Assessment Report

Ferron Creek Watershed
Millsite Dam
Emery County, Utah

Natural Resources Conservation Service
Salt Lake City, Utah

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Abstract

The Small Watershed Rehabilitation Amendments, PL 106-472, authorized funding and technical assistance to rehabilitate aging flood control dams built under the USDA Small Watershed Program. Sponsors of these project dams can apply for rehabilitation assistance to extend the service life of their dams 50 to 100 years and ensure that the dams meet applicable safety and performance standards. The policy established by the Natural Resources Conservation Service (NRCS) allows sponsors of dams to request an assessment of their site. This assessment by NRCS will provide the sponsor with information to help them decide if they should pursue the rehabilitation of their aging dam. In March 2003, Mr. Roger Barton, Chairman, San Rafael Soil Conservation District, requested an assessment of the Ferron Watershed Project Millsite Dam. Teams of NRCS and Forest Service specialists completed field assessments of the site on June 25, 2003 and April 13, 2004. NRCS field personnel also conducted additional support work in gathering data for this assessment.

Millsite Dam was built within the Ferron Creek Watershed under the Small Watersheds Program (PL 83-566). The construction of Millsite Dam was completed in 1971. In 2003, the sponsors requested that the NRCS complete an assessment of Millsite dam. The need for this assessment was based primarily on concerns about the adequacy of the original design hydrologic study and, consequently, concern with regard to the safety of the dam. Should the dam fail, occupants of the Town of Ferron, which lies in the breech path of the dam, would be in danger of loss of life as well as loss of or damage to homes, schools, and businesses. Dams with downstream hazards have more stringent design criteria than sites without downstream hazards. Because of the current downstream hazard, Millsite Dam does not meet current safety and performance standards. The sponsors also requested the assessment on the basis of their concern that the reservoir may be losing storage capacity due to sedimentation. This assessment addresses the options available to the sponsors of rehabilitation for Millsite Dam.

The current status of Millsite Dam qualifies for inclusion in the Small Watershed Rehabilitation Amendments, PL 106-472.
Project Map
Plan View of Millsite Dam
Description of Millsite Dam

Millsite dam is a 115-ft. tall earthen embankment with a drainage area of 157 square miles. The permanent pool, or normal pool during non-flood periods, is 435 acres. During major flood events, the pool could enlarge to cover an area of 525 acres. The site has the capability to store 5,800 ac-ft. of sediment and 18,000 ac-ft. irrigation water at the spillway crest elevation. At flood stage, the site can store up to 20,000 ac-ft. of potential floodwater that is then slowly released after the storm event. The principal spillway system consists of a 54-in. diameter welded steel pipe passing through the dam with a concrete intake structure in the pool area of the reservoir. This system controls the release of floodwater. The pipe discharges into a reinforced concrete outlet works. Potential seepage alongside the pipe system is controlled with 25-ft. x 30-ft. concrete anti-seep collars surrounding the principal spillway pipe. Foundation seepage control measures include an 8-ft wide slurry trench, located 220-ft upstream from centerline of dam and a cutoff trench with 30-ft bottom width with 1:1 sideslopes, also upstream from centerline of dam. Embankment seepage control includes a zone fill cross section with a downstream chimney drain.

Brief History and Existing Condition of Millsite Dam

Millsite Dam was designed in 1969 and construction on the site was completed in 1971. The site was designed and constructed as a Class “c” (high) hazard site, meaning there was a high probability of loss-of-life if the dam should fail. The dam was planned and built with flood control being the primary purpose of the structure and with M&I and irrigation water storage for the Town of Ferron and recreational uses as the secondary purposes. It was designed to have a 100-year economic life.

The site has been well maintained with the only visible deterioration being some minor deterioration of metal components in the water control structures associated with the dam.

The 54-in. principal spillway pipe through the dam has been visually inspected and was sandblasted and re-coated to extend the life of the pipe.

Sponsors of Millsite Dam

The original sponsors of Millsite included:

- San Rafael Soil Conservation District
- Ferron Canal and Reservoir Company
- Ferron City
- Emery County Water Conservancy District
- Emery County
- Utah State Department of Fish and Game

Other sponsors may be added during the rehabilitation process if added purposes or uses of the site are desired and the site conditions are suitable.
Existing Beneficiaries

The benefited area for the Millsite Dam is shown on the Project Map. The dam provides flood prevention or reduction benefits on the agricultural, residential, and business areas downstream. Landowners downstream of the dam benefit from the reduction of flooding occurrences, reduced periods of denied access to their property, and reduction in sedimentation of their property. The local and state highway departments and the general public benefit from the reduction of flooding occurrences and potential damage to road and bridge crossings downstream of the dam. The watershed work plan estimated that $19,060 damage reduction benefits accruing to structural measures represent a 60% reduction in flood damages. Millsite Dam also provides recreational benefits such as boating, fishing, hiking, and bird watching.

Sediment Yield Data

The local sponsors have reported that the reservoir of Millsite Dam has been receiving large masses of dark grey to black, fine grained sand and high plasticity clay from the upper areas of the watershed. The sediment volume is reported by sponsors to be about half or greater than half of the total reservoir volume. Based on aerial visual inspection, channel and gully erosion are present in acceptable levels within the upper watershed and are not a significant part of the sediment yield to the reservoir.

There is an area in the north central section of the watershed, known as Black Dragon Creek, that is in a very active mode of landslide activity. Black Dragon Creek subwatershed is probably a primary source of the reported excessive sediment deposits in the reservoir. The rock formation involved in this landslide, the North Horn Shale, is a very unstable geologic formation known to have caused or contributed to multiple major landslides within the state of Utah.

It is possible that an increased volume of sediment is being added to Ferron Creek by the active landslide in the Black Dragon Creek area. Field observations have also identified other tributaries contributing to the reservoir sediment load in Ferron Creek above Millsite Dam. The sediment loading evaluation conducted for this assessment finds that the sediment loading rate and sediment volume is below and, therefore, within the design-level of the 1965 Ferron Watershed Work Plan (FWWP, page 67). The sediment plume is, however, beginning to interfere with the planned recreation uses of the reservoir. Accordingly, sediment removal should be considered in any rehabilitation plan. NRCS recommends that the sponsors take steps to determine the actual sediment load in the reservoir. Should efforts prove successful in retrieving existing data from Bureau of Reclamation databases, no additional sediment study should be necessary. For additional information on sedimentation, see Appendix A.

Hydrology Summary

The dam and reservoir were designed in May, 1969. The hydrologic criteria used for sizing the principal spillway and auxiliary (emergency) spillway do not meet current criteria as outlined for Technical Release 60-Earth Dams and Reservoirs. RB&G Engineering is currently conducting a study to determine the status of the structure with respect to its ability to adequately handle a maximum flow storm event. Preliminary findings indicate that the dam would not function properly were a large-scale storm event to occur. This situation poses a significant risk to lives...
and property within inundation zone downstream from the dam. Consequently, rehabilitation is needed in order to bring the dam up to current standards and to enable the dam to provide adequate protection from flooding.

Hazard Classification

The current hazard classification for Millsite Dam is Class “c” (high) hazard meaning that if the dam should fail for any reason there is a high probability that loss-of-life will occur. The potential losses exist due to the hazards associated with the homes, businesses, and schools that are downstream of the site and within the flood zone if the dam should ever fail. The downstream floodplain is in a slowly developing area. It is probable that other homes will be constructed within the flood zone in the future.

Rehabilitation Needs of Millsite Dam and Eligibility of the Dam for Rehabilitation

Several items need to be addressed in order for Millsite Dam to meet current NRCS criteria associated with a high hazard site and to insure the useful life of the site as stated in the 1965 Work Plan. General rehabilitation work would include:

1. Modify the dam and auxiliary (emergency) spillway to meet the modern criteria required of a Class “c” (high) hazard dam. This may consist of raising the top of the dam, raising and/or widening the auxiliary (emergency) spillway, installing a concrete chute spillway, or a combination of these.
2. Extend the principal spillway pipe system if the dam is raised.
3. Replace some or all of the metal work in the water conveyance system.
4. Sediment removal

Millsite Dam is eligible for the Rehabilitation provisions of the Watershed Program. Funding for rehabilitation is based upon a priority ranking system, which considers the potential for dam failure and the potential consequences of a dam failure. Class “c” (high) hazard dams can have a higher ranking for funding than low hazard dams.

The sponsors of the potential rehabilitation project should be aware that additional landrights might be required for construction. This cost is part of the sponsor’s cost for the project and can be included in their portion of the total project cost. Sponsors are also responsible for any permitting costs or water and resource rights costs, which are not considered part of the total project cost.

The rehabilitation provisions of the PL 106-472 can provide 65% of the total rehabilitation cost, but shall not exceed 100% of the actual construction costs incurred in the rehabilitation. Total rehabilitation cost for the project shall include all costs associated with all components of the project, including acquisition of land, easements, rights-of-way, project administration, non-Federal technical assistance (TA), non-structural measures, contracting, and construction. The cost of TA provided by NRCS shall not be considered part of the total cost of the rehabilitation project. If, however, the sponsor provides or otherwise obtains TA for planning, design, and/or construction, the TA cost is included in the computation of total cost of the rehabilitation project. The sponsor is responsible for the cost of all water, mineral, and other resource rights and all
federal, state, and local permits, which are not considered part of the total cost of the rehabilitation project. The sponsor’s 35% can be in the form of cash, in-kind services, the value of land rights in addition to those acquired for the current project, or any combination of these items.

**Adequacy of O&M for the Dam**

The dam has been well maintained by the owner.

**Planning and Implementation Process**

Should the sponsors make application for rehabilitation of Millsite Dam, the application will go through the conventional watershed planning process with consideration and evaluation of all potential alternatives and their impacts (economically, environmentally, socially, etc.). During the planning process, there will be opportunities for public participation and comment.

The estimated time-frame for the activities are:

- Planning: 1 year
- Design: 1 year
- Implementation: 1 year

This time frame is subject to revision as needed for compliance with provisions of the National Environmental Policy Act (NEPA).

**Potential for Addressing Other Resource Needs**

If rehabilitation is pursued, the sponsors will have the opportunity to investigate the optimization of other purposes for which the dam and reservoir are currently being used, including potentially increasing the amount of storage for municipal and agricultural use. Any costs associated with adding additional M&I water capacity will be provided in their entirety by local sponsors.

**Potential Scope of the Rehabilitation Project**

The following are rehabilitation needs for this site:

1. **Extend the Useful Life of the Structure by upgrading the site to current NRCS criteria for a Class “c” (high) hazard dam by raising the top of the dam.** This alternative would involve some or all of the following actions: Raising the auxiliary (emergency) spillway, providing adequate auxiliary (emergency) spillway capacity, raising the top of the dam, extending the 54-inch steel pipe, upgrading the monitoring system, repairing or replacing metal components of the water conveyance system.
   
   a. Estimated Total Project Cost: $5,600,000.
   b. The costs do not include landrights costs.

2. **Other possible alternatives would include either removal of the dam or removal of the downstream hazards.** Due to the critical use of the reservoir for irrigation water storage and
the economic and social value of downstream developments these alternatives are not considered practical or desirable.

3. **Re-establish the original surface area of the reservoir for recreational and other uses by removal of sediment to an offsite location.** This alternative would entail removal of the upstream sediment to a contained area for permanent storage.
   a. Estimated cost for removal of about 25% of sediment is $2,250,000.
   b. Does not include landrights cost

4. **Re-establish the original surface area of the reservoir for recreational and other uses by relocation of the sediment to a place within the reservoir.** Perform a more detailed sedimentation study of the reservoir and determine the location and depth of the sediment deposit throughout the reservoir. Use as much of previously developed detail data as possible. This item would move the sediment from the upper end of the reservoir to the deep portion of the reservoir near the dam. This work will be possible if the sediment study determines that the sediment loading is significantly within design limits.
   a. Estimated cost for relocation of a 25% of sediment within the reservoir is $800,000.
   b. There are no landrights for this work item.

5. **Install sediment control measures on a portion of the landslide area in Black Dragon Creek.** This would be a series of soil conservation measures including fencepost and wire water spreaders, straight fences, hay bales and other minimally impacting measures. This will entail a search for recent and innovative control measures for landslide areas. These measures will help load sediment on the toe of active slides to slow the movement to the stream channel and trap overland sheet flow of sediments on the landslide areas.
   a. Estimated cost of developing and implementing soil conservation measures on the landslide areas $500,000.
   b. This item will entail coordination with the US Forest Service for appropriate clearances and permit related studies. The studies may increase the costs of this item.

**Rehabilitation of Millsite Dam**

Millsite Dam is eligible for the Rehabilitation Program. In order to pursue the rehabilitation of Millsite Dam, the sponsors must:

Complete a Standard Form 424 “Application for Federal Assistance” with the following information attached to the application:

- Project name,
- Dam number,
- Original Project Authority,
- Dam location (legal description)
- List of the current Sponsoring Local Organizations (SLOs)
- The name(s), address(es), and contact information for the person(s) designated as the contact(s) for each of the SLO(s),
• Year the dam was constructed,
• Description of existing conditions and known rehabilitation needs of the dam,
• Description of current benefits provided by the dam.
• Dam Safety Agency information; permit needs, comments, and recommendations on rehabilitation needs for the specific dam. If the State Dam Safety Agency ordered any action on the dam, attach a copy of the order.
• Statements that the SLO(s) commit to:
  o Assistance in leading a locally-led planning effort,
  o Obtaining the required landrights including the use of power of eminent domain, if necessary,
  o Providing local cost-share funds and/or in-kind services to provide the required 35 percent of the total project costs,
  o Enter into a new Operation and Maintenance (O&M) Agreement with the Natural Resources Conservation Service,
  o Providing funds for continuing O&M actions,
  o Obtaining required permits and approvals at their costs,
  o Providing leadership to assure appropriate land use controls are enacted or acquired for downstream areas prior to construction if a Class “a” (low) or Class “b” (significant) hazard dam is involved, and
  o Providing leadership to assure adequate land treatment measures have been installed on at least 50 percent of the watershed areas above the dam.
• Statement the SLO(s) plan to provide in-kind services and/or acquire landrights will sign a Memorandum of Understanding with NRCS before being credited with the value of any in-kind contribution.

Appendix A: Sediment

The NRCS sediment loading evaluation included the following estimates and observations:
• The bulk of the sediment in question is deposited as a triangular shaped wedge in the upper reaches of the reservoir.
• There is a significant downstream terrace developed lower downstream end of the sediment wedge.
• 5800 acre-feet sediment volume allocation in the reservoir design (FWWP, page 67).
• 157.2 square miles in the drainage area above Millsite Dam (FWWP, page 67).
• 18,000 acre-feet total reservoir storage (FWWP, page 54).
• About 40 feet maximum depth is estimated for the black sediment in the upper reservoir (this estimate is near the maximum depth that the sediment can accumulate (58 feet).
• The length of the deposit is estimated at 2000 feet and the width is estimated as 1000 feet.
• The surface of the deposit is in the shape of an equilateral triangle with a base of 1000 feet and a height of 2000 feet.
• The maximum depth is 40 feet and the average depth for volume calculations is 20 feet.
• The following values of sediment and other items are derived from the above data.
  o Estimated sediment in the upper watershed is 760,000 cubic yards.
  o Estimated current sediment volume in the upper reservoir is 475 acre-feet for 33 years.
  o Sediment storage allotment for design is 5800 acre-feet for 100 years.
The 2004 sediment volume estimate is less than 10% of the allocated sediment volume for 33 years (33% of the 100 year life of the dam) or about 4 times lower than the allocated sediment volume.

The conclusions from this assessment are:
- That the current sediment loading in the upper portion of Millsite reservoir is apparently within design limits; even with the additional sediment deposited downstream from the end of the wedge to the dam.
- The observed sediment mass in the upper area of the reservoir may be more of a visual impact perception problem, less of a water storage problem and actually represent a significant problem of highly decreased useable water surface area.
- It appears that the bulk of the sediment deposited in the 33 years existence of the reservoir has been deposited in the upper end of the reservoir instead of the expected depositional area near the dam.
- The observed mass of sediment is significantly limiting the amount of surface area available for recreation and other uses.

It is recommended that the sedimentation issue be included in the dam rehabilitation effort for this site because the sediment problem is significantly impacting some of the planned uses of the reservoir.

It is recommended that the US Bureau of Reclamation sediment study of the reservoir be completed for planning purposes (this effort will take about 2 weeks to complete).
Pictures of Existing Conditions at Ferron Creek Watershed Millsite Dam