the first paragraph in Section 5.3.9.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on riparian resources when combined with the effects of UDOT Highway 89 widening projects. These potential minor cumulative effects could occur on riparian resources along the parallel alignments of Highway 89 and would be short-term if construction occurred during the same periods.**

A new paragraph is inserted after the first paragraph in Section 5.3.9.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on riparian resources when combined with the effects of the South Central Communications Fiber Optic Project. These potential minor cumulative effects could occur on riparian resources along the parallel alignments where the fiber optic cable construction resulted in riparian vegetation removal and would be short-term until removed riparian vegetation is restored to previous functions.**

Special Status Plant Species

A new paragraph is inserted after the third paragraph in Section 5.3.10.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on special status plant species when combined with the effects of UDOT Highway 89 widening projects. These potential long-term cumulative effects could occur on special status plant species along the parallel alignments of the LPP and Highway 89 widened segments until the LPP disturbed area is revegetated with the special status plant species.**

A new paragraph is inserted after the third paragraph in Section 5.3.10.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on special status plant species when combined with the effects of the South Central Communications Fiber Optic Project. These potential long-term cumulative effects could occur on special status plant species along the parallel alignments where the fiber optic cable construction resulted in special status plant species removal and would be long-term until removed special status plant species are restored to pre-construction conditions.**

Wildlife Resources

A new paragraph is inserted after the third paragraph in Section 5.3.11.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on wildlife resources when combined with the effects of UDOT Highway 89 widening projects. These potential short-term and long-term cumulative effects could occur on wildlife resources along the parallel alignments of the LPP and Highway 89 widened segments until the LPP disturbed area is revegetated to pre-construction conditions.**

A new paragraph is inserted after the third paragraph in Section 5.3.11.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on wildlife resources when combined with the effects of UDOT Highway 89 widening projects. These potential short-term and long-term cumulative effects could occur on wildlife resources along the parallel alignments of the LPP and Highway 89 widened segments until the LPP disturbed area is revegetated to pre-construction conditions.**

A new paragraph is inserted after the third paragraph in Section 5.3.11.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on wildlife resources when combined with the effects of the GLCA pending Off-Road Vehicle Management Plan and LPP construction. These potential short-term cumulative effects could occur on wildlife resources in the Ferry Swale area during LPP transmission line construction and at the intersection of GLCA GMP roads with the LPP alignment construction. There would be no measurable long-term cumulative effects on wildlife resources from LPP construction and the GLCA pending Offroad Vehicle management plan.**

A new paragraph is inserted after the third paragraph in Section 5.3.11.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on wildlife resources when combined with the effects of the South Central Communications Fiber Optic Project. These potential long-term cumulative effects could occur on wildlife resources along the parallel alignments where the fiber optic cable construction resulted in shrub species removal and would be long-term until shrub species are restored to pre-construction conditions.**

Special Status Wildlife Resources

A new paragraph is inserted after the third paragraph in Section 5.3.12.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on special status wildlife species when combined with the effects of UDOT Highway 89 widening projects. These potential short-term and long-term cumulative effects could occur on special status wildlife species along the parallel alignments of the LPP and Highway 89 widened segments until the LPP disturbed area is revegetated to pre-construction conditions.**

A new paragraph is inserted after the third paragraph in Section 5.3.12.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on special status wildlife species when combined with the effects of the GLCA pending Off-Road Vehicle**

Management Plan and LPP construction. These potential short-term cumulative effects could occur on special status wildlife species in the Ferry Swale area during LPP transmission line construction and at the intersection of GLCA GMP roads with the LPP alignment construction. There would be no measurable long-term cumulative effects on special status wildlife species from LPP construction and the GLCA pending Off-road Vehicle management plan.

A new paragraph is inserted after the third paragraph in Section 5.3.12.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on special status wildlife species when combined with the effects of the South Central Communications Fiber Optic Project. These potential long-term cumulative effects could occur on special status wildlife species along the parallel alignments where the fiber optic cable construction resulted in special status wildlife species habitat removal and would be long-term until habitats are restored to preconstruction conditions.**

Recreation Resources

A new paragraph is inserted after the third paragraph in Section 5.3.13.4.1, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action could have cumulative effects on recreation resources under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Cumulative effects on recreation resources in Lake Powell would include effects to marinas and other lake-side concessions and reduced surface area for lake-base recreation activities. These cumulative effects could be significant.

A new paragraph is inserted after the third paragraph in Section 5.3.13.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on recreation resources when combined with the effects of UDOT Highway 89 widening projects. These potential short-term cumulative effects could occur on recreation resources at specific recreation access locations along the parallel alignments of the LPP and Highway 89 widened segments until the LPP construction is completed and access is restored to pre-construction conditions.**

Transportation

A new paragraph is inserted after the third paragraph in Section 5.3.15.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on transportation when combined with the effects of UDOT Highway 89 widening projects. These potential short-term cumulative effects could occur on Highway 89 traffic and infrastructure in specific locations along the parallel alignments of the LPP and Highway 89 widened segments until**

the LPP construction is completed. Minor traffic delays could occur on Highway 89 in areas where highway widening and LPP construction traffic are coincident.

Visual Resources

A new paragraph is inserted before the first paragraph in Section 5.3.16.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have cumulative effects on visual resources under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Cumulative effects on visual resources at Lake Powell would include increased color, line, form and texture contrasts along the exposed shoreline of the reservoir. These cumulative effects could be significant.

A new paragraph is inserted after the new first paragraph in Section 5.3.16.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action would have short-term cumulative effects on visual resources when combined with the effects of UDOT Highway 89 widening projects. These potential short-term cumulative effects of contrasts in color, line, form and texture would occur at coincident construction locations along the parallel alignments of the LPP and Highway 89 widened segments. The potential cumulative effects on visual resources would occur until the LPP coincident construction with Highway 89 widening is completed.**

Air Quality

The first paragraph in Section 5.3.17.4.1, Chapter 5, Exhibit E of the License Application is revised to read: **The Proposed Action could have minor cumulative effects on air quality under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Cumulative effects on air quality in Lake Powell

could include increased fugitive dust along the exposed shoreline of the reservoir. These minor cumulative effects would not be significant.

A new paragraph is inserted after the new first paragraph in Section 5.3.17.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action could have minor cumulative effects on air quality when combined with the effects of UDOT Highway 89 widening projects. These potential short-term cumulative effects could increase fugitive dust and equipment emissions at coincident construction locations along the parallel alignments of the LPP and Highway 89 widened segments. The potential cumulative effects on air quality could occur until the LPP coincident construction with Highway 89 widening is completed and disturbed soils are revegetated.**

Archaeological and Historic-era Resources
Cumulative effects on archaeological and historic-era resources at Lake Powell are discussed in the response to NPS Comment No. 113 in this revised Narrative Response document.

A fifth bullet is added to the first paragraph in Section 5.3.19.4, Chapter 5, Exhibit E of the License Application and reads:

- **UDOT Highway 89 Widening Projects**

A new subsection is added to Section 5.3.19.4, Chapter 5, Exhibit E of the License Application and reads: **5.3.19.4.5 UDOT Highway 89 Widening Projects. Highway 89 parallel to the LPP alignment has been widened under past actions and further widening is planned, which would affect previously identified sites and sites determined eligible for NRHP listing. Construction disturbance of cultural resource sites along the LPP alignment and Highway 89 where widening activities would occur would have cumulative effects on cultural resources. These cumulative effects on cultural resource sites would be significant.**

Ethnographic Resources
Cumulative effects on ethnographic resources at Lake Powell are discussed in the response to NPS Comment No. 113 in this revised Narrative Response document.

The first paragraph in Section 5.3.20.4.1, Chapter 5, Exhibit E of the License Application is revised to read: **The Proposed Action combined with UDOT Highway 89 Widening Projects would have no known direct cumulative effects on identified sites important to the tribes. The Proposed Action combined with UDOT Highway 89 Widening Projects would have long-term indirect cumulative effects on identified sites, cultural landscapes and regions important to tribes throughout the Colorado River basin.**

A new paragraph is inserted after the first paragraph in Section 5.3.20.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action combined with GLCA pending Off-road Vehicle Management Plan would have no known direct cumulative effects on identified sites important to the tribes. The Proposed Action combined with GLCA pending Off-road Vehicle Management Plan would have long-term indirect cumulative effects on identified sites, cultural landscapes and regions important to tribes throughout the Colorado River basin.**

A new paragraph is inserted after the first paragraph in Section 5.3.20.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action combined with the South Central Communications Fiber Optic Project would have no known direct cumulative effects on identified sites important to the tribes. The Proposed Action combined with the South Central Communications Fiber Optic Project would have long-term indirect cumulative effects on**

identified sites, cultural landscapes and regions important to tribes throughout the Colorado River basin.

Paleontological Resources

A new paragraph is inserted before the first paragraph in Section 5.3.21.4.1, Chapter 5, Exhibit E of the License Application and reads: **The Proposed Action combined with UDOT Highway 89 Widening Projects would have no known direct cumulative effects on paleontological sites. The Proposed Action combined with UDOT Highway 89 Widening Projects could have long-term indirect cumulative effects on paleontological sites where coincident construction occurs.**

Energy Resources

The fifth bullet in the second paragraph in Section 5.3.22.4, Chapter 5, Exhibit E of the License Application is revised to read:

- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

A new paragraph is added after the third paragraph in Section 5.3.22.4, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action could have cumulative effects on energy resources under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Cumulative effects on energy resources associated with Lake Powell would include suspended hydroelectric generation during the period the reservoir is below the minimum power pool elevation. These cumulative effects on energy resources could be significant.

A new paragraph is added after the third paragraph in Section 5.3.22.4, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action combined with UDOT Highway 89 Widening Projects would have short-term negligible cumulative effects on energy resources. Construction equipment consumption of fuel during construction of the LPP and Highway 89 would result in negligible cumulative effects on energy resources during the period of coincident construction.**

A new paragraph is added after the third paragraph in Section 5.3.22.4, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action combined with GLCA pending Off-road Vehicle Management Plan could have short-term minor cumulative effects on socioeconomics. ORV rentals, use of trails and guided tours would be temporarily suspended in the Ferry Swale area during transmission line construction to protect public safety and avoid conflicts in using the same access roads. ORV rentals, use of trails and guided tours involving GLCA GMP roads intersecting**

with the LPP alignment construction would be temporarily re-routed around active construction areas and could lead to voluntary avoidance of affected roads. These short-term cumulative effects on socioeconomics would not be significant.

NPS Comment No. 107

The first paragraph and Table 5-157 in Section 5.3.18.1.2.1, Chapter 5, Exhibit E of the License Application are revised to read: **A field investigation was performed to collect existing ambient sound level data along the LPP alternative alignments in July 2009. Recorded peak sound levels were generally below 70 dBA except at roadways with vehicular traffic, which were as high as 89 dBA. Field-measured existing ambient sound levels were typically at or below 52 dBA except near roadways or waterways. Table 5-157 details the existing ambient sound level field data gathered in the region. The approximate locations of field data measurements collected along the LPP area of potential effect are shown in Figures 5-210 (Water Conveyance System Decibel Contours), 5-211 (Hydro System Decibel Contours), 5-212 (Water Conveyance System Transmission Decibel Contours), and 5-213 (Hydro System Transmission Decibel Contours). Additionally, NPS provided existing ambient sound level data for NPS-administered land at locations shown in Table 5-157.**

Table 5-157
LPP Existing Ambient Sound Level Measurement Field Data

Location	Existing Ambient Level (dBA)	Peak Level (dBA)	Comments
Water Conveyance System (see Figures 5-210, 5-212 and 5-213a for sound level measurement locations)			
LPP Water Intake Pump Station Site	36[a]	66	Vehicle traffic on Highway 89, wind
LPP BPS-1 Site	35[a]	66	Vehicle traffic on Highway 89, wind
Unnamed wash east of Blue Pool Wash at LPP crossing	31[a]	54	Vehicle traffic on Highway 89, wind
Blue Pool Wash at LPP crossing	31[a]	62	Vehicle traffic on Highway 89, wind
"Wetland" West of Blue Pool Wash at LPP crossing	30[a]	54	Vehicle traffic on Highway 89, wind
2nd wash east of Big Water at LPP crossing	32[a]	64	Vehicle traffic on Highway 89, wind
Unnamed wash at GSENM trailhead east of Paria River at LPP crossing	<50	68	Vehicle traffic on Highway 89, wind
Paria River south side at LPP crossing alternative	54	70	Vehicle traffic on Highway 89, wind
Hydro System (see Figures 5-211 and 5-213 for sound level measurement locations)			
Johnson Canyon Wash at LPP crossing	51	64	Vehicle traffic on Highway 89, wind
White Sage Wash access road in AZ	<50	64	Sound caused by wind
Jacob Canyon at LPP crossing on Southeast Corner Alternative	51	79	Sound caused by wind
Jacob Canyon at LPP crossing on SE corner Kaibab-Paiute Indian Reservation – Proposed Action	<50	51	Slight sound caused by wind
Jacob Canyon at confluence with Kanab Creek at LPP crossing – Proposed Action	<50	64	Sound caused by wind
Bitter Seeps Wash at LPP crossing for Proposed Action	<50	<50	No wind
Kanab Creek at LPP crossing of Existing Highway Alternative	<50	<50	No wind
Cottonwood Creek at LPP crossing on Kaibab-Paiute Indian Reservation - Existing Highway Alternative	<50	68	Vehicle traffic on Highway 389
Two-Mile Wash at LPP crossing on Kaibab-Paiute Indian Reservation - Existing Highway Alternative	<50	59	Vehicle traffic on Highway 389
Two-Mile Wash at Toroweap Road crossing	<50	60	Sound caused by wind
Unnamed wash E. of Two-Mile Wash at LPP crossing on Kaibab-Paiute Indian Reservation - Existing Highway Alternative	51	89	Vehicle traffic on Highway 389; sound caused by wind
Unnamed wash west of Pipe Springs at LPP crossing on Kaibab-Paiute Indian Reservation - Existing Highway Alternative	<50	78	Vehicle traffic on Highway 389

Table 5-157
LPP Existing Ambient Sound Level Sound Level Measurement Field Data

Location	Existing Ambient Level (dBA)	Peak Level (dBA)	Comments
Short Creek at LPP crossing in Colorado City	52	64	Proximity to Highway 389 traffic influenced sound levels
Short Creek at LPP crossing in Canaan Gap area (East Crossing)	<50	62	Measureable sound caused by wind
Short Creek at LPP crossing in Canaan Gap area (West Crossing)	<50	51	Slight sound caused by wind
Hydro System (see Figures 5-211 and 5-213 for sound level measurement locations)			
Unnamed wash south of Hurricane Cliffs forebay site at LPP crossing	<50	53	Slight sound caused by wind
Gould Wash at TL crossing	<50	50	Slight sound caused by wind
Sand Hollow Reservoir West Dam	66	72	Measureable sound caused by wind
Hurricane West substation site	68	77	Measureable sound caused by wind

Notes:
[a]NPS geospatial existing ambient model used to estimate existing ambient sound levels in GLCA, available at: https://irma.nps.gov/DataStore/Reference/Profile/2217356
1. All sound level measurements recorded on a Realistic Sound Level Meter. All sound level measurements recorded in dBA.
2. Vehicle traffic sounds are generated by mobile sources. Sound generated by wind is considered temporary.
3. Existing ambient sound levels were recorded over a 30-second period.
4. Peak sound levels recorded represent maximum sound generated over the 30-second period of measurement. Peak levels attributed to wind is not microphone flow-induced noise (wind turbulence) and the requirements of ANSI 12.9-2013 Part 3, section 6.3 (b) maximum wind velocity were met.
5. Data collected on 7/23/2009 and 7/24/2009 (MWH 2009).
6. TL = Transmission Line

NPS Comment No. 110

Further explanation on how noise from highways compare with access roads is provided as requested. The first bullet in the first paragraph in Section 5.3.18.2.2, Chapter 5, Exhibit E of the License Application is revised to read: **Existing traffic noise is 85 dBA along much of the LPP alignment, including Highway 89 through Glen Canyon National Recreation Area and Grand Staircase-Escalante National Monument. The noise created from LPP temporary construction access road use parallel to the highways would be inconsequential relative to the highway noise. The LPP alignment construction access road parallel to Highway 89 in GLCA would be within 40 to 70 feet of the existing pavement edge. Average annual daily traffic (AADT) at the Utah/Arizona state line is 3,130 comprised primarily of semi-trucks with trailers, over-sized recreational vehicles, and tour buses. The LPP construction traffic would be approximately 28 AADT consisting of pickup trucks (average 75 dBA), pipeline delivery trucks (average 76 dBA, peak 90 dBA), water trucks (average 76 dBA, peak 90 dBA), and service trucks (average 76 dBA, peak 90 dBA) (see Table 5-155). LPP temporary construction access road traffic noise would have lower sound levels than the Highway 89 traffic. Therefore, LPP temporary access road traffic noise is not analyzed further.**

NPS Comment No. 113

NPS Comment No. 113 requests further analysis regarding how LPP withdrawals would affect Lake Powell levels and cultural resources along the shoreline. Please see the response to NPS Comment No. 51 in the revised Narrative Response document for a discussion on assumptions regarding use of the State of Utah's water rights in the various alternatives. Please see the response to NPS Comment No. 51 in this revised Narrative Response document to review the hydrological modeling performed by Reclamation on Lake Powell and for clarification regarding cumulative effects on surface water resources under climate change conditions. The below response and associated text changes address comments regarding cultural resources.

The effects analysis for archaeological and historic-era resources is presented in Section 5.3.19.2, Chapter 5, Exhibit E of the License Application. The effects analysis for ethnographic resources is presented in Section 5.3.20.2, Chapter 5, Exhibit E of the License Application.

Archaeological and Historic-era Resources Direct Effects

A new sentence is added to the first paragraph in Section 5.3.19.2.1, Chapter 5, Exhibit E of the License Application and reads: **Potential effects of the LPP diversion from Lake Powell on cultural resources along the reservoir shoreline would be negligible, as resulting reservoir elevations would be within the monthly normal operations elevations.**

Archaeological and Historic-era Resources Cumulative Effects

A new paragraph is added before the first paragraph in Section 5.3.19.4, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action would have indirect cumulative effects on cultural resources along the Lake Powell shoreline under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. These cumulative effects on cultural resources along the Lake Powell shoreline could be significant.

Ethnographic Resources Direct Effects

A new sentence is added to the first paragraph in Section 5.3.20.2.1, Chapter 5, Exhibit E of the License Application and reads: **Potential effects of the LPP diversion from Lake Powell under the Proposed Action on cultural resources along the reservoir shoreline would be negligible, as resulting reservoir elevations would be within the monthly normal operations elevations.**

A new sentence is added to the first paragraph in Section 5.3.20.2.2, Chapter 5, Exhibit E of the License Application and reads: **Potential effects of the LPP diversion from Lake Powell under the Existing Highway Alternative on cultural resources along the reservoir shoreline would be negligible, as resulting reservoir elevations would be within the monthly normal operations elevations.**

Ethnographic Resources Cumulative Effects

A new paragraph is added after the first paragraph in Section 5.3.20.4.1, Chapter 5, Exhibit E of the License Application and reads: **The LPP Proposed Action would have indirect cumulative effects on cultural resources along the Lake Powell shoreline under climate change conditions at the 10th percentile when combined with interrelated actions including:**

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. These cumulative effects on cultural resources along the Lake Powell shoreline could be significant.

NPS Comment No. 114

This comment response addresses assumptions regarding the surface water resource modeling, and provided additional information regarding Glen Canyon Dam release temperature impacts.

Surface Water Modeling Assumptions

The U.S. Bureau of Reclamation (Reclamation) was contracted by UDWRe to model the effects of LPP depletions (or withdrawals) on Lake Powell elevations. Reclamation is recognized as the U.S. Government's expert agency in operation and modeling of the Colorado River, Lake Powell and Glen Canyon Dam. Reclamation's LPP modeling results should be interpreted with consideration to the model assumptions. Reclamation's CRSS modeling of Lake Powell elevations for the LPP assumes that no new projects or depletions will occur in the Upper Basin (i.e., the Colorado River upstream of Glen Canyon Dam) by holding depletions constant at 2015 levels. Reclamation states in their CRSS report on LPP prepared for UDWRe: "This model assumption adopts a rigorous definition of what reasonably foreseeable future depletions are in the Upper Basin and is consistent with DOI NEPA Implementing Regulations. Under this approach, a reasonably foreseeable future depletion is one which has state legislation, or a tribal resolution or Federal Indian water settlement, or a Federal finding of no significant impact (FONSI) or record of decision (ROD). These are the criteria of certainty that a future depletion would occur at a particular time and place.

It is recognized that the Upper Basin States may develop their compact allocated Colorado River water and that depletions may increase above 2015 levels in the future. The LPP alternatives modeling, however, is conservative and takes the strictest approach to defining what is included and excluded for the cumulative impact analysis required by the Council on Environmental Quality regulations at 40 CFR 1508.7 (Reclamation. 2015. Draft Lake Powell Pipeline Hydrologic Modeling. Prepared for UDWRe by U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah. Prepared by Katrina Grantz, Ph.D. September 2015. 24 pp.).

The 2007 Interim Guidelines EIS modeling and ROD were applied by Reclamation to the CRSS modeling for the LPP. The CRSS model runs with LPP depletions implement the Interim Guidelines through 2026 and revert to the 2007 Interim Guidelines Final EIS No Action Alternative for model years 2027 through 2060 because that is the reasonably foreseeable operation. CRSS model runs by Reclamation with LPP depletions at 86,249 acre-feet per year and the current operating regime (i.e., 2007 Interim Guidelines) were not performed or analyzed because such conditions are not in the reasonably foreseeable future. The LPP effects of 86,249 acre-feet per year depletion (full development of current UBWR water rights for LPP) from Lake Powell are evaluated under post-Interim Guidelines operational policies because this condition is reasonably foreseeable and consistent with the 2007 Interim Guidelines FEIS and ROD.

During the UDWRe and NPS meeting on February 1, 2017, clarification of 1) "recent modeling by Colorado West Slope water users", 2) who the referenced Colorado West Slope water users are, and 3) if copies of the referenced modeling results/reports are available, was requested by UDWRe. The NPS response to this request is that Malcom Wilson, BOR, has the federal version of the Colorado West Slope Water Users Report. Malcom Wilson supervised and reviewed the CRSS modeling performed and updated for the LPP by Katrina Grantz, Ph.D., Reclamation Hydrologist. The CRSS modeling for LPP incorporated all reasonably foreseeable future depletions (withdrawals) in the Upper Basin and is consistent with DOI NEPA Implementing Regulations, as stated in Reclamation's report prepared for UDWRe.

Surface Water Impacts – Direct Natural Inflow Hydrology

NPS Comment No. 114 incorrectly assumes the 2007 Interim Guidelines operations extend beyond 2026 and when combined with potentially low Lake Powell elevations and the LPP full depletions, could trigger either a different Operating Tier and/or Drought Response at Upper Basin CRSPA reservoirs, resulting in the reservoir elevation to drop below the minimum power pool of 3490 feet MSL. As stated earlier in this response, the 2007 Interim Guidelines operations are in effect through 2026, and the FEIS No Action Alternative operations are in effect from 2027 through 2060. Both of these conditions are incorporated into the CRSS model on the LPP prepared by Reclamation for UDWRe. The annual LPP depletions would be 15,468 acre-feet from 2024 through 2026, and subtracting this quantity from the lowest 10th percentile data point (3552.0 feet MSL) for Lake Powell end-of-December water elevations for the 2007 Interim Guidelines Preferred Alternative (Appendix R, Attachment C: CRSS Model Outputs, Figure BA-3 on page Att. C-2; and Appendix A, Attachment B: CRSS Model Documentation, Table Att. B-1 on page Att. B-3, 2007 FEIS Colorado River Interim Guidelines), the resulting Lake Powell elevation would be 3551.8 feet MSL. This elevation value is 61.8 feet above the Lake Powell minimum power pool elevation established by Reclamation. Therefore, the LPP depletions during the 2007 Interim Guidelines operations would not trigger a different Operating Tier, Drought Response at Upper Basin CRSP reservoirs (3525 feet MSL threshold elevation in Lake Powell), or decrease Lake Powell elevation below the minimum power pool elevation of 3490 feet MSL.

The 2007 Interim Guidelines operations between 2027 and 2060 would be as described for the FEIS No Action Alternative and ROD. LPP depletions from Lake Powell would gradually increase from 15,648 acre-feet annually in 2027 to 86,249 acre-feet annually in 2048, depending on the growing demand for M&I water from the LPP. The 10th percentile average No Action Alternative and Proposed Action elevations in Lake Powell during a period of full LPP depletions (2048-2060) would be 3568.3 feet MSL and 3567.2 feet MSL, respectively (corrected for not storing UBWR's water right in Lake Powell – see responses to NPS Comment No. 51 in this revised Narrative Response document regarding UBWR depletion of their water right from Lake Powell) These elevations would be over 75 feet above the Lake Powell minimum power pool elevation. Therefore, the LPP full depletion during the post-Interim Guidelines operating period would not trigger a Drought Response at Upper Basin CRSP reservoirs (3525 feet MSL threshold elevation in Lake Powell) or decrease Lake Powell elevation below the minimum power pool elevation of 3490 feet MSL.

The most conservative analysis of the combined effect of LPP full depletion and post-Interim Guidelines operation on Lake Powell elevations involves subtracting the LPP full depletion difference (1.1 feet, corrected for not storing UBWR's water right in Lake Powell – see responses to NPS Comment No. 51 in this revised Narrative Response document) from the lowest 10th percentile data point (3544.5 feet MSL) for Lake Powell end-of-December water elevations for the 2007 Interim Guidelines No Action Alternative (Appendix R, Attachment C: CRSS Model Outputs, Figure BA-3 on page Att. C-2; and Appendix A, Attachment B: CRSS Model Documentation, Table Att. B-1 on page Att. B-3, 2007 FEIS Colorado River Interim Guidelines). The resulting Lake Powell elevation at 10 percent probability would be 3543.4 feet MSL, which is 53.4 feet above the Lake Powell minimum power pool elevation. Therefore, the LPP full depletion during the post-Interim Guidelines operating period would not trigger a Drought Response at Upper Basin CRSP reservoirs (3525 feet MSL threshold elevation in Lake Powell) or decrease Lake Powell elevation below the minimum power pool elevation of 3490 feet MSL.

Reclamation's 2015 updated report on CRSS modeling of LPP prepared for UDWRe acknowledges potential future depletions by Upper Basin states to utilize their full allocations could decrease Lake

Powell elevations; however, these future depletions are not in the reasonably foreseeable future consistent with DOI NEPA Implementing Regulations.

Surface Water Impacts – Climate Change Hydrology

Reclamation's updated CRSS model of LPP prepared for UDWRe in 2015 incorporates climate change inflow hydrology. The climate change inflow hydrology simulation results show a 90 percent probability that Lake Powell elevation with LPP full depletion would average 3675.9 feet MSL in any one year between 2049 and 2060, 0.60 feet below the No Action CRSS modeled elevation (corrected for UBWR full depletion of their water right – see responses to NPS Comment No. 51 in this revised Narrative Response document). The climate change simulation results show a 50 percent probability that Lake Powell elevation with LPP full depletion would average 3597.3 feet MSL in any one year between 2049 and 2060, 0.9 feet below the No Action CRSS modeled elevation (corrected for UBWR full depletion of their water right – see responses to NPS Comment No. 51 in this revised Narrative Response document). The 90th and 50th percentiles of Lake Powell elevations with LPP full depletion would not result in elevations below the minimum power pool.

The climate change simulation results show a 10 percent probability that Lake Powell elevation with LPP full depletion would average 3409.7 feet MSL in any one year between 2049 and 2060, 3.0 feet below the LPP No Action CRSS-modeled elevation of 3412.8 feet MSL (corrected for UBWR full depletion of their water right – see responses to NPS Comment No. 51 in this revised Narrative Response document). Therefore, the 10th percentile of CRSS modeled Lake Powell elevations with climate change inflow hydrology and full LPP depletions would trigger a Drought Response at Upper Basin CRSP reservoirs (3525 feet MSL threshold elevation in Lake Powell) and decrease Lake Powell elevation below the minimum power pool elevation of 3490 feet MSL. It is important to note that the predominate driver of this cumulative effect are the reduced inflows resulting from the most extreme projections of climate change. The 10th percentile CRSS model runs with climate change inflow hydrology but without LPP full depletions would still trigger a Drought Response at Upper Basin CRSP reservoirs and decrease Lake Powell elevation below the minimum power pool (see Figure 7 in Appendix 2, Reclamation Colorado River Modeling Report, in the Water Resources Final Study Report). The same scenario would occur when elevations are corrected for UBWR full depletion of their water right (see response to NPS Comment No. 51 in this revised Narrative Response document).

Surface Water Quality Impacts
The following sections of Exhibit E, Chapter 5 (as amended by the March 31, 2017 Submission of Responses to Department of the Interior Agency Comments) are amended as follows.

5.3.4.2 Environmental Effects

5.3.4.2.2 Proposed Action.

5.3.4.2.2.3 Operations and Maintenance Effects.

Lake Powell and Lower Colorado River Water Quality Effects

Glen Canyon Dam Releases

Modeled release results from Glen Canyon Dam for the No Action alternative and Proposed Action pipeline simulations were evaluated for effects on temperature, TDS, and dissolved oxygen concentrations. Simulated mean dam release temperatures for hydrology Trace 59 (a trace is a potential future reservoir inflow scenario) for the period 2045 to 2060 indicate that generally in the Proposed Action pipeline scenario, dam release temperatures are slightly colder in winter and spring months (colder by approximately 0.1°C) and slightly warmer (warmer by approximately 0.1°C) in summer and fall months compared with the No Action alternative scenario (Reclamation 2016). Hydrology Trace 59 was selected for evaluation as it covers a broad range of wet and dry conditions at Lake Powell (Reclamation 2016). When evaluated with an additional 99 hydrology traces, changes in median seasonal temperatures are less than 0.1°C (Figure 5-94A).

Glen Canyon Dam release temperatures often peak in October and simulated results show that when the reservoir is at or near full pool elevations, as was the case from 2050 to 2056, water temperatures of releases from the dam for the Proposed Action scenario were colder than in the No Action alternative scenario. The release temperatures from the dam in the pipeline scenarios are colder when the reservoir is near full capacity because of the removal of warm water from the upper, warm layer of the reservoir by the pipeline. Simulated release temperatures for the Proposed Action scenario were warmer than the No Action alternative scenario during summer and fall months when reservoir pool elevations were below full pool.

The largest differences between the Proposed Action scenario and the No Action alternative scenario for all 100 traces coincided with drier conditions and lower reservoir pool elevations (see 10th percentile temperatures in Figure 5-94B). Temperatures in wetter conditions (50th and 90th percentiles) are driven more by higher reservoir inflows and elevations, and less by small diversions. On average, the Trace 59 modeled results for the Proposed Action compared with the No Action alternative are within 0.1°C for the 2045-2060 period. For individual years, differences of up to 0.71°C were predicted (Reclamation 2016). For all 100 traces, average temperature changes between the Proposed Action and the No Action Alternative range between -0.1°C and 0.2°C. For individual months, differences range between -1.9°C and 0.5°C.

TDS results from the No Action alternative and Proposed Action models indicate that the average release TDS concentrations from 2045-2060 for the results of the three models would all be within 0.7 mg/L of each other. The Proposed Action average TDS values would be slightly higher than the No Action alternative (Reclamation 2016).

Dissolved oxygen results from the No Action alternative and Proposed Action models indicate that the average release dissolved oxygen concentrations from 2045-2060 for the two models would not vary (Reclamation 2016).

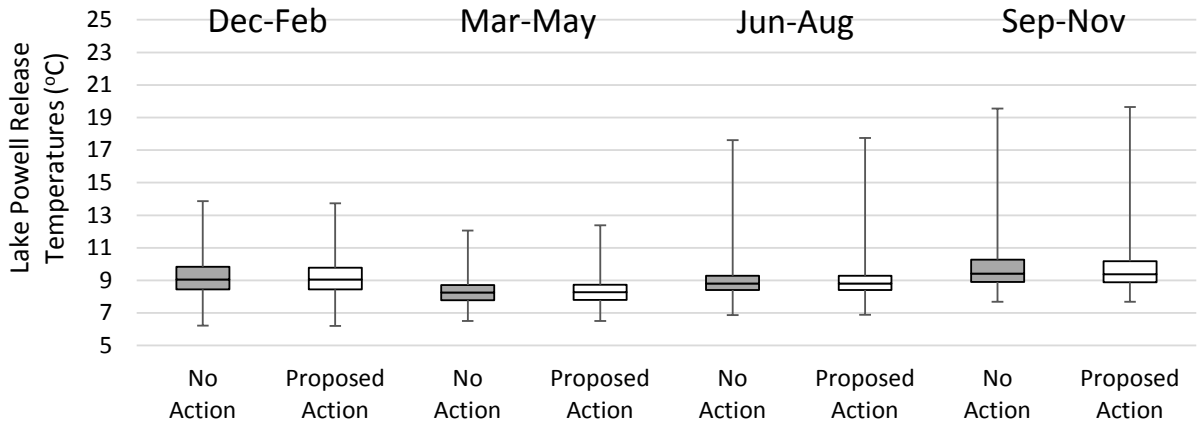

Figure 5-94A. Seasonal Glen Canyon Dam Release Temperatures for the LPP Proposed Action
(Note: Box plots represent the range of 100 hydrology traces; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum.)

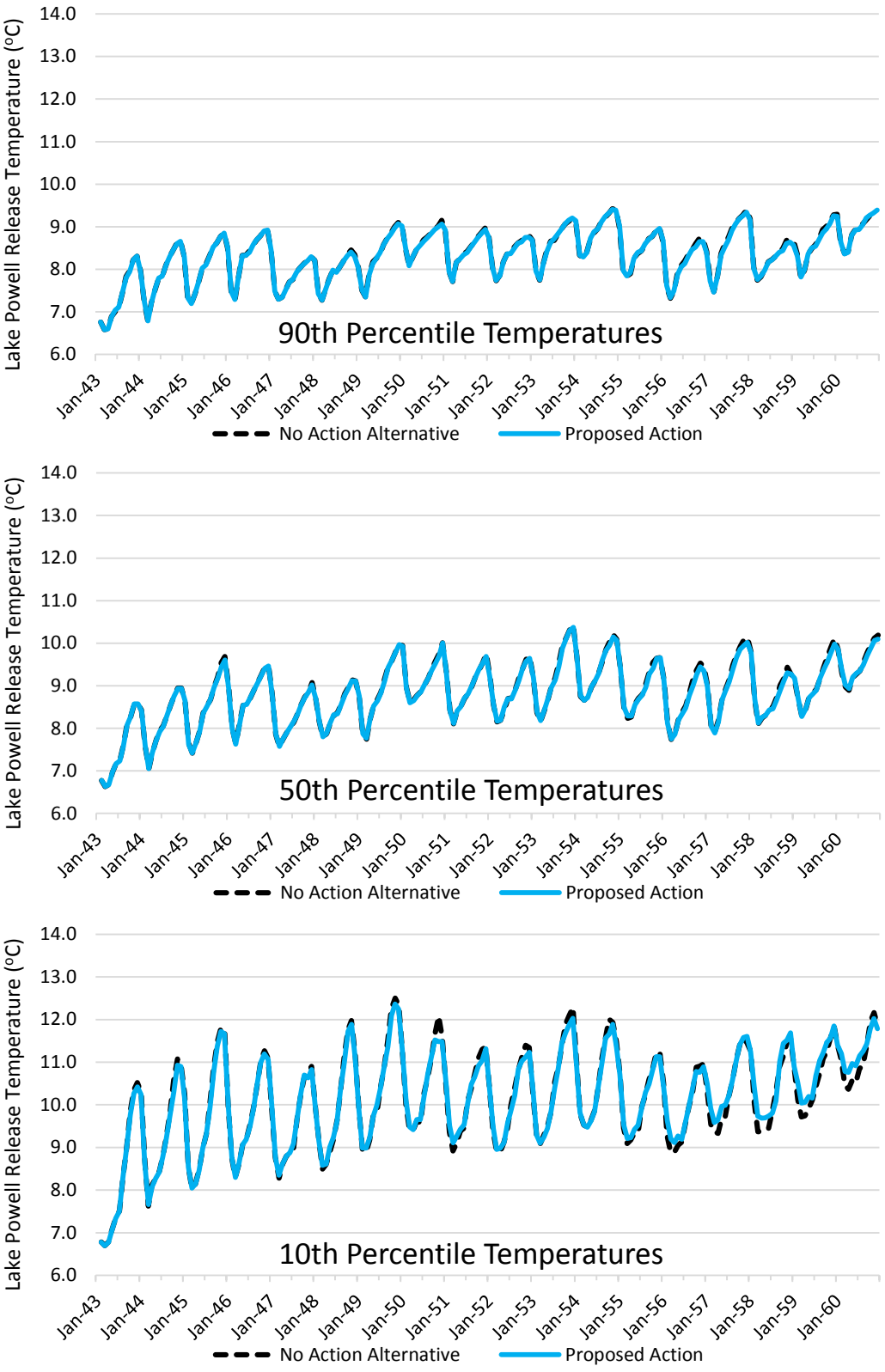

Figure 5-94B. Glen Canyon Dam Release Temperature Percentiles for the LPP Proposed Action

5.3.4.4 Cumulative Effects

5.3.4.4.1 Proposed Action.

The Proposed Action would have minimal short-term effects on surface water quality during construction. Therefore, there would be no measurable cumulative effects of the LPP alternatives on surface water quality when combined with other past, present, and reasonably foreseeable future actions. The unmeasurable short-term cumulative effects would not be significant.

The Proposed Action could have minimal long-term cumulative effects on surface water quality in Lake Powell and Glen Canyon Dam releases when combined with the following past, present, and reasonably foreseeable future actions during operations:

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

These interrelated actions determine the elevation, storage, release, operational timing, and volume of water in Lake Powell and release rates, release volumes, and operational timing of Glen Canyon Dam releases to the Colorado River. The Proposed Action would have minimal effects on surface water quality in Lake Powell, and when combined with these interrelated actions, there would be long-term minimal cumulative effects on surface water quality. Similarly, the Proposed Action would have minimal effects on Glen Canyon Dam release water quality and when combined with these interrelated actions, there would be long-term minimal cumulative effects on surface water quality. These long-term cumulative effects would not be physically measurable in Lake Powell and Glen Canyon Dam releases. However, these unmeasurable long-term cumulative effects would result from depletions up to 86,249 acre-feet per year from Lake Powell, and there would be minimal cumulative effects on Bureau of Reclamation operations and other actions implemented by the U.S. Department of the Interior. These cumulative effects on surface water quality would not be significant.

The LPP Proposed Action could have cumulative effects on surface water quality under climate change conditions at the 10th percentile when combined with interrelated actions including:

- **Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead EIS and ROD**
- **Operation of Glen Canyon Dam EIS and ROD**
- **Interim Surplus Criteria EIS and ROD**
- **Bureau of Reclamation and National Park Service LTEMP EIS and ROD**

Low reservoir elevations below Lake Powell's normal operating range, resulting from 10th percentile climate change inflow hydrology conditions as modeled by Reclamation, would be lowered further by the combination of the LPP Proposed Action depletions and one or more of the listed interrelated actions. The climate change inflow hydrology would be the primary cause of the lowered reservoir elevation in Lake Powell, and the combination of LPP depletions and one or more of the other interrelated actions would further lower the reservoir level by 1.7 feet at the 10th percentile of climate change inflow conditions. Cumulative effects on surface water quality in Lake Powell would include increased and decreased water temperatures (Figure 5-94C), decreased

dissolved oxygen concentrations, and increased TDS concentrations. These cumulative effects would be significant.

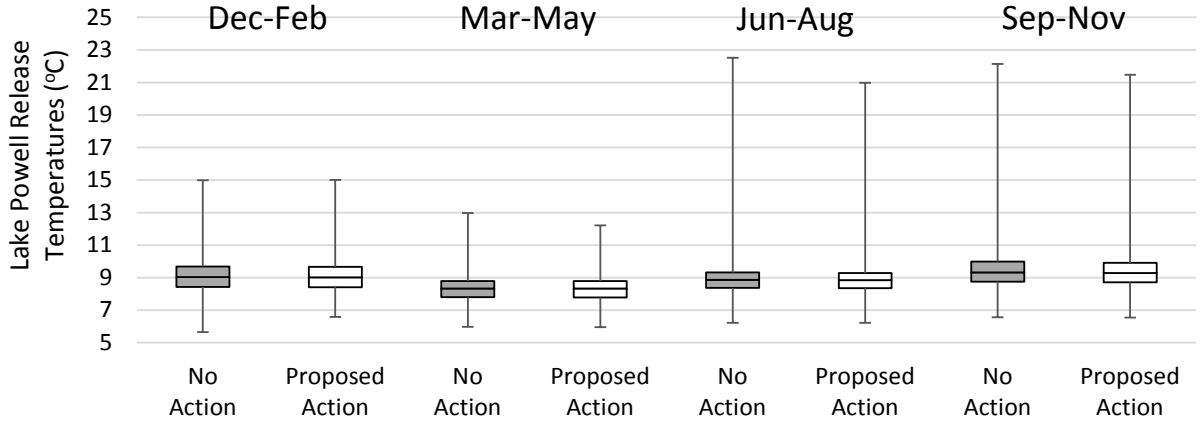

Figure 5-94A. Seasonal Glen Canyon Dam Release Temperatures for the LPP Proposed Action (Note: Box plots represent the range of 100 hydrology traces; horizontal line = median; lower extent of box = 25th percentile; upper extent of box = 75th percentile; lower whisker = minimum; upper whisker = maximum.)

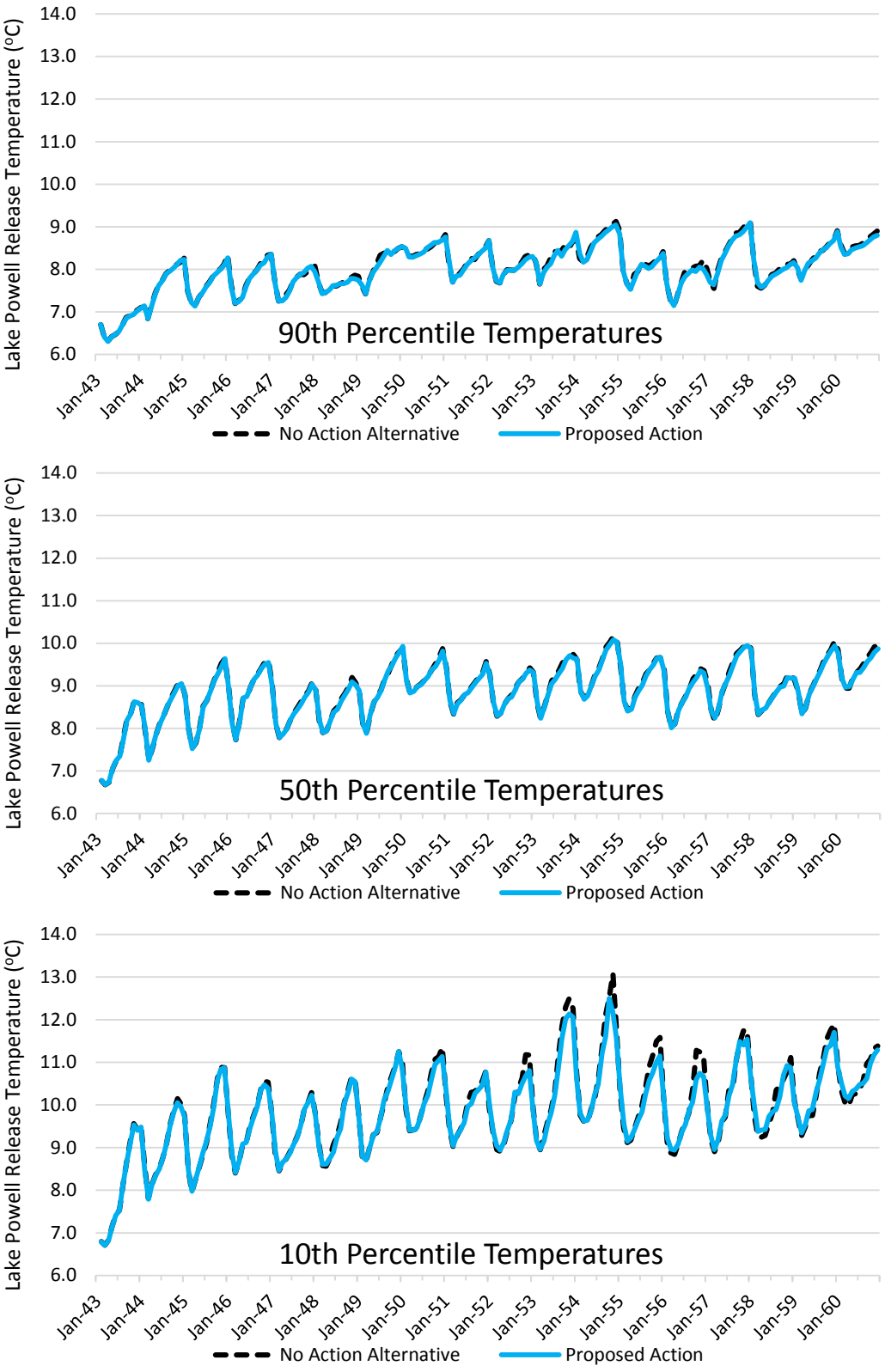

Figure 5-94D. Glen Canyon Dam Release Temperature Percentiles for the LPP Proposed Action Under Climate Change

NPS Comment No. 115

Flow duration data and curves from the Virgin River Daily Simulation Model (VRDSM) developed by UDWRe demonstrate no to minimal differences between the future without the LPP and future with the LPP in the Virgin River. A flow duration curve is a cumulative frequency curve that shows the percent of time specified discharges are equaled or exceeded during a given period. It combines in one curve the flow characteristics of a stream throughout the range of discharge, regardless of the sequence of occurrence. If the streamflow during the period on which the flow duration curve is based represents the long-term flow of the stream, the curve may be considered a probability curve and used to estimate the percent of time that a specified discharge will be equaled or exceeded in the future (USGS 1959). The Virgin River flows used in the flow duration curve analysis represent historical flow data from the period 1941 through 2013 (72 years). These flow data are corrected for projected decreases in Virgin River streamflow resulting from climate change modeled by Reclamation for UDWRe. The minimal differences between comparisons of the VRDSM flow duration curves are caused by timing of the simulated return flows between the future without the LPP and future with the LPP. The LPP would convey the water into Sand Hollow Reservoir, which would be transferred to the Washington County Water Conservancy District (WCWCD) Quail Creek Water Treatment Plant for treatment to meet future M&I water demands. No LPP water would flow directly into the Virgin River; after use for M&I purposes, some return flows would flow into the Virgin River through a variety of pathways.

The VRDSM flow duration curves represent long-term Virgin River flows and are considered a robust data set for probability curves used to estimate the percent of time a specified discharge would be equaled or exceeded in the future. The VRDSM flow duration curves are not annual curves; they represent the continuum of flow conditions in the Virgin River based on 72 years of daily flow data. For example, the flow duration curve data for VRDSM node QX29 in the Virgin River at the Utah-Arizona state line (Figure 4-13 in Final Study Report 18, Surface Water Resources, and Figure 5-88 in Section 5.3.3.2.2.2, Chapter 5, Exhibit E of the License Application) demonstrate a 70 percent probability of 53 cfs with the LPP and 48 cfs under No Action (without the LPP) at any point in time. Virgin River flows at the Utah-Arizona state line are downstream of where LPP indirect return flows would enter the river, and it would appear the estimated 5 cfs increase in flow with the LPP return flows in this example could improve the condition, trend, abundance, and diversity of biotic resources (e.g., fisheries, aquatic macroinvertebrates, food web dynamics, riparian/wetland vegetation, available/usable habitat) and abiotic resources (thermal loading capacity, channel and sediment dynamics, dissolved oxygen concentrations, other water quality parameters). However, the 5 cfs flow increase in this example is within the accuracy rating for USGS gage number 09413500 at the state line (ranging from 8 cfs in the low flow months of July and August to 45 cfs in the high flow month of April) and every month throughout the year. The U.S. government's expert agency on stream gaging (USGS) recognizes the difficulty in making exact, accurate measurements of streamflows in open, natural channels and would consider the 5 cfs increase in this example to be within the measurement accuracy of the stream gage.

Sixty-six percent of the flow duration curve data with the LPP show Virgin River flows would be equal to or slightly greater than No Action (without LPP return flows) for all VRDSM nodes (QX21, QX26, QX27, QX28, and QX29) shown in the analyses. Thirty-four percent of the flow duration curve data with No Action (without LPP return flows) are slightly greater than with the LPP for all VRDSM nodes shown in the analyses, and all of these data represent a range from 1 percent to 27 percent of the flow probabilities (the higher end of stream flows). All of the differences between the flow probabilities with the LPP and without the LPP for all the VRDSM nodes shown in the analyses are within the accuracy rating of the closest downstream USGS stream gage. Therefore, the effects of minor simulated increases

or decreases in flow between with the LPP and without the LPP (No Action) are not measurable in the Virgin River.

NPS Comment No. 115 references Table 4-3 and Figure 4-6 in Final Study Report 18, Surface Water Resources (same as Table 5-24 and Figure 5-79, respectively, in Section 5.3.3.2.2.2, Chapter 5, Exhibit E of the License Application), which show VRDSM simulated mean monthly flow differences of 14 cfs in March, 17 cfs in April, and 11 cfs in May between No Action (future without LPP) and with LPP indirect return flows at VRDSM node QX21. The mean monthly flows during these months demonstrate the annual spring runoff period, with streamflows under the No Action (without LPP) and with the LPP greater than 200 cfs, which coincides with the period when WCWCD diverts a large portion of their water rights into off-stream storage reservoirs (Quail Creek and Sand Hollow) to help meet demands for M&I water throughout the year. It is important to note that VRDSM node QX21 is at the Highway 9 bridge over the Virgin River, corresponds to USGS gage number 09408150, and is upstream of any of the VRDSM simulated return flows from the use of LPP water. All of the simulated mean monthly flow differences between the No Action (without LPP) and with LPP return flows at VRDSM node QX21 are within the accuracy rating for USGS gage number 09408150. The simulated mean monthly flow results show the magnitude of flows occurring during each month throughout the period of record (72 years). Figure 4-7 in Final Study Report 18, Surface Water Resources (same as Figure 5-80 in Section 5.3.3.2.2.2, Chapter 5, Exhibit E of the License Application) is the flow duration curve for VRDSM node QX21, representing 72 years of daily flow data and probability of Virgin River flow at any point in time.

Using the same example as described earlier in this response, the QX21 flow duration curve data demonstrate a 70 percent probability of 86 cfs with the LPP and 86 cfs under No Action (without the LPP) at any point in time. At 98 percent probability, the QX21 flow duration curve data demonstrate 86 cfs with the LPP and 86 cfs under No Action (without the LPP) at any point in time. At 25 percent probability, the QX21 flow duration curve data demonstrate 86 cfs with the LPP and 88 cfs under No Action (without the LPP) at any point in time. The 2 cfs difference at 25 percent probability in this example is within the accuracy rating for USGS gage number 09408150, and the flow difference is not measurable. The effects of the simulated flow differences between LPP indirect return flows and No Action (without the LPP) on biotic resources and abiotic resources associated with the Virgin River would be negligible.

NPS Comment No. 115 identifies a statement in USGS documentation for gage number 09413500 Virgin River Near St. George, UT under the heading Extremes for Period of Record: “[N]o flow at times in some years.” The comment correctly identifies that simulated mean monthly flows do not adequately reflect or capture the duration and frequency of no-flow or extreme low flow events. However, the 72 years of daily streamflow data at USGS gage 09413500 (VRDSM node QX29) do capture the duration and frequency of these events in the flow duration curve data, which is a probability curve. The graph of flow duration curves in Figure 4-13 in Final Study Report 18, Surface Water Resources (same as Figure 5-88 in Section 5.3.3.2.2.2, Chapter 5, Exhibit E of the License Application), demonstrates that the Virgin River streamflow approaches zero cfs between 99 percent and 100 percent of the time. This means that less than 1 percent of the time during the 72 years of daily streamflow data, the Virgin River flows as simulated by the VRDSM approach or equal zero cfs at the Utah-Arizona state line. The flow duration curve data show 3 cfs flow at 100 percent with the LPP and 3 cfs flow at 100 percent under No Action (without the LPP), with no difference between the two modeled scenarios. The 3 cfs daily flow probability represents an average of specific daily flow events between zero cfs and 6 cfs over the period of record. The occurrence of these extreme low flow or no-flow days less than 1 percent of the time demonstrates they are infrequent and of short duration, which is why the USGS notes “no flow at times in some years” under

the heading Extremes for Period of Record at gage number 09413500. The flow duration curves for VRDSM node QX29 show the same 3 cfs low-flow values with the LPP and without the LPP return flows, which proves it is possible to determine the LPP would not alter the frequency or duration of no-flow or extreme low-flow events that occur less than one percent of the time during the 72-year period of daily stream flow data.

Changes in Virgin River low flows can also be evaluated using extreme value design flows, such as 7Q10, 10Q10 and 30Q10 low flow values. The following paragraph and table is added to the end of in Section 5.3.3.2.2.2, Chapter 5, Exhibit E of the License Application:

Changes in low flows at various Virgin River gage locations were evaluated using extreme value design flows, such as 7Q10, 10Q10 and 30Q10 low flow values. These extreme value design flows are the annual minimum 7, 10 or 30-day average flow whose probability of not being exceeded is 1 in 10 years. The U.S. Environmental Protection Agency's DFLOW program was used with output from the Virgin River Daily Simulation Model to calculate low flows for futures with and without the Lake Powell Pipeline (see Table 5-24a). All river locations show the same or higher low flows under alternatives that include the Lake Powell Pipeline.

Table 5-24a. Changes in Virgin River Low Flows

Location	Virgin River Daily Simulation Model Node	Future Without LPP (Base Case)			Future With the LPP (Proposed Action)		
		7Q10 (cfs)	10Q10 (cfs)	30Q10 (cfs)	7Q10 (cfs)	10Q10 (cfs)	30Q10 (cfs)
Virgin River above Quail Creek	QX20	27	29	33	27	29	33
Virgin River below Quail Creek	QX21	27	29	33	43	44	51
Virgin River below Washington Fields Diversion	QX26	0	0	0	0	0	0
Virgin River below Bloomington Bridge	QX27	16	16	17	23	23	24
Virgin River below Santa Clara River	QX28	25	25	23	34	35	36
Virgin River at UT-AZ State Line	QX29	27	27	29	37	37	38

USGS (United States Geological Survey). 1959. Manual of Hydrology: Part 2. Low Flow Techniques, Flow-Duration Curves. Geological Survey-Water Supply Paper 1542-A. 33 pp.

U.S. Environmental Protection Agency (EPA). 2017. DFLOW 4.0. Available at: https://www.epa.gov/waterdata/dflow.