Appendix B – Data Gathering

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- **2023 Map Book**
  - 2023 TRFMA Mapbook Flood Project Elements Approved July 2023.pdf
    - *Description of Flood Project Elements completed, in progress, or planned by TRFMA on the Truckee River. Includes general objectives and conceptual features.*
    - *Includes Rock-McCarran Project, and adjacent projects (p.26-27)*
    - *Project will involve restoration instream, terracing and riparian restoration.*
    - *Outcome of the project to protect flooding from the north and south industrial areas as well as the Reno-Tahoe International Airport.*
- **FEMA Physical Map Revision Docs**
  - Meadows_Work_Maps_Compiled.pdf
    - *Consists of Truckee River Physical Map Revision (October 2023) showing both proposed and effective FEMA flood zones prepared by HDR. These maps cover portions of the Truckee River and its floodplain from approximately the Lockwood area on the east end to Mayberry Park to the west.*
    - *Includes Rock-McCarran Project (p.31)*
  - Truckee Meadows PMR Report Oct 2023.pdf
    - *Description of the Truckee River Physical Map Revision (PMR) and includes support for the revisions based on hydrology of the Truckee River and hydraulic modeling for the Truckee Meadows, Steamboat Creek, and the Lower Reach of the Truckee River.*
    - *A broad description of the floodway analysis and model of the overall Truckee Meadows Reach that includes the Rock-McCarran reach.*
    - *The Truckee Meadows 2D HEC-RAS model, developed from this report, stems from the Regional Truckee Meadows Model. This model was validated using the 2006 flood event.*
    - *Record flood event, 1997. The estimated peak was 23,000 cfs. The next largest record was the 2006 flood event. Other significant flooding events within the years of 1950,1955,1986,1997,2006, and 2017.*
    - *Terrain extends of the model are shown in Figure 2. Topographic data mostly from LiDAR from USGS in 2017.*
    - *Buildings are represented as elevated features in HEC-RAS from a building footprint shapefile from the Washoe County GIS dept.*
    - *HDR modified the tributary inflow hydrographs by revising the time at which the peak of the hydrograph occurs.*

- **GSR Related Docs**
  - GSR Phase 3 Piping Evaluation FINAL DRAFT 5.05.22.pdf

        - *Description of the Grand Sierra Resort (GSR) Flood Control Embankment Phase 3 Hydrogeologic Evaluation (2022) performed by McGinley & Associates. The focus was to address hydrologic evaluations of the potential for seepage and sediment piping through the earthen embankment planned along the south side of the Truckee River near the GSR.*
        - *The Rock-McCarran project is approximately a little over half a mile downstream from the GSR flood embankment.*
    - TRFMA GSR Spoils - Borrow Source Hydraulic Conductivity Memorandum.pdf
        - *Description of the Borrow Source Hydraulic Conductivity Memorandum prepared by CME regarding hydraulic conductivity estimates from borrow source materials used as part of the Vista Narrows project to be considered for reuse within the GSR study area.*
    - TRFMA GSR Spoils - Geotechnical Data Report-draft.pdf
        - *Description of the Geotechnical Data Report for the TRFMA GSR Spoils Piping Study prepared by CME that includes subsurface and laboratory investigation data as well as a summary of the geological profile encountered.*
- **Locally Preferred Plan 2013**
    - Volume I of III April 2013.pdf
        - *The Locally Preferred Plan Amendment to Draft General Reevaluation Report includes the Locally Preferred Plan (LPP), is a refinement to the Floodplain Terrace Plan and is referred to as alternative 4. The LPP is developed by TRFMA in coordination with the U.S. Army Core of Engineers (Corps). In this document there is appendix A -C (Historic photographs of flooding on the Truckee River, real estate plan, and economics).*
    - Volume II of III April 2013.pdf
        - *Volume II includes the engineering appendix D which summarizes the engineering analysis and design of the Locally LPP*
    - Volume III of III LPP_Plans_2013.04.30 11 DRAFT.pdf
        - *This figure is a draft sheet titled Alternative 4 LPP in plan view.*
        - *This figure displays the Rock-McCarran project site.*
    - Volume III of III LPP_Plans_2013.04.30.pdf
        - *This is a set of plans titled Truckee Meadows Flood Control Project Engineering Plans Alterative 4 Locally Preferred Plan*
        - *This plan set includes the LPP from the lower reach from Wadsworth to Pyramid Lake, the lower reach from Vista to Wadsworth, as well as the Truckee Meadows from Hwy 395 to Vista.*
        - *The Rock McCarran project is shown on p. 10-11.*
- **Misc Presentations and Reports**
    - FMA 12-08-23 Item 4 (Meadows Flood Project Permit-timeline-budget).pdf
        - *The TRFMA staff report discusses the updated Meadows Flood Project (flood protection elements from U.S. I-580 to Vista Narrows) considering inflation, private development plans, and mitigation negotiations with the PLPT.*

        - *Intermittent discussion about the Rock-McCarran Project throughout the staff report*
    - FMA 12-08-23 Item 4 Slides Meadows Plan Status Cost Timeline.pdf
        - *TRFMA presentation by George R. on the updated schedule, costs, and cashflow for the Meadows Flood Project*
        - *Rock-McCarran project image, formerly called Mill McCarran project, is shown on p.9-10.*
    - FMA 12-08-23 Item 5a (Rationale).pdf
        - *Rationale for Mitigation of Downstream Tribal Resources discusses the New Meadows project and the impacts and mitigation in regard to the PLPT.*
    - FMA 12-08-23 Item 6 (Mill Mcarran possible RFQ for design).pdf
        - *TRFMA staff report of the possible scope design for flood elements on the properties along the Truckee River lying north of Mill Street and between Rock Blvd. and McCarran Blvd. (the Rock and McCarran Properties)*
        - *Directly involves the project site of the Rock McCarran project.*
    - FMA 12-08-23 Item 6 Slides Rock McCarran RFQ.pdf
        - *TRFMA presentation by George R. Rock-McCarran design request for qualifications*
        - *Directly related to the Rock-McCarran project*
    - Mill-McCarranExcerpt from FMA-10-11-19-Agenda-Book-Full
        - *TRFMA Board Meeting and Agenda – Task 2 discusses the potential temporary uses by the City of Reno of a portion of the property at Mill & McCarran for recreation.*
        - *Includes status update on the property, update on future plans, priorities and timelines for levee configurations, and legal agreements between TRFMA and the City of Reno or Washoe County.*
- **Rock to McCarran Docs**
    - DRAFT Geotechnical Data Report - McCarran Boulevard Terracing.pdf
        - *Draft Geotechnical for the McCarran Boulevard Terracing portion (on the northeast side of the Rock-McCarran Project). The goal of the report is to evaluate the soil to be removed within the terrace to be reutilized for a levee on the Vista Narrows project.*
    - Rock-McCarran.pdf
        - *Engineering plan sheets for the alternative 4 locally preferred plan.*
- **TRFMA Recreation Plan**
    - TRFMA Rec Plan.pdf
        - *The Truckee River Conceptual Recreation Master Plan prepared by TRFMA and Stantec.*
        - *Transmitted from TRFMA as 15 constituent documents, combined by J-U-B as one for ease of reference.*
        - *From Readme:* "Please also be aware that, while the recreation plan was an important plan when it was being developed, many of the governing ideas have changed such as the need for flat fields vs. baseball fields has shifted to flat fields since its publication."

- **USACE General Re-eval Rep 2013**
    - 1.Truckee Meadows GRR.pdf
        - *Description of the Truckee Meadows Flood Control Project Final General Reevaluation Report prepared by the U.S. Army Corps of Engineers (March 2014) includes the assessment of the risks of flooding, analyzes ecosystem problems, evaluates alternatives to reduce flood risk, opportunities for fish passage, and identifies the Recommended Plan.*
        - *USACE Engineers' Research and Development Center (ERDC) developed measures to address upstream and downstream fish passage problems.*
        - *Discussion of environmental effects of the overall Truckee Meadows Flood Control Project, p. S-8 to S-9. Environmental resources discussed p.2-19 to 2-22. A biological opinion was received by the USACE December 5th, 2013.*
        - *Recreation projects performed discussed on pg. 2-22 to 2-24.*
    - 13-part Appendices
        - *Includes historic photos, real estate plan, economic appendix, engineering appendix, hydrology, hydraulics, cost estimate, geotechnical summary, and figures, engineering plans, and Trucke Meadows EO.*
    - Final EIS Vol I.pdf
        - *Description of the Final Environmental Impact Statement for the overall Truckee Meadows Flood Control Project.*
        - *Terrace floodplain description within the Rock-McCarran project pg. 4-7 to 4-13.*
        - *Potentially Affected Species including the LCT and Cui-ui as well as other species that could be found in the project area. Pg. 5-95 to*
    - Final EIS Vol II.pdf
        - *Description of the Final Environmental Impact Statement for the overall Truckee Meadows Flood Control Project appendices.*
        - *Rock-McCarran project plan sheet, RC-103*
        - *U.S. Fish and Wildlife Coordination Act Report*
    - Truckee Signed Chiefs Report.pdf
        - *A report from the Department of Defense on flood risk management in the Truckee Meadows area.*
    - Geotech
        - TM_Final_Report_-06Dec2011.pdf
            - *Description of the Geotechnical Report for the Truckee Meadows Flood Control Project Washoe and Storey Counties prepared by HDR for the U.S. Army Corps of Engineers*
            - *Does not include the Rock-McCarran project site and instead includes a site in downtown Reno, painted rock site, Wadsworth, and a site in Lockwood.*
- **Vista Narrows Design Docs**
    - Final 65% DDR - Cost and Quantities.pdf
    - Final 65% DDR - DS Modeling Dyer+ Part 1 (Report).pdf

        - *This analysis studied the downstream impacts of the proposed Vista Narrows Project which would potentially increase post-project river flows.*
        - *Results of this analysis include an 11% increase in the peak flow of the 100-year storm and a 4% increase in the 50-year flow. A summary of the hydraulic incremental changes, including the WSE, average flow, and average velocity, from the HEC-RAS model are shown for the different locations along the river.*
    - Final 65% DDR - DS Modeling Dyer+.pdf
    - Final 65% DDR - DS Modeling Dyer+Part II (Appendices).pdf
    - Final 65% DDR - DS Sediment Dyer+.pdf
        - *This sediment analysis quantifies the difference in sediment transport due to the Vista Narrows Projects and includes the three scenarios: pre-project, post-project, and restoration comparison.*
        - *The results of the analysis show an overall increase in riverbed erosion of approximately 0.02 ft. The significant increase in flow during the 100 year event due to the project occurs at about 33 hours during the six day event. The cumulative effects on the sedimentation and geomorphology due to the Project are minor.*
    - Final 65% DDR - Hydrualic Modeling HDR.pdf
        - *This hydraulic modeling report discusses the modeling efforts for the Vista Narrows project including the bathymetric, terrain surfaces, 2-D HEC-RAS modeling and 1D HEC-RAS modeling.*
        - *The goal of the design is to minimize the increase in peak of discharge due to the project and create a no rise condition along the Truckee Meadows region.*
        - *The results of the modeling included a final terracing of 2 and 3 located near the abandoned NDOT rest station below the upper railroad bridge and terracing 6 downstream of the TMWRF facility. Both 1-D and 2-D HEC-RAS models were used to determine a no rise condition for the Truckee Meadows for the Vista Narrows project.*
    - Final 65% DDR - Vista Narrows Design Project.pdf
        - *P. 40 includes a table that summarizes the probability of inundation of terraces at each return interval based on Vista Gage annual flow data from 1970-2017. The Environmental Services Team calculated the flows using bulletin 17B flow frequency analysis for the annual peak events from the gauge.*
    - Final 65% DDR CORE - Vista Narrows Design Project.pdf
        - This design report is prepared by Atkins and includes the changes in design from the 30% to the 65% design (additional details added to the levee, the reduction of the # of terraces, terrace configuration detailed, soil locations identified), the overall cost ($56.3M with a 15% contingency), construction date (2021), issues/key concerns identified in final design (NV Energy power relocations, a landslide area needing additional geotechnical exploration/analysis, grading refinement on Terrace 6 etc).

        - Results of the design include the Projects increase in WSE of less than a ft an increase in maximum velocity of 0.5 fps for the 100-year event. Changes in sedimentation was insignificant, bank erosion analysis showed minimal impact on bank erosion with only a maximum increase of 1% for the 100-yr event.
    - Vista Narrows - 65% Plans.pdf
        - *These include the 65% plans for the Vista Narrows project. Similar design components may be used for the Rock-McCarran project.*

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\\jub.com\central\Clients\NV\TRFMA\Projects\49-24-009_RockMcCarran\Data\Previous Enviro Studies

- EA for Lockwood, 102 Ranch, and Mustang Ranch Restoration Projects
    - *Lower Truckee Restoration Projects EA_USBOR_USBLM_2008*
        - *This EA was performed by the Bureau of Reclamation and Bureau of Land Management in compliance with NEPA.*
        - *This EA, Environmental Assessment, discusses the potential environmental consequences of the three lower Truckee River restoration projects at Lockwood, 102 Ranch, and Mustang Ranch. It includes the existing habitat at these sites, the restoration activities, and proposed future conditions.*
        - *The need for this project is due to anthropogenic changes to the Truckee River including the straightening and widening of the river in the 1960's which incised the channel lowering the groundwater table which prevented access to water for riparian vegetation. With the reduction in riparian vegetation along the riverbank, invasive species were able to then establish.*
        - *It was concluded that the proposed restoration activities would restore environmental damage from previous channel realignment of the Truckee River and allow for benefits of floodplain management, habitat for special-status species, improve water quality, remove invasive weeds, and increase biological diversity.*
        - *Riffles can be created in a river by adding rounded river rock. This helps to increase oxygen levels in the water and decrease CO2 levels.*
        - *During the summer phosphorus and nitrogen levels in the Truckee River increase and reduce dissolved oxygen levels which make for an unhealthy environment for fish.*
        - *Conditions to avoid include algal blooms, decay of organic matter, and low flow conditions*
        - *Health habitat for fish includes shaded areas, lower water temperatures, prevent sediment from entering the river and erosion on riverbanks. Otis Bay Ecological Consultants 2007a suggest that a narrow deeper channel that is shaded can help lower water temperatures.*
        - *Earthen "plugs" were used to prevent sediment transport and increased turbidity during construction. Silt curtain BMPs also used to minimize the amount of sediment reaching the waterway.*
        - *Pg. 4-22 includes description of aquatic habitat.*
        - *Cover for fish includes consideration of substrate composition including cobbles and gravels, presence and size of woody debris, turbulence, vegetation, undercut banks, and water depth. Consider allowing for protection from birds or other prey.*
        - *The proposed Lower Truckee River projects created approximately 3,117 lineal feet of riffle habitat with specific gradation of spawning gravels.*

        - *This EA has beneficial suggestions on how to reduce the impact to the LCT and other fish species during construction*.
- Fish
    - Cui-ui Second Revision Recovery Plan 1992 Revision – U.S. Fish and Wildlife Service
        - *Cui-ui are listed as an endangered species. They reside in Pyramid Lake and spawn in the lower Truckee River. They are able to pass the Marble Bluff Fish Facility and Numana Dam through the use of a fish ladder.*
    - Recovery Plan for the Lahontan Cutthroat Trout January 1995 – U.S. Fish and Wildlife Service
        - *A thorough review of the LCT population segments, life history, as well as strategies for recovery.*
        - *Habitat requirements include pools in close proximity to cover and velocity breaks, well vegetated stable stream banks, silt free rocky substrate in riffle run areas. Appropriate temperatures between 55 deg F to 72 deg F.*
        - There is lacustrine LCT that inhabit Independence and Summit Lakes that reproduce naturally in their native range.
    - Updated Goals and Objectives for the Conservation of Lahontan Cutthroat Trout (*Oncorhynchus clarkia henshawi*) prepared by the Lahontan Cutthroat Trout Coordinating Committee May 2019
        - *Descriptions of the different LCT management units including the Pyramid/Truckee Unit and conservation actions to approach recovery of the LCT.*
        - *These are updates to the USFWS 1995 LCT Recovery Plan. Focus of the plan is three conservation principles; representation, redundancy, and resiliency.*
        - *Two strains of LCT occur in the PTU (Pyramid-Truckee HUC unit); the Pyramid and Pilot Peak (within the Truckee).*
        - *Activities that led to the decline of the LCT's historical range include overharvesting, non-native species introduction, water diversions, mining, logging, and dams and reservoirs. The LCT was federally listed as endangered in 1969 and reclassified as threatened in 1975.*
    - LCT Action Plan_USFWS_2009
        - *A list of conservation actions and their costs is outlined to update the recovery plan and improve the LCT population size and interconnectivity.*
    - Map of NV Diversions on Truckee River_USGS_2001
        - *An excerpt of the Water Resources Investigation Report 01-4017 that includes the hydrologic features of the Truckee River Basin and corresponding data collection sites.*
    - Short-Term Action Plan for Lahontan Cutthroat Trout (*Onchorhynchus clarki henshawi*) in the Truckee River Basin 2003
        - *This short-term action plan was developed by the Truckee River Basin Recovery Implementation Team for U.S Fish and Wildlife Service*
        - *Discussion of riparian ecosystems in the Truckee River Basin. Riparian habitat communities consist of wetlands, cottonwood forests and riparian shrubs. Woody debris in the stream helps to increase the amount and*

quality of hydraulic habitat types, allows for fish to seek rest and refuge, increases nutrient cycling and sediment storage (Robison and Beschta 1990). Although cottonwood stands reside on the outer banks of the River and have roots that can reach the water table, regeneration of cottonwood saplings need the flooding occurrences to allow them to thrive. Without the upper cottonwood canopy the river has lost portions of shade and stream temperatures therefore have risen.

- *Development of an ecosystem flow methodology combining ecological decision factors and flow regimes of the Truckee River.*

- Truckee River Fish Passage Improvement Study
  - *An overview of fish passage barriers along the Truckee River and recommendations for improvements of each barrier.*
- Hydrologic Geomorphic Studies
  - 1982_Geomorphic Study of LTR_Gregory at CSU
  - 1983_Channel Improvement Proposal for LTR_WET for PLPT
  - 1983_Lower Truckee Channel Improvement Plan_USBOR
  - 1990_Channel Stabilization & Restoration Plan LTR_PLPT_USEPA
  - 1990_Geomorph Analysis of TR_Booth St to Vista_WET for USACE
  - 1990_LTR Hydrology Study_Murray,Burns, Kienlen
  - 1990_Recon_Lower_Truckee_Agency_notes
  - 1991_TR Geomorph Recon Vista to Pyramid Lk_WET for USACE
  - 1993_TR Riparian Veg & Fluvial Geomorph Study_USFWS
  - 1993_Truckee River Sedimenation Study_USACE WES
  - 1994_Lower Truckee River Stream Restoration Report_Reckendorf at SCS
  - 1995_LTR Recon Investigation_USACE for PLPT
  - 1995_LTR Recon Investigation_USACE for PLPT_Maps
  - 2007_Channel & Floodplain Changes on LTR_K Adams at DRI_Draft
- USACE Common Features Project
  - *Two different basemaps with a tree survey figure from July 2019. Trees mapped on the south end of the McCarran project by Atkins.*
- Below Derby Dam Restoration Project EA_USBOR_2009
  - *This is an environmental assessment for riparian ecosystem restoration for the Truckee River below Derby Dam. This document complies with NEPA.*
  - *The riparian corridor is being repaired to reconnect the river to the flood plain allowing for a more functional river, establishment of native plant communities to benefit fish habitat, and improving water quality. Additionally the project would allow a permanent transfer of 250 acre-feet of water annually to the lower Truckee River and Pyramid Lake.*
- Below Derby Dam Restoration Project FONSI_USBOR_2009
  - *The lower Truckee River restoration project below Derby Dam was deemed a Finding of No Significant Impact (FONSI) since the project would only have short term environmental impacts and no significant effects on any resource.*

        - *Some of the impacts identified include minimally effecting water quality in the short term but allowing for a multi-layered riparian habitat would increase the amount of overhanging vegetation allowing for shade and reducing the water temperatures. Native vegetation establishment would remove noxious weeds and restore 3.1 acres of riparian vegetation. The proposed action had a A No Effect determination on the federally listed species and the project was expected to improve fish habitat in the long-term*.
- LTR Final Geomorphic Assessment & Final Preliminary Design Prepared for USACE by Otis Bay Consultants 2004
    - *This Lower Truckee River geological assessment and final preliminary design includes a historical synopsis of the Truckee River watershed's geological and soil characteristics. As well as detailed geomorphological descriptions for each segment of the Truckee River along with its hydrology and sediment transport, species descriptions, proposed actions, and revegetation plan*.
- Vista Narrows Integrated Weed Management Plan Prepared by Redhorse Corporation for TRFMA 2021
    - *This plan identifies common weeds at the site and methods to establish native plant communities in replacement of the weeds*.
    - *The plan includes existing species that are to be identified onsite, treatment efforts, treatment prescriptions, BMP for removal of weeds, and monitoring and reporting on the establishment of natives*.
- Vista Narrows Revegetation Plan Prepared by Redhorse Corporation for TRFMA 2021
    - *This plan includes the floodplain terrace revegetation and riprap concepts, discussion of the project's environmental context, a work plan of the floodplain terraces and vegetated riprap, and maintenance and monitoring criteria*.
    - *Terraces 2 ,3, and 6 are described since they were developed during the engineering design*.
    - *Key goals driving the revegetation design included meeting the design capacity for flood flow conveyance, facilitate permitting needs, improve ecological function, maximizing wetland community acreages, reduce invasive weeds, and establish native plant communities*.
    - *Plant communities included wetland, dry riparian shrub, and upland plants*.
    - *Planting zone dependent on seasonal inundation and depth to the summer water table. Willow stakes were to be planted in erosive areas. Plant mixes had both wet and dry species*.
    - *Weed control program consisted of chemical, mechanical, and cultural methods*.
    - *Truckee river flood return intervals were based on flows at the Vista gage and are based on a 24-hour event. Flows adjusted for design because Project is two miles downstream of gauge. Source of data from Vista Narrows 65% Submittal Design Documentation Report (Atkins 2019)*.

- *Levels of flood plain zones: Active channel (just below the OHWM, no reveg performed), floodplain zone (0-3 ft above OHWM, flood return interval is between 1.1-3 years) where inundation occurs when flows exceed 503 cfs, the dry riparian zone (1-8 ft higher than the wetlands in the floodplain zone, 3.1-5 year flood inundation level), and the upland zone (flood return interval is greater than 5 years). Cross sections of each river terrace are provided.*

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- **LCT_Coordinating_Committee**
  - Lahontan Cutthroat Trout 2019 Updated Goals and Objectives
    - *Descriptions of the different LCT management units including the Pyramid/Truckee Unit and conservation actions to approach recovery of the LCT.*
    - *These are updates to the USFWS 1995 LCT Recovery Plan. Focus of the plan is three conservation principles; representation, redundancy, and resiliency.*
    - *Two strains of LCT occur in the PTU (Pyramid-Truckee HUC unit); the Pyramid and Pilot Peak (within the Truckee).*
- **LCT_Temperature_Criteria**
  - NDEP folder – *includes an article written by NDEP in 2006 about recommended maximum daily temperature criteria for various fish species depending on life stage.*
    - *Five main stages of life for the fish – spawning, incubation, nursery-fry, juvenile, and adult.*
    - *According to NDOW, maximum daily temp ranges are between 55.9-71.9 deg F*
      - *Spawning (April-May, 13.3 deg C, 55.9 deg F)*
      - *Incubate (April-August, 16.7 deg C, 62.0 deg F)*
      - *Nursery (May-August, 20 deg C, 68 deg F)*
      - *Juvenile (June-October, 21.1 deg C, 69.9 deg F)*
      - *Adult (Jan-December, 22.2 deg C, 71.9 deg F)*
  - USGS_Gauge_Temp_Data – *Raw temperature data from the USGS gauge stations both from Glendale Avenue prior to project site and at McCarran downstream of the project site.*
  - Fish Temperature Ranges – *This spreadsheet was put together by JAW. Temperature data from the USGS stream gauge downstream of the project site was used in combination with the temperature criteria provided from the NDEP article (2006) to compare the temperatures in the river with the corresponding temperatures needed by the LCT at different life stages.*
  - *Comparing the USGS downstream of the project stream gauge temperatures, it appears between June to September is when the stream temperatures in the project area during 2023 corresponded with the later in the season incubation and nursery life stages and early in the season juvenile stage. The temperatures during 2023 did not overlap with the spawning stage of the trout.*
- **National_Fish_and_Wildlife_Foundaton**
  - A Business Plan for the Conservation of the Lahontan Cutthroat Trout: A Ten Year Plan for Conservation Throughout Its Range (2010).
    - *A broad overview of the LCT species and the key strategies to be implemented under the Keystone Initiative.*
    - *The LCT is only salmonid native to the Lahontan basin.*
    - *Population monitoring of LCT is conducted by NDOW.*

        - *In 2004, NDOW obtained the Safe Harbor Agreements (SHAs) with the USFWS for the northwestern and eastern basins to help protect landowners who may acquire or have LCT on their land.*
        - *Spring flows need to be high to create spawning habitat but low enough to prevent mortality of young-of year fish (flushing of gravels without extreme flooding – Ray et al 2007). Temperature dependent habitat (Dunham et al 2003a). LCT densities are higher at lower stream width: depth ratios which is an indicator of high-quality riparian habitat (Dunham et al. 2002b).*
- **Notes**
    - LCT Literature Review
        - *A brief literature review put together by ESK to summarize general background information and optimal habitat characteristics for the LCT.*
    - LCT_Questions for USFWS
        - *Questions prepared by ESK and JAW about levee design considerations in conjunction with LCT habitat.*
- **Trout Unlimited**
    - State of the Trout
        - *Brief inclusion of the LCT along with multiple other Trout species history.*
        - *LCT has been lost from almost 99% percent of its historic habitat and less than 9% of historic stream/river habitat is occupied.*
        - *One of the 1st species to be listed under the 1973 Endangered Species Act.*
- **USFWS_Plans**
    - Cui-ui Recovery Plan (1992)
        - *Cui-ui inhibit Pyramid Lake and the Lower Truckee River therefore it's my understanding that they would not be within the project area.*
    - LCT Recovery Plan (1995)
        - *A thorough review of the LCT population segments, life history, as well as strategies for recovery.*
        - *Habitat requirements include pools in close proximity to cover and velocity breaks, well vegetated stable stream banks, silt free rocky substrate in riffle run areas. Appropriate temperatures between 55 deg F to 72 deg F.*
    - Habitat Suitability Index Models: Cutthroat Trout (1982)
        - *Description of habitat use and HIS models that apply to all cutthroat trout (Salmo clarki). Temperature, migration, and other life history and habitat characteristics is different depending on the trout species.*
- **Western_Native_Trout_Status_Report (2020)**
    - *Includes a summary of the history, habitat requirements, threats to habitat, and conservation approaches by watershed areas.*
    - *The LCT was first listed in 1970 as an endangered species and reclassified as federally threatened in 1975 to which it remains.*
    - *The LCT in the Truckee River are part of the Western Geographic Management Unit (GMU). This unit includes the Truckee, Carson, Walker, and Susan rivers.*

- *The historical decline of the species is largely attributed to a combination of overharvesting, mining, logging, water pollution, water diversions, and introduction of non-native species.*
- *LCT occupy about 15% of the remaining suitable habitat (LCT MOG 2019).*
- *In the Truckee River Basin there are two naturally reproducing stream populations.*
- *Habitat requirements: cool water, highly vegetated and stable stream banks, stream velocity breaks, silt free, rocky riffle run areas.*
- *Tolerate – higher water temp for short periods of time, high alkalinity (as high as 3,000 mg/L) and high TDS (as high as 16,000 mg/L).*
- *LCT are obligatory stream spawners generally from April-July. Eggs are generally laid in small gravels within riffles or pool crests (USFWS 1995). Hatching occurs within 4-6 weeks depending on the temperature, and fry emerge 13-23 days later (Lea 1968, Moyle 2002).*
- *Threats to the species – reduction and alteration of stream discharge, loss of undercut banks, increased silt, exposed stream channels, shallow and wider streams, elevated temperatures or temperatures that are too cold.*
- *Non-native species that compete for habitat include rainbow trout, brook trout, and brown trout.*
- *The Pilot-Peak strain is the most suitable strain for this interconnected habitat between the two Lakes; Tahoe and Pyramid.*

- **NDOW, Nevada Department of Wildlife**
  - 2022 Nevada State Wildlife Action Plan , pg. 373-374
  - *Brief species status and description of habitat and life characteristics.*
  - *Status – threatened per USFWS, Game- state protection*
  - *Coloration – pink band along the lateral line, numerous body spots, red slash under the jaw, sometimes parr marks into adulthood*
  - *Optimal habitat – clear, cold water with temperatures not to exceed 23 deg C for winter and summer (73 deg F), silt free substrate, 1:1 riffle to pool ratio, slow deep water, vegetative cover on streambanks for cover and shade like trees, logs, as well as boulders and undercut banks,*
  - LakeSuperiorStreams - Riffles, runs and pools –
    - Pools are beneficial to trout as the water moves slower here and allows other insects and worms to habitat this area as well. Allows for a deeper area to locate.
    - Riffles are beneficial as they are shallow areas where water is running fast, this is where other types of net-winged insects will get caught.
  - *Toleration: LCT can tolerate high levels of alkalinity and TDS.*
  - *Stream obligate spawners (release or deposit eggs), generally in spring and early summer dependent on stream temperatures, elevation, and flow*
  - *Stream LCT can live up to 5 years (longer in Pyramid Lake). Males are sexually mature at 2-3 yrs and females 3-4 yrs.*
  - *Concerns for stream systems include livestock grazing, mining, development, water pollution, and loss of connectivity between streams such as water diversions,*

dewatering and barriers like dams. Loss of riparian vegetation and introducing nonnative trout. Rainbow trout hybridize with LCT.

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