DAM AND CANYON FACILITIES MASTER PLAN
MESA COUNTY, COLORADO

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1.0 Executive Summary

The Colorado Basin Roundtable (CBRT) identified the Roller Dam Rehabilitation project as a Basinwide “Top Priority” in its Basin Implementation Plan (BIP). The Roller Dam Rehabilitation project addresses the rehabilitation needs of the Grand Valley Project Diversion Dam (commonly known as the “Roller Dam”) and the portion of the Government Highline Canal immediately below the Roller Dam. This project will help maintain the Cameo Call; improve water delivery system operations, capacity and reliability; sustain the ecological health of the Colorado River; and preserve the agricultural economy of the Grand Valley.

The efforts to fully understanding the rehabilitation needs of these facilities are ongoing and dynamic. This Dam and Canyon Facilities Master Plan (Phase 1) is only the first step in assessing and defining these rehabilitation needs. It is anticipated that the conclusions and recommendations of this and future studies will continually provide dynamic input to the rehabilitation efforts. The Grand Valley Water Users Association (Association) and other partnering agencies received a Water Supply Reserve Account Grant to fund Phase 1 of the Roller Dam and Canyon Facilities Master Plan which:

- Identified and prioritized the rehabilitation needs of the Roller Dam and Canyon Facilities (structural, cosmetic, environmental, etc.);
- Developed implementation plans for the top five (5) needs, specifically addressing the project costs, hydropower potential, funding opportunities, schedule, and list of potential teaming partners and sponsors and;
- Recommends actions for Phase 2 of the Master Planning efforts including remediation and/or upgrades as appropriate.

The top five rehabilitation needs identified in Phase 1 include:

1. Lining the Upper 500 feet of the Canyon Canal
2. Upgrade the Roller Dam Electrical and Control Systems
3. Rehabilitate the Canal Headworks
4. Rehabilitate the Roller Tracks and Canal Concrete
5. Replace the Radial Gates at the Canal Station 22 Spillway

1.1 Next Steps and Recommendations

The Dam and Canyon Facilities Master Plan (Phase 1) identified the top five rehabilitation needs for the Roller Dam and upper Government Highline Canal facilities. The successful identification of these needs was a result of the input and investment of the Association, OMID, and the project participants, and supports future implementation of multi-purpose/multi-benefit projects within the Colorado River Basin. Specifically, these top priorities align with the project objectives to support the:

- structural and operational improvements required to maintain and enhance the water delivered by the Roller Dam and related facilities; and
- Roller Dam and GVPP operations.

The top five rehabilitation needs include:

1. Lining the Upper 500 feet of the Canyon Canal
2. Upgrade the Roller Dam Electrical and Control Systems
3. Rehabilitate the Canal Headworks
4. Rehabilitate the Roller Tracks and Canal Concrete
5. Replace the Radial Gates at the Canal Station 22 Spillway

Section 4 provided information specific to each of these top five rehabilitation needs while the Project Implementation Plan summarized the next steps, permitting requirements, constraints and challenges, known funding plan elements/participants, schedule, and potential project partners. Each of these rehabilitation needs, with the exception of the Top Priority, requires further investigation and evaluation with varying degrees of investment.

Phase 2 of the Dam and Canyon Facilities Master Plan should focus on developing at least a 30 percent design drawing in order to better understand the final design scope, fee and schedule. This effort includes outlining a plan to address the specific permitting and constraints for each project. Priority 2, Upgrade the Roller Dam Electrical and Control Systems, and Priority 3, Rehabilitate the Canal Headworks, had a near-term, 1 to 3 year, timeframe identified for action; hence, should be evaluated first.

Development of funding to support these rehabilitation needs will be an ongoing effort with identified project partners.

The GVPP rehabilitation project, not included as part of this effort, is critical to the long-term administration of the Colorado River and support of the Recovery Program's 15-Mile Reach; hence, may dictate the prioritization of these rehabilitation needs.

2.0 Project Information

This section summarizes the background, purpose and project approach.

2.1 Background

The Association is the managing entity for the federally owned Grand Valley Project. The Grand Valley Project facilities include the Grand Valley Diversion Dam, known as the Roller Dam, on the Colorado River in De Beque Canyon; an attendant headgate diversion structure; five miles of Canyon Canal and related facilities, including endangered fish recovery facilities; the Stub Ditch pump station; the 55-mile-long Government Highline Canal; 150 miles of project laterals; 100 miles of drainage ditches; and the Grand Valley Hydroelectric Power Plant (GVPP) which is operated under a Lease of Power Privilege (LOPP) with Bureau of Reclamation (Reclamation). These facilities:

1) provide irrigation water for Orchard Mesa Irrigation District (OMID), Palisade Irrigation District (PID), Mesa County Irrigation District (MCID) with combined acreages of over 15,000;
2) deliver water through the Association's Government Highline Canal which provides irrigation water to approximately 23,500 acres in the Gravity Division of the Grand Valley Project;
3) deliver water year round water to the 3.5 megawatt (MW) GVPP; and
4) maintain stream flows in the 15 Mile Reach of the Colorado River, which is critical habitat for four species of endangered fish.

The Roller Dam, which was constructed in the early 1900's, is structurally sound however the aging structure is in need of rehabilitation and upgrades in order to maintain the high functioning level required to manage and divert the large flows in the Colorado River. In addition, the upper portion of the Highline Canal (Upper Canal) immediately below the Roller Dam, is in need of repair and upgrades are needed to support the reliable conveyance of water diverted at the Roller Dam. The continued operation of these facilities provides multiple benefits, justifying a cost share approach to project financing commensurate with the derived benefits.

2.2 Purpose

The overall purpose of this project is to protect the water rights associated with the "Cameo Call" by outlining and prioritizing the rehabilitation needs of the Roller Dam and the portion of the Government Highline Canal immediately below the Roller Dam (collectively referred to as the 'Dam and Canyon Facilities'). Exercise of these water rights and the continued operation of the Dam and Canyon facilities provide predictability to river flows and associated environmental and cultural benefits. These benefits include more reliable flows in the upper portions of the Colorado River which improves water quality in the lower portions of the basin. The flows generated by the Cameo Call also provide water for recreational activities on the Colorado River and for riparian habitat and aesthetic values along the entire Colorado River corridor. Flows generated by the Cameo Call also assist the state in complying with its obligations under the Colorado River Compact and in maintaining acceptable lake levels in Lake Powell.

Phase 1 of the Dam and Canyon Facilities Master Plan:

1) identified and prioritized the rehabilitation needs (structural, cosmetic, additional hydropower potential, environmental, etc.) of the Roller Dam and Canyon Facilities;
2) developed implementation plans for each of the prioritized needs, specifically addressing the costs, funding opportunities, schedule, and list of potential teaming partners and sponsors; and
3) recommends actions for Phase 2 of the Master Planning efforts including remediation and/or upgrades as appropriate.

2.3 Approach

The overall approach for Phase 1 of the Master Plan project was founded upon a collaborative process among potential participants that support the implementation of multi-purpose/multi-benefit projects within the Colorado River Basin. The project partners were instrumental in the identification of the Dam and Canyon Facilities needs, and provided valuable guidance, input and feedback regarding the current operations and where rehabilitation may offer opportunities to successfully manage and improve operations while at the same time benefiting other uses. The project partners represented entities that may support one or more of the following needs, including but not limited to:

- structural and operational improvements required to maintain and enhance the water delivered by the Roller Dam and related facilities;
- Roller Dam and GVPP operations; and/or
- capital and operational costs, etc.

The following tasks supported the identification of the rehabilitation needs and development of this Master Plan.

- Task 1 – Identify and Prioritize Rehabilitation Needs
  - Inventory Existing Information and Documentation
  - Facilitate Two Working Sessions with Project Partners

- Task 2 – Develop Project Implementation Plans

Implementation of these tasks provided the information for this Master Plan (Phase 1) and future Phase 2 Master Planning efforts.

3.0 Rehabilitation Needs

SGM reviewed several reports and documents and obtained input from key stakeholders during two working sessions to identify the existing rehabilitation needs of the Dam and Canyon Facilities.

3.1 Existing Reports and Information

The primary sources of reports and information summarizing the condition of the Dam and Canyon Facilities were provided by Reclamation; the Association, and OMID. A summary of the reports and information reviewed is provided in the Appendices A through D.

Tables 1 & 2 summarize the findings and recommendations from the various reports and studies for the Roller Dam elements and the top 500 feet of the Government Highline Canal, respectively.

3.2 Partner Working Sessions

Two working sessions were held (December 7, 2015 and January 11, 2016) at the Grand Junction Reclamation office. Participants represented the following agencies; Reclamation, Colorado River Water Conservation District, the Association, PID, OMID, and the Nature Conservancy (TNC). A summary of the critical input and direction received from the participants is summarized below. A copy of the meeting minutes, including a list of participants, for both meetings is provided in Appendix E.

3.2.1 Work Session #1

Work Session #1 focused on obtaining information from participants that would assist in documenting the needs for the Master Plan project; communicating the current status of the Roller Dam and Canyon Facilities; and confirming the project goals. Participants identified their interest and understanding of the project and project goals. Common themes for sustaining and maintaining the Roller Dam and Canyon Facilities, as agreed upon by the work session attendees, included:

1. Maintaining the Association's and OMID's historical water rights
2. Maintaining the administrative call at Roller Dam
3. Developing partnerships
4. Meeting Reclamation Urbanization Canal Project requirements
5. Developing funds to address project needs
6. Increasing capacity of the Government Highline Canal to allow for an additional 70-100 [cubic feet per second (cfs)] of decreed water
7. Maintaining 15-mile Reach flows
8. Addressing Colorado River Basin issues

3.2.2 Work Session #2

Work Session #2 provided the participants the opportunity to reviewed the data and information included in Table 1, specific to the Roller Dam needs, and Table 2, specific to the Canal Needs. Meeting minutes are provided in Appendix E.

Table 1. Inventory of Rehabilitation Needs for the Roller Dam.

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
Roller Dam														
Overflow Weir									2005-2-C Need an underwater examination. (Category 2)		2005-2-C Need an underwater examination. (Category 2) **Incomplete.**			2005-2-C Need an underwater examination.
Roller Gate				1991-3 Rehabilitate the roller gates					2005-2-A Replace or repair and then recoat longitudinal interior metal bracing (all roller gates) (Category 2)		2005-2-A Replace/repair/recoat longitudinal interior metal bracing (all roller gates) (Category 2) **Incomplete.**	Repaired and replaced mechanical components such as bearings, seals, gears, chains, sprockets **Completed in 2012-2013.**	Repair and replace mechanical components such as bearings, seals, gears, chains, sprockets and improved perimeter and base gate	2005-2-A Replace/repair/recoat longitudinal interior metal bracing (all roller gates)
											2011-2-A Identify then patch areas of the roller gate shielding that have worn to an unsafe thickness. (Category 2)			2011-2-A Identify then patch areas of the roller gate shielding that have worn to an unsafe thickness.
	84-2-A Enclose all transfer switch and circuit breaker panels or replace with more up-to-date equipment. (Category 2)	84-2-A Enclose all transfer switch and circuit breaker panels or replace with more up-to-date equipment. (Category 2) **Incomplete**	84-2-A Enclose all transfer switch and circuit breaker panels or replace with more up-to-date equipment. **Incomplete.** (Category 2)	1991-5 Upgrade the dc and ac power systems to comply with current codes (recommended keeping and upgrading dc rather than converting to ac)	84-2-A Enclose all transfer switch and circuit breaker panels or replace with more up-to-date equipment. (Category 2) **Incomplete - Waiting for approval of R&B loan.**		84-2-A Enclose all transfer switch and circuit breaker panels or replace with more up-to-date equipment. (Category 2) **Incomplete - Waiting for approval of R&B loan.**		84-2-A **Deleted** - Access to these switches and panels is critical to the operation of the roller gate hoists. Covering the switches and panels would not be practical and replacement would be cost prohibitive. (Category 2)				Upgrade the electrical and control system that operates the roller gates and supplies other required electrical needs	Upgrade the electrical and control system that operates the roller gates and supplies other required electrical needs
				1991-2 Replace two of the roller gates on the left side of the diversion dam with a permanent ogee crest.									Investigate replacing one or more roller gates with different style gates allowing for more positive control of dam pond level.	Investigate replacing one or more roller gates with different style gates allowing for more positive control of dam pond level.
				1991-4 Modify the roller gates to provide additional head on the canal works										
					93-3-A Monitor ceiling in control room where roof has leaked in the past. Remove any material that could fall. (Category 3)		93-3-A Monitor ceiling in control room where roof has leaked in the past. Remove any material that could fall. (Category 3) **Incomplete.**		93-3-A Monitor ceiling in control room where roof has leaked in the past. Remove any material that could fall. (Category 3) **Complete (Ceiling was replaced).**					

Table 1. Inventory of Rehabilitation Needs for the Roller Dam (Continued).

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
Roller Dam														
Sluiceway									2005-2-C Need an underwater examination. (Category 2)		2005-2-C Need an underwater examination. (Category 2) **Incomplete.**			2005-2-C Need an underwater examination.
Footbridge			90-2-A Clean and recoat (paint) all metal work throughout the structure, especially on the service bridge. (Category 2)		90-2-A Clean and recoat (paint) all metal work throughout the structure, especially on the service bridge. (Category 2) **Incomplete - Waiting for approval of R&B loan.**		90-2-A Clean and recoat (paint) all metal work throughout the structure, especially on the service bridge. (Category 2) **Incomplete - Waiting for approval of R&B loan.**		90-2-A **Deleted -** as written, this is difficult to complete. When specific areas need to be recoated they will be addressed on a case-by-case basis. (Category 2)					
									2005-2-B Repair/replace the concrete on top of all the piers between sections of the service footbridge on the Roller Dam to provide a smooth walking surface. (Category 2)		2005-2-B Repair/replace the concrete on top of all the piers between sections of the service footbridge on the Roller Dam to provide a smooth walking surface. (Category 2) **Completed in 2011-2012.**			
			90-2-B replace all damaged planking on the service bridge. (Category 2)		90-2-B replace all damaged planking on the service bridge. (Category 2) **Completed.**				2005-3-A Replace the decking boards on the sections of the service footbridge that are deteriorated and unsafe. (Category 3)		2005-3-A Replace the decking boards on the sections of the service footbridge that are deteriorated and unsafe. (Category 3) **Complete.**			
Piers									2005-2-C Need an underwater examination. (Category 2)		2005-2-C Need an underwater examination. (Category 2) **Incomplete.**			
		1987-2-A Have association take two concrete core samples on the east abutment for testing. (Category 2)	1987-2-A Have association take two concrete core samples on the east abutment for testing. (Category 2) **Completed.**		1987-2-A Have association take two concrete core samples on the east abutment for testing. (Category 2) **Completed.**								Repair and/or replace deteriorating and spalling concrete throughout facility.	Repair and/or replace deteriorating and spalling concrete throughout facility;

Table 1. Inventory of Rehabilitation Needs for the Roller Dam (Continued).

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
River Embankment											2011-2-A Reinforce the river embankment immediately upstream of the right abutment, where erosion is evident. (Category 3)			2011-2-A Reinforce the river embankment immediately upstream of the right abutment, where erosion is evident.
				1991-6 Repair the river training wall										
Dam Structure			88-1-A Have Association develop a plan of corrective action to resurface all decaying concrete on the diversion dam and canal headworks (per May 24, 1988, memorandum) (Category 1) **Incomplete**	1991-1 Repair the concrete surface of the diversion dam.	88-1-A Have Association develop a plan of corrective action to resurface all decaying concrete on the diversion dam and canal headworks (per May 24, 1988, memorandum) (Category 1) **Incomplete - Waiting for approval of R&B loan.**		99-2-A (Replacing 88-1-A) The Association should develop/implement a plan of corrective action to resurface all deteriorating concrete on the diversion dam and canal headworks (Category 2)		99-2-A (Replacing 88-1-A) - **Deleted** The Association should develop/implement a plan of corrective action to resurface all deteriorating concrete on the diversion dam and canal headworks (Category 2)		2011 Weathered concrete; spalling and exposed concrete		Repair and/or replace deteriorating and spalling concrete throughout facility;	Repair and/or replace deteriorating and spalling concrete throughout facility;
							99-3-A Investigate/repair the void beneath the concrete slab near the building on the right abutment (Category 3)		99-3-A Investigate/repair the void beneath the concrete slab near the building on the right abutment (Category 3) **Completed (Void was filled with concrete).**					
Fish Passage Facility			90-2-C Repair the fencing on the left abutment (i-70 side) to improve the security and to prevent unauthorized entry. (Category 2)		90-2-C Repair the fencing on the left abutment (i-70 side) to improve the security and to prevent unauthorized entry. (Category 2) **Completed.**									
									Install Fish Passage (Structure will have its own RO&M and is not included in examination for GVDD). **Constructed in 2003 and 2004.**					

Table 2. Inventory of Rehabilitation Needs for the Top 500 Feet of the Government Highline Canal.

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
Government Highline Canal System (Top 500 Feet)														
Canal Headworks/Slide Gates									2005-2-C Need an underwater examination. {Category 2}		2005-2-C Need an underwater examination. {Category 2} **Incomplete.**			2005-2-C Need an underwater examination. {Category 2}
	78-1-A Complete draft of Standing Operating Procedures as soon as possible {Category 2} **Completed 1982.**													
	78-2-A Repair concrete at canal headworks {Category 2} **Not completed.**	78-2-A Repair concrete at canal headworks {Category 2} **Not completed.**	78-2-A Repair concrete at canal headworks {Category 2} **Not completed.**	1991-9 Repair the concrete on the canal headworks	78-2-A Repair concrete at canal headworks {Category 2} **Incomplete - Waiting for approval of R&B loan.**		78-2-A Repair concrete at canal headworks {Category 2} **Incomplete - Waiting for approval of R&B loan.**		78-2-A **Deleted** - The right downstream wall is structurally sound and surficial deterioration of the concrete seen on top of the wall does not threaten this stability. {Category 2}		2011 Concrete is deteriorating. Bottom seal missing.		Repair and/or replace deteriorating and spalling concrete throughout facility;	Repair and/or replace deteriorating and spalling concrete throughout facility;
					88-1-A Have Association develop a plan of corrective action to resurface all decaying concrete on the diversion dam and canal headworks (per May 24, 1988, memorandum} {Category 1} **Incomplete - Waiting for approval of R&B loan.**		99-2-A {Replacing 88-1-A} The Association should develop/implement a plan of corrective action to resurface all deteriorating concrete on the diversion dam and canal headworks {Category 2}		99-2-A **Deleted** - the concrete is old but structurally sound. As written this recommendation is not achievable. When areas of deteriorated concrete are structurally unsound or could adversely affect the operation of the dam, gates or other features they will be addressed on a case-by-case basis. {Category 2}					
				1991-9 Add a guardrail along side the canal gate hoists **Completed.**										

Table 2. Inventory of Rehabilitation Needs for the Top 500 Feet of the Government Highline Canal System (Continued).

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
Government Highline Canal System (Top 500 Feet)														
Canal Headworks/Slide Gates				1991-8 Replace two spillway radial gates on the canal. (Station 22 spillway)									Rehabilitate, repair, and replace as required the canal headgates and related operational facilities	Rehabilitate, repair, and replace as required the canal headgates and related operational facilities
			90-2-D Cover the exposed hoist gear boxes on the canal headworks operating deck. (Category 2}		90-2-D Cover the exposed hoist gear boxes on the canal headworks operating deck. (Category 2} **Incomplete - Waiting for approval of R&B loan.**		90-2-D Cover the exposed hoist gear boxes on the canal headworks operating deck. (Category 2} **Incomplete - Waiting for approval of R&B loan.**		90-2-D (**Deleted**} Cover the exposed hoist gear boxes on the canal headworks operating deck. (Category 2}				Repair and replace mechanical components such as bearings, seals, gears, chains, sprockets and improved perimeter and base gate	Repair and replace mechanical components such as bearings, seals, gears, chains, sprockets and improved perimeter and base gate
				1991-10 Upgrading the canal foot bridge and gauging station										
						96-3-A Repair the concrete wall on the south side of the canal at the dam tenders residence. (Category 3}		96-3-A Repair the concrete wall on the south side of the canal at the dam tenders residence. (Category 3} **Incomplete.**		96-3-A Repair the concrete wall on the south side of the canal at the dam tenders residence. (Category 3} **Incomplete.**	96-3-A Repair the concrete wall on the south side of the canal at the dam tenders residence. (Category 3} **Incomplete.**	96-3-A Repair the concrete wall on the south side of the canal at the dam tenders residence. (Category 3} **Incomplete.**		
													Install gate automation devices with water level sensors; and install flow measurement devices	Install gate automation devices with water level sensors; and install flow measurement devices

Table 2. Inventory of Rehabilitation Needs for the Top 500 Feet of the Government Highline Canal System (Continued).

	1984 BOR GVDD RO&M	1987 BOR GVDD RO&M	1990 BOR GVDD RO&M	1991 BOR Rehabilitation and Betterment Study	1993 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	1999 BOR GVDD RO&M	2002 BOR GVWUAS RO&M	2005 BOR GVDD RO&M	2008 BOR GVWUAS RO&M	2011 BOR GVDD RO&M	2014 BOR GVWUAS RO&M	CBRT BIP Project Information Sheet	Remaining Identified Needs
Government Highline Canal System (Top 500 Feet)														
Upper 500 feet of Canal				1991-7 Concrete line the first 600 feet of the canal								2014-2-A Replace the lining in the first 500' of the GHC (Category 2)		Line top 500' of canal floor
				1991-10 Cleaning and reshaping the canal, structure repair and adding material (free-board) to the canal banks in areas									Reshaping, stabilizing, and relining the upper portion of the canal sidewalls, adjacent service and access areas, and utilities	Reshaping, stabilizing, and relining the upper portion of the canal sidewalls, adjacent service and access areas, and utilities
											2011 Concrete is deteriorating. Right downstream side slope is deteriorated (structurally sound and functioning). Left side slope is deteriorated and unstable. Parapet wall has slid indicating bank destabilization (No Category)		Repair and/or replace deteriorating and spalling concrete throughout facility;	Repair and/or replace deteriorating and spalling concrete throughout facility;

[1]Category 1 – recommendations involving the correction of severe deficiencies where immediate and responsive action is required to ensure structural safety, operational integrity of a facility, or operating personnel/public safety.
Category 2 – recommendations covering a wide range of important matters where action is needed to prevent or reduce further damage, preclude possible operational failure of the facility, or reduce safety risks to operating personnel/public.
Category 3 – recommendations covering less important matters but believed to be sound and beneficial suggestions to improve or enhance the O&M of the project or facility.

3.3 Top Five Rehabilitation Needs

The top five rehabilitation needs/projects (Table 3) were selected based on their importance in sustaining the dam functions for downstream uses and additional realized benefits to the project participants and stakeholders. Note these projects were identified based upon current participation in the Master Plan Phase 1 project and the list of potential projects is anticipated to grow with additional investigations and studies.

The top five projects include:

1. Lining the Upper 500 feet of the Canyon Canal
2. Upgrade the Roller Dam Electrical and Control Systems
3. Rehabilitate the Canal Headworks
4. Rehabilitate the Roller Tracks and Canal Concrete
5. Replace the Radial Gates at the Canal Station 22 Spillway

A Project Implementation Plan was developed for each of these top priority projects and is presented in the following section.

Table 3. Top Five Rehabilitation Needs.

Association System Element	Reclamation Remaining Identified Needs	Category[1]	CBRT BIP Project Information Sheet	Type of Rehabilitation	Potential Project Outcome	Top Beneficiaries	Association Top Priorities Rank (1 is highest)
Roller Dam							
Roller Gates		-	Upgrade the electrical and control system that operates the roller gates and supplies other required electrical needs to meet code(s).	System Upgrade	Electrical System Upgrade/ Safety Issues		2
	1991-2 Replace two of the roller gates on the left side of the diversion dam with a permanent ogee crest. (Concrete cap replacing the rollers).	-	Investigate replacing one or more roller gates with different style gates allowing for more positive control of dam pond level.	Structural	Upgrade - Increased Operational Efficiency		
	1991-4 Modify the roller gates to provide additional head on the canal works.	-		Study/ Operations	Upgrade		
River Embankment	2011-3-A Reinforce the river embankment immediately upstream of the right abutment, where erosion is evident.	3		Structural	General Maintenance		
Fish Passage	Study of sediment issues & fish passage.	-		Study	Improve Stream Health		
Government Highline Canal System							
Canal Headworks	2011 - Rehabilitate, repair, and replace Canal Headgates. Install gate automation devices with water level sensors; and install flow measurement devices (Currently 0.2-0.3 foot change before open/close signal sent). Bottom seal missing at gates.	-		Operations	System Improvements		3
Upper 500 Feet of Canyon Canal	2014-2-A Replace the lining in the first 500 feet of the Canyon portion of the Government Highline Canal to Float House.	2	Reshaping, stabilizing, and concrete lining the upper portion of the canal, adjacent service and access areas, and utilities. (Will develop more capacity in canal)	Structural/ Operations/ Dam Safety	Upgrade - Increased flows, Increased Operational Efficiency		1
System Wide							
Underwater Structures	2005-2-C Need an underwater examination (overflow weirs, Sluiceway, Piers, Canal Headgate Structure, etc.).	2		Study	Structural Integrity Study		
Concrete	Weathered concrete; spalling and exposed concrete. - Roller Dam Structure (Roller Track Supports) - Canal Headworks - Canal Transition (Exposed rebar on floor, Left side, Parapet wall, etc.)		Repair and/or replace deteriorating and spalling concrete throughout facility.	Cosmetic/ Maintenance/ Structural	General Maintenance		4 (Investigate top areas to address and repair)
Canal Capacity Control	1991-8 Replace two spillway radial gates on the canal (at station 22).	-		Structural/ Operations	General Maintenance		5

Note 1:

Category 1 – recommendations involving the correction of severe deficiencies where immediate and responsive action is required to ensure structural safety, operational integrity of a facility, or operating personnel/public safety.

Category 2 – recommendations covering a wide range of important matters where action is needed to prevent or reduce further damage, preclude possible operational failure of the facility, or reduce safety risks to operating personnel/public.

Category 3 – recommendations covering less important matters but believed to be sound and beneficial suggestions to improve or enhance the O&M of the project or facility.

4.0 Implementation Plans

Project Implementation Plans were developed for the top five rehabilitation projects and include a summary of:

- **Project overview** –summarizes the reports and/or input received from the Association, Reclamation, and/or stakeholders regarding the rehabilitation need(s).
- **Project details** –summarizes the project need(s) as supported by existing documentation and/or Association, Reclamation, and/or stakeholder input.
- **Permitting requirements** – identifies the potential permitting efforts needed to construct the project. Most permitting requirements are common among all identified projects and involve the National Environmental Policy Act (NEPA) process because of the historical nature of the facilities and structures. The Association has been in close coordination with Reclamation staff regarding the need for NEPA compliance and any activities planned for these facilities.
- **Project schedule** – outlines milestones and anticipated design and construction of the project. Note "timing" identifies the general range for project implementation. Most of the identified projects are in the early stages of design. This document will be updated in future phases to document milestones and schedules for design and construction, as available.
- **Project partners** – Association staff, Reclamation, OMID, TNC, the Colorado River Water Conservation District, and PID (partners) participated in the two working sessions associated with this study. Additional partners will be identified as these projects become more defined.
- **Project funding plan** – documents available costs for each project and are estimated to be within 10% of actual. Reclamation provided input and cost estimates for some of the identified projects. Other project costs were based upon contractors estimates. These costs are preliminary and based upon best bids. It is recommended that these costs be indexed at a minimum rate of 3% annually.
- **Next steps, studies, and investigations** – recognizes the likely next steps to advancing the identified project.

The information compiled for each Project Implementation Plan is preliminary and intended to be used as a planning tool to outline future work and funding needs. The following sections discuss each of these elements for the top five rehabilitation projects.

4.1 Priority 1 – Lining of the Upper 500 Feet of Canyon Canal

4.1.1 Project Overview

The 1991 Rehabilitation and Betterment Study first identified the need to line the upper 500-600 feet of the Canal in an effort to reduce seepage and improve the hydraulics. This need remains today and has been identified as the top priority. Review of the canal upper 500 feet has shown that lining and reshaping this section will allow for higher canal capacity, more accurate flow measurements and reduce seepage. Reclamation has performed preliminary engineering for the project and funding is actively being pursued with federal, state and local government entities. This project is in the most advanced stage of design of the top five identified needs.

4.1.2 Project Details

The embankment immediately below the Roller Dam is relatively narrow and separates the Canyon Canal from the Colorado River (Figure 1 and Figure 2). This section of canal was constructed between 1913 and 1915. Over the last 100 years, the embankment has sloughed, settled and degraded. Water has induced piping erosion within the embankment which has led to material loss and sinkholes. This process has caused further destabilization of the area and has most likely contributed to some of the sloughing. Over the years, measures have been taken to control and prevent these processes from escalating. One such action, which can still be observed, is shotcrete lining along the side slope. This solution was temporary as the movement of the bank has continued and led to cracking and displacement of the shotcrete, resulting in a reduced canal cross section. In addition, the degraded shotcrete, as well as displaced masonry stone and riprap, has created a very rough surface which restricts water flow. The combination of the reduced cross section and roughened surface has created a “choke” in the conveyance of water in the canal.

Measurements of the canal cross section were taken at several locations along the top 500 feet. Manning’s formula was used to calculate theoretical flow values for a full canal and it verified readings being taken by the Association’s flow gage. The canal is being restricted to approximately 1,600 cfs while the water rights are for 1,730 cfs. An additional 100 cfs to 150 cfs is needed to operate the new fish screen located downstream in the canal. Again using Manning’s formula, it was determined if the canal were returned to its original cross section and lined with shotcrete; it would be capable of conveying all of the water entitled to be diverted under the Cameo Call water rights and the water needed to operate the fish screen.

Two conceptual designs were developed by Reclamation for this project. Both designs begin where the concrete transition structure of the Roller Dam terminates and end at the float-house structure approximately 500 feet downstream of the transition structure (Figure 3).

4.1.3 Permitting Requirements

Any improvements need to consider the applicability of the NEPA process due to the historical nature of the Roller Dam and Canyon Facilities. Reclamation and the Association have a (pending) Memo of Understanding (MOU) outlining the identified environmental and regulatory compliance requirements. A cultural assessment was conducted to address the culturally sensitive areas with further cultural assessment work expected as the project nears final design and construction. Reclamation identified potential mitigation of the historically significant features depending on final design of the canal. Permitting with U.S. Army Corp of Engineers and habitat assessments remain as additional potential environmental components of the project.

The Association is going to trench the overhead powerline as part of this project and will need to coordinate with Mesa County Building Department and the State of Colorado Electrical inspector as part of this activity.

4.1.4 Project Schedule

Table 4 outlines the estimated schedule for this project.

Figure 1. General setting and existing condition of the top 500 feet of the Canyon Canal; looking down canal.

Figure 2. General setting and existing condition of the top 500 feet of the Canyon Canal; looking down canal.

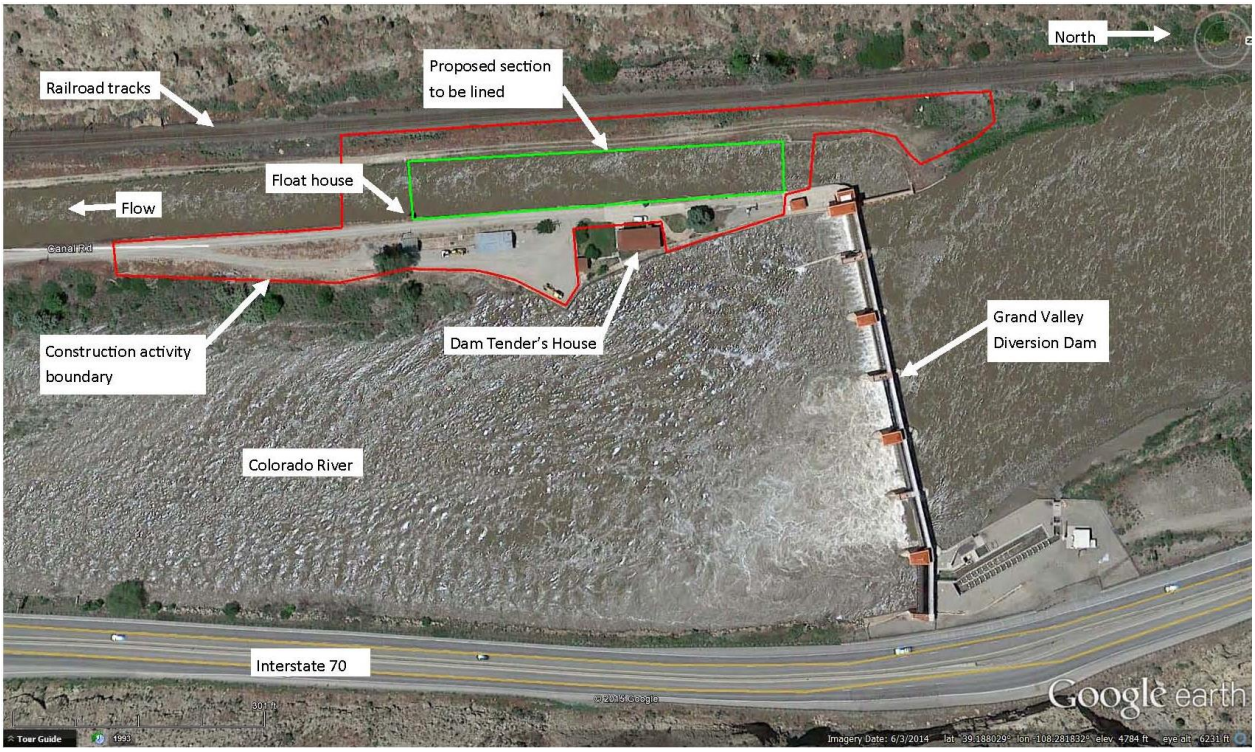

Figure 3. Aerial View of the Roller Dam (Grand Valley Diversion Dam) and Top 500 Feet of the Canyon Canal to be Lined.

4.1.5 Project Partners

The potential project partners include PID, Colorado Water Conservation Board (CWCB), CBRT, Reclamation, Colorado River Water Conservation District and TNC. The River District, TNC, and PID provided letters of support for this project.

4.1.6 Project Funding Plan

Reclamation developed the total project cost estimate at $800,000, which includes engineering, environmental and regulatory work, reporting, and construction. A breakdown of Reclamation's estimated project budget is provided in Appendix F. Potential funding sources for the project are identified in Table 5.

4.1.7 Next Steps, Studies & Investigations

The next steps for this project include ongoing efforts to prepare and submit funding, loan and grant applications. A cultural assessment will also be conducted in an effort to fully document and understand the required features that need to be preserved as part of the new design.

Table 4. Project Schedule.

	2015		2016				2017				2018	Milestones and Dates
Task	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	
Reclamation Coordination												
1. Secure Funding (Commitments)												Secure commitments; loan
2. NEPA Compliance												
Cultural Inventory and Survey												Class III Cultural Resource Inventory
- SHPO Review & Findings Concurrence												Concurrence
- ACHP Coordination and MOA												MOA
- Submit Cultural Mitigation Document												Approval
3. Final Project Design												
Survey												
Develop 100% CDs												
4. Develop Bid Package and Contract Documents												
Secure Contractor												
5. Permitting												
Electrical Permit												
6. Approval to Start Construction												
7. Construct Project												

Table 5. Funding Sources.

Funding Sources	Funding Amount
Non-Federal entities	
Association Cash	$42,000 (5.25%)
Association In-Kind Services	$12,000 (1.50%)
Colorado Water Supply Reserve Account (WSRA) Loan	$150,000 (18.7%)
Colorado Water Supply Reserve Account Grant	$300,000 (37.5%)
Non-Federal Subtotal:	$504,000
WaterSmart Grant (Federal Funding)	
Awarded Reclamation Funding	$296,000 (37%)
TOTAL PROJECT FUNDING	$800,000

4.2 Priority 2 – Upgrade the Roller Dam Electrical and Control Systems

4.2.1 Project Overview

The electrical and control systems at the Roller Dam and Canal headgate are aged and in need of repair (as identified by Reclamation since their 1984 RO&M examination report). The safety and reliability of the electrical systems are the two main drivers for this project being a top priority since only minor repairs and maintenance have occurred since 1984. In general this project includes the electrical rewiring of all structures, replacing the Roller Dam and Canal headgates motors and fuses, and adding an onsite generator.

4.2.2 Project Details

The existing Roller Dam has an existing overhead three phase service line from Xcel Energy. The largest load on the dam is a motor-generator which converts power from AC to DC power. The DC power operates the seven roller gate motors. Each roller gate motor is 10 horsepower (hp) DC. The headgates are powered by a single 5 hp AC motor which transmits power to the gates via an elaborate bevel gear arrangement. There is very little automation on the roller gate controls. The canal headgates are controlled with a rudimentary mechanical level switch located downstream on the canal. The remainder of the power consumption on the property is for the dam tender's house a workshop and several storage buildings.

The existing Roller Dam power distribution system and associated DC motors powering the canal headgates have been operating but rely on the motor-generator not allowing for any redundancy in the system. This project aims to replace the DC motors driving the headgates with AC motors and variable speed drives. Switching to AC allows for generally cheaper and more accessible parts, larger diversity in drive motor power and allows for direct connection with proposed back-up generator. The canal headgate drive will also be replaced and new distribution circuits will be installed. New SCADA-based controls will also be installed to operate the canal headgates to a higher level of accuracy and reduce the operator input currently required.

The existing onsite electrical and control systems are very rudimentary and have old wiring that is not up to current regulatory codes. Providing worker safety and reliability of the electrical and control systems is pivotal in the continued operations of the Roller Dam and canal headworks. Following is a summary of the several different components of this project.

1) Bury overhead powerlines: The overhead powerlines will need to be buried if they were not already as part of the canal lining project. This activity will need to take place first as part of the electrical upgrades project. Approximately 800 feet of wire needs to be buried starting at the existing power lines south of the Float House to the dam power house at the right abutment. A new transformer will also be installed. Telephone lines would also be relocated underground (Figure 4).

2) Replace service box: A new service box and breakers will be installed to replace the old fuse boxes. The new box will meet the current code requirements, improve safety for the operators and provide flexibility to add other circuits as needed.

3) Rewire Canal headgate controls: The need for wiring will depend on the status and/or planning progress of the Rehabilitation of the Canal Headworks project (Priority 3). Proper wiring would need to be added allow each headgate to operate individually. However, should the operations remain the same; the wiring will be replaced to the drive motor, limit switches and the control wiring from the Float House. Upgrading the wiring will bring the headgate controls into code compliance and will lead to increased operational efficiencies as canal flows could be measured and controlled more closely (Figure 5 and Figure 6 and Figure 8).

4) Replace Roller Dam wiring and upgrade electrical system: The wiring across the Roller Dam to each roller will be replaced to meet code requirements. More outlets and lighting may also be added, including 220 volt welder plugs, to facilitate easier maintenance and safety during night operations. Changing to AC power to operate the Rollers will be also be considered and evaluated (Figure 7).

5) Install an on-site standby generator: The Roller Dam and Canyon Facilities have experienced frequent power outages due to high winds or lightning storms in the canyon and the remote location. Installation of an on-site standby generator would allow the dam to operate during these periods some of which could be during vital dam operations.

6) Upgrade electrical wiring in outbuildings: The electrical systems that support several outbuildings at the dam site, including the Dam Tender's House, a workshop, and two smaller storage buildings, need to be upgraded. These currently are separate single phase services and the wiring have been added and modified over time. It would be prudent to also replace the electrical fuses and wiring to these outbuildings.

7) Deliver power to fish passage: The U.S. Fish and Wildlife currently owns and maintains a 20 kW propane generator to drain the fish passage and facilitate their operations. Providing electrical power to the fish passage will reduce the maintenance and overhead costs associated with operating the 20 kW generator.

Figure 4. View of existing overhead power lines and the limited space for machinery mobility during mandatory repairs or maintenance on the Dam or canal headworks.

Figure 5. Existing outdated transfer switches and circuit breaker for diversion dam roller gates.

Figure 6. Switch and breaker panels and on/off push button switch (on black panel) for DC power to Grand Valley Diversion Dam, located in power house on the right abutment. Grand Valley Diversion Dam RO&M Exam, Grand Valley Project; November 9, 2005.

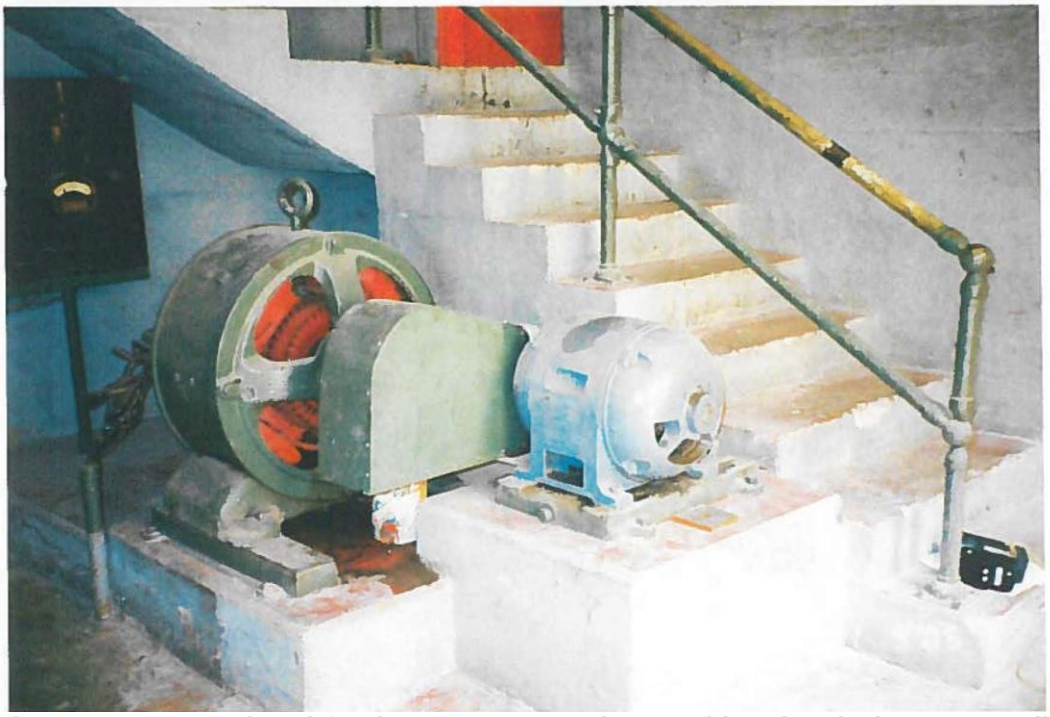

Figure 7. AC motor (gray) for the DC generator that provides electrical power to roller gate hoists on the Grand Valley Diversion Dam. Grand Valley Diversion Dam RO&M Exam, Grand Valley Project; November 9, 2005.

Figure 8. Automation mechanism that regulates flow in canal. Grand Valley Diversion Dam RO&M Exam, Grand Valley Project; November 28, 2011.

4.2.3 Permitting Requirements

Special handling of any improvements needs to be reviewed through the NEPA process due to the historical nature of the Roller Dam and Canyon Facilities. Reclamation and the Association have a pending MOU detailing the identified environmental and regulatory compliance requirements. Additional cultural assessments may also be required. Post July 1, 2015, a cultural assessment was conducted to address the culturally sensitive areas with further cultural assessment work expected as the project nears final design and construction.

The Association will coordinate with Mesa County Building Department and the State of Colorado Electrical inspector as part of this activity.

4.2.4 Project Schedule

Burying of the overhead electrical and telephone lines will likely occur during the Priority 1 project, lining of the upper 500 feet of the canyon portion of the canal. Wiring of the canal headgates may as be completed during the Priority 3 – Canal Headworks Rehabilitation project. The Association and OMID intend to initiate the upgrading of this electrical and control systems in one to three years' timeframe.

4.2.5 Project Partners

Reclamation has identified the need to upgrade the electrical systems at the Roller Dam and canal headworks since 1984 and therefore is in support of this project. U.S. Fish & Wildlife are also potential partners.

4.2.6 Project Funding Plan

Total project cost is estimated to be $633,000, including engineering design, environmental and regulatory work, reporting and construction. A breakdown of the estimated project budget is provided in Appendix G.

4.2.7 Next Steps, Studies & Investigations

A 30-percent design drawing will be developed to better outline the project scope, cost estimates and permitting requirements. Project managers at the Association and OMID will work to identify project partners to share in the expense of this effort. Funding sources from local, state and federal agencies will also be considered and combined with funds from the Association and OMID prior to beginning final design, permitting and construction of the project.

4.3 Priority 3 – Rehabilitate the Canal Headworks

4.3.1 Project Overview

The operation of the Government Highline Canal headgate has been strained due to the wear and tear on the headgates and the antique controls operating the gates. Repair of the canal headgates, modernizing headgate controls by individualizing gate operations, adding torque limits to the headgate controls and refining the open/close signal to the gates need to be addressed to maximize the operations of the ditch and reduce the maintenance cost for repairing and replacing the canal headgates.

4.3.2 Project Details

The Roller Dam maintains a water level for the Government Highline Canal headgates to divert from the Colorado River. There are nine (9) headgates for the canal currently which operate in unison to control diversions ranging from 0 to 1,730 cubic cfs. The gates have upper and lower limit switches but currently operate without any torque limits which causes disrepair in the brittle cast iron gates when they close on an obstruction. Replacement of all nine gates is required as every gate is currently operating with patched metal work, missing seals or cracks. New gates will be manufactured to closely resemble the existing gates. The replacement gates will be manufactured as one or two pieces depending on the available existing clearance to insert the gates into the slots.

Operations of the gates use a float valve, accurate to 2-3 tenths of a foot, to control the opening and closing of the gates leading to variances ranging from 20-30 cfs. Updating the float valve system to a SCADA based controls can improve the accuracy, especially upon completion of Priority 1 Project, to within hundredths of a foot and reduce the flow variability of the canal. Improvements of the flow readings and operations of the headgate will lead to more accurate and efficient operations of the canal.

4.3.3 Permitting Requirements

Special handling of any improvements needs to be reviewed through the NEPA process due to the historical nature of the Roller Dam and Canyon Facilities. Reclamation and the Association have developed a pending MOU detailing the identified environmental and regulatory compliance requirements. Additional cultural assessments may also be required. Post July 1, 2015, a cultural assessment was conducted to address the culturally sensitive

areas with further cultural assessment work expected as the project nears final design and construction.

The Association will also need to coordinate with Mesa County Building Department and the State of Colorado Electrical inspector as part of this activity.

4.3.4 Project Schedule

Wiring of the canal headgates may be completed during the Priority 2 – Canal Headworks Rehabilitation project. The Association and OMID are intending to initiate the upgrading of canal headgates and control systems in one to three years.

4.3.5 Project Partners

The Association will work with the project partners regarding the specific investment in these improvements. Potential project partners may include TND, The Colorado River Water Conservation District, Reclamation, and/or U.S. Fish and Wildlife.

4.3.6 Project Funding Plan

Total project cost is estimated at $500,000, including engineering design, manufactured headgates, environmental and regulatory work, reporting and construction. Breakdown of the estimated project budget is provided in Appendix H.

Funding for this project will be developed as the project scope is refined but is likely to include a combination of local, state and federal grants and loans with matching contributions from the Association and OMID. Additional grants will be sought from project partners such as those who participated in the stakeholders meeting.

4.3.7 Next Steps, Studies & Investigations

Cultural Assessment of the Canal headgate and Roller Dam are needed to identify what design alternatives will be allowed. Following a cultural assessment a 30-percent design drawing will be developed to better outline the project scope, cost estimates and permitting requirements. Project managers at the Association and OMID will work to identify project partners to share in the expense of the project. Funding sources from local, state and federal agencies will be considered and combined with funds from the Association and OMID prior to beginning final design, permitting and construction of the project.

4.4 Priority 4 – Roller Track and Canyon Canal Concrete Rehabilitation

4.4.1 Project Overview

The structural integrity of the Roller Dam and the Canal is outstanding considering its age at over 100 years. However, weathering and spalling is occurring throughout both structures. The concrete supporting the roller tracks was identified as the top area of concern following a review of the above-water concrete inspection. The areas particularly near the water surface have exposed rebar and in some places only rebar to protect and secure the support structure for the roller tracks. The exposed rebar is prevalent on all roller bays and on along each track of the rollers. This effort will efficiently address the proper repair and protection to continue safe and capable operations of the rollers well into the future.

Concrete rehabilitation is also needed in the canal transition zone. The transition zone of the canal is the existing concrete lined area from the canal headgates downstream for approximately 130 feet in length. Rehabilitation of the three specific areas of the transition zone described below will consist of removing loose material by hydro demolition, applying polymer modified repair mortar, and finishing with a trowel for a smooth finish. This specific mortar is recommended as it can be trowel or sprayed and is enhanced with silica fume and fibers for increased density, abrasion resistance and compressive strength. The mortar reportedly has very good freeze thaw values that are important for a long term solution.

1) Areas of the floor have severe weathering and exposed rebar. Rehabilitation is needed on approximately 950 square feet.

2) The canal walls in the transition are weathered near the full flow water surface elevation where freeze/thaw has occurred. Rehabilitation of the canal walls is needed across approximately 1,140 square feet. In addition to the rehabilitation efforts, a concrete cap is being proposed along the north wall to provide two feet of freeboard and limit the opportunity for canal water to leak over and behind the existing canal wall.

3) The downstream side of the canal headgates headwall concrete is showing signs of freeze/thaw weathering despite previous efforts to shotcrete eroded areas. Rehabilitation of the canal headgate concrete is needed for approximately 1,560 square feet.

4.4.2 Project Details

The 1987 and 2011 BOR RO&M reports indicate that the concrete on the piers supporting the rollers is severely weathered, and in some locations, eroded from the face of the piers exposing the reinforcement (Figure 9). The top of the rollers, where the river flow contacts the face of the pier immediately after flowing over the top of the gate, has shown the most severe indications of erosion as flow passes over the gates for a majority of the year when the roller gates are in the down position. The erosion is most likely caused by the dynamic force of the water infiltrating the concrete, and the subsequent freeze/thaw action that occurs during the winter months. Additionally, once water has penetrated the concrete over a period of time, corrosion of reinforcement takes place, which then expands and spalls the concrete.

The Roller Dam was constructed in 1916, 100 years old at the time of this report. The 1987 report stated “an attempt has been made to improve the appearance of the structure by shotcreting; however, due to freeze-thaw action, the shotcrete is peeling off…” There have likely been additional efforts of repair over the life of the structure, but would appear that the last concrete repairs were made 30+ years ago.

4.4.2.1 Roller Track Rehabilitation Plan

Spalling is occurring near the downstream bearing of the roller track (Figure 10 and Figure 11). The track is anchored to the face of the concrete by pairs of bolts spaced 8” to 12” along the almost vertical path of the roller (Figure 12). The roller is supported vertically by the drive chain on the upstream side, and the track on the downstream side (Figure 13). The hydraulic force on the upstream face of the roller drives the roller into the pier at this support. A complete concrete failure that could impact the end of the roller support is highly

Figure 9. Weathered concrete along upstream footers of Roller Dam. Grand Valley Diversion Dam RO&M Exam, Grand Valley Project; November 28, 2011.

Figure 10. Weathered concrete surface on the downstream side Roller Dam tower.

Figure 11. Spalling near the downstream bearing of the roller track (typical).

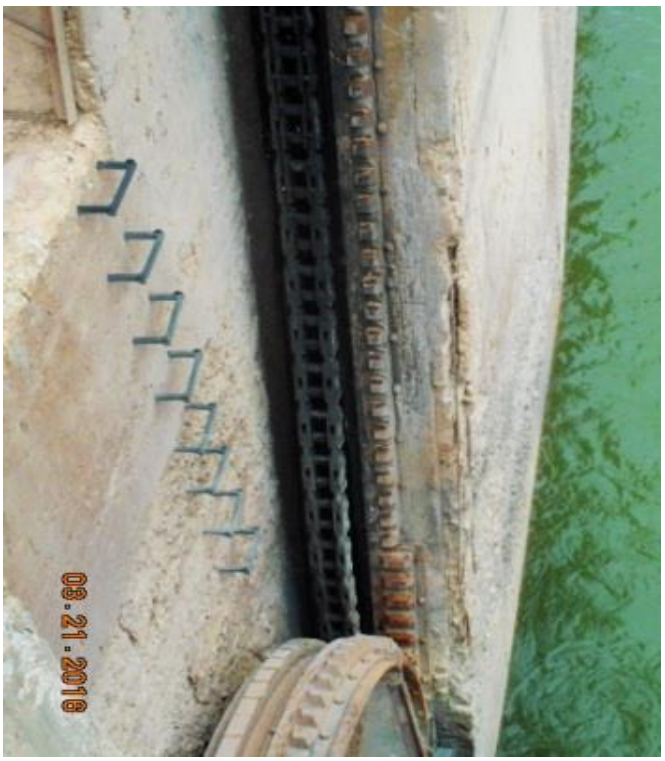

Figure 12. Bolt connections to the vertical path of the rollers.

Figure 13. Drive chain (upstream) and track (downstream).

unlikely in the near future under the existing conditions (with approximately 3” and cracking is noted between the remaining face of concrete and the edge of the track); however, continued spalling affecting the alignment of the track is much more likely in the next several years if the concrete is not repaired and could potentially prevent operation of the roller.

The repair of these eroded areas would consist of removal of all loose concrete to a depth at least 1” beyond the back face of the existing reinforcement. The method that would be most efficient in this case would be hydro demolition, which removes concrete with high-pressure water. The repair area is estimated to be 2 feet wide by 24 feet long, which is adjacent to the full length of the roller track. During the demolition, concrete would be removed to sound concrete, and may be more or less than 24” wide by 5” deep (Figure 14). Edges of the removal area would be square cut or dovetail cut to provide a clean edge to work to, and to facilitate anchorage to the existing concrete.

Existing reinforcement would be blast cleaned to remove all corrosion, then coated with a corrosion inhibitor. New epoxy coated reinforcing would be installed to lap with the existing. The reinforcement would be #3 dowels, 12” on center, with a 4” leg drilled and epoxied in-place 2” clear of the track base. The leg of the dowel would be installed to avoid the existing track bolt embedment region.

New concrete would be placed by the shotcrete method, which requires no formwork, and allows installation of the material at a very low water/cement ratio, thereby reducing shrinkage and the possibility of future cracking. The final surface would be screeded to achieve the profile, followed by steel troweling to provide a smooth surface. Following the

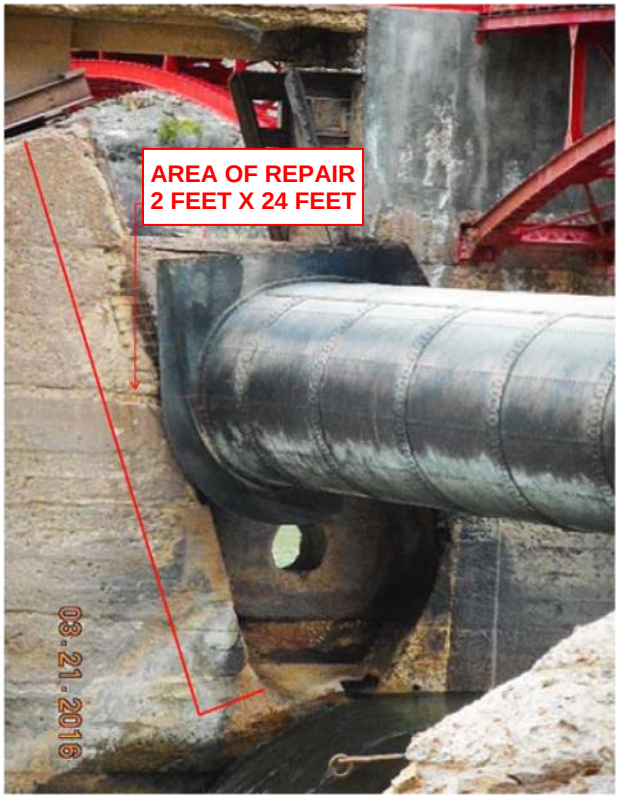

Figure 14. Approximate area of repair, which will be excavated to a 5" depth.

recommendations in the 1987 report, concrete cores were taken from the dam at the end of the same year. Results indicated concrete strengths from 2,500 to 3,500 psi, and noted aggregates to be sandstone and shale. In determining a mix design for the shotcrete, materials should be chosen that will be compatible with the existing concrete as well as for their engineering properties. Materials such as silica fume, which significantly increases the abrasion resistance of the concrete, could also be considered.

The repairs are envisioned to take place during a ditch outage, which is typically a two week period during the late fall and early spring. To perform repairs at 12 locations (6 gates x 2 sides) in 14 days may be challenging. The Association could consider repairs at the most eroded areas first, and then repair additional locations at later outages until complete. Access to the repair area would likely begin with the gate in the raised position, with sandbags on the crest acting to divert water away from the work area. Scaffolding would likely be supported from the top of the piers and the footbridge. As work progressed vertically, the gates could be lowered to allow access to upper areas.

4.4.2.2 Canal Transition Rehabilitation Plan

Three areas of the canal transition zone will be repaired including the canal floor, canal walls and the backside of the canal headgate. Rehabilitation efforts have occurred in the area including an application of shotcrete that partially remains in some areas (Figure 15). However, the shotcrete has mostly been eroded in all areas and original concrete and sometimes the supporting rebar is visible (Figure 16 and Figure 17).

Figure 15. Canal Headgate Structure, downstream side needing concrete repair. Remaining shotcrete from previous rehabilitation efforts can be seen on the support piers.

Figure 16. Canal transition zone flooring with observed spalling and exposed rebar.

Figure 17. Canal transition zone walls with observed spalling near the top of the wall and near the winter water surface elevations.

Similar to the Roller Dam roller track rehabilitation the canal transition zone will consist of hydro demolition to remove all loose concrete to a depth of 1-2 inches beyond the existing surface. A polymer modified repair mortar (SikaRepair 224) will be placed in the exposed areas. The Mortar can be trowel or sprayed and is enhanced with silica fume and fibers for increased density, abrasion resistance and compressive strength. The recommended mortar has very good freeze thaw values. The mortar mix was selected to address the spalling problems historically impacting the canal transition concrete. Once applied, the mortar will be finished with a smooth trowel to aid in the high capacity required of the canal.

4.4.3 Permitting Requirements

Special handling of any improvements needs to be reviewed through the NEPA process due to the historical nature of the Roller Dam and Canyon Facilities. Reclamation and the Association have developed a pending MOU detailing the identified environmental and regulatory compliance requirements. Additional cultural assessments may also be required. Post July 1, 2015, a cultural assessment was conducted to address the culturally sensitive areas with further cultural assessment work expected as the project nears final design and construction.

Depending on final design of the concrete rehabilitation the Reclamation identified potential mitigation efforts may be required on the historically significant features.

All proposed rehabilitation efforts are expected to be done above the water however, should repairs require a coffer dam or modifications to the river channel for equipment access, permitting with the Army Corp of Engineers may be required.

4.4.4 Project Schedule

The Association, OMID and Reclamation are intending to complete the project in three to ten years. Initial steps will be taken in the next two to five years to understand NEPA

requirements and any mitigation efforts that may influence changes in the project scope and associated costs.

4.4.5 Project Partners

The Association will work with the project partners regarding the specific investment in these improvements. Potential partners may include TNC, The Colorado River Water Conservation District, Reclamation, and/or American Rivers.

4.4.6 Project Funding Plan

Total project costs have been developed in coordination with a concrete contractor and structural engineers familiar with the site. Estimated costs are expected to be approximately $742,000, including engineering design, environmental and regulatory work, reporting and construction. Breakdown of the estimated project budget is provided in Appendix I.

Funding for this project will be developed as the project scope is refined but is likely to include a combination of local, state and federal grants and loans with matching contributions from the Association and OMID. Additional grants will be sought from project partners such as those who participated in the stakeholders meeting.

4.4.7 Next Steps, Studies & Investigations

A 20-percent design drawing will be developed to better outline the project scope, cost estimates and permitting requirements. Project managers at the Association and OMID will work to identify project partners to share in the expense of the project. Funding sources from local, state and federal agencies will be considered and combined with funds from the Association and OMID prior to beginning final design, permitting and construction of the project.

4.5 Priority 5 – Replace Canal Spillway Radial Gates at Station 22 Spillway

4.5.1 Project Overview

The Association and OMID have identified a spillway, located approximately 0.4 miles downstream of the canal headgate at Station 22, as a key safety factor for the operations of the canal. This project aims to replace the radial spillway gates as they are degrading and need attention in order to properly function. Improvements to the gates may also include electric controls and the ability to be used for winter operations.

4.5.2 Project Details

The canal spillway at Station 22 is the only spillway between the Canal headworks and the Palisade bypass, located approximately 6.5 miles down canal. The Station 22 spillway is designed to allow the full canal diversions to spill back to the Colorado River should an emergency arise. The spillway is used primarily in the spring and fall to sluice the silt and debris out of the upper portion of the canal before and after the increased irrigation use. The Association usually runs approximately 100 cfs through the canal and spillway during these flushing operations.

In the winter, when the canal is carrying water to the GVPP, the canal headgate and the Roller Dam rollers are typically frozen and not capable of being adjusted. The operation of

Station 22 spillway operations is essential to address and mitigate any emergencies within the canal and GVPP operations during these times.

The radial gates need to be replaced in order to keep the Station 22 spillway functional. The frames supporting both radial gates are rusting out requiring the gates to be completely rebuilt or replaced with a more modern design. Each gate is uniquely designed and will require a review of the historical drawings and reissued before a local craftsman can rebuild them. More modern replacement options such as vertical lift gates could be used and will be easier to maintain in the future.

Additional design considerations will also be needed to evaluate options for preventing ice buildup on the gates to make sure they remain operational throughout the winter. Further design is needed to update the crude electric hoists on one radial gate and the hand operated hoist for the other gate. Upgrading the hoists will allow for more accurate and efficient operations of the gates especially during an emergency situation. See Figure 18 through Figure 22.

Figure 18. Looking SE across the Canal at the inlet for the Station 22 spillway to the Colorado River, located approximately ½ mile from the Roller Dam. Grand Valley Project RO&M Exam; July 9, 2008.

Figure 19. Station 22 spillway. Grand Valley Project RO&M Exam; March 18, 2002.

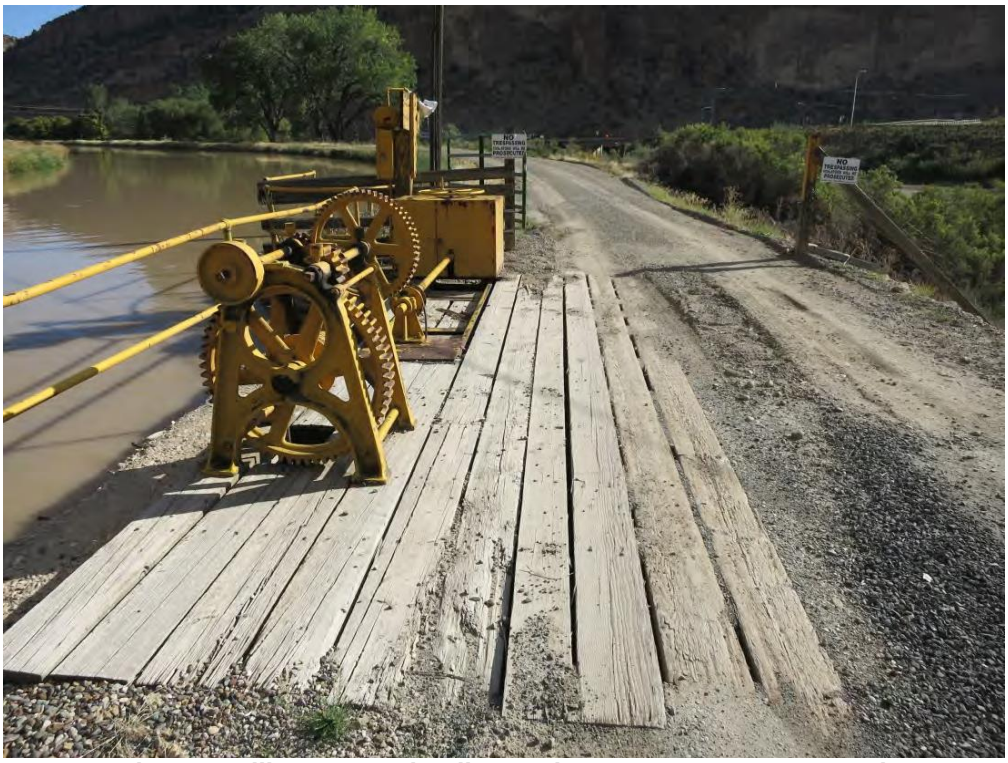

Figure 20. Station 22 spillway. Grand Valley Project RO&M Exam; September 23, 2014.

Figure 21. Looking at the manual gate operator (left) and the automated gate operator (right); Grand Valley Project RO&M Exam; July 9, 2008.

Figure 22. Looking up the canal towards the dam tenders residence at the Roller Dam. Sediment seen in the bottom of the canal is typically sluiced through the Station 22 spillway before and after increased irrigation season flows. Grand Valley Project RO&M Exam; March 18, 2002.

4.5.3 Permitting Requirements

Special handling of any improvements needs to be reviewed through the NEPA process due to the historical nature of the Roller Dam and Canyon Facilities. Reclamation and the Association have developed a pending MOU detailing the identified environmental and regulatory compliance requirements. Additional cultural assessments may also be required. Post July 1, 2015, a cultural assessment was conducted to address the culturally sensitive areas with further cultural assessment work expected as the project nears final design and construction.

Depending on final design of the Station 22 spillway, Reclamation identified potential mitigation efforts may be required on the historically significant features.

4.5.4 Project Schedule

The Association, OMID and Reclamation are intending to initiate the design and construction of the radial gate improvements in three to ten years.

4.5.5 Project Partners

The Association will work with the project partners regarding the specific investment in these improvements. Potential project partners may include TNC, the Colorado River Water Conservation District, and/or Reclamation.

4.5.6 Project Funding Plan

Total project cost is estimated to be $160,000, including engineering, materials and installation. Breakdown of the estimated project budget is provided in Appendix J.

Funding for this project will be developed as the project scope is refined but is likely to include a combination of local, state and federal grants and loans with matching contributions from the Association and OMID. Additional grants will be sought from project partners such as those who participated in the stakeholders meeting.

4.5.7 Next Steps, Studies & Investigations

The first step of this project is to prepare a preliminary design for the replacement of the radial gates framework, update the gate hoists and consider how to mitigate winter ice buildup issues. An assessment of varying options may be included as part of the preliminary design. Final design and implementation of the design will follow once funding has been secured.

5.0 Hydropower Potential

The Roller Dam currently diverts water into the Government Highline Canal to support hydropower under very senior water rights that collectively make up the "Cameo Call" from the Colorado River. This water is additional to the irrigation water provided to four irrigation entities: The Association and the Orchard Mesa, Palisade and Mesa County Irrigation Districts (Irrigation Districts), which supply irrigation water to approximately 39,000 acres of land in the Grand Valley. The hydropower water diverted at the Roller Dam is used to produce hydropower at the GVPP, which has a capacity of approximately 800 cfs and a current electrical generation capacity of about 3.5 MW.

The Colorado Basin Roundtable members requested that this Master Plan include information regarding the additional hydropower potential of the Dam and Canyon facilities. Two recent reports helped provide information and data to support this request. The first was authored by Reclamation (2011) and documents the hydropower potential of 530 sites across the United States, including the Roller Dam. The Roller Dam ranked 18th for hydropower development based on the benefit to cost ratio and the overall 5th best site in the Upper Colorado Region. The second report, authored by Olsson Associates (funded by the Association), investigated any potential unused capacity within the Power Canal1, including the potential for additional water to generate hydroelectric power. Following is a summary of these reports and their overall conclusions.

5.1 Hydropower Resource Assessment at Existing Reclamation Facilities (Reclamation, March 2011)

The purpose of the Resource Assessment was to provide information on whether or not hydropower development at existing Reclamation facilities would be economically viable and possibly warrant further investigation. The assessment was mainly targeted towards municipalities and private developers that could further evaluate the potential to increase hydropower production at Reclamation sites. Developers could use the information provided in this assessment to focus more detailed analysis on sites that demonstrate a reasonable potential for being economically and financially viable. The Resource Assessment is not intended to provide feasibility level analyses for the potential sites.

The first step in the Resource Assessment was collecting available flow, head water and tail water elevation data for each site. Significant efforts were made to collect hydrologic data for all 530 sites, including obtaining data from existing stream gages, facility designs, Reclamation offices' and irrigation districts' records, and field staff knowledge. Minimum data required for analysis included the state the site is located in, a continuous period of daily flow records of at least 1 year (3 years recommended), defined head water and tail water elevations, and distance to the nearest transmission or distribution line.

Data collection indicated that each of the 530 sites were in one of the following data categories.

[1] The Power Canal is that portion of the Grand Valley Project that conveys water from the Roller Dam to the GVPP.

1) Site has some level of hydropower potential – Hydrologic data was collected for the site and the Hydropower Assessment Tool indicated that some level of hydropower could be generated at the site;
2) Site does not have hydropower potential – Local area knowledge or available hydrologic data indicated that the site does not have hydropower potential because flows or net head are too low or infrequent for hydropower development;
3) Canal or tunnel site that needs further analysis – All dams and diversion dams were evaluated for hydropower potential, but further analysis is needed to determine net head and seasonal flows at some canal and tunnel sites to determine hydropower potential. Reclamation canal and tunnel sites are being addressed in a separate ongoing analysis; or
4) Site should be removed from the analysis – The site was either a duplicate to another site identified, no longer a Reclamation-owned site, had hydropower already developed or hydropower was being developed at the site.

Reclamation categorized data collected as high, medium, or low confidence based on data source, availability and consistency of data. High confidence data was assigned to sites with complete daily flow data, generally from stream gages, and recorded head and tail water elevations. Of the total 530 sites, 117 sites had high confidence data, 69 sites had medium confidence data, and 275 sites had low confidence data (note 69 sites were removed from the analysis, as described above, and not assigned confidence ratings). Low confidence sites include canals and tunnels that require further analysis. Results from low confidence data, though useful to analyze a site's potential at this preliminary level of investigation, should not be used for more detailed or feasibility level analyses. Efforts to collect more reliable data (i.e. higher confidence) should be made in subsequent analyses.

Reclamation developed the Hydropower Assessment Tool to estimate potential energy generation and economic net benefits at the identified Reclamation facilities. The tool is an Excel spreadsheet model with embedded macro functions. Using the data inputs described above, the tool computes power generation, cost estimates, and economic benefits. The distance to the nearest transmission or distribution line allows for calculation of a cost of transmission, but does not necessarily indicate that an interconnection can be made with the transmission line. Further site specific analysis for transmission would be needed if a site is pursued.

To estimate power potential, the tool developed flow and net head exceedance curves and set design flow and design net head at a 30 percent exceedance level to calculate installed capacity. The tool then assigned a Pelton, Kaplan, Francis, or low-head (modified Francis) turbine based on the installed head and flow capacity and general turbine operating ranges. Non-traditional turbine technologies for very low heads or flows were not considered. Monthly and annual energy generation was calculated based on the selected turbine, turbine efficiency, and daily hydrologic data.

For the economic calculations, cost curves were embedded in the model to estimate total construction, development (includes construction, licensing and mitigation), and annual operation and maintenance costs. Economic benefits from power generation were based on current and forecasted energy prices. The benefits analysis also incorporated green incentives available from existing Federal and state programs. After estimating annual and total benefits and costs, the tool calculated a benefit cost ratio and internal rate of return (IRR) for each site as an indicator of economic feasibility. The benefit cost ratio and IRR were based on a 50 year period of analysis using the Fiscal Year 2010 Federal discount rate

of 4.375 percent. The interest rate can be easily modified in the Hydropower Assessment Tool.

The Hydropower Assessment Tool is intended for use as a preliminary evaluation of potential hydropower sites and is valuable for informational purposes to support further evaluation of a potential site. The tool does not substitute the need for a feasibility study.

The report stated the Grand Valley Diversion Dam does have hydropower potential, with a medium data confidence interval, and could produce approximately 2.0 MW of installed capacity with a design flow of 2,260 cfs and 14 feet of design head. The cost for construction was estimated at approximately $9 million dollars (see Table 6). It was recognized that there may be some potential permitting constraints that may impact the cost and viability to constructing a hydropower project at the Roller Dam. These include, but are not limited to:

- Fish and Wildlife
- Recreation
- Historical and Archaeological

Additional investigation regarding the hydropotential for the Roller Dam needs to occur and should address the following:

- Existing water agreements, diversions and allocations The hydrologic data used by Reclamation to determine the potential power generated by constructing hydropower at the diversion dam should be reviewed to ensure it addressed existing water agreements, diversions and allocations adequately.
- Validate the economic data and results. The data used to support the benefit cost ratio and rate of return for the hydropower development should be reviewed and updated to reflect current conditions.
- The constructability and feasibility of the project needs to include:
    - Conceptual level design(s) to include hydropower at the diversion dam. There are multiple significant site constraints that must be considered which will impact adding hydropower including the railroad, Interstate 70, irrigation canal and other dam infrastructure. Given the site constraints, adding hydropower may require modification to the existing irrigation canal and/or canal headworks, dam infrastructure and river bank. Conceptual design should include evaluation of low-head turbines, turbine support hardware and connection to power transmission lines.
    - Impacts and mitigation measures with regards to Recreation, Fish and Wildlife and Historical and Archaeological issues concerns as identified in the Bureau's assessment.
    - Key stakeholders including local water users, local, state and federal agencies and environmental groups.
    - Potential funding sources for construction including Federal and State grants or incentives, local power agencies and stakeholders.
    - Updated conceptual level cost estimates to include the considerations listed above.

Table 6. Grand Valley Diversion Dam Data Summary.

Site ID	UC-49	**Plant Factor**	0.84	**T-Line Distance (miles)**	5
Project	Grand Valley	**Cost per Installed Capacity ($/kW)**	4,584	**Benefit Cost Ratio with Green**	1.55
Installed Capacity (kW)	1,979	**Design Head (feet)**	14	**Benefit Cost Ratio without Green**	1.45
Annual Production (MWh)	14,246	**Design Flow (cfs)**	2,260	**Constraint**	Fish and Wildlife; Recreation; Historical & Archaeological
				Data Confidence	Medium

5.2 Power Canal Capacity Report (Olsson Associates, 2015)

The data within this report indicates that throughout the historical record analyzed capacity exists within the power canal to convey additional water. The amount of unused power canal capacity varies between years and is dependent on a number of factors. The potential unused capacity varies from a maximum of 49,279 acre-feet (AF) during the 2002 irrigation season to a minimum of 9,824 AF during the 2005 irrigation season. It is important to note that sufficient capacity does not always exist within the power canal to convey additional water.

5.2.1 Report Findings

This report demonstrated that the power canal has unused capacity during each irrigation season. However, through conversations with staff at both the Association and OMID it has become apparent that there are still a number of unresolved issues related to the utilization of the unused capacity. Some of the issues that may need to be explored further are:

- Who realizes the benefits of any potential increased power production?
- How do the Orchard Mesa Check Case and certain critical river flow points affect the future operations of the power canal?
- Will future operations by the Association and OMID use any unused capacity of the power canal?
- How will system improvements by OMID and Association affect the operation and unused capacity of the power canal?
- Is it possible for OMID and Association to come to an agreement prior to each irrigation season that dedicates a certain amount of capacity in the power canal to some identified benefit?
- How would such an agreement affect existing water rights?

It has become apparent through this report that while the ability to use the power canal as a protective mechanism may be convenient for a pilot project it is most likely only available to the Association on a temporary basis.

5.3 Hydropower Potential Conclusion

Renewable hydropower generation has been a part of the Grand Valley Project since its inception, over a hundred years ago with the development of the GVPP. The Association and partners continue to recognize the benefits of the GVPP in addition to maintaining the ability to divert waters making up the Cameo Call. Although these two reports took a rudimentary look at the potential for furthering their commitment to developing hydropower, the current thinking is that it is better to invest in improvements to the GVPP. Additional investigations will need to fully understand all unique characteristics associated with the dam, canal system and operations of the GVPP. Future hydropower generation potential at the Roller Dam should consider the constraints identified in these two reports and the realized benefits for investing in the existing GVPP to realize additional hydropower revenues and advantages.

Appendix A

Summary of Reports and Documents
Bureau of Reclamation Studies and Projects

- Grand Valley Diversion Dam Review of Operations and Maintenance (RO&M) Program Examination Reports
- Grand Valley Water Users Association RO&M Program Examination Reports
- 1991 Rehabilitation and Betterment Study
- March 2011 Hydropower Resource Assessment at Existing Reclamation Facilities
- Grand Valley Project (Wm Joe Simonds at Reclamation, 1994)

Grand Valley Diversion Dam Review of Operations and Maintenance (RO&M) Program Examination Reports

The rehabilitation needs of the Dam and Canyon facilities have been documented by the Reclamation as part of special investigations and their ongoing maintenance and operations obligations. The Roller Dam has been examined approximately every seven (7) years since 1949 as required under the Reclamation's Review of Operation and Maintenance (RO&M) Program.

Reclamation assigned a category based upon the severity of the deficiency (1, 2, or 3).

- Category 1 - Recommendations involving the correction of severe deficiencies where immediate and responsive action is required to ensure structural safety and operational integrity of a facility.
- Category 2 – Recommendations covering a wide range of important matters where action is needed to prevent or reduce further damage or preclude possible operational failure of a facility.
- Category 3 – Recommendations covering less important matters but believed to be sound and beneficial suggestions to improve or enhance the O&M of the project or facility.

Table 1 documents the findings and recommendations from the 1984, 1987, 1990, 1993, 1999, 2005, and 2011 reports. Note some of the findings are carried over from previous investigations as they were determined to be "incomplete".

Grand Valley Water Users Association RO&M Program Examination Reports

Program examination reports have been prepared by Reclamation since 1954 for the Grand Valley Water Users System. The examination report addressed the condition of the "Government Highline Canal from the Grand Valley Diversion Dam (Roller Dam) to the end of the approximately 55-mile long canal system. Other facilities examined include the Price-Stub Pumping Plant, tunnels, facilities added to the system by the Colorado River Basin Salinity Control Project, various control gates and checks, the drain system and other features."

This information was reviewed for relevant needs associated with the Roller Dam down to the float valve approximately 500 feet down canal. Table 1 includes the resulting findings and recommendations from the 1991, 1996, 2002, 2008, and 2014 reports. Note some of the findings are carried over from previous investigations as they were determined to be "incomplete".
December 16 & 17, 1987 Core Drilling on Grand Valley Diversion Dam Left (east) Pier
Two cores, one vertical and one horizontal, were drilled on a Roller Dam pier to test the fracture strength of the concrete. Five samples were tested for compressive strength from those two concrete cores. It was concluded that there was not any interior degradation of the concrete due to chemical reaction and that the concrete was enduring "quite well".

1991 Rehabilitation and Betterment Study

In 1991 Reclamation developed a study to summarize the concerns identified in the previous RO&M reports in an effort to support the Association with a federal grant application. The study reiterated several of the identified concerns as well as contributed

several new concerns, many of which remain a high priority today. A cost estimate was prepared by Reclamation as part of the study. The grant request was ultimately unsuccessful and the projects identified found alternate funding to address the concerns or remained unaddressed.

This study identified the following top concerns to be addressed at the Dam and Canyon Facilities which are documented in Table 1:

- Repair the concrete surface of the diversion dam
- Replace two of the roller gates on the left side of the diversion dam with a permanent ogee crest
- Rehabilitate the roller gates
- Modify the roller gates to provide additional head on the canal works
- Upgrade the dc and ac power systems to comply with current codes
- Repair the river training wall
- Line the first 600 feet of the canal
- Replace two spillway radial gates on the canal
- Repair the concrete on the canal headworks and place a guardrail alongside the gate hoists
- Miscellaneous work between the dam and the inlets to the Power Canal and Tunnel No. 3 (cleaning and reshaping the canal), investigate the canal prism and remove any obstructions and build-up canal freeboard where necessary to safely carry the maximum canal diversion requirements, and upgrading the canal foot bridge and gauging station.

This study also concluded that:

- The dc electrical system should be upgraded to comply with current codes instead of converted to ac power - most cost effective.
- Modification to the entrance of the tunnel will not reduce headloss through Tunnel No. 3.

Hydropower Resource Assessment at Existing Reclamation Facilities, March 2011

Bureau of Reclamation evaluated potential hydropower production sites across the United States in 2011. Out of the 530 sites evaluated, the Grand Valley Diversion Dam was identified as the 18th best site for hydropower development based on benefit cost ratio, and the 5th best in the Upper Colorado Region. However, the assessment identified the site had constraints that may impact the cost and viability to construct hydropower including:

- Fish and Wildlife
- Recreation
- Historical and Archaeological

The report stated the Grand Valley Diversion Dam could produce approximately 2.0 megawatts (MW) of installed capacity with a design flow of 2,260 cfs and 14 feet of design head. The cost for construction was estimated at approximately $9 million dollars.

Grand Valley Project (Wm Joe Simonds at Reclamation, 1994)

This report documented the historical setting of the Grand Valley Project.

Appendix B

Summary of Reports and Documents
Grand Valley Water Users Association Studies and Projects

- Water Management Plan
- Upper Canal Improvements
- Salinity Projects
- Power Canal Capacity Report (December 2015)

Water Management Plan

The ASSOCIATION received a Water Supply Reserve Account Grant in the amount of $45,000 to fund a comprehensive update to the Water Management Plan (WMP), a critical component to long-term maintenance, asset management, water stewardship, and most importantly, creating a funding plan to accomplish those projects – whose costs will be in the millions. The objective of the WMP project is to prepare a conditional assessment and operational analysis of the 50 miles of the canal below the outfall of Tunnel No. 3, identify and document water losses, identify priority projects, conduct a benefits analysis, ascertain environmental concerns, determine costs associated with the projects and create a strategic funding plan to implement the priority projects. The WMP project will also allow the ASSOCIATION to implement certain provisions of the Colorado River Cooperative Agreement (CRCA, Section 7, specific to conservation and avoidance of Colorado Compact issues). The WMP project began in fall 2015 and is anticipated to conclude in early 2017.

Upper Canal Improvements

One component of the Roller Dam Master Plan has already been designed, the Upper Canal Improvements Project. This project addresses the rehabilitation of the top 500 feet of the canal, immediately below the dam. Reclamation provided the design work and attendant pricing estimates for reshaping the canal prism and replacing the concrete liner currently in place. Reclamation will continue to provide technical and professional assistance, ultimately delivering construction drawings and specifications. Construction is planned to be complete in the spring of 2016 should the entire length of canal be undertaken; should the project be bifurcated for logistical reasons, the work would be completed in the fall of 2016 or the spring of 2017.

Salinity Projects

<u>Reclamation Salinity Program – Government Highline Canal – Reach 1A Lower Section Lining Project</u>

The Reach 1A Salinity Lining Replacement project was undertaken by the ASSOCIATION and includes approximately $160,000 of replacement work on Stage 1A of the Government Highline Canal. The overall purpose of the Reach 1A Lower Section Lining project is to install approximately 4,774 feet of PVC liner to an unlined and open section of the Government Highline Canal. The section of canal to be lined is earthen that was originally designed with a trapezoidal cross section with a 30-foot bottom and 2:1 side slopes. Over the years the slopes have eroded and sloughed. In some sections heavy vegetation has grown in along the sides down to the high water surface line in the canal. The proposed improvements include lining with 2 layers of geotextile fabric on either side of a 30 mil PVC liner covered with a protective 3 inch shotcrete layer. A gravel underdrain will also be installed. The total project award is $3.6 million. The ASSOCIATION performed approximately $40,000 of the work in FY 2015 and the remainder will be done in approximately equal parts in FYs 2016 and 2017.

Power Canal Capacity Report (December 2015)

The Power Canal Capacity Report evaluated potential to increase diversions to the Grand Valley Power Plant in the event Conserved Consumptive Use credits, available through a water bank, were needed and could be put to beneficial use through the power plant. The

report concluded that in most years some excess capacity of approximately 5,000 AF per irrigation season is available however many operational issues would need to be worked out before implementing this type of a program. The report also highlighted the need for more consistent and accurate flow measurement in the power canal.

Appendix C

Summary of Reports and Documents
Orchard Mesa Irrigation District Studies

- Grand Valley Power Plant (GVPP) Feasibility Study
- Check Case Settlement

Grand Valley Power Plant (GVPP) Feasibility Study

The forthcoming $5.3 million GVPP Rehabilitation Project is being jointly pursued jointly by the ASSOCIATION and OMID. The GVPP is owned by OMID and the ASSOCIATION. The plant was built in 1933 and is currently operating is an inefficient and deteriorating state. The purpose of this feasibility report is to assess rebuild and upgrade options. The objective of OMID and the ASSOCIATION is to restore the facility to an economically and operationally sustainable condition.

The rebuild/upgrade recommendation is to increase the maximum generation output from 2.75 MW to 4.1 MW. This will not require additional flows. The increased generation is due to increased turbine and generator efficiencies, as well as increased head on the power plant due to lowering tailrace elevation an additional one foot. Due to the current interconnect and power sales agreements, the maximum production is limited to 3.5 MW. This can be increased in the future as explained in the feasibility study.

Check Case Settlement

The ASSOCIATION, OMID and the United States were co-applicants for a water right decree to allow historical operations of the Check to continue. The Check refers to the "borrow" of up to 640 cfs from the river to run through the GVPP and return it to the river above the Grand Valley Irrigation Canal's (GVIC) headgate and senior call. The Check case benefits upstream users in that the Check operation can reduce calling period through the sharing of water in Grand Valley. The benefit to the co-applicants is continued historical operations and the guarantee of allowing the full 66,000 AF released annually to improve water quality for the Grand Valley in the late season and improving flows for the 15-mile reach. The decree also provides protection to the co-applicants against any wasting claims by objectors.

Appendix D

Summary of Reports and Documents

Other Studies

- Study of Alternative Water Supplies for Endangered Fishes in the “15-Mile Reach” of the Colorado River (Reclamation, January 1992)
- 10825 Water Supply Study – Phase 1 Report (Upper Colorado River Endangered Fish Recovery Program, 2007)
- 10825 Water Supply Study – Phase 2 Report (Upper Colorado River Endangered Fish Recovery Program, January 2008, Draft)
- Sedimentation above the Roller Dam Study

Study of Alternative Water Supplies for Endangered Fishes in the "15-Mile Reach" of the Colorado River (Reclamation, January 1992)

The Implementation Committee for the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin asked Reclamation to prepare a study of potential alternative water supplies for instream flows in the Colorado River. The study included the reach of river from the Grand Valley Irrigation Company diversion dam in Palisade, Colorado, downstream to the confluence with the Gunnison River (15-Mile Reach).

The report evaluated identified a goal of sustaining flows at 700-1,200 cfs during July August and September. Therefore a cumulative volume of 47,102 AF is required to meet the minimum flows in 4 out of 5 years and 75,776 AF is required to guarantee the 15-mile Reach should never fall below a dry-year target flow of 600 cfs. The report assessed multiple water supplies and water saving efforts as well as combinations of both. The top three alternatives concluded in the report are as follows:

1.) Grand Valley Salinity Control Project could result in about 41,500 AF of additional water. However, this would be dependent on a) the Grand Valley irrigators would curtail diversions related to efficiency improvements, b) continue to deliver Green Mountain Reservoir water to Grand Valley irrigators but administering the river as if the water required at Cameo, and c) assign portions of the existing irrigation water rights to instream flow.
2.) Buying portions of the water supplies in the Grand Valley. The amount of water available is unknown, but a thought of 5 percent reduction in river diversions was considered possible leading to approximately 8,000 AF to remain in the river for instream flows.
3.) Developing new upstream reservoirs from 1,500 to 20,000 AF could be pursued for a reasonable cost per acre-foot.

10825 Water Supply Study – Phase 1 Report (Upper Colorado River Endangered Fish Recovery Program, 2007)

A temporary solution was implemented by Denver Water and the Colorado River Water Conservation District to release 10,825 AF of water from their respective reservoirs, Williams Fork Reservoir and Wolford Mountain Reservoir. A permanent solution was needed to make the full 10,825 AF releases each year to meet the late summer flows. A list of 10 top alternatives was identified with a project sheet detailing cost, volume available, pros and cons. The top 10 alternatives included:

- Orchard Mesa Irrigation Improvements
- Sulphur Gulch Reservoir
- Buzzard Creek Reservoir
- Wolford Mtn Reservoir Improvements Water Supply
- Roan Creek Reservoir Design
- Wolcott Reservoir
- 15-Mile Reach Pumpback
- Yank Creek Reservoir
- Ruedi Reservoir (2012 Backfill) Impacts
- Synchronized Use of Multiple Facilities

Information from the Phase 2 Assessment was intended to facilitate the selection of a preferred alternative or group of alternatives that can be supported by both West Slope and East Slope water providers.

10825 Water Supply Study – Phase 2 Report (Upper Colorado River Endangered Fish Recovery Program, January 2008, Draft)

A broad coalition of East and West Slope water providers agreed in early 2007 to cooperatively analyze and compare a wide range of alternatives that would meet their obligations to provide 10,825 AF of water to the 15-Mile Reach on a permanent basis. The alternatives must be practicable and capable of efficiently and effectively delivering the 10,825 AF of water to the 15-mile reach in all years. An agreement for the permanent delivery of the water must be in place by December 20, 2009 and the project must be implemented by the date specified in this required agreement. The delivered water must be of sufficient quality to avoid adversely affecting the target fish species, irrigation or crop yields, municipal water treatment costs, or cause exceedances of existing water quality standards. This report summarizes the second phase of an assessment that evaluated the likelihood of the alternatives to meet these objectives.

Six water supply alternatives were identified that meet the primary objectives and the primary evaluation criteria that have been established for this study, with the possible exception of the “Stakeholder Consensus” evaluation criteria. Secondary objectives related to headwater benefits are better met by several of these six alternatives than others. The six alternatives included:

- Alternative A – Ruedi Reservoir
- Alternative B – Sulphur Gulch Reservoir (16,000 AF)
- Alternative C1 – Ruedi & Sulphur Gulch Reservoirs (8,000 AF)
- Alternative C7 – Granby & Ruedi Reservoirs
- Alternative C8 – Granby & OMID/ Green Mtn. / Ruedi Reservoirs
- Alternative C9 – Granby & Sulphur Gulch Reservoirs

Sedimentation above the Roller Dam Study

In 2014 Brent Mefford of WildFish Engineering, LLC published a report identifying the sedimentation buildup at the entrance to the PNM Fishway and assessing alternatives to address the issue. Alternatives evaluated included in-river structures, bankline modifications, sedimentation management near the fishway and alternatives that address both. This report was reviewed in regards to similar sedimentation scenario occurring near the entrance of the fish bypass at the Roller Dam. Many of the alternatives addressed in the report could be used to at the Roller Dam.

Appendix E

Working Sessions Meeting Minutes

Grand Valley Roller Dam Rehabilitation Phase 1
Development of the Dam and Canyon Facilities Master Plan
Meeting Minutes
December 7, 2015

Attendees

Name	Organization	Email
Dan Birch	Colorado River Water Conservation District	dbirch@crwcd.org
Frederick Busch	Bureau of Reclamation, Western Area Office	fbusch@usbr.gov
Kevin Conrad	Grand Valley Water Users Association	kconrad@gvwua.com
Dan Crabtree	Palisade Irrigation District	dan.crabtree.pe.@gmail.com
Aaron Derwingson	The Nature Conservancy	aderwingson@TNC.org
Ted Dunn	Bureau of Reclamation, Western Area Office Recovery Program	edunn@usbr.gov
Tom Fowlds	Bureau of Reclamation, Western Area Office Recovery Program	tfowlds@usbr.gov
Angie Fowler	SGM	angief@sgm-inc.com
Mark Harris	Grand Valley Water Users Association	mharris@gvwua.com
Mark Hermundstad	Williams, Turner & Holmes	mherm@wth-law.com
Brendon Langenhuizen	SGM	blangenhuizen@sgm-inc.com
Max Schmidt	Orchard Mesa Irrigation District	max@omirrigation.com
Brent Uilenberg	Bureau of Reclamation, Western Area Office Recovery Program	BUilenberg@usbr.gov
Ed Warner	Bureau of Reclamation, Western Area Office Recovery Program	lwarner@usbr.gov

1. Self-introductions
2. Mark Harris reviewed the "umbrella" Roller Dam & Canyon Facilities Master Plan (attached)
    - Upper End Canyon Canal (Design in Progress)
    - Headgates
    - Roller Dam Phased Rehab (from minor to major)
    - Hydro GVPP & Dam
3. Angie reviewed the Purpose of the Project
    - Basin Implementation Plan Project Information Sheet
    - Master Plan Water Supply Reserve Account (WSRA) grant application and SGM Scope of Services
        - This Working Session is part of Task 1 of SGM's scope of services (Identify and Prioritize Rehabilitation Needs)
4. Mark Hermundstad mentioned the April 1960 Hearing before a House Subcommittee chaired by Wayne Aspinall where Wayne Chiesman testified that the Roller Dam and Facilities were

expected to perform for another 25 years before substantial reconstruction work would be needed on the dam!

5. Attendees provided input regarding 1) Interest in project; 2) Anticipated benefits; and 3) Risks if the project is not successful
    - Brent U.
        - Recognize the dam and canyon facilities are not at the point of imminent failure but need rehabilitation to avoid getting to that point
        - Facilities maintain the stability of the Colorado River to protect both the Shoshone and Cameo calls (the canal/ditch functionality supports the ability to meet the Cameo call)
        - The Master Plan project presents great opportunity for coalitions/partnerships
    - Dan C.
        - Reviewed the Palisade Irrigation District's water rights – operation of the dam and canyon facilities is critical for these water rights
        - Prior to the dam and canyon construction this water was pumped out of the Colorado River
        - PID controls a 1889 adjudicated water right for 80 cfs; fully used during irrigation season
        - PID also has a pre-1922 water right for 23.5 cfs that is only used when the canal has capacity but would like to fully divert this right.
        - During the June-July timeframe the Grand Valley Water Users Association typically requests Palisade Irrigation District to curtail the 23.5 cfs water right
        - Asked about the condition of Tunnel No. 3 as it may be the limiting factor in the ability to deliver the full 23.5 cfs water right
    - Max S.
        - Reviewed the Orchard Mesa Irrigation District (OMID) Check Case
            - Reminded the group that the last 70-100 cfs conveyed in the Government Highline Canal is critical to operating the check
            - Rehabilitation of the canal will support firming of the water rights
            - Every drop counts and is critical to support the entire Grand Valley
        - Reviewed the check operations
    - Aaron D.
        - Works for the Colorado River Program (of The Nature Conservancy)
        - TNC's mission supports partnerships – this project is important to support this
        - TNC supports infrastructure improvements to benefit the 15 Mile Reach, agriculture, minimize instream flow gaps
    - Dan B.
        - The project will support and protect the Shoshone and Cameo calls
        - Stabilize Colorado River flows
        - If the water isn't secured, at risk for not supporting:
            - Consumptive and non-consumptive needs

        - Water downstream of the Colorado Stateline
    - The rehabilitation of these facilities is not optional
    - Recognized that the mechanism to support the rehabilitation needs comes down to funding
    - Interested in expanding collaborative process to other entities within the River District
- Mark Hermundstad
    - Represents OMID and Grand Valley Water Users Association
    - Pre-1922 water rights protect the Grand Valley
    - Rehabilitation of the dam and canyon are critical to support and maintain these water rights
- Ed Warner
    - Important to protect the pre-1922 water rights & Recovery Program
    - Would not have an interest in the Grand Valley Power Plant if the Recovery Program was not present
    - There have been times when the Programmatic Biological Opinion (PBO) flow targets have not being met
    - BOR, as owner, has project maintenance responsibility
    - Need to capitalize on the momentum of the Colorado Water Plan/Basin Implementation Plan
    - Reviewed the Urbanized Canal program – started because of the Nevada canal failure incident
    - Although the dam facilities are outside of this program area, important to maintain entire canal
    - Ed (and Pam) wrote a similar master plan report in the early 1980s to support the Category 1 recommendations and requirement to develop a plan within one year of identification of these.
    - He recalled the recommendation to replace the slide gates with radial gates, for example
    - Momentum is prime for success of this project
    - Pitfalls will be funding and financing the improvements and the cultural mitigation requirements
- Mark Harris
    - Reviewed the Water Management Plan work along the canal and laterals in the valley portion of the system
    - 1955 agreement to maintain and operate the dam (between GVWUA and BOR)
    - The visual and aesthetic elements of the project rehabilitation are important as well
    - Operations and functionality of the dam and canyon facilities is important to support the Recovery Program
    - The Grand Valley Power Plant (GVPP) is also one of the best protective measures for Grand Valley operations

- Kevin C.
  - The Grand Valley Project supports 22,000 acres of agriculture
  - Concern for answering the common question of "will it last another season?"
  - Safety of the crews maintaining and operating the system and the general public is also critical to rehabilitation of the facilities
  - Funding is something that needs to be addressed with any rehabilitation
- Tom F.
  - Serves as the Facilities' Group Chief (both Roller Dam and Upper Canal)
  - Maintenance of the facilities is important
  - The condition of the dam and efficient operations will support the delivery of water downstream (along the canal) and support the Urbanized Canal Program
  - The Urbanized Canal Program minimizes the loss of property and life; no money to support inventorying (every 3 years) nor "fixing" of identified issues.
- Ted Dunn
  - The success of the rehabilitation will be built upon good partnerships and improve the need to fix the aging infrastructure
- Frederick B.
  - Operations and Maintenance Engineer
  - Responsible for inspecting facilities – issues identified are "rising to the top" of the needs
  - Providing design support for the upper 500 feet of the canal which will fix the sinkholes and stability issues.
  - The Upper Canal project will support firming of the pre-1922 Compact water rights (should be a TOP PROJECT in the Master Plan)

6. Discussion regarding additional partners for the project
   - Sooner:
     - Colorado Water Conservation Board (Tim Feehan) – important for the Funding Plan for the project
   - After Phase I of the Master Plan communicate with:
     - Grand Valley Irrigation Company
     - State Engineer's Office (Division 5)
     - Recovery Program (Tom Pitts)
     - Environmental Defense Fund (EDF)
     - Other green investment firms?
     - Domestic water users (Ute Water, Clifton, Palisade); Ute Water relies on the delivery of water through the canal as they do not provide outdoor water to their customers. Failure of the system to operate would increase the water demands on their system.
     - County/Municipal (City of Grand Junction; Mesa County; Garfield County; Pitkin County) – River District help support this communication?
7. Water Bank
   - Mark Hermundstad reviewed the OMID Check Case (mid-1990s)

- Power right can't call during irrigation unless the diversion is less than 1,310 cfs
- The protection of the endangered fish and the water bank are tied to the GVPP

8. SGM has the following reports to review for Task 1 of the Scope of Work
    - Grand Valley Diversion Dam Grand Valley Project, Colorado (BOR, January 2011)
    - Study of Alternative Water Supplies for Endangered Fishes in the "15-Mile Reach" of the Colorado River (BOR, January 1992)
    - Grand Valley Project (Wm Joe Simonds at BOR, 1994)
    - Department of Interior Study (Roller Dam top 5 projects in Colorado for hydropower potential)
    - 1984 Review and Operation and Maintenance Program, Examination Report for the Grand Valley Diversion Dam, (Ed W 1980 report) has been found and sent since this meeting
    - OMID Power Canal Study (driver for water delivery downstream)
9. Other Input
    - Brent U. – page 15 of the WSRA application, subsection "Upper Canal Improvements", mentioned that the Bureau of Reclamation…will be "delivering construction drawings and specifications" for the top 500 feet of the canal. Brent questioned the BOR's ability to provide these for construction in spring 2016.
        - Mark Harris mentioned that the schedule will most likely be the fall of 2016 now for this project.
    - Dan B. – discussed the Shoshone Call; the Colorado River Cooperative Agreement (CRCA) group is very active in protecting this.
        - Recognized that it is ok to pursue the potential hydropower connection to the rehabilitation of the dam and canyon facilities (will not impact CRCA Shoshone efforts)
    - Ed W. – questioned whether there would need to be a change of use for water used for hydropower at Roller Dam
        - O&M inspections of the dam occur every 6 years
        - Review the need to coordinate with the Federal Energy Regulatory Commission (FERC)
    - Aaron D. – offered TNC's input regarding creative financing to support environmental projects/benefits (only) in the future
10. Potential Project Constraints
    - Operations
    - Administration
    - Federal BOR Grand Valley project constraints
    - Permitting
    - Access
11. Other Concurrent Studies
    - Upper 500' of Government Highline Canal (occurring in parallel with Master Plan)
    - Salinity Project Canal Lining
    - GVPP Project Rehabilitation

- Water Management Plan
- Recovery Program

12. Next Steps
    - Max share a copy of the OMID Power Canal Study
    - SGM will share a copy of the draft rehabilitation table
    - BOR review and edit draft rehabilitation table by December 16, 2015
    - SGM will provide meeting minutes for all to review/edit/approve
    - SGM will summarize existing data, reports and information into a brief memorandum
    - SGM will summarize input from this meeting into the memorandum
    - SGM will develop an outline for the Master Plan
    - SGM will develop the draft implementation plans for the top Roller Dam and Rehabilitation projects for the Working Group's input for the January 11, 2016 Working Session
        - Project need
        - Additional studies and investigations
        - Potential partners
        - Permitting requirements
        - Other constraints
        - Funding plan
            - Primary beneficiaries
            - Funding options/sources
            - Economic viability of hydropower
        - Schedule
    - SGM work on a GIS map of the upper 500 feet of the canal and dam
    - SGM Jeff Grebe to provide estimate of how often the dam spills/FERC involvement
        - Jeff G. mentioned that FERC does NOT have to get involved if BOR is involved and can do a LOPP
    - SGM will research how often the dam historically spills (under flood conditions? Talk with dam tender/operator)
13. Meeting Recap
    - Identified potential benefits of project success
    - Identified risks associated with project failure
    - Recognized project drivers outside the project area
    - Generated ideas for top master plan projects to consider

Grand Valley Roller Dam Rehabilitation Phase 1
Development of the Dam and Canyon Facilities Master Plan
Work Session #2 Meeting Minutes
January 11, 2016

Attendees

Name	Organization	Email
Dan Birch	Colorado River Water Conservation District	dbirch@crwcd.org
Frederick Busch	Bureau of Reclamation, Western Area Office	fbusch@usbr.gov
Kevin Conrad	Grand Valley Water Users Association	kconrad@gvwua.com
Dan Crabtree	Palisade Irrigation District	dan.crabtree.pe.@gmail.com
Aaron Derwingson	The Nature Conservancy	aderwingson@TNC.org
Tom Fowlds	Bureau of Reclamation, Western Area Office Recovery Program	tfowlds@usbr.gov
Angie Fowler	SGM	angief@sgm-inc.com
Mark Harris	Grand Valley Water Users Association	mharris@gvwua.com
Mark Hermundstad	Williams, Turner & Holmes	mherm@wth-law.com
Brendon Langenhuizen	SGM	blangenhuizen@sgm-inc.com
Brent Uilenberg	Bureau of Reclamation, Western Area Office Recovery Program	BUilenberg@usbr.gov
Not Present (Invited)		
Max Schmidt	Orchard Mesa Irrigation District	max@omirrigation.com
Steve Ryken	Ute Water	sryken@utewater.org

The overall purpose of this meeting was to obtain feedback and input on the project, specifically the top identified priorities for the Dam and Canyon Facilities.

- Introductions
- Reviewed the outcome of Working Session #1
    - Reviewed Identified Interest in Participation matrix and revised per stakeholder comments (***attached***)
- Reviewed work conducted since Session #1
    - Master Plan Outline
        - Mark Harris – aggregate the more important factors that led to selection of top facilities' needs
        - Aaron – format is good
        - Brent – all identified needs are interrelated; important to recognize with funding applications
        - Dan C. – highlight and mention the diversity of the stakeholders represented
    - Table 1 - Identified Dam and Canyon Facilities' Needs
        - Some of the publications documenting the needs addressed the dam or canal portions only
        - Category 1 recognizes immediate needs

        - Specific to the identified Roller Gates portion of the facility, would not replace all gates; reliability of the rollers is not in question and may be useful for ~ 100 years
    - Table 2 – Identified Dam and Canyon Facilities' Needs since 1985 combined with Colorado Basin Implementation Plan Needs
        - May need to refine this list pending the water rights and water management information over time
    - GIS Map (location of the identified needs)
    - ***A copy of the most recent version based upon the Working Session #2 input and meetings with GVWUA is attached***
- Discussed Other Concurrent Activities
    - WaterSMART Letter of Support
- Next Steps for this Project
    - Implementation Plans for Top Priorities ***(a Draft Template is attached)***
    - Draft Master Plan mid-March 2016; will distribute to the work group members
    - Colorado Basin Roundtable presentation May 2016
    - Submit a Water Supply Reserve Account (WSRA) Grant Application in May 2016
- Meeting Recap
    - Received input regarding the Dam and Canyon Facilities' Needs
    - Received support and buy-in regarding the top 5 priorities/needs

GVWUA ROLLER DAM AND CANAL MASTER PLAN

Working Group Meeting 1 - Identified Interest in Participation

DRAFT

Name	Identified Interest in Project							
	Maintaining Water Rights Historical Use	Maintaining Administrative Call	Partnership Development	Urbanization Canal Project Requirements	Developing Funds to Address Project Needs	Increasing Capacity (Last 70-100 cfs)	Maintaining 15-mile Reach Flows	Addressing Colorado River Basin Issues
Brent Uilenberg	X	X						
Dan Crabtree	X	X	X		X	X		X
Max Schmidt	X	X				X		
Aaron Derwingson		X	X		X		X	X
Dan Birch	X	X	X		X		X	X
Mark Hermundstad	X	X				X		
Ed Warner	X			X		X	X	X
Mark Harris	X	X	X	X	X			
Kevin Conrad	X			X	X			
Tom Fowlds	X			X				
Ted Dunn	X			X				
Frederick Busch	X			X				

TABLE 1

DRAFT

2016 GVWUA ROLLER DAM AND UPPER CANAL IDENTIFIED NEEDS

Master Plan Identified Needs

	GVWUA System Element	BOR Remaining Identified Needs	Category[1]	CBRT BIP Project Information Sheet	Type of Rehabilitation	Potential Project Outcome	Top Beneficiaries	GVWUA Top Priorities (1 is highest)
	Roller Dam							
1	**Roller Gates**		-	Upgrade the electrical and control system that operates the roller gates and supplies other required electrical needs to meet code(s).	System investigation	Electrical System Upgrade/ Safety Issues		2
2		1991-2 Replace two of the roller gates on the left side of the diversion dam with a permanent ogee crest.(Concrete cap replacing the rollers).	-	Investigate replacing one or more roller gates with different style gates allowing for more positive control of dam pond level.	Structural	Upgrade - Increased Operational Efficiency		
3		1991-4 Modify the roller gates to provide additional head on the canal works.	-		Study/ Operations	Upgrade		
4	**River Embankment**	2011-3-A Reinforce the river embankment immediately upstream of the right abutment, where erosion is evident.	3		Structural	General Maintenance		
5	**Fish Passage**	Study of sediment issues & fish passage.	-		Study	Improve Stream Health		
	Government Highline Canal System							
6	**Canal Headworks**	2011 - Rehabilitate, repair, and replace Canal Headgates. Install gate automation devices with water level sensors; and install flow measurement devices (Currently 0.2-0.3' change before open/close signal sent). Bottom seal missing at gates.	-		Operations	System Improvements		3
7	**Upper 500 Feet of Canal**	2014-2-A Replace the lining in the first 500' of the GHC to Float House.	2	Reshaping, stabilizing, and concrete lining the upper portion of the canal, adjacent service and access areas, and utilities. (Will develop more capacity in canal)	Structural/ Operations/ Dam Safety	Upgrade - Increased flows, Increased Operational Efficiency		1
	System Wide							
8	**Underwater Structures**	2005-2-C Need an underwater examination. (Overflow weirs, Sluiceway, Piers, Canal Headgate Structure, etc.)	2		Study	Structural Integrity Study		
9	**Concrete**	Weathered concrete; spalling and exposed concrete. - Roller Dam Structure - Canal Headworks (Rebar showing on floor , deteriorating walls) - Canal Transition (Left side, Parapet wall, etc.)		Repair and/or replace deteriorating and spalling concrete throughout facility.	Cosmetic/ Maintenance	General Maintenance		4 (Investigate top areas to address and repair)
10	**Canal Capacity Control**	1991-8 Replace two spillway radial gates on the canal. (At station 22)	-		Structural/ Operations	General Maintenance		5

Note 1.

Category 1 – recommendations involving the correction of severe deficiencies where immediate and responsive action is required to ensure structural safety, operational integrity of a facility, or operating personnel/public safety.

Category 2 – recommendations covering a wide range of important matters where action is needed to prevent or reduce further damage, preclude possible operational failure of the facility, or reduce safety risks to operating personnel/public.

Category 3 – recommendations covering less important matters but believed to be sound and beneficial suggestions to improve or enhance the O&M of the project or facility.

Top Need - Upper 500 Feet of Canal Lining

Project Description, Need(s), & Benefits:			
Identified Next Steps/Study(ies) & Investigation(s)		Timing:	☐ Immediate (< 1 year) ☐ Near Term (1-3 years) ☐ Long Term (3 – 10 years)
Permitting Requirements	Agency	Permit(s)	Schedule for Approval
Constraints and Challenges	Technical: Staffing**:** Legal**:**		
Conceptual Costs **-design** **-implementation** **-permitting**			
Funding Plan	Specific Need	Funding Sources	
Schedule	Milestone	Date	
Potential Project Partners			

Appendix F

Priority 1 Project (Lining of the Upper 500 Feet of Canyon Canal) Information

Grand Valley Water Users Roller Dam Master Plan Phase 1

Top Need - Upper 500 Feet of Canyon Canal Lining

<table>
<tr><td colspan="4">Project Description, Need(s), & Benefits:
GVWUA and OMID are proposing to improve the hydraulic efficiency of the top 500 feet of the Canyon Canal by installing a PVC liner and a shotcrete wear surface. These improvements are expected to result in the accommodation of at least 100 cubic feet per second (cfs) more of the legal water rights adjudicated for this structure and increase the diversion ability and efficiency during times of river flow below 2,250 cfs. In addition to the direct economic benefits in supporting the agricultural economy of the Grand Valley, this project will promote the full exercise of the “Cameo Call” water rights, support the continued operation of the Roller Dam and canyon facilities, provide reliability to Colorado River flows in the Upper and Lower Colorado River Basins, provide for more efficient operation of the Grand Valley Power Plant and the production of more renewable energy from that facility, provide benefits for endangered fish, and provide associated environmental and cultural benefits.</td></tr>
<tr><td>Identified Next Steps/Study(ies) & Investigation(s)</td><td colspan="2">1. Secure funding
2. Finalize design
3. Permitting
4. Construction</td><td>Timing:
☒ Immediate (< 1 year)
☐ Near Term (1-3 years)
☐ Long Term (3 – 10 years)</td></tr>
<tr><td rowspan="5">Permitting Requirements</td><td>Agency</td><td>Permit(s)</td><td>Schedule for Approval</td></tr>
<tr><td>Bureau of Reclamation</td><td>NEPA Compliance (Cultural Assessment)</td><td>Cultural Inventory and survey is currently underway and will continue through final design.</td></tr>
<tr><td>U.S. Army Corp of Engineers</td><td>Waters of the U.S.</td><td>Will be addressed with final design.</td></tr>
<tr><td>Mesa County</td><td>Mesa County Building Permit</td><td>GVWUA is going to trench the overhead powerline as part of the project and will need to coordinate with Mesa County Building Department and the State of Colorado Electrical inspector.</td></tr>
<tr><td>State Historical Preservation Office (SHPO)</td><td>Section 106</td><td>A Class II Cultural Resource Inventory was conducted in November 2015. Awaiting concurrence from SHPO for the proposed approach regarding the interim maintenance work in the GHC canal levee/road.</td></tr>
<tr><td>Constraints and Challenges</td><td colspan="3">Technical: The project has been designed to a 70% level and only final technical design is remaining. Reclamation identified potential mitigation efforts may be required on the historically and culturally significant features. Permitting with U.S. Army Corp of Engineers as well as habitat assessments remain as potential environmental components of the project.

Staffing: GVWUA and OMID have the available staffing to supervise and manage this project.

Legal: There are no foreseen legal constraints for this project.</td></tr>
</table>

Conceptual Costs **-design** **-implementation** **-permitting**	The expected cost to finalize the design, permit and construct the project is $800,000. In order to determine unit costs, GVWUA relied upon contract unit prices provided by the Reclamation project engineer who derived item costs from similar Reclamation projects and RSMeans 2015 and indexed to 2017 construction dollars. See attached Proposed Budget for the project.	
Funding Plan	Potential Funding Sources	Funding Amounts
	GVWUA Cash	$42,000 (5.25%)
	GVWUA In-Kind Services	$12,000 (1.50%)
	Colorado Water Supply Reserve Account (WSRA) Loan	$150,000 (18.7%)
	Colorado Water Supply Reserve Account Grant	$300,000 (37.5%)
	Requested Reclamation Funding	$296,000 (37.0%)
Schedule	Milestone	Date
	See attached estimated Project Schedule	
Potential Project Partners	Colorado Water Conservation Board, Colorado River Water Conservation District, Colorado River Basin Roundtable, U.S. Bureau of Reclamation, Palisade Irrigation District, The Nature Conservancy	

Table 1. Canyon Canal Improvement Project Estimated Project Budget

#	ITEM DESCRIPTION	QUANTITY	UNIT	EXPLANATION	$/UNIT	ITEM COST
1	Mobilization, Demobilization & Prepatory Work	1	LS		$35,000.00	$35,000
2	Water for Dust abatement	30	Day	1 off highway 6,000 gal water truck rented by the month and used 4hrs/day	$ 742.63	$22,279
3	Removal of water	1	LS	Providing, maintaining and attending pump for removing water in canal invert	$20,000.00	$20,000
4	Erosion control	2000	LF	Silt fence, polypropylene, 3' high	$ 2.24	$4,480
5	Excavation of canal - waste material	4000	CY	Muck in canal to be removed	$ 4.24	$16,960
6	Haul of waste material	4000	CY	Assume 10 CY truck @ 1 round trip/hr	$ 10.15	$40,600
7	Placing fill material	2900	CY	Placed fill material in canal prism and compact	$ 5.73	$16,617
8	Borrow Material	2900	CY	Material to be purchased and hauled from borrow source	$ 34.07	$98,803
9	Side slope compaction	10	Day	Excavator with Ho-pac, 8 hour day	$ 1,472.40	$14,724
10	Underdrain excavation	50	CY	Trench 1.5' x 1.5'	$ 13.54	$677
11	Underdrain geotextile	3800	SF	Placed in trench with overlapped top after filled with pipe and gravel	$ 0.30	$1,140
12	Underdrain perforated pipe	500	LF	Furnishing and laying 6" diameter perforated pipe for canal underdrain system	$ 8.54	$4,270
13	Gravel for canal underdrain system	50	CY	1/4" Chat	$ 48.80	$2,440
14	Daylight underdrain	1	EA		$15,000.00	$15,000
15	Furnishing and placing PVC lining (30 mil)	42000	SF	Furnishing and placing PVS lining	$ 0.75	$31,500
16	Geotextile - Upper layer	42000	SF	Furnishing and placing geotextile	$ 0.30	$12,600
17	Geotextile - Lower layer	42000	SF	Furnishing and placing geotextile	$ 0.30	$12,600
18	Shotcrete Lining	4120	SY	Shooting shotcrete on canal prism including material cost and labor (3" thick)	$ 36.44	$150,133
19	Gravel surfacing	670	SY	3" of crushed 3/4" gravel for road and surface on one side of canal, 12 ft wide	$ 5.95	$3,987
20	Safety Ladder	2	EA		$ 2,300.00	$4,600
					Construction Subtotal	$508,409
				NON-CONSTRUCTION COSTS		
21	Construction Management & Testing				10%	$ 50,841
22	Survey				0.5%	$ 2,542
23	Professional Assistance (legal, audit, and compliance)				2.5%	$ 12,710
24	Reporting				1%	$ 5,084
25	Construction Contingency				20%	$ 101,682
26	NEPA - EA (Habitat, Cultural, Mitigation, USACE Permitting)				5%	$ 22,878
27	Detailed Design Engineering				10%	$ 50,841
					Professional Services Subtotal	$ 246,578
28	Pre-Award Costs: NEPA - Enviornmental Assessment (Cultural)					$ 14,835
29	Pre-Award Costs: WaterSMART grant and securing additional funding - Consultants					$ 10,977
30	Pre-Award Costs: WaterSMART grant and securing additional funding - GVWUA					$ 7,200
					Pre-Award Subtotal	$ 33,012
31	In-Kind Service - GVWUA (Post Award)					$ 12,000
					Total Costs	**$ 800,000**

*Construction cost values were derived from RSMeans 2015 and have been indexed to 2017 construction dollars

Table 2. Canyon Canal Improvement Project Estimated Project Schedule.

	2015		2016				2017				2018	Milestones and Dates
Task	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	
Reclamation Coordination												
1. Secure Funding (Commitments)												Secure commitments; loan
2. NEPA Compliance												
- Cultural Inventory and Survey												Class III Cultural Resource Inventory
- SHPO Review & Findings Concurrence												Concurrence
- ACHP Coordination and MOA												MOA
- Submit Cultural Mitigation Document												Approval
3. Final Project Design												
Survey												
Develop 100% CDs												
4. Develop Bid Package and Contract Documents												
Secure Contractor												
5. Permitting												
Electrical Permit												
6. Approval to Start Construction												
7. Construct Project												

Appendix G

Priority 2 Project (Upgrade the Roller Dam Electrical and Control Systems) Information

2 – Electrical and Control Systems Upgrade

Project Description, Need(s), & Benefits:
The electrical and control systems at the Roller Dam and canal headgate have been identified by Reclamation as needing upgrades since their 1984 RO&M examination report. This need remains today and has been identified as a top priority as only minor repairs and maintenance have occurred since 1984. The overarching drivers for this project are the safety and reliability of the electrical system. The current electrical and control systems at the Roller Dam and canal headgate are very rudimentary and the wiring is not up to current codes.

There are several different components to this project including:

1) Bury overhead powerlines: If not already addressed as part of the canal lining project this will need to take place as a first step in the electrical upgrades. Approximately 800 feet of wire needs to be buried starting at the existing power lines south of the Float House to the dam power house at the right abutment. A new transformer will also be required as part of this effort. Telephone lines would also be relocated underground.

2) Replace service box: A new service box and breakers will be installed to replace the old fuse boxes. The new box will meet the current code requirements, improve safety for the operators and provide flexibility to add other circuits as needed.

3) Rewire Canal Headgate Controls: Wiring will depend on the status and/or planning progress of Priority 3 Project - Canal Headworks Rehabilitation project. Proper wiring would need to be added allow each headgate to operate individually. However, should the operations remain the same; the wiring will be replaced to the drive motor, limit switches and the control wiring from the Float House. Upgraded wiring will bring the headgate controls into code compliance and could lead to increased operational efficiencies as canal flows could be measured and controlled more closely.

4) Replace Roller Dam wiring and upgrade electrical system: Wiring across the Roller Dam to each roller will be replaced to meet code requirements. More outlets and lighting may be added including 220 volt welder plugs to facilitate easier maintenance and safety during night operations. Possibilities of changing to A.C. power to operate the Rollers will be evaluated and pursued per evaluation recommendations.

5) Install an on-site standby generator: The Roller Dam and Canyon Facilities have experienced frequent power outages due to high winds or lightning storms in the canyon and the remote location. Installation of an on-site standby generator would allow the dam to operate during these periods some of which could be during vital dam operations. This project address reliability of electricity at the dam to operate the roller gates and the canal headgates make all the operations safer.

6) Upgrade electrical wiring in outbuildings: There are several outbuildings at the dam site, including the Dam Tender's House, a workshop, and two smaller storage buildings, which have electrical systems that need to be upgraded. These are separate single phase services and the wiring have been added and modified over time. It would be prudent to also replace the electrical fuses and wiring.

7) Deliver power to fish passage: U.S. Fish and Wildlife currently owns and maintains a 20 kW propane generator to drain the fish passage and facilitate their operations. Providing electrical power to the fish passage will reduce the maintenance and overhead costs associated with operating the 20kW generator.

Identified Next Steps/Study(ies) & Investigation(s)	1. Cultural Assessment 2. Secure Funding 3. Finalize Project Scope 4. Final Design 5. Construction	Timing: ☐ Immediate (< 1 year) ☒ Near Term (1-3 years) ☐ Long Term (3 – 10 years)

Permitting Requirements	Agency	Permit(s)	Schedule for Approval
	Bureau of Reclamation	NEPA Compliance (Cultural Assessment)	
	Mesa County	Mesa County Building Permit	
	SHPO		

Constraints and Challenges	Technical: The dam structure is on the National Register of Historic Places, and any changes to existing equipment, unless there's a failure, would require NEPA compliance. The existing DC motor brakes are not working. Staffing**:** GVWUA and OMID have the available staffing to supervise and manage this project. Legal**:** There are no foreseen legal constraints foreseen in this project.
Conceptual Costs **-design** **-implementation** **-permitting**	Estimated cost of design, permitting, materials and construction is approximately $633,000 per the attached cost estimate.

Funding Plan	Funding Sources	Funding Amounts
	GVWUA & OMID Cash	
	GVWUA Loan	
	US Fish & Wildlife Recovery Program	

Schedule	Milestone	Date
	Cultural Assessment	

Potential Project Partners	GVWUA, OMID, Bureau of Reclamation, US Fish & Wildlife

Electrical System Upgrade

#	ITEM DESCRIPTION	QUANTITY	UNIT	EXPLANATION	$/UNIT	ITEM COST	Cost Source
1	Mobilization, Demobilization & Prepatory Work	1	LS		$ 21,350.00	$ 21,350	Industry standard between 5%-10% (Currently at 5%)
2	Unlisted items	1	LF	erosion control, water for dust abatement	$ 15,000.00	$ 15,000	RSMeans 2015, 31 25 14.16 (1000)
3	New transformer	1	LS		$ 40,000.00	$ 40,000	SGM estimate
4	Bury overhead power lines	800	LF		$ 35.00	$ 28,000	SGM estimate
5	Electrical upgrades to outbuildings	1	LS	upgrade single phase electrical systems in dam tenders house, shop and two storage sheds	$ 25,000.00	$ 25,000	SGM estimate
6	New electrical distribution at the Roller Dam	1	LS		$ 150,000.00	$ 150,000	SGM estimate
7	New 10 hp Roller AC Motors with variable speed drives	6	EA		$ 4,000.00	$ 24,000	SGM estimate
8	New electrical distribution at canal headgates	1	EA		$ 15,000.00	$ 15,000	SGM estimate
9	Connect US Fish & Wildlife Fish Passage to power grid	1	EA		$ 5,000.00	$ 5,000	SGM estimate
10	SCADA based automation for canal headgate operations	1	LS		$ 50,000.00	$ 50,000	SGM estimate
11	On-site 100kW generator with transfer switch	1	EA		$ 75,000.00	$ 75,000	SGM estimate
					Construction Subtotal	$ 448,350	
	NON-CONSTRUCTION COSTS						
12	Construction Management & Testing				4%	$ 17,934	SGM estimate
13	Survey				2%	$ 8,967	SGM estimate
14	Professional Assistance (legal, audit, and compliance)				2%	$ 8,967	SGM estimate
15	Reporting				3%	$ 13,451	SGM estimate
16	Construction Contingency				15%	$ 67,253	Installation of gates and any additional concrete work needed or housing above ground for actuator and motor.
17	NEPA - EA (Habitat, Cultural, Mitigation, USACE Permitting)				5%	$ 22,418	Estimate (Likely higher due to unknown costs)
18	Detailed Design Engineering				10%	$ 44,835	SGM estimate based on large construction contingency. Typically in 10-15% range
					Professional Services Subtotal	$ 183,824	
					Total Costs	**$ 633,000**	

*Construction cost values were derived from RSMeans 2015 and have been indexed to 2017 construction dollars

Appendix H

Priority 3 Project (Rehabilitate the Canal Headworks) Information

3 – Canal Headworks Rehabilitation

Project Description, Need(s), & Benefits:

The Roller Dam maintains a water level for the Government Highline Canal headgate to divert from the Colorado River. There are nine (9) headgates for the canal currently which operate in unison to control diversions ranging from 0 to 1,730 cubic cfs. The gates have upper and lower limit switches but currently operate without any torque limits which causes disrepair in the brittle cast iron gates when they close on an obstruction. Replacement of all the gates is required; however each of the nine headgates is in different stages of disrepair. Some gates have cracked in several places and have been welded and fish-plated to hold them together. Additionally, operations of the gates use a float valve, accurate to 2-3 tenths of a foot, to control the opening and closing of the gates leading to variances ranging from 20-30 cfs. Updating the float valve system to a SCADA based controls can improve the accuracy, especially upon completion of Priority 1 Project, to within hundredths of a foot and reduce flow variability.

Repairing the headgates, individualizing headgate controls, adding torque limits to the headgate controls and refining the open/close signal to the gates need to be addressed in an effort to maximize the operations of the Government Highline and reduce the maintenance cost for repairing and replacing the canal headgates.

Identified Next Steps/Study(ies) & Investigation(s)

1. Cultural Assessment
2. Finalize Project Scope
3. Secure Funding
4. Final Design
5. Construction

Timing:
- ☐ Immediate (< 1 year)
- ☒ Near Term (1-3 years)
- ☐ Long Term (3 – 10 years)

Permitting Requirements

Agency	Permit(s)	Schedule for Approval
Bureau of Reclamation	NEPA Compliance (Cultural Assessment)	
SHPO		

Constraints and Challenges

Technical: The dam and canal headgate structure is on the National Register of Historic Places, and any changes to existing equipment, unless there is a failure, would require NEPA compliance. Several options exist for upgrading the canal headgate operations system including individualizing gate operations, adding a torque limit and upgrading flow control system to a sonic level sensor.

Staffing**:** GVWUA and OMID have the available staffing to supervise and manage this project.

Legal**:** There are no foreseen legal constraints foreseen in this project.

Conceptual Costs
-design
-implementation
-permitting

Total project cost is estimated at $500,000, including engineering design, cultural assessment, manufactured headgates, environmental and regulatory work, reporting and construction. Breakdown of the estimated project budget is provided.

Grand Valley Water Users Roller Dam Master Plan Phase 1

Funding Plan	Funding Sources	Funding Amounts
	GVWUA & OMID Cash	
	GVWUA Loan	
	Federal, State or local grants	
Schedule	Milestone	Date
	Cultural Assessment	
	20-percent Design	
Potential Project Partners	GVWUA, OMID, The Nature Conservancy, The Colorado River Water Conservation District, U.S. Bureau of Reclamation, US Fish & Wildlife	

Canal Headgate Replacement

#	ITEM DESCRIPTION	QUANTITY	UNIT	EXPLANATION	$/UNIT	ITEM COST
1	Mobilization, Demobilization & Preparatory Work	1	LS		$ 30,829	$30,829
2	Water for dust abatement	14	Day	1 off highway 6,000 gal water truck rented by the month and used 4hrs/day	$ 743	$10,402
3	Headgate with Rotork Gearbox and Rotork Actuator	9	EA	Stainless steel slide gate with a skin plate on front and back and rotor actuators	$ 26,432	$237,888
4	SCADA based automation	1	LS	operational equipment	$ 50,000	$50,000
5	Unlisted Items	1	LS	Erosion Control, Safety Ladders, Etc.	$ 10,000	$10,000
					Construction Subtotal	$329,119
	NON-CONSTRUCTION COSTS					
6	Construction Management & Testing				4%	$ 13,165
7	Survey				2%	$ 6,582
8	Professional Assistance (legal, audit, and compliance)				2%	$ 6,582
9	Reporting				3%	$ 8,228
10	Construction Contingency				30%	$ 98,736
11	NEPA - EA (Habitat, Cultural, Mitigation, USACE Permitting)				5%	$ 14,810
12	Detailed Design Engineering				7%	$ 22,709
					Professional Services Subtotal	$ 170,813
					Total Costs	**$ 500,000**

Appendix I

Priority 4 Project (Rehabilitate the Roller Tracks and Canal Concrete) Information

4 – Concrete Rehabilitation (Dam and Canal Headgate)

Project Description, Need(s), & Benefits:

The structural integrity of the Roller Dam and the Canal is outstanding considering its age at over 100 years. However, weathering and spalling is occurring throughout both structures. The concrete supporting the Roller Tracks was identified as the top area of concern following a review of the above-water concrete inspection. The areas particularly near the water surface has exposed rebar and in some places only rebar to protect and secure the support structure for the roller tracks. The exposed rebar is prevalent on all roller bays and on along each track of the rollers. This effort will efficiently address the proper repair and protection to continue safe and capable operations of the rollers well into the future.

Concrete rehabilitation is also needed in the canal transition zone. The transition zone of the canal is the existing concrete lined area from the canal headgates downstream for approximately 130 feet in length. Rehabilitation of the three specific areas of the transition zone described below will consist of removing loose material by hydro demolition, applying polymer modified repair mortar and finishing with a trowel for a smooth finish. This specific mortar is recommended as it can be trowel or sprayed and is enhanced with silica fume and fibers for increased density, abrasion resistance and compressive strength. The mortar reportedly has very good freeze thaw values that are important for a long term solution.

A) Areas of the floor have severe weathering and exposed rebar. Rehabilitation is needed on approximately 950 square feet.
B) The canal walls in the transition are weathered near the full flow water surface elevation where freeze/thaw has occurred. Rehabilitation of the canal walls is needed across approximately 1,140 square feet. In addition to the rehabilitation efforts, a concrete cap is being proposed along the north wall to provide two feet of freeboard and limit the opportunity for canal water to leak over and behind the existing canal wall.
C) The downstream side of the canal headgates headwall concrete is showing signs of freeze/thaw weathering despite previous efforts to shotcrete eroded areas. Rehabilitation of the canal headgate concrete is needed on approximately 1,560 square feet.

Identified Next Steps/Study(ies) & Investigation(s)	1. Develop full scope of repair 2. Develop funding plan to address top recommended actions 3. Cultural assessment 4. Construction	Timing: ☐ Immediate (< 1 year) ☐ Near Term (1-3 years) ☒ Long Term (3 – 10 years)

Permitting Requirements	Agency	Permit(s)	Schedule for Approval
	Bureau of Reclamation	NEPA Compliance (Cultural Assessment)	
	State Historic Preservation Office (SHPO)		

Grand Valley Water Users Roller Dam Master Plan Phase 1

Constraints and Challenges	Technical: The dam structure is on the National Register of Historic Places, and any changes to existing equipment, unless there's a failure, would require NEPA compliance. Water levels in the Colorado River and the Canal should be considered when scheduling the site evaluation of the dam. All work will require the canal to be off which typically only occurs for a few weeks twice a year. Limiting extended down periods for the canal will be a challenge. Staffing**:** GVWUA and OMID have the available staffing to supervise and manage this project. This project will be in coordination with the Bureau of Reclamation staff. Legal**:** There are no foreseen legal constraints foreseen in this project.	
Conceptual Costs **-design** **-implementation** **-permitting**	The estimated costs for design, permitting, materials, construction and construction oversight is $740,000.	
Funding Plan	Funding Sources	Funding Amounts
	GVWUA & OMID Cash	
	GVWUA Loan	
	GVWUA Grants	
Schedule	Milestone	Date
Potential Project Partners	GVWUA, OMID, The Nature Conservancy, The Colorado River Water Conservation District, Bureau of Reclamation, American Rivers	

Roller Track & Canal Concrete Repair

#	ITEM DESCRIPTION	QUANTITY	UNIT	EXPLANATION	$/UNIT	ITEM COST
1	Mobilization, Demobilization & Preparatory Work	2	LS	includes mobilization, floating platforms, scaffolding, forklift, Project Manager and Superintendent	$ 59,600	$119,200
2	Erect Scaffolding	3	EA	erect scaffolding on floating platforms at (3) repair locations concurrently	$ 2,100	$6,300
3	Concrete Removal	576	SF	remove concrete 4" to 5" below face of pier by hydro demolition methods over area 2 ft x 24 ft per repair location; sawcut square edge	$ 46	$26,208
4	Reinforcement	576	SF	clean existing reinforcement and coat with anti-corrosion material; drill and install #3 epoxy coated dowels @ 12" oc	$ 18	$10,460
5	Shotcrete	284	CF	install shotcrete; provide smooth trowel finish; chamfer leading edge	$ 162	$46,107
6	Winter Protection	576	SF	blanket insulation if required	$ 12	$7,010
7	Safety & Personal Protective Equipment	1	LS		$ 4,600	$4,600
8	Mobilization, Demobilization & Preparatory Work (not concurrent with Item 1)	1	LS	includes mobilization, scaffolding, Project Manager and Superintendent	$ 30,000	$30,000
9	Canal Floor rehabilitation	950	SF	remove loose material by hydro demolition; apply polymer modified repair mortar; trowel finish	$ 50.00	$47,500
10	Canal Wall Rehabilitation	1140	SF	remove loose material by hydro demolition; apply polymer modified repair mortar; trowel finish	$ 60.00	$68,400
11	Canal Headgate rehabilitation	1560	SF	remove loose material by hydro demolition; apply polymer modified repair mortar; trowel finish	$ 60.00	$93,600
12	Canal North Wall Cap Beam	17.1	CY	install cap beam 18" thick x 24" wide continuous, reinforced, with dowels into existing canal wall	$ 1,200.00	$20,520
					Construction Subtotal	$479,905
	NON-CONSTRUCTION COSTS					
12	Construction Management & Testing				4%	$ 19,196
13	Survey				2.0%	$ 9,598
14	Professional Assistance (legal, audit, and compliance)				2.0%	$ 9,598
15	Reporting				3%	$ 11,998
16	Construction Contingency				30%	$ 143,972
17	NEPA - EA (Habitat, Cultural, Mitigation, USACE Permitting)				5%	$ 21,596
18	Detailed Design Engineering				10%	$ 46,071
					Professional Services Subtotal	$ 262,028
					Total Costs	**$ 742,000**

Assumptions:

1 excavated concrete material will be minimal in volume, and allowed to return to the river

2 work would be done in 10 to 12 days during the typical shut-down time in either October or March

3 Winter Protection includes blanket insulation only; no tenting or heating.

4 Estimate does not include water diversion, coffer dams, water pumping or water control for all work and access.

5 Rehabilitation of the front side of the Headgate Canal was not included in this assessment.

Appendix J

Priority 5 Project (Replace the Radial Gates at the Canal Station 22 Spillway) Information

5 – Spillway Gate Replacement at Station 22

Project Description, Need(s), & Benefits:

The Association and OMID have identified a spillway, located approximately 0.4 miles downstream of the canal headgate at Station 22, as a key safety factor for the operations of the canal. This project aims to replace the radial spillway gates as they are degrading and need attention in order to properly function. Improvements to the gates may also include electric controls and the ability to be used for winter operations.

The canal spillway at Station 22 is the only spillway between the Canal headworks and the Palisade bypass, located approximately 6.5 mile down the canal. The Station 22 spillway is designed to allow the full canal diversions to spill back to the Colorado River should an emergency arise. The spillway is used primarily in the spring and fall to sluice the silt and debris out of the upper portion of the canal before and after the increased irrigation use. The Association usually runs approximately 100 cfs through the canal and spillway during these flushing operations.

In the winter, when the canal is carrying water to the GVPP, the canal headgate and the Roller Dam rollers are typically frozen and not capable of being adjusted. The operation of Station 22 spillway operations is essential to address and mitigate any emergencies within the canal and GVPP operations during these times.

The radial gates need to be replaced in order to keep the Station 22 spillway functional. The frames supporting both radial gates are rusting out requiring the gates to be completely rebuilt or replaced with a more modern design. Each gate is uniquely designed and will require a review of the historical drawings and reissued before a local craftsman can rebuild them. More modern replacement options such as vertical lift gates could be used and will be easier to maintain in the future.

Additional design considerations will also be needed to evaluate options for preventing ice buildup on the gates to make sure they remain operational throughout the winter. Further design is needed to update the crude electric hoists on one radial gate and the hand operated hoist for the other gate. Upgrading the hoists will allow for more accurate and efficient operations of the gates especially during an emergency situation.

Identified Next Steps/Study(ies) & Investigation(s)	1. Develop 20-percent Design 2. SHPO Assessment 3. Secure Funding 4. Final Design 5. Construction	Timing: ☐ Immediate (< 1 year) ☐ Near Term (1-3 years) ☒ Long Term (3 – 10 years)

Permitting Requirements	Agency	Permit(s)	Schedule for Approval
	Bureau of Reclamation	NEPA Compliance (Cultural Assessment)	
	SHPO	USACE	
	USACE	Waters of the US	

Grand Valley Water Users Roller Dam Master Plan Phase 1

Constraints and Challenges	Technical: Design for ice buildup is challenging. Staffing**:** GVWUA and OMID have the available staffing to supervise and manage this project. Legal**:** There are no foreseen legal constraints foreseen in this project.	
Conceptual Costs **-design** **-implementation** **-permitting**	Total project cost is estimated at approximately $160,000, including engineering, materials and installation. Breakdown of the estimated project budget is attached.	
Funding Plan	Funding Sources	Funding Amounts
	GVWUA & OMID Cash	
	GVWUA & OMID Loan	
	State and Federal Grants	
Schedule	Milestone	Date
	Alternatives Assessment Report	
	Preliminary Engineering and Cost Est.	
	Secure Funding	
Potential Project Partners	GVWUA, OMID, The Nature Conservancy, The Colorado River Water Conservation District, Bureau of Reclamation	

Spillway Gate Replacement (Station 22) Cost Estimate

#	ITEM DESCRIPTION	QUANTITY	UNIT	EXPLANATION	$/UNIT	ITEM COST
1	Mobilization, Demobilization & Preparatory Work	1	LS		$ 10,000	$10,000
2	Headgate with Rotork Gearbox and Rotork Actuator	2	EA	Stainless steel slide gate with a skin plate on front and back and rotor actuators	$ 36,332	$72,664
3	Unlisted Items	1	LS	Erosion Control, Dust Control, Safety Ladders, Etc.	$ 18,000	$18,000
					Construction Subtotal	$100,664
	NON-CONSTRUCTION COSTS					
4	Construction Management & Testing				4%	$ 4,027
5	Survey				2%	$ 2,013
6	Professional Assistance (legal, audit, and compliance)				2%	$ 2,013
7	Reporting				3%	$ 2,517
8	Construction Contingency				30%	$ 30,199
9	NEPA - EA (Habitat, Cultural, Mitigation, USACE Permitting)				5%	$ 4,530
10	Detailed Design Engineering (including analysis on spillway capacity)				10%	$ 10,066
					Professional Services Subtotal	$ 55,365
					Total Costs	**$ 160,000**