OREGON WATER RESOURCE DEPARTMENT
WATER CONSERVATON, REUSE AND STORAGE
FEASIBILTY STUDY GRANT PROGRAM

I. Grant Information

Study Name: *McMullin Creek Dam and Spillway Analysis*

Type of Feasibility Study: ☐ Water Conservation ☐ Reuse ☒ Above-Ground Storage
☐ Storage Other Than Above-Ground [Including Aquifer Storage and Recovery (ASR)]

Program Funding Dollars Requested: $ $73,000
Note: Request may not exceed $500,000

Total Cost of Feasibility Study: $ $146,000

II. Applicant Information

Applicant Name: ***Charles DeJanvier, County Engineer Josephine County Public Works Department***		**Co-Applicant Name:**	
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	Grants Pass, OR 97527		
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Principle Contact: ***Jeff Bernardo, PE OBEC Consulting Engineers***	
Address:	*920 Country Club Rd. Suite 100B*
	Eugene, OR 97401
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Email:	*jbernardo@obec.com*

Certification:

I certify that this application is a true and accurate representation of the proposed work for a project feasibility study and that I am authorized to sign as the Applicant or Co-Applicant. By the following signature, the Applicant certifies that they are aware of the requirements of an Oregon Water Resources Department grant, have read and agree to all conditions within the sample grant agreement and are prepared to conduct the feasibility study if awarded.

Applicant Signature: [signature] Date: 2-1-2016

Print Name: CHARLES A. DEJANVIER Title: COUNTY ENGINEER

III. Feasibility Study Summary

Please give a brief summary of the feasibility study using no more than 150 words.

Josephine County proposes a feasibility study to evaluate the existing condition of the McMullin Creek Dam. The dam was constructed in 1960-1961 to form Lake Selmac, a popular recreation site in the county park system. Based upon the results of the 2015 Oregon Water Resources Department dam inspection and hazard assessment, the county initiated a hydraulic study to evaluate the dam's performance during high flood events. The feasibility study will evaluate hydraulic design alternatives to upgrade the dam and service spillway to modern standards, and will evaluate the public benefit offered by the recreation area. The result of the feasibility study will be the selection of a preferred alternative for construction.

IV. Grant Specifics

Section A. Common Criteria

Instructions: Please answer all questions contained in this section. It is anticipated that completed applications will result in additional pages.

1. Describe your goal and how this study helps to achieve the goal.

   Josephine County has identified safety and capacity upgrades to the McMullin Creek Dam as a high priority project to maintain the recreational opportunities provided by Lake Selmac. In 2015, The Oregon Water Resources Department (OWRD) upgraded the dam's hazard rating to High, requiring that the County either upgrade the dam's capacity to safely pass the probable maximum flood (PMF) event or to breach the dam altogether. A subsequent hydraulic analysis verified that the existing dam cannot safely pass the PMF and presented the County with design alternatives that would satisfy ORWD safety criteria and ensure that Lake Selmac is preserved for recreational users.

   Josephine County requires additional technical studies in order to select a preferred alternative for project implementation The goal of the proposed feasibility study is to provide the County with all required technical information to select the most practicable and cost effective design alternative. In addition, the County will use the study to evaluate public benefits presently offered by the recreational area as well additional benefits that could be readily implemented to enhance public use of this resource.

   The key components of the feasibility study include a geotechnical evaluation of the dam structure, an evaluation of fish passage triggers for dams, and a historic resource determination. Associated studies to guide the County in the decision process include an assessment of the current public benefits associated with recreation area, an evaluation of local restoration opportunities and a hydrologic study of flows within McMullin Creek. Lastly, the feasibility study will be used to develop a cost estimate for project implementation and identify all local, state and federal permits applicable to construction.

   The following attachments are included in support of this application:

   Attachment 1 - Location Map

   Attachment 2 - McMullin Creek Dam and Spillway Analysis

   Attachment 3- 2015 OWRD Dam Inspection Report

   Attachment 4 - Josephine County Parks Letter of Support

2. Describe the water supply need(s) that the proposed project addresses. Identify any critical local, regional, or statewide water supply needs that implementation of the project associated with the feasibility study will address. **Responses should rely upon solid water availability and needs data/analysis.** For examples of water supply needs see “Criteria and Evaluation Guidance Document.”

   Upgrades to the McMullin Creek Dam proposed by the feasibility study will ensure that water use for recreation is met into the future. Josephine County holds current water rights to operate the McMullin Creek Dam for recreation, and upgrades to the dam are of paramount importance in order to maintain use of the lake and the economic opportunities its provides.

   Lake Selmac is in close proximity to the communities of Selma and Cave Junction, and is easily accessible from the Redwood Highway. The resulting recreational district, with Lake Selmac at its center, is of critical economic importance to Josephine County. Upon its completion in 1961, Lake Selmac was considered one of the first lakes in Oregon to have been built solely for recreation, and it remains the largest lake in Josephine County. Over time, numerous recreational opportunities have been created in the area that are directly associated with the lake. Josephine County operates camping and day-use facilities at Lake Selmac, including *floating fishing docks and boat launching facilities, small restrooms, and related picnic areas. Campgrounds at the lake's western, southern and southeast shores offer additional camping sites. Other public amenities located at the eastern end of the lake are available for group rental and include a baseball field and an 18-hole disk golf course. The privately-owned and operated Lake Selmac Resort on the lake's north shore offers a variety of camping and other services, including a small boat dock, a full-service country store, coin laundry, miniature golf, RV sites, tent camping and boat rentals. The small day-use area at the lake's north end provides public access to the dam and opportunities to view the spillway.*

3. Explain how the proposed project will meet the water supply need(s), and indicate what percentage of that need will be met. (For example: If your water supply need is 20,000 acre-feet of additional water and the project will supply 10,000 additional acre-feet, 50 percent of your need will be met).

Josephine County currently holds all water rights for project needs, and 100 percent of the water supply is met for the proposed project. The proposed project will increase the safety of the McMullin Creek Dam by ensuring there is adequate capacity for the dam to safely pass the probable maximum flood (PMF) event. Proposed modifications to the dam structure are intended to achieve the required safety standards based on the current operation of the reservoir for recreation. The County does not intend to store additional water as a result of proposed upgrades. The intention of the feasibility study is to select a design alternative that would ensure the dam has adequate capacity based on its safety rating.

4. Describe the technical aspects of the feasibility study and why your approach is appropriate for accomplishing the specific study goals and objectives.

Many regulatory and design standards have changed in the 55 years since construction of the McMullin Creek Dam was completed. Over this time, the County has diligently maintained the dam to ensure it remains in good operational condition. However, the scope of the upgrades currently proposed require important technical studies to ensure selection of the preferred alternative is in compliance with modern standards. The feasibility study will perform all necessary technical studies for this purpose.

The geotechnical work will include exploratory drilling and laboratory testing to evaluate the subsurface conditions. Settlement and slope stability analysis will be completed to evaluate the existing and proposed dam configurations for static and seismic conditions. Additionally, Swaisgood analysis will be completed as a secondary performance index to evaluate settlement. The earthquake design parameters will be selected using a deterministic approach utilizing current USGS seismic design tools. Finite-element modeling of the dam will be performed if determined to be necessary based on earlier analyses.

At present, the McMullin Creek Dam is a complete barrier to native migratory fish. Construction of the dam predates Oregon Fish Passage requirements. However, significant alterations to the dam structure may trigger fish passage. The feasibility study would be used to review Oregon Fish Passage Law (OAR 635-412-0005-0040 and ORS 509.580-.910) with respect to dam triggers. This task will require close coordination with ODFW district and statewide fish passage program staff to clarify regulatory requirements for each of the design alternatives.

The study will evaluate seasonally varying flows within McMullin Creek upstream and downstream of the dam to determine existing habitat conditions for native aquatic organisms. This task will involve a hydrologic study of expected exceedance discharges in the stream as well as site visits to evaluate in-stream conditions. As a component of the hydrologic study, a recommendation will be made as to whether in-stream flows are adequate for native migratory fish downstream of the dam. Additional restoration opportunities will be evaluated as a component of the study. This will involve coordination with the local watershed council, soil and water conservation district, and other organizations performing or promoting habitat projects within the McMullin Creek or adjacent basins.

The dam has previously been identified as potentially eligible for listing as a historic resource within the Lake Selmac Recreational District. Alterations to the dam associated with each of the design alternatives will be *evaluated to determine the potential impact, or "effect," the project may have on this resource. In addition, the study will evaluate suitable mitigation opportunities to implement if it is determined the project will adversely affect a historic resource. Mitigation could be used to promote the site's interesting and unique history.*

The County will select the preferred design alternative based upon findings from the above studies. It is anticipated that proposed upgrades to the spillway will be coordinated with replacement of the adjacent Lakeshore Drive (Lake Selmac Spillway) Bridge, which a separately funded project.

5. Describe how the feasibility study will be performed. Include:
    a. General summary statement that describes the study progression.
    b. When the feasibility study will begin.
    c. Listing of key tasks to be accomplished with each task having:
        i. Title
        ii. Timeline for completion
        iii. Description of the activities to be performed in this key task
        iv. Description of the resources necessary for accomplishing the key task

    Example:

    (i) Streamflow measurement;

    (ii) September-April;

    (iii) Weekly streamflow measurements will be performed to gather hydrographic data for the hydrologic analysis to take place in May;

    (iv) A technician will be hired to perform the streamflow measurements.

    (Key tasks listed here are to be placed in Section VI. Project Feasibility Study Schedule for a quick reference "graphical" representation of the schedule.)

a. The study progression has been organized such that tasks requiring the greatest length of time or required for subsequent tasks will be started soon after grant funding is received. Tasks that do not require additional studies in order to be completed will be performed concurrently. The ultimate goal of the feasibility study is to select a preferred design alternative as rapidly as possible. The County hopes to implement the project as early as 2017, depending upon the availability of construction funding.

b. The County is in a favorable position to begin the feasibility study soon after grant funding is awarded. Specialists identified for all key tasks are already familiar with the project area due to previous work on the Lakeshore Drive (Lake Selmac Spillway) Bridge project. It is anticipated that the most critical tasks will begin shortly after grant funding is awarded.

c. Key tasks are listed below and summarized under Section VI.

1(i) Geotechnical analysis of dam embankment

(ii) Geotechnical analysis will be performed first in the study sequence, and it is anticipated to take approximately 2 months to complete testing and reporting. This task is anticipated to be completed within Q3, 2016.

(iii) The geotechnical work will include exploratory drilling and laboratory testing to evaluate the subsurface conditions. Settlement and slope stability analysis will be completed to evaluate the existing and proposed dam configurations for static and seismic conditions. Additionally, Swaisgood analysis will be completed as a secondary performance index to evaluate settlement. The earthquake design parameters will be selected using a deterministic approach utilizing current USGS seismic design tools. Design recommendations will be made based on results of the evaluation.

(iv) It is anticipated that Foundation Engineering Inc., the geotechnical firm utilized during the Lake Selmac Spillway Bridge project, will complete the analysis.

2(i) Evaluation of Fish Passage Requirements

(ii) Analysis and coordintion will be performed during the first month following award of grant funding and will be completed during Q3, 2016.

(iii) Coordination with the Oregon Department of Fish and Wildlife will be performed to determine potential fish passage triggers for each project alternative.

(iv) OBEC Environmental personnel will be utilized to evaluate fish passage triggers. OBEC has performed ODFW coordination on numerous projects in the Rogue District, including successful coordination of a fish passage exemption for the Lake Selmac Spillway Bridge project in 2015. This task is anticipated to be largely a coordination effort, and it is anticipated that one site visit will be required for discussion by project stakeholders.

3(i) Selection of hydraulic design preferred alternative

(ii) The County will select a preferred design alternative following completion of the previous analyses. It is anticipated that this will be completed 2-3 months after funding during Q3 and Q4, 2016.

(iii) The County will evaluate results of the hydraulic, geotechnical and regulatory analyses performed to date. Selection of the preferred alternative will be made based upon which alternative is most economically feasible.

(iv) OBEC will assist the County in this evaluation. It is anticipated that this process will require meetings between OBEC and the County, including meetings at the project location. No additional testing or analyses are anticipated to be required to make this selection.

4(i) Identification and coordination of all federal, state and local permits.

(ii) It is anticipated that this will be completed 2-3 months after funding during Q3, 2016.

(iii) An initial evaluation of permits anticipated to be required has been completed and is presented below. After selection of a preferred alternative, OBEC will evaluate all elements of design and construction to verify the preliminary list.

(iv) OBEC environmental personnel will complete the permit evaluation. OBEC staff regularly performs project scoping, including permit identification for large transportation and structural projects. It is anticipated that this process will require coordination between OBEC and regulatory agencies based upon the information gathered during the study. No additional testing or analyses are anticipated to be required to complete this task.

5(i) Evaluation of restoration opportunities within McMullin Creek and adjacent watershed basins.

(ii) It is anticipated that this will be completed during Q2 and Q3, 2016.

(iii) Funding opportunities for project implementation will require a restoration component. The primary goal of the project is dam safety. Therefore, the County proposes to investigate restoration opportunities within the basin to be completed in conjunction with dam upgrades. Opportunities may consist of stand-alone projects conducted by the County, or partnerships with existing organizations to provide funding to execute already-defined restoration projects.

(iv) OBEC environmental personnel will complete the evaluation of restoration opportunities. This is anticipated to be a task largely requiring coordination between OBEC and local organizations

within Josephine County. A limited number of on-site meetings may be required to discuss project options. No additional resources are anticipated to be required to complete this task.

6(i) Hydrologic evaluation of exceedance flows within McMullin Creek.

(ii) It is anticipated that this will be completed during Q3, 2016.

(iii) An initial evaluation of basin hydrology was completed as a component of the hydraulic analysis performed in December, 2015. Further study is required to characterize existing flows downstream of the dam and to evaluate seasonal varying flows necessary to support native aquatic organisms. A determination will be made as to whether adequate instream flows are presently being met downstream of the dam, and, if not, whether existing County water rights can be diverted for this purpose. This analysis will require desktop research to evaluate monthly exceedance discharges within McMullin Creek as well as on site measurements to evaluate actual stream flows.

(iv) OBEC environmental personnel will complete the hydrologic evaluation. On-site streamflow measurement will be performed by OBEC staff in coordination with Josephine County personnel. No additional resources are anticipated to be required to complete this task.

7(i) Evaluation of historic resources and project effect.

(ii) It is anticipated that this will be completed during Q3, 2016.

(iii) An evaluation of historic resources within the project area was previously completed for the Lake Selmac Spillway Bridge replacement project, presently in design. Based on that evaluation, the dam is known to exist within a historic recreation district that is likely eligible for listing on the National Registry of Historic Places. Any proposed alterations to the dam will likely result in an effect determination to its historic status. This task proposes to fully evaluate the district status of the recreation area, to prepare a Determination of Effect/Finding of Effect for concurrence from the State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (ACHP), and to evaluate potential mitigation opportunities if an adverse effect determination is made. This analysis will require significant desktop and on-site research.

(iv) Heritage Research Associates has worked with OBEC and the County on numerous projects, including the Lake Selmac Spillway Bridge project. Heritage has performed district evaluations as well as effect determinations on dam structures, and is well-qualified to perform this evaluation.

8(i) Project implementation cost estimate.

(ii) It is anticipated that this will be completed during Q3, 2016.

(iii) A cost estimate to construct the preferred alternative will be developed.

(iv) OBEC will perform this task with the County. No additional resources are anticipated to be required to complete this task.

9(i) Public Benefits Analysis

(ii) It is anticipated that this will be completed during Q3, 2016.

(iii) The County intends to apply for an OWRD Implementation Grant. OBEC, on the County's behalf, will research and compile information regarding existing and potential public benefits provided by the lake. It is anticipated that this process will require additional desktop research and site analysis.

(iv) OBEC will perform this task with the County. No additional resources are anticipated to be required to complete this task.

10(i) Project Administration

(ii) It is anticipated that this task will be performed throughout the feasibility study.

(iii) Management and reporting throughout the feasibility study will be required to assist the County.

(iv) OBEC will perform this task with the County. No additional resources are anticipated to be required to complete this task.

6. Please provide the following data and information for the proposed project and the project's sources of water supply:

a. The location of the proposed project. Include the basin, county, township, range and section. Attach a **map** that identifies the project's implementation area to this application.

The McMullin Creek Dam is located in the Illinois Basin (HUC 17100311) in Josephine County, east of the community of Selma, Oregon. The proposed project location is within Township 38 South, Range 7 West, Section 18. Please see the project location maps provided in Attachment 1.

b. The name(s) and river mile(s) of the source water and what they are tributary to, if applicable.

McMullin Creek Dam impounds McMullin Creek forming Lake Selmac. McMullin Creek is the lake's principal source, originating approximately 5.4 miles to the southeast of the dam location within the Siskiyou National Forest. The lake is also fed by Quedo Creek, which originates approximately 2.3 miles to the southwest. The main tributary to McMullin Creek downstream of the dam is Thompson Creek, located approximately 400 feet downstream of the dam. The confluence of McMullin Creek with Deer Creek is approximately 1.5 miles downstream of the dam, and the confluence of Deer Creek with the Illinois River is approximately 7.5 miles downstream of the dam.

c. Whether the project will be off-channel or on-channel (for above-ground storage only).

The existing dam was constructed on-channel. Please see the attached figures showing the dam location, as well as historical topographic and aerial maps of the project area predating the dam.

d. Water availability to meet project storage. For above-ground storage the Department typically evaluates availability using a 50 percent exceedance water availability analysis.

Lake Selmac is an existing reservoir, and Josephine County holds the water right for its current recreational use. No additional water allocations will be required to complete this project. The hydraulic study identified maximum outflows associated with PMF event that would overtop the existing dam embankment, spillway gate, emergency spillway and adjacent areas resulting in inundation of Lakeshore Drive. The goal of project implementation is to increase the water storage capacity of the existing dam to meet safety requirements consistent with its hazard rating. Although the project proposes an increase in capacity, this additional storage is specifically *intended to safely control the PMF flood event. No long-term storage or additional diversion is proposed, and the acquisition of additional water rights will not be sought as a component of this project. Water would only be diverted during high flow events specifically for the purpose of safely passing flows during large precipitation events up to the PMF.*

e. Proposed purposes and/or uses of conserved or stored water.

Lake Selmac is currently used for recreation, and the County has an approved water right to impound water for this purpose. The future use of Lake Selmac for recreation and the associated economic benefit to the region require that the operational capacity of the dam meet all regulatory requirements. The feasibility study will provide Josephine County with all technical information necessary to proceed with implementation of dam upgrades, thereby ensuring the continued use of the lake for recreational purposes.

f. Environmental flow needs and water quality requirements of supply source water bodies.

McMullin Creek Dam impounds the flow of McMullin Creek and Quedo Creek. According to the Oregon DEQ 2012 Water Quality Assessment Database, neither McMullin Creek nor Quedo Creek are listed as water quality limited for pollutants upstream of Lake Selmac. McMullin Creek is water quality limited for aquatic weeds/algae and turbidity within Lake Selmac. However, there are no water quality requirements within or upstream of Lake Selmac, and this project will not result in any deleterious effects to water quality for supply water sources.

McMullin Creek is water-quality limited for temperature and pH downstream of the dam location. Environmental flows are required downstream of the dam for juvenile fish. The feasibility study will be used to evaluate whether existing environmental flows are adequate for aquatic organisms downstream of the dam.

7. What local, state or federal project permitting requirements/issues/approvals do you anticipate in order for the feasibility study to be conducted? If approvals are required, indicate whether you have obtained them. If you have not obtained the necessary permits/governmental approval, describe the steps you have taken to obtain them. If no permits are needed, please provide explanation.

   No state or federal permits are anticipated to be required to complete the feasibility study. The subject dam is owned and operated by the grant applicant, and all required approvals to conduct technical studies will be obtained from the County as needed.

8. Describe the level of involvement, interest and/or commitment of local entities associated with the feasibility study. Describe how the feasibility study and/or proposed project will benefit/impact these entities. Attach letters of support if available.

   The project proponent, Josephine County Public Works, has closely coordinated with OWRD on dam inspections and has proactively initiated a hydraulic analysis of the dam. Public Works has sought technical assistance to evaluate design alternatives and secure funding. The feasibility study is specifically intended to facilitate Public Work's selection of a preferred alternative for project implementation. Matching funding has been secured by Public Works through the County General Fund.

   Josephine County Parks has prioritized the necessary upgrades to the McMullin Creek Dam in order to maintain Lake Selmac as a recreational resource. Attached is a letter of support from the County Parks Director highlighting the lake's benefits and describing its importance to the County.

9. Identify when matching funds will be secured, from whom, and the dates of matching funds availability.

   Matching funds are presently pending for this project from the Josephine County General Fund and will be available on May 1, 2016.

10. Provide a description of the relevant professional qualifications and/or experience of the person(s) that will play key roles in performing the feasibility study. If the personnel have not been decided upon, include a description of the professional qualifications and/or experience of the person(s) you anticipate will play key roles in performing the feasibility study.

    1. Geotechnical Analysis and Report: Foundation Engineering, Inc.

Foundation Engineering, Inc. will complete the geotechnical investigation for the project. Dave Running, PhD, PE, GE will be the lead. He has 19 years of experience completing geotechnical investigations in Oregon. His experience encompasses a wide range of project types including numerous site-specific seismic hazard analyses, dozens of landslide mitigations, and geotechnical explorations for levees, berms and earth dams. Dave will work jointly with Tim Pfeiffer, PE, GE who has 30 years of experience and has completed slope stability and seepage analyses for hundreds of projects, including landslides, levees and dams. Dave and Tim are currently completing the geotechnical investigation for the adjacent bridge over the spillway.

2. Fish Passage Coordination: Andy Burke, OBEC Consulting Engineers

Andy Burke will lead the fish passage coordination. Over the past two years, he has coordinated with ODFW on three projects in the Rogue District. His relationships with ODFW Biologists and Fish Passage staff, and his knowledge of statewide fish passage regulations come from numerous fish passage projects, including recent coordination for a fish passage exemption on the adjacent Lake Selmac Spillway Bridge replacement. He has a BS in Biological and Ecological Engineering and a second BS in Biology. Andy's fisheries experience includes over 120 hours of fish salvage in Oregon, and he has met the NMFS standard for backpack electrofishing in streams with ESA-listed fish species.

3. Conceptual Hydraulic Design: WEST Consultants, Inc.

For several years, WEST Consultants, Inc. has provided dam breach and inundation analyses for the OWRD and bridge hydraulics for ODOT, totaling well over six hydraulics projects within the state. Chris Bahner, PE, DWRE, has more the 22 years of experience in water resources and hydraulic engineering. His areas of technical expertise are hydraulics, hydraulic design, geomorphology, and sediment transport. He has worked on a wide range of projects involving delineation of flood hazard areas, evaluation of potential flooding impacts, design of hydraulic structures, hydrologic and hydraulic engineering design, and hydraulic modeling. Prior to WEST, he worked for the U.S. Army Corps of Engineers (USACE) on several large flood control projects.

4. Permit Identification: Austin Bloom, OBEC Consulting Engineers

Austin Bloom has 15 years of experience leading permit identification, documentation, and coordination. His early research on the adjacent bridge project helped to identify likely required permits, including fish passage approval, Endangered Species Act consultation, and Section 4(f) coordination. His success in leading the environmental permitting efforts on more than 40 state- and federally-funded projects in Oregon speaks strongly to his abilities.

5. Evaluate Restoration Opportunities: OBEC Consulting Engineers

OBEC will work with Josephine County, the Rogue District of the Oregon Department of Fish and Wildlife, the Illinois River Watershed Partnership, the Illinois River Soil and Water Conservation District, and other local natural resource organizations to develop restoration opportunities within the project area. OBEC routinely coordinates with local partner agencies to develop restoration projects.

6. Hydrologic Study: Ben Wewerka, PE, OBEC Consulting Engineers

Ben Wewerka, PE, has 16 years of experience with hydraulic and hydrologic studies and modeling, specifically in the Rogue Valley. He has received specific training in stream stability, scour, streambank restoration, and river engineering and analysis. Ben has employed both conceptual and empirical methods to predict design flow, given properties of the watershed, channels, rainfall, or streamflow, compared with/against statistical analyses of flood frequency and regression. He has performed flow/hydrologic analysis on all of OBEC's major projects in southern Oregon, including more than 10 bridges.

7. Historic Resource Evaluation: Kathryn Toepel, PhD, RPA, Heritage Research Associates, Inc.

Kathryn Toepel, PhD, RPA with HRA, has 35 years of experience in archaeological, cultural, and historic investigations. Since 1980, Kathryn has prepared Section 106 compliance under the National Historic Preservation Act (NHPA), directed cultural resource field investigations, and prepared more than 100 reports concerning archaeology, ethnography, and the history of the Pacific Northwest. She has directed cultural resource investigations for public agencies, overseeing historic and prehistoric surveys and investigations for numerous roadway and bridge projects throughout Oregon.

8. Project Implementation Cost Estimate: Jeff Bernardo, PE, OBEC Consulting Engineers

Jeff has 18 years of experience leading multidiscipline projects in southern Oregon. He uses proven techniques to create accurate cost estimates, routinely coming within the competitive bidding range. His methods include:

- *A comprehensive approach that captures all costs from permitting requirements to project close-out.*
- *Preliminary estimates that include square-foot planning costs and appropriate contingencies.*
- *A comprehensive and detailed breakdown of bid items and quantities, including a QA/QC of the list.*
- *Estimated unit costs based on OBEC's bid history, and verified with ODOT's database of bid prices.*

- *Independent review by field engineers to incorporate market factors that affect pricing.*

9. Public Benefits Analysis: OBEC Consulting Engineers and Josephine County Parks

OBEC will work with Josephine County Parks and other County agencies to quantify the public benefits associated with Lake Selmac. It is anticipated that existing and projected County economic data will be used for this analysis. In addition, OBEC will conduct independent research to evaluate the economic, social, cultural and environmental impacts of the recreation area.

10. Project Administration: Jeff Bernardo, PE, OBEC Consulting Engineers

Jeff has 18 years of experience leading complex projects involving multiple disciplines, agencies, stakeholders, and funding mechanisms/reporting requirements. He has led more than 50 major infrastructure projects, providing project management and scheduling, design oversight, coordination with agencies/stakeholders, and public involvement support. Through his management approach, Jeff's last 12 projects have received public approval, met delivery milestones, and come in at or below budget, all while achieving the project objectives. He has worked with all of the proposed team members and knows how to leverage their varied skills into a cohesive end product that will set the stage for a buildable, feasible construction project.

11. If the project concept is ultimately deemed feasible, describe how the project will be implemented. Response should include a tentative funding plan for project implementation (e.g. other state or federally sponsored grant or loan programs) and the project proponent's track record in implementing similar projects.

Josephine County intends to seek funding through the OWRD Water Supply Development Account (SB 839) for implementation of the preferred design alternative. Over the past 4 years, some of the federally funded transportation projects the County has successfully implemented include the following:

Lakeshore Drive (Lake Selmac Spillway) Bridge Replacement (in progress)

Slate Creek Road (Slate Creek) Bridge Replacement (2015)

Lakeshore Drive (Deer Creek) Bridge Replacement (2015)

Woodcock Creek Bridge Rehabilitation (2015)

Lower Sucker Creek (Holland Loop Road) Bridge Replacement (2013)

Munger Creek (Davidson Road) Bridge Replacement (2012)

Section B. Unique Criteria

Instructions: Address the set of items below that applies to the type of feasibility study that this grant will fund.

☐ Water Conservation or ☐ Reuse

1. Water Conservation or Reuse projects that are identified by the Department in a statewide water assessment and inventory receive a preference in the scoring process. Contact the Department's Grant Specialist to include your project on the inventory.

2. Explain how the associated project will either: (a) mitigate the need to develop new water supplies and/or (b) use water more efficiently. Reference documentation and/or examples of the success of similar or comparable water conservation/reuse projects that would be available upon request.

3. Provide a description of: (a) Local, state and/or federal permitting requirements and issues posed by the **implementation** of the project associated with the feasibility study and (b) property ownership status within the project implementation area. If permitting or other approvals are not needed please indicate and provide an explanation.

☒ Above-Ground Storage

Please answer the following three questions **BEFORE** proceeding:

Will the project divert more than 500 acre-feet of surface water annually?	☐ Yes ☒ No
Will the project impound surface water on a perennial stream?	☒ Yes ☐ No
Will the project divert water from a stream that supports sensitive, threatened or endangered species?	☒ Yes ☐ No

If you answered "Yes" to any of these questions, by signature on this application, you are committing to include the following required elements in your feasibility study.

Describe how you intend to address the required elements in your feasibility study:

a) Analyses of by-pass, optimum peak, flushing and other ecological flows of the affected stream and the impact of the storage project on those flows.

OBEC will conduct a hydrologic analysis of seasonally varying flows within McMullin Creek downstream of the dam. Regression analysis of similar basins with published exceedance data will be used to provide an estimate of flows within McMullin Creek. These will be compared to on-site estimates of actual flows within the stream. Differences between calculated and measured flows will be evaluated to determine whether downstream flows are sufficient for the species and life stages of native aquatic organisms anticipated to be present. OBEC has coordinated with ODFW on native migratory species likely to be present in McMullin Creek.

b) Comparative analyses of alternative means of supplying water, including but not limited to the costs and benefits of water conservation and efficiency alternatives and the extent to which long-term water supply needs may be met using those alternatives.

Josephine County holds an existing water right to impound water in Lake Selmac for recreation. No additional water rights will be required to for project implementation, and no alternative means for supplying water were analysed.

c) Analyses of environmental harm or impacts from the proposed storage project.

The proposed project will perform necessary upgrades to an existing dam. A preliminary evaluation of environmental resources indicates that there are species listed under the Endangered Species Act (ESA) in proximity to the project area.

According to StreamNet Maps and GIS data, Deer Creek provides spawning and rearing habitat for Southern Oregon/Northern California Coast (SONCC) coho salmon (ESA-listed threatened species). Due to its proximity to Deer Creek and the apparent lack of passage barriers downstream of the project area, it is assumed that McMullin Creek also supports coho. Based on communication with Peter Samarin, Oregon Department of Fish And Wildlife District Biologist for the Rogue District, several species of native migratory fish inhabit McMullin Creek in addition to coho salmon, including winter steelhead, coastal cutthroat trout, and Pacific lamprey. McMullin Creek is designated Essential Salmonid Habitat by the Oregon Department of State Lands (DSL). In addition, the project area is designated as Essential Fish Habitat (EFH) and critical habitat for coho listed by the National Marine Fisheries Service (NMFS). Project activites are anticipated to have minimal temporary impacts on McMullin Creek, mostly associated with temporary water management during construction. There are no listed aquatic species or critical habitat in Lake Selmac. Potential impacts to coho and their critical habitat are anticipated to be covered under a NMFS Programmatic Biological Opinion, if needed.

Cook's lomatium (US Fish and Wildlife Service ESA-listed endangered species) is known to occur in 3 miles southwest of the dam location within the Illinois River Valley. The project area was most recently assessed on April 13, 2015 in conjunction with the adjacent bridge project. The reconnaissance was conducted during the known flowering season for Cook's lomatium (mid-March through Mid-May). The project area, including the full length of the dam embankment, was thoroughly surveyed and Cook's lomatium was not observed. No other USFWS or NMFS-listed species are identifed or likely to occur in the project area, and the proposed project is anticipated to have no effect on USFWS-listed species.

All necessary permit approvals and environmental clearances will be obtained early in the project design phase, as needed.

d) Evaluation of the need for and feasibility of using stored water to augment instream flows to conserve, maintain and enhance aquatic life, fish life and any other ecological values.

Josephine County currently holds a water right to provide instream flows downstream of the dam to maintain aquatic life. However, this water right is junior to the right held by the County to impound water for recreational use. As a component of the feasibility study, OBEC will conduct a hydrologic study of McMullin Creek to determine whether existing downstream flows are meeting the needs of aquatic organisms. The existing spillway radial tainter gate cannot release water once the elevation within the *reservoir drops below the spillway crest. The proposed design will incorporate either an Obermeyer gate or a mid-level relief conduit to provide the ability to reduce the water level in the reservoir more efficiently. If results of the hydrologic study show that downstream flows during summer months are insufficient for aquatic organisms, and if it is determined to be feasible with existing water rights, the reconstructed spillway will provide the County with the ability to augment flows for ecological purposes .*

Is the proposed storage project for municipal use?

☐ Yes ☒ No

If "Yes," then please describe how you intend to address the following required element in your feasibility study:

e) For a proposed storage project that is for municipal use, analysis of local and regional water demand and the proposed storage project's relationship to existing and planned water supply projects.

NA

Proceed in addressing the following items:

1. Describe to what extent the project associated with the feasibility study includes provisions for using stored water to augment instream flows to conserve, maintain and enhance aquatic life, fish life or other ecological values. Projects that include the above provisions receive preference in the scoring process.

   At present, Josephine County holds a water right to release flows for the benefit of instream aquatic organisms. The reservoir level is closely monitored by County personnel and the release of water downstream is strongly correlated to inputs by source water bodies during precipitation events. The feasibility study will evaluate seasonally varying flows within McMullin Creek as well as the potential for the County to utilize some of their exsiting water right allocation for environmental flows.

2. Provide a review of: (a) Local, state and/or federal permitting requirements and issues posed by the **implementation** of the project associated with the feasibility study and (b) property ownership status within the project implementation area.

   A preliminary assessment of permitting requirements for project implementation indicates that the following local, state and federal permits will be required:

   1. Josephine County Development Permit
   2. NMFS Programmatic Biological Opinion (SLOPES STU)
   3. Oregon Department of State Lands Individual or General Permit Authorization
   4. U.S. Army Corps of Engineers Section 404 Permit Authorization
   5. Oregon Department of Fish and Wildlife Fish Passage Approval
   6. Section 106 Letter of Concurrence
   7. Section 4(f) Letter of Concurrence

☐ Storage Other Than Above-Ground [Including Aquifer Storage and Recovery (ASR)]

Please answer the following three questions **BEFORE** proceeding:

Will the project divert more than 500 acre-feet of surface water annually?	☐ Yes ☐ No
Will the project impound surface water on a perennial stream?	☐ Yes ☐ No
Will the project divert water from a stream that supports sensitive, threatened or endangered species?	☐ Yes ☐ No

If you answered "Yes" to any of these questions, by signature on this application, you are committing to include the following required elements in your feasibility *study.*

Describe how you intend to address the required elements in your feasibility study:

a) Analyses of by-pass, optimum peak, flushing and other ecological flows of the affected stream and the impact of the storage project on those flows.

b) Comparative analyses of alternative means of supplying water, including but not limited to the costs and benefits of water conservation and efficiency alternatives and the extent to which long-term water supply needs may be met using those alternatives.

c) Analyses of environmental harm or impacts from the proposed storage project.

d) Evaluation of the need for and feasibility of using stored water to augment instream flows to conserve, maintain and enhance aquatic life, fish life and any other ecological values.

Is the proposed storage project for municipal use?

☐ Yes ☐ No

If "Yes," then please describe how you intend to address the following required element in your feasibility study:

e) For a proposed storage project that is for municipal use, analysis of local and regional water demand and the proposed storage project's relationship to existing and planned water supply projects.

Proceed in addressing the following items:

1. Underground storage projects that are identified by the Department in a statewide water assessment and inventory receive a preference in the scoring process. Contact the Department's Grant Specialist to include your project on the inventory.

2. Provide a review of: (a) Local, state and/or federal permitting requirements and issues posed by the **implementation** of the project associated with the feasibility study and (b) property ownership status within the project implementation area.

V. Match Funding Information

Applicants must demonstrate a minimum dollar-for-dollar match based on the total funding request. The match may include a) secured funding commitment from other sources, b) pending funding commitment from other sources, and/or c) the value of in-kind labor, equipment rental, and materials essential to the feasibility study. For secured funding, you must attach a letter of support from the match funding source that specifically mentions the dollar amount shown in the "Amount/Dollar Value" column. For pending resources, documentation showing a request for the matching funds must accompany the application.

In the "type" column below matching funds may include:	In the "status" column below matching funds may have the following status:
• **Cash -** Cash is direct expenditures made in support of the feasibility study by the applicant or partner*.	• **Secured -** Secured funding commitments from other sources.
• **In-Kind -** The value of in-kind labor, equipment rental and materials essential to the feasibility study provided by the applicant or partner.	• **Pending -** Pending commitments of funding from other sources. In such instances, Department funding will not be released prior to securing a commitment of the funds from other sources. Pending commitments of the funding must be secured within 12 months from the date of the award.

*"Partner" means a non-governmental or governmental person or entity that has committed funding, expertise, materials, labor, or other assistance to a proposed project planning study. OAR 690-600-0010.

Match Funding Source (if in-kind, briefly describe the nature of the contribution)	**Type** (✓ One)	**Status** (✓ One)	**Amount/ Dollar Value**	**Date Match Funds Available** *(Month/Year)*
Josephine County General Funds	☒ cash ☐ in-kind	☐ secured ☒ pending	*$73,000*	*5/1/2016*
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		
	☐ cash ☐ in-kind	☐ secured ☐ pending		

VI. Feasibility Study Schedule

Estimated Study Duration: June, 2016 to December, 2016

Place an "X" in the appropriate column to indicate when each Key Task of the project will take place.

	2016			2017				2018 & Beyond
Feasibility Study Key Tasks	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	
1. Geotechnical Analysis and Report		X						
2. Fish Passage Coordination		X						
3. Conceptual Hydraulic Design		X						
4. Permit Identification		X						
5. Evaluate Restoration Opportunities		X						
6. Hydrologic Study		X	X					
7. Historic Resource Evaluation		X	X					
8. Project Implementation Cost Estimate		X						
9. Public Benefits Analysis		X	X					
10. Project Administration		X	X					

- **Please Note**: Successful grantees must include all invoices and identify which key tasks are associated with each invoice when requesting financial reimbursement.

VII. Feasibility Study Budget

Section A

Please provide an estimated line item budget for the proposed feasibility study. Examples would include: labor, materials, equipment, contractual services and administrative costs.

Line Items	**Number of Units*** *(e.g. # of Hours)*	**Unit Cost** *(e.g. hourly rate)*	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
Staff Salary/Benefits						
Contractual/Consulting	*973 Hours*	*$150.00*	*$0*	*$73,000*	*$73,000*	*$146,000*
Equipment (must be approved)						
Supplies						
Other:						
Administrative Costs**						
		Total for Section A				*$146,000*
		Percentage for Section A				***100%***

** Note: The "Unit" should be per "hour" or "day" – not per "project" or "contract."* *Units x Unit Costs = Total Cost*
*** Administrative Costs may not exceed 10 percent of the total funding requested from the Department*

Section B

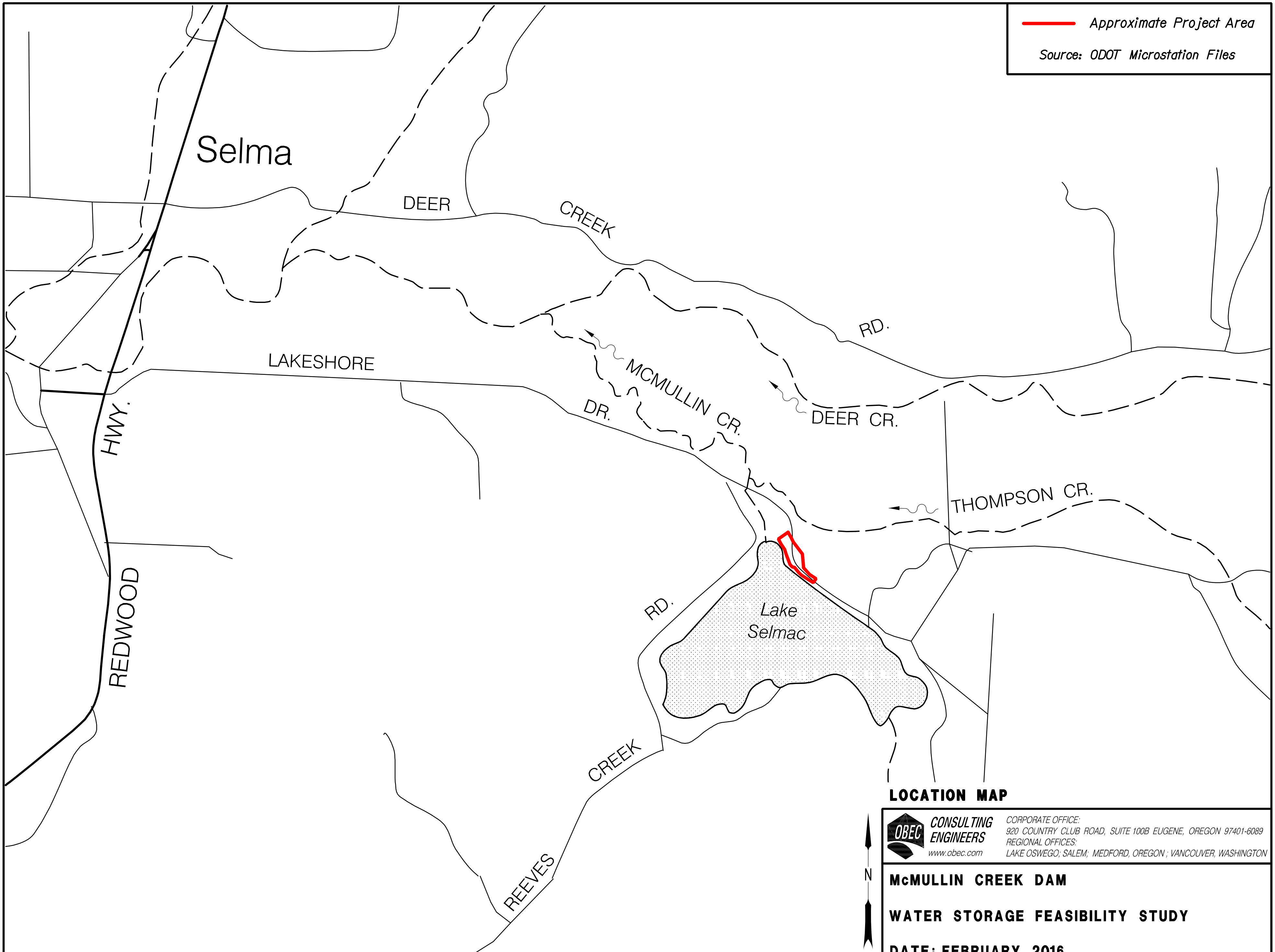
If grant amount requested is $50,000 or greater, you MUST complete Section B. Key Tasks in Section B should be the same as the Key Tasks in Section VI (Feasibility Study Schedule).

Feasibility Study Key Tasks	**In-Kind Match**	**Cash Match Funds**	**OWRD Grant Funds**	**Total Cost**
1. Geotechnical Analysis and Report				*$60,000*
2. Fish Passage Coordination				*$7,000*
3. Conceptual Hydraulic Design				*$25,000*
4. Permit Identification				*$1,000*
5. Evaluate Restoration Opportunities				*$10,000*
6. Hydrologic Study				*$7,500*
7. Historic Resource Evaluation				*$10,000*
8. Project Implementation Cost Estimate				*$4,000*
9. Public Benefits Analysis				*$15,000*
10. Project Administration				*$6,500*
Total for Section B				*$146,000*

Totals in Section B must match the totals in Section A

<u>ATTACHMENT 1</u>

PROJECT LOCATION MAPS



LOCATION MAP

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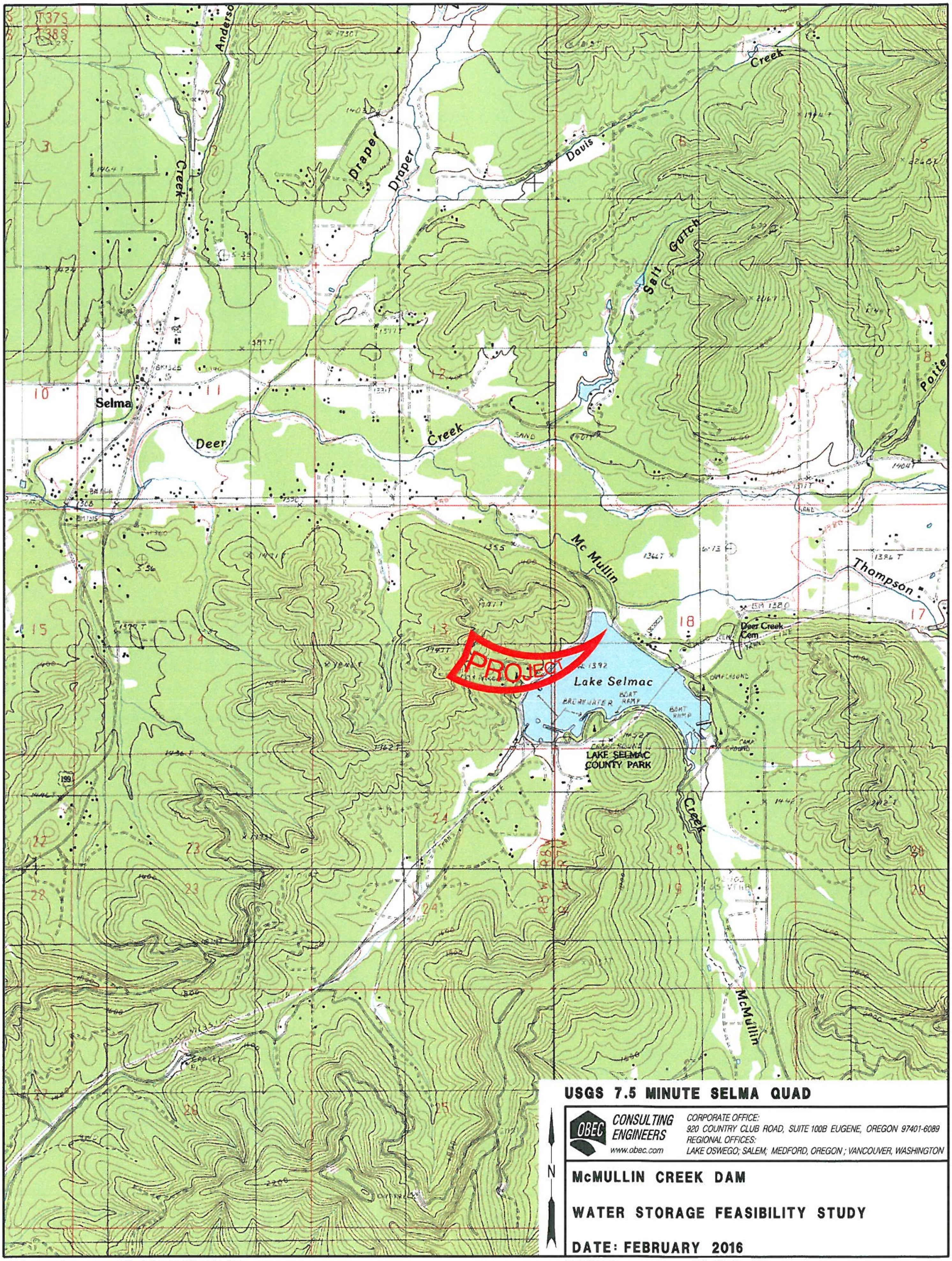
REGIONAL OFFICES:
LAKE OSWEGO; SALEM; MEDFORD, OREGON ; VANCOUVER, WASHINGTON

McMULLIN CREEK DAM

WATER STORAGE FEASIBILITY STUDY

DATE: FEBRUARY 2016



USGS 7.5 MINUTE SELMA QUAD

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McMULLIN CREEK DAM

WATER STORAGE FEASIBILITY STUDY

DATE: FEBRUARY 2016

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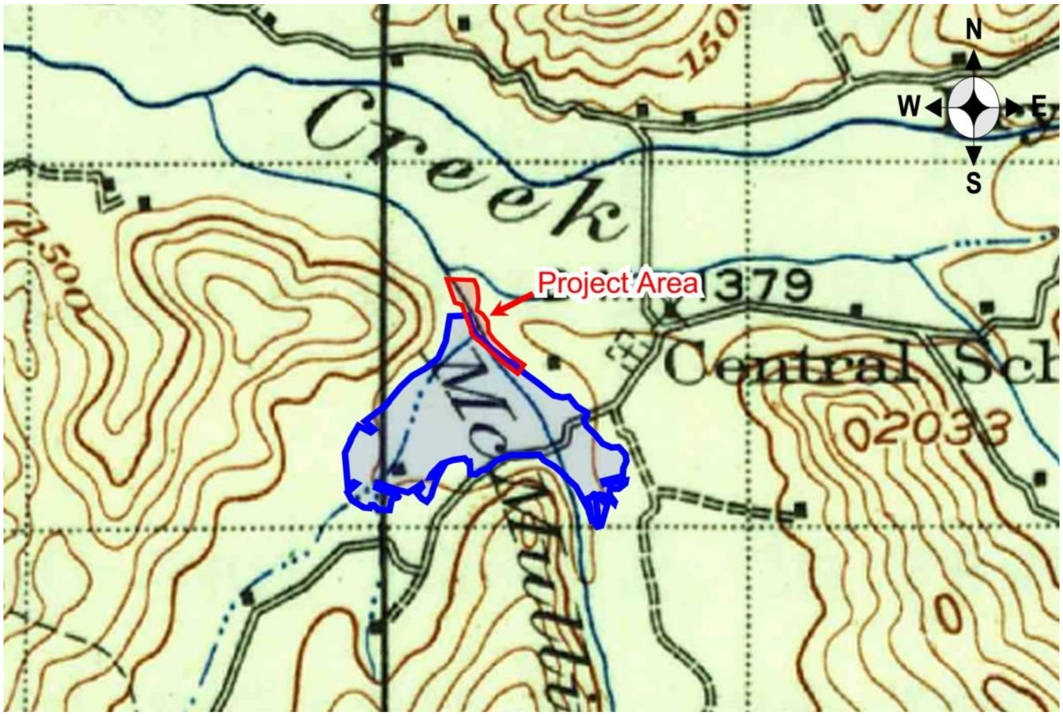
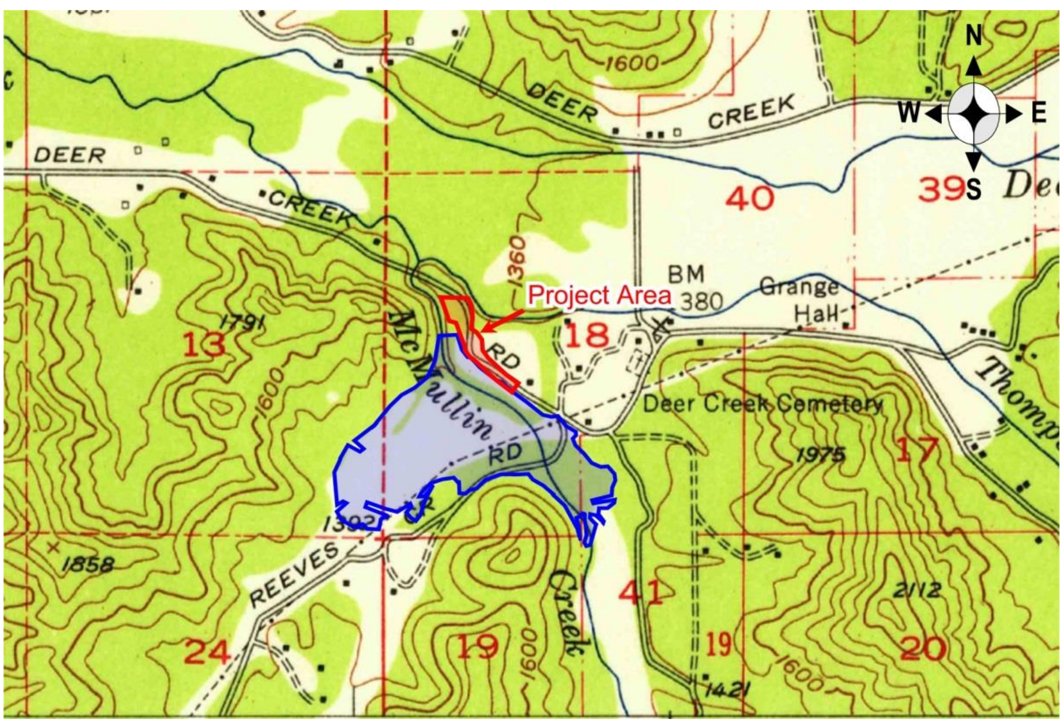
Historical topographic maps developed for the adjacent Lakeshore Drive Bridge Project.

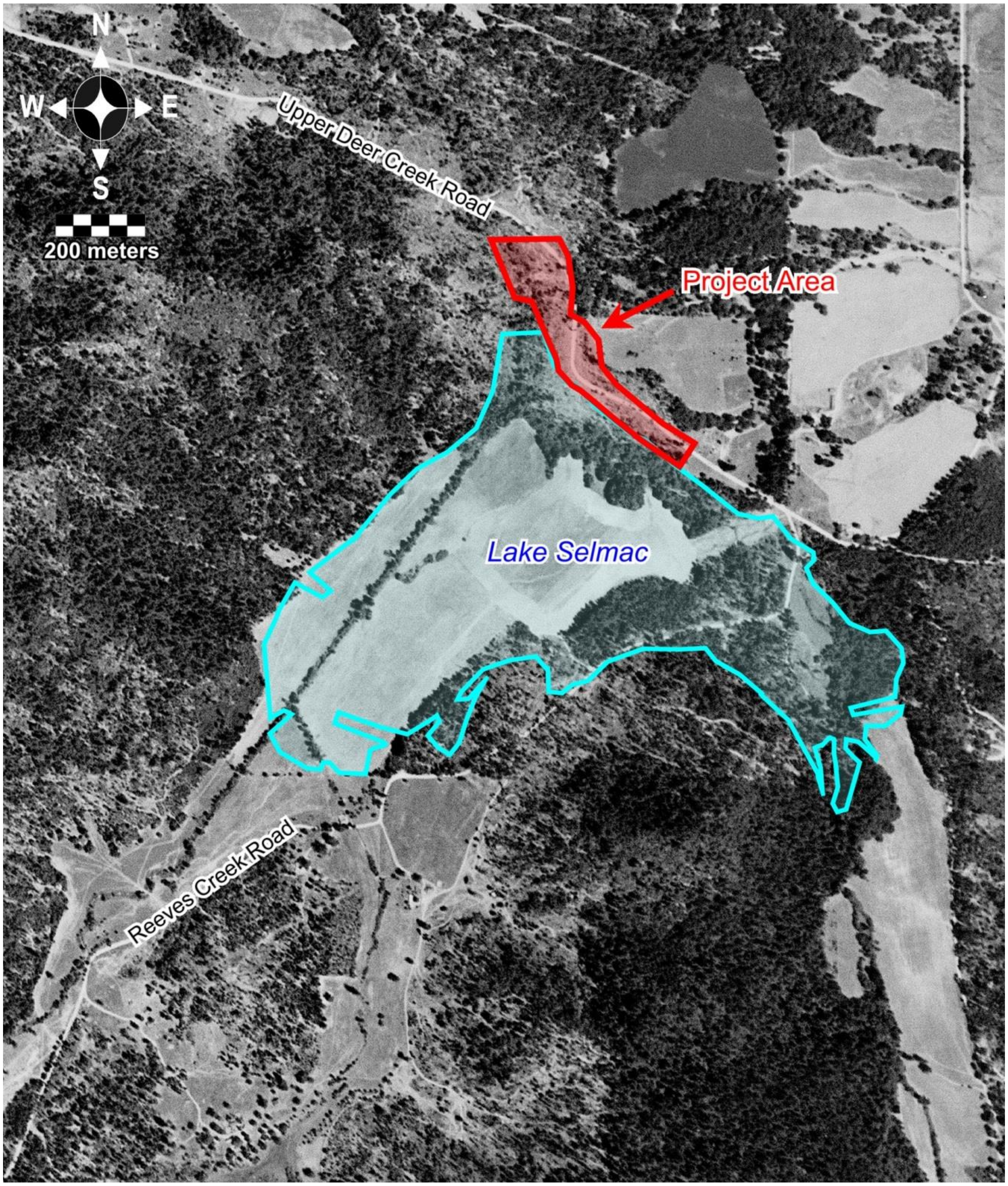


Location of the project area and Lake Selmac on the 1917 USGS Kerby, Oregon 30´ quadrangle (enlarged to 1.9 inches = 1 mile).



Location of the project area and Lake Selmac on the 1954 USGS Kerby, Oregon 15´ quadrangle (enlarged to 1.9 inches = 1 mile).

Historical aerial image of the dam location developed for the adjacent bridge replacement project.



Location of the project area and Lake Selmac on a 1952 USGS aerial photograph, showing the original alignments of Upper Deer Creek (now Lakeshore Drive) and Reeves Creek roads.

ATTACHMENT 2

MCMULLIN CREEK DAM AND SPILLWAY ANALYSIS

McMullen Creek Dam and Spillway Analysis

Prepared by
WEST Consultants, Inc.
2601 25th Street SE
Suite 450
Salem, OR 97302

January 4, 2016

WEST
Consultants, Inc.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

List of Abbreviations

AEP.......................................Annual Exceedance Probability
AMC ....Antecedent Moisture Conditions
CN...Curve Number
DOGAMI ....Department of Geology and Mineral Industries
GIS ....Geographic Information System
GPS ....Global Positioning System
HEC ....Hydrologic Engineering Center
HEC-HMS ....Hydrologic Modeling System
HEC-RAS ....River Analysis System
HEC-SSP ....Statistical Software Package
HMR ....Hydrometeorological Report
LiDAR...................................Light Detection and Ranging
NAD......................................North American Datum
NAVD ....North American Vertical Datum of 1988
NCDC ....National Climatic Data Center
NGVD...................................National Geodetic Vertical Datum of 1929
NOAA...................................National Oceanic and Atmospheric Administration
NRCS ....Natural Resources Conservation Service
NWS ....National Weather Service
OCRS ....Oregon Coordinate Reference System
ODOT ....Oregon Department of Transportation
OWRD ....Oregon Water Resource Department
PMF ....Probable Maximum Flood
PMP ....Probable Maximum Precipitation
RM ....River Mile
SCS ....Soils Conservation Service
USACE .................................U.S. Army Corps of Engineers
USGS ....................................U.S. Geological Survey
WEST....................................WEST Consultants, Inc.

1 Introduction

1.1 Purpose

McMullen Creek Dam forms Lake Selmac in Josephine County, Oregon. The existing dam was built in 1960 and is operated by the Josephine County Parks Department. Lake Selmac is used mainly for recreational purpose. The outlet channel from the McMullen Creek Dam service spillway and emergency spillway is crossed by Lakeshore Drive. Replacement of the Lakeshore Drive Bridge is required. Various deficiencies in the existing dam, dam outlet works and dam spillways have been identified by the State of Oregon Water Resources Department (OWRD). Necessary improvements to the dam and appurtenant structures include:

- Development of a plan to restore the dam crest height reduced by settlement, erosion or other factors
- Abandonment of an existing inoperable low level outlet through the dam
- Design of a mid-level outlet structure through the dam
- Design of a Probable Maximum Flood (PMF) capable spillway, due to an expected future High Hazard dam designation.
- Design of new surfacing for the emergency spillway outlet channel.

The required dam improvement design must be integrated with the bridge replacement design. It is understood that the proposed replacement bridge may be overtopped by the PMF or other lower frequency events; however, the bridge replacement design cannot adversely impact the performance of the spillway(s) or reduce the required freeboard between the maximum reservoir pool PMF elevation and the dam crest.

This report documents the hydrologic and hydraulic analysis, evaluations and designs that were conducted to define the requirements for the necessary dam safety improvements to McMullen Creek Dam.

1.2 Field Reconnaissance

A field reconnaissance of the study area was conducted by Chris Bahner, P.E., of WEST Consultants (WEST) on 14 August 2014. The site visit was conducted to become familiar with the physical conditions of the area to be modeled. A photo log from the field reconnaissance is provided in Appendix A of this report. Observations noted during the visit are summarized as follows:

- The emergency spillway is in poor condition (Photos 3 through 5).
- A minor leak from the radial gate was observed (Photo 7)
- Stability issues with service spillway walls immediately upstream of Lakeshore Drive bridge (Photo 8)
- There are signs of wave erosion of the embankment (Photo 11)
- There is about a six foot drop downstream of the service spillway channel (Photos 13 and 15)
- Bedrock material exists underneath the service spillway channel at the downstream end of the channel (Photo 16)

1.3 Study Area Description

A location map of the study area is provided as Figure 1-1. McMullen Creek Dam is located on McMullen Creek within Josephine County, Oregon. The dam was constructed in the 1960's. It is an earth filled dam that has a maximum height of about 30 feet, a length of about 760 feet, and an average crest elevation of about 1399.8 feet NAVD88 (minimum crest elevation of 1398.67 feet NAVD88). The service spillway structure is located on the northeast side of the dam (Figure 1-2). It consists of a concrete lined channel that is about 20 feet wide and controlled by a 6 foot high radial gate. The inlet elevation of the spillway channel is at about 1389.64 feet NAVD88 and the top of gate elevation is at about 1395.64 feet NAVD88. The spillway walls are at the same elevation at the top of gate for a distance of about 20 feet downstream of the gates. At about 35 feet downstream of the gate, the spillway channel drops at a steep slope of about 38 percent for a distance of about 73 feet. There is a relative short stilling basin (about 14.5 feet long) at the end of the steep slope. The stilling basin has two rows of baffle blocks and an end sill that are all about 2 feet high. The width of the service spillway outlet channel transitions from 20 feet to 24 feet through the stilling basin. The 24-foot-wide channel extends through the Lakeshore Drive bridge at a flat slope. An approximate 6-foot drop exists at the downstream end of the outlet channel.

The emergency spillway is located east of the service spillway. It consists of a broad crested weir that has a width of about 90 feet, a minimum crest elevation of about 1396.34 feet, and a trapezoidal cross section. It is a side channel type spillway. The water overtopping the spillway is conveyed in a channel back to the service spillway channel just upstream of the Lakeshore Drive bridge.

The drainage basin for the McMullen Creek Dam has a total area of about 13.5 square miles (Figure 1-1). The basin is bounded on all sides by the Klamath mountain range. McMullen Creek flows from south to north. The average annual precipitation over the watershed is about 44 inches (NRCS, 1998).

1.4 Report Organization

This report is organized into five chapters. Chapter 1 provides introductory and background information. Chapter 2 provides information related to the hydrology analysis. Chapter 3 provides information about the hydraulic analysis and spillway alternative analysis. Chapter 4 provides a summary of the study. Finally, Chapter 5 documents the references cited in this study.

1.5 Datums

All geographic and spatial data used in this study were adjusted to a horizontal datum of the NAD 1983 Oregon Coordinate Reference System (OCRS), Grants Pass-Ashland. A vertical datum of North American Vertical Datum of 1988 (NAVD88), and International Feet units was usesd.

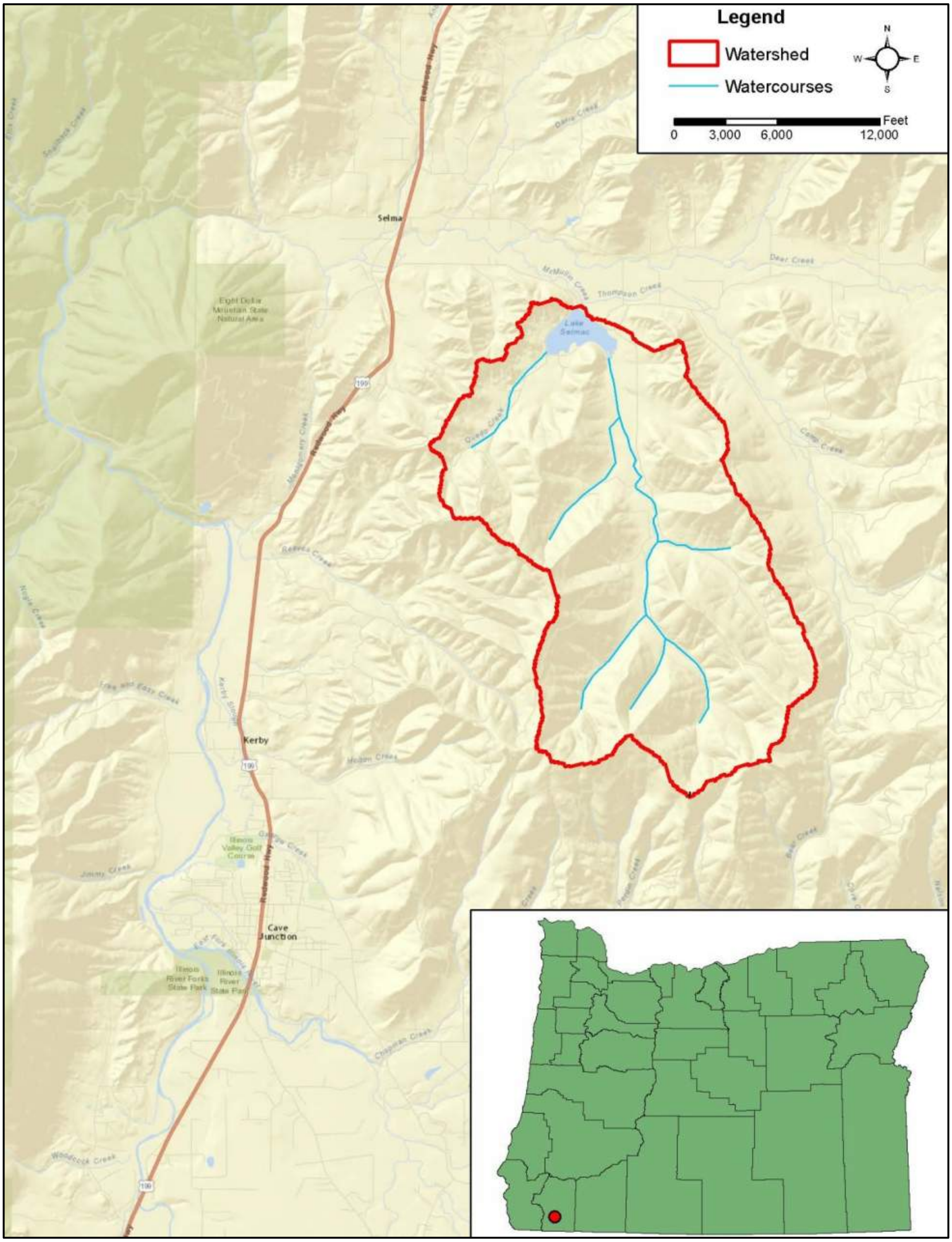


Figure 1-1. McMullen Creek Dam location and watershed map

Figure 1-2. McMullen Creek Dam spillway configuration

1.6 Acknowledgements

Chris Bahner, P.E. was the WEST Consultants, Inc. (WEST) project manager for this study. He developed the hydrologic and hydraulic modeling for the study and wrote the majority of this report. Kevin Denn, P.E. assisted in the development of the models and spillway analysis alternatives. Thomas Grindeland, P.E. provided quality control review.

2 Hydrology

2.1 Introduction

McMullen Creek Dam is classified as a high hazard structure by the OWRD Safety Program. Due to this classification, the Inflow Design Flow for this structure is the Probable Maximum Flood (PMF) event. The PMF is the flood associated with the Probable Maximum Precipitation (PMP), which is theoretically the greatest depth of precipitation for a given duration that is physically possible over a given area at a particular geographic location at a certain time of year. For this project, the PMP was derived using the methodology presented in National Weather Service (NWS) Hydrometeorological Report Number 57 (HMR 57), "Probable Maximum Precipitation – Pacific Northwest States." (U.S. Department of Commerce, 1994).

The replacement of Lakeshore Drive Bridge, immediately downstream of the dam, requires estimation of peak discharge associated with the 1% and 0.2% annual exceedance probability (AEP) flood events. Therefore, the hydrologic analysis conducted for this study included developing McMullen Creek Dam inflow hydrographs for the 1% and 0.2% AEP and PMF flood events. The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) computer program was used to develop a hydrologic model for the contributing watershed area. HEC-HMS (USACE, 2015) is a rainfall-runoff model developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. No precipitation or streamflow gages exist within the watershed, so the HEC-HMS model was calibrated using data for stream gages within the vicinity of the McMullen Creek watershed. The hydrographs from the calibrated HEC-HMA model were used as inflow to a HEC-RAS model of the reservoir and outlet channel used to estimate the discharge released by the dam. Information about the development of the HEC-HMS model is provided in the remainder of this chapter.

2.2 Hydrologic Model Development

The data requirements of the HEC-HMS model include:

- Precipitation – defines both the total volume of water that falls on a basin and the distribution of the rainfall amount through time.
- Loss Rate – determines how much of the precipitation volume is lost (for example, going to groundwater, ponding in local depressions, intercepted by vegetation). The precipitation amount remaining after losses are subtracted is free to flow to watercourses or storage areas and is called direct runoff.
- Runoff Transform – determines how the direct runoff volume for a given period of time is transformed into a hydrograph, i.e., flow over time.
- Channel Routing – determines how a flow hydrograph at one point in a watershed is transformed as it moves downstream to another point of interest in the basin.

The HEC-HMS model developed as part of this study is provided on the DVD located in Appendix C.

2.2.1 Precipitation

Four hydrologic events were considered for the present study: (1) 1% AEP (formerly referred to as the 100-year event), (2) 0.2% AEP (formerly referred to as the 500-year event), (3) General PMP, and (4) Local PMP. Since runoff volume is a key consideration in analyzing reservoirs, storm durations of 24, 48, and 72 hours were evaluated for each hydrologic event.

The 1% and 0.2% AEP events were derived using the latest precipitation-frequency relationships for Oregon (ODOT, 2008). The temporal distribution of rainfall used was based on the distribution documented in NOAA Atlas 14 (NOAA, 2014). The General and Local PMP magnitude and temporal distributions were defined using the methodology outlined in HMR 57 (NWS, 1994). The total precipitation amount for each event and duration considered is summarized in Table 2-1.

Table 2-1. Summary of Precipitation Amounts

	Precipitation Depth per AEP (in.)		Probable Maximum Precipitation Depth (in)	
Duration	1%	0.2%	Local	General
6 hour	-	-	6.1	-
24 hour	8.0	10.0	-	17.9
48 hour	14.0	14.0	-	26.7
72 hour	16.1	19.7	-	31.7

PMP values were compared with the 1% AEP rainfall values as a general check for reasonableness. The ratio of the 10-square mile 24-hour PMP to 24-hour 1% AEP rainfall amounts is generally expected to range between two and four, with values as low as 1.7 and as high as 5.5 found in HMRs 57 (NWS, 1994). As mentioned in HMR 57 (NWS, 1994), lower ratio values are anticipated where general storm, long duration precipitation is prevalent. This should be the case for McMullen Creek Dam. The ratio of the PMP to the 1% AEP rainfall for the 24 hour duration was calculated to be 2.2, which is reasonable for the site.

2.2.2 Loss Rate Method

The Soil Conservation Service (SCS) Curve Number (CN) loss method was used to define excess rainfall as a function of total precipitation, soil type, land cover, land use, and antecedent moisture condition. The initial weighted average CN selected was adjusted as part of hydrologic model calibration efforts. The calibrated CN for the 0.2% AEP event was then adjusted to account for extreme antecedent moisture conditions (AMCIII) appropriate for an PMP event. A CN of 72.6 was used in the final HEC-HMS model to convert the defined PMP to a PMF inflow hydrograph.

2.2.3 Runoff Transform

Once the loss calculations are performed, the remaining precipitation (called excess precipitation or runoff) is transformed into a discharge hydrograph of flow through time. The SCS Unit Hydrograph was used in the HEC-HMS model. The standard unit hydrograph that is based on a peak rate factor of 484 was assumed for this method. The lag time was estimated to be about 58 minutes, which is about 0.6 times the time of concentration determined for the watershed (about 97 minutes). The time of concentration was using the procedure recommended in TR-55 (NRCS, 1986).

2.2.4 Channel Routing Method

Channel routing was not required since a single basin was used to represent the McMullen Creek Dam watershed.

2.2.5 Calibration

A streamflow gage does not exist within the McMullen Creek watershed. Therefore, the calibration effort utilized data from the closest gaged watershed to the McMullen Creek watershed. The closest gaged watershed with similar hydrologic characteristics is USGS Gage 14375100, *Sucker CR BL L Grayback CR NR Holland, OR*. This gage is located about 8.5 miles southwest of McMullen Creek dam. It has an elevation of 1,713 and a drainage area of 83.9 mi^2.

A HEC-HMS model was developed for the Sucker Creek basin using the same approach as applied for the McMullen Creek watershed. The initial CNs were adjusted to ensure the computed peak discharge and runoff volume values are within about ±10% of the 1% and 0.2% AEP values estimated from a flood frequency analysis of the gage data. The CN adjustment factor associated with the calibration effort was then applied to the initial CNs estimated for the McMullen Creek Dam watershed. As previously stated, the final CN for the 0.2% AEP was then adjusted to reflect for higher AMC conditions for the PMF determination. The results of the calibration effort are summarized in Table 2-2.

Table 2-2. Summary of Calibration Results

Variable	1% AEP Flood Events			0.2% AEP Flood Events		
	Gage	Computed	Percent Difference	Gage	Computed	Percent Difference
Peak Discharge (cfs)	14,400	14,419	0.1%	19,200	19,395	1.0%
24 hour Volume (ac-ft)	16,066	17,037	6.0%	21,947	22,874	4.2%
48 hour Volume (ac-ft)	29,355	28,198	-3.9%	41,236	36,389	-11.8%
72 hour Volume (ac-ft)	38,380	36,444	-5.0%	54,060	49,423	-8.6%

2.2.6 Results

The results from the HEC-HMS model are summarized in Table 2-3.

Table 2-3. Summary of HEC-HMS Results

Duration	Peak Discharge (cfs)	Runoff Volume (ac-ft)
1% AEP Flood Event		
24 hour	2,440	2,832
48 hour	2,000	5,148
72 hour	1,570	6,539
0.2% AEP Flood Event		
24 hour	3,260	3,773
48 hour	2,470	6,534
72 hour	2,080	8,712
PMP General		
24 hour	12,290	10,117
48 hour	12,290	16,273
72 hour	13,100	19,859
PMP Local		
6 hour	16,230	2,273

Hydrologic level pool routing of the various duration inflow hydrographs through the McMullen Creek Dam reservoir indicated that the controlling duration (duration that results in the highest reservoir elevation) is 24 hours for the 1% and 0.2% AEP flood events and 72 hours for the PMF event.

3 Spillway Alternative Analysis

3.1 Introduction

A hydraulic analysis of McMullen Creek Dam reservoir, spillway, and outlet channel was completed to determine the maximum reservoir elevation for the 1% and 0.2% AEP flood events and assess dam overtopping potential for the PMF flood event. The analysis was completed using HEC-RAS. HEC-RAS is a hydraulic computer software developed by the Hydrologic Engineering Center of the U.S. Corps of Engineers. It has capabilities to perform one- and two-dimensional steady or unsteady flow calculations. Models were developed for Existing Conditions and Proposed Spillway Alternatives. This section of the report also includes documentation on the hydraulic design of a mid-level outlet structure that is necessary to meet OWRD's requirements. Finally, this section of the report includes recommendations for erosion protection measures downstream of the service spillway channel.

3.2 Existing Conditions Hydraulic Model

HEC-RAS calculates water surface elevations within a network system that can be comprised of open channels, closed conduits, storage areas, various hydraulic structures, and 2-dimensional areas. Models were developed for both steady and unsteady flow conditions. The steady flow model encompasses the service spillway channel through the Lakeshore Drive bridge. The steady flow model was used to compute the water surface profile along the spillway channel. The unsteady flow model encompasses a large area within the vicinity of the dam. The unsteady flow model was used to route the inflow hydrograph through the reservoir. Information about the model development and results are provided in the following paragraphs.

3.2.1 Model Development

The initial unsteady flow HEC-RAS model was developed using HEC-GeoRAS. A schematic of the model is shown in Figure 3-1 and Figure 3-2. Figure 3-1 depicts the entire modeled area, while Figure 3-2 is a close up view of the area in the vicinity of the spillway structure. The model includes two storage areas, two 2-dimensional areas, a single 1-dimensional reach, several Storage/2D Area connections, and multiple lateral weir structures. The HEC-GeoRAS model was imported into HEC-RAS and further revisions were made to the model.

The elevation of the geometric data in the model is based on a Digital Elevation Model (DEM) developed from two sources: (1) survey data collected near the dam spillway by OBEC Consulting, and (2) LiDAR data available from the Oregon Department of Geology and Mineral Industries (DOGAMI). The elevation versus volume relationship for Lake Selmac employed was based on the relationship provided on the existing dam design plans.

The in-line weir option was utilized to represent the inlet control structure for the service spillway and a Storage/2D Area connection was defined for the dam embankment, emergency spillway, Lakeshore Drive Road, and the area east of the emergency spillway structure. A weir coefficient of 3 was assumed for the emergency spillway and embankment structure, and a weir

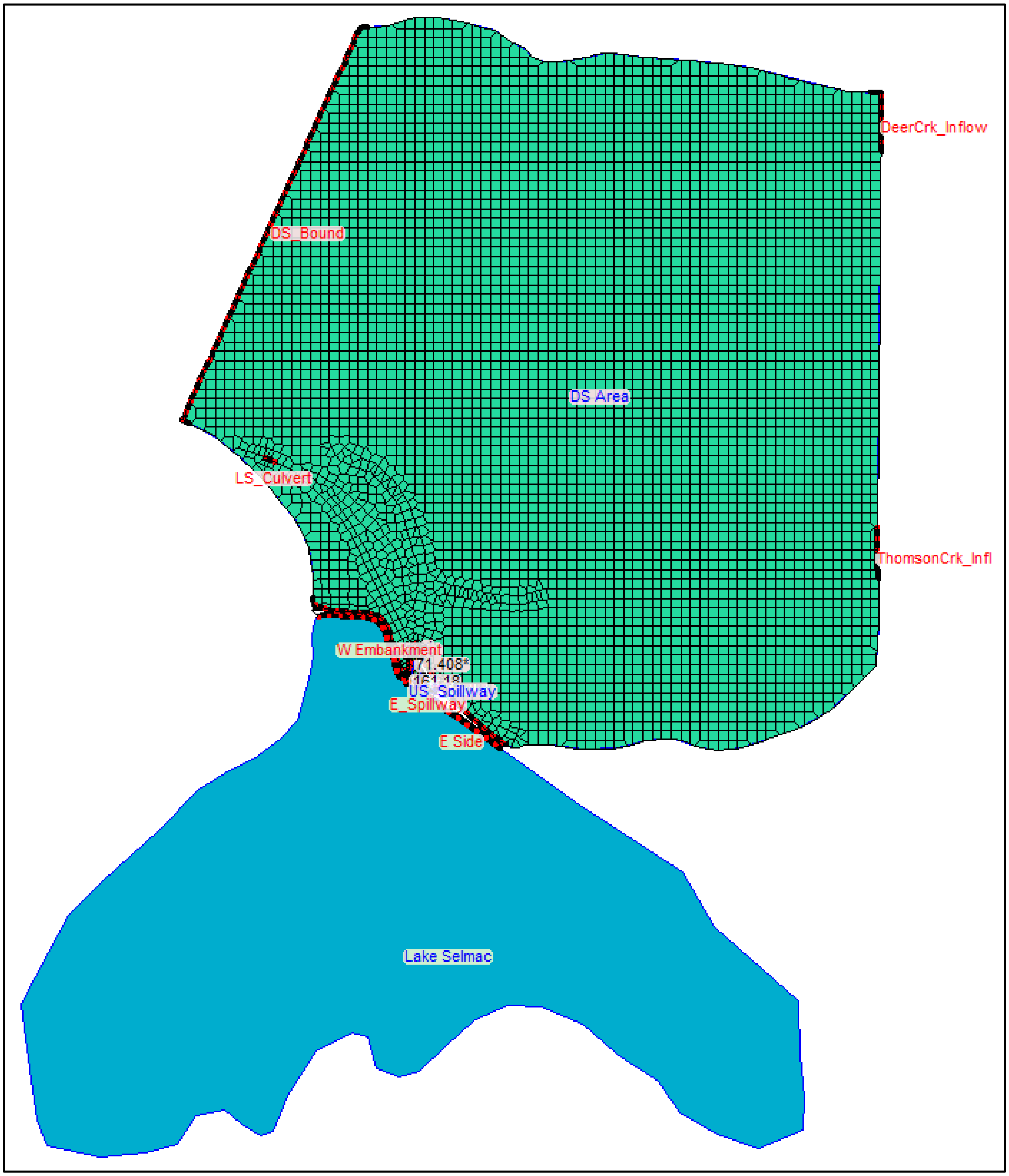


Figure 3-1. Schematic of unsteady HEC-RAS model for McMullen Creek Dam

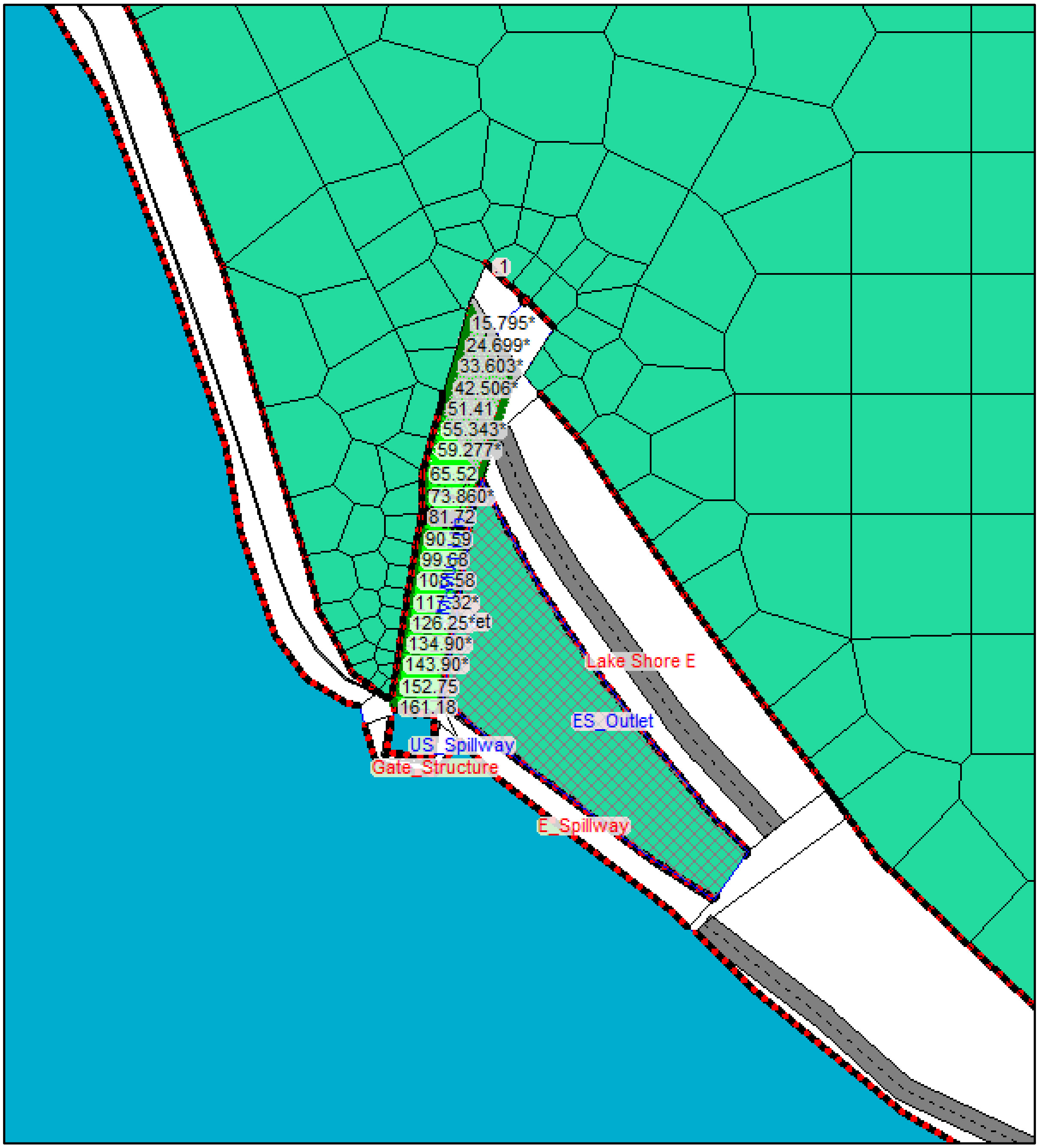


Figure 3-2. Schematic of unsteady HEC-RAS model of McMullen Creek Dam near the spillway structures

coefficient of 2.9 for the inlet structure (weighted average with 3.2 assigned to the portion that performs as a sharp crested weir and 2.6 for portion that reflects a broad crested weir).

The County does not have an operation manual that clearly defines how the spillway gate is operated. Therefore, models were developed for the gate both closed and all the way open (referred to as simply "open" in the remainder of this memorandum).

A land cover shapefile was created for the area within the vicinity of the dam using aerial photographs. The Manning's n coefficients assumed for each of the involved land use types are summarized in Table 3-1.

Table 3-1. Manning's n-values per Land Cover Type

Land Cover Name	Manning's n-value
Channel	0.042
Concrete	0.013
Dense Veg	0.10
Open Field	0.05
Road	0.016
Rock	0.055
Water	0.010

Three boundary conditions are considered for the unsteady flow model. The first boundary (DS_Bound) is the downstream boundary of the model. A normal depth slope of 0.00691 (based on slope derived from LiDAR data) was assumed at this location. The second location (DeerCrk_Inflow) is for the inflow of Deer Creek to the model. A constant discharge of 2,980 cfs, the estimated 50% AEP discharge, was assumed for Deer Creek. The last location (ThomsonCrk_Infl) is for the inflow of Thomson Creek to the model. A constant discharge of 777 cfs, the estimated 50% AEP discharge, was assumed for Thomson Creek.

The steady flow model was developed from the unsteady flow model. Several additional cross sections were included downstream from the Lakeshore Drive Bridge. The steady flowmodel was run in a mixed flow regime.

3.2.2 Results

The results from the Existing Conditions HEC-RAS model are summarized in Table 3-2 and shown in Figure 3-3 and Figure 3-4. Table 3-2 provides the maximum reservoir elevation and outflow discharge for the 1% AEP, 0.2% AEP, and PMF events for the flood gate being open and closed, and information about whether or not overtopping occurs. The results indicate the following: (1) the open gate at the beginning of the flood event has a pronounced influence (decrease) on the maximum reservoir elevation and outflow releases from the dam, (2) the open gate will have an influence on whether or not the embankment will be overtopped for the 1% and 0.2% AEP events, and (3) overtopping of the embankment and area east of the emergency spillway will occur for the PMF event with the gate open or closed.

Figure 3-3 shows the water surface profile through the service spillway structure. The results indicate that a hydraulic jump will not occur at the end of the steep chute and the flow leaving the service spillway channel will consist of supercritical flow with extremely high velocities. Figure 3-4 shows the inundation extents downstream of the dam for the PMF event (Note: Based on gate open, but the extents are not significantly different for the gate being closed).

Table 3-2. HEC-RAS Results for Existing Conditions of McMullen Creek Dam

Gate Condition	Maximum Reservoir Level (ft)	Maximum Outflow (cfs)			Overtopping
		Service Spillway	Emergency Spillway	Total[(1)]	
1% AEP Flood Event					
Open	1396.77	1,849	73	1,922	No (Freeboard of 1.9 ft)
Closed	1398.85	932	1,356	2,288	Yes (Embankment)
0.2% AEP Flood Event					
Open	1397.59	2,342	419	2,761	No (Freeboard of 1.1 ft)
Closed	1399.36	1,161	1,841	3,002 (3,117)	Yes (Embankment and Area East of Emergency Spillway)
PMF General Event					
Open	1401.10	4,345	3,858	8,203 (12,749)	Yes (Embankment, Area East of Emergency Spillway, and Lakeshore Drive)
Closed	1401.44	2,262	4,321	6,574 (12,803)	Yes (Embankment, Area East of Emergency Spillway, and Lakeshore Drive)

Notes:

1. For some of the events, two values are provided for the total discharge. The first values is for the total discharge conveyed through the service spillway and emergency spillway. The second value, provided in the parenthesis, is total discharge conveyed passing the dam (includes flow overtopping the embankment and the area east of the emergency spillway).

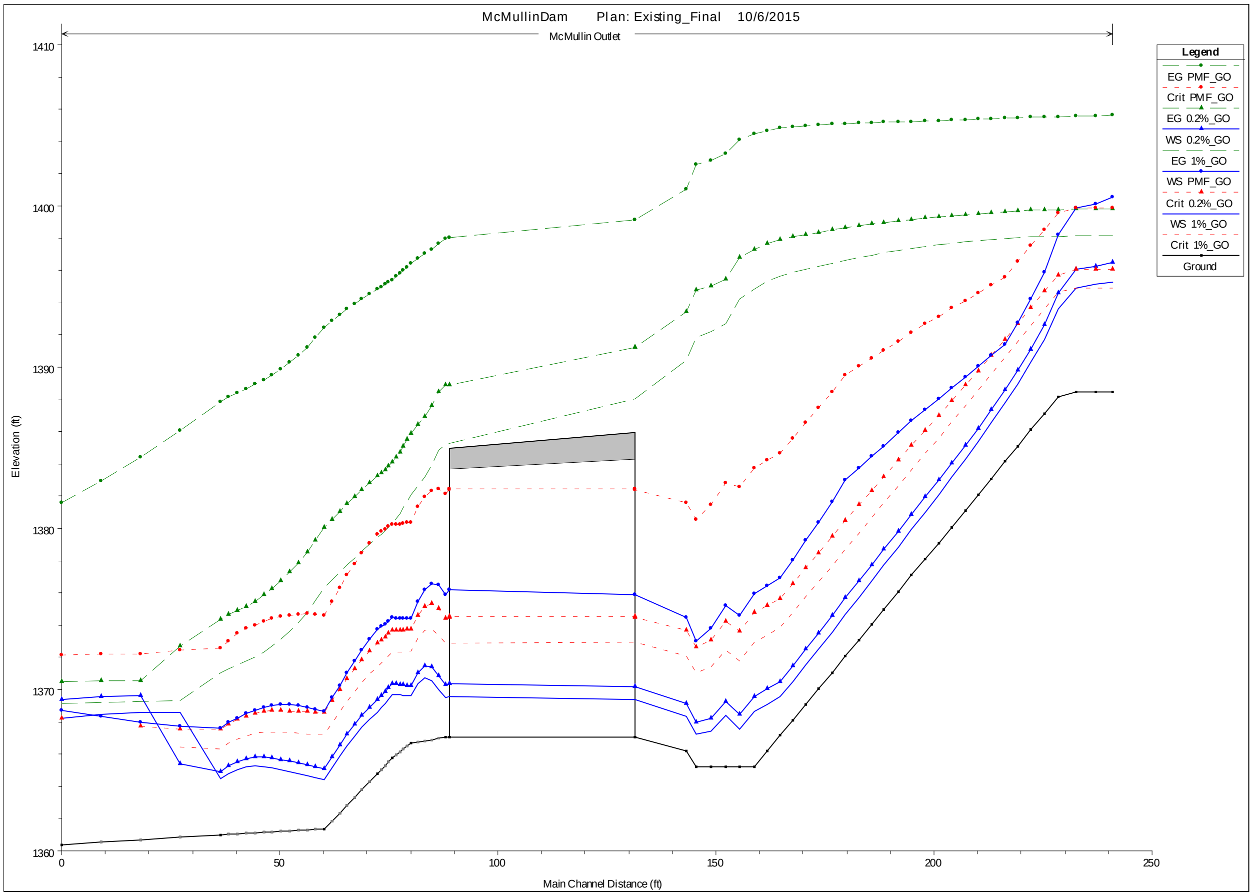


Figure 3-3. Existing Conditions HEC-RAS model results of McMullen Creek Dam service spillway channel

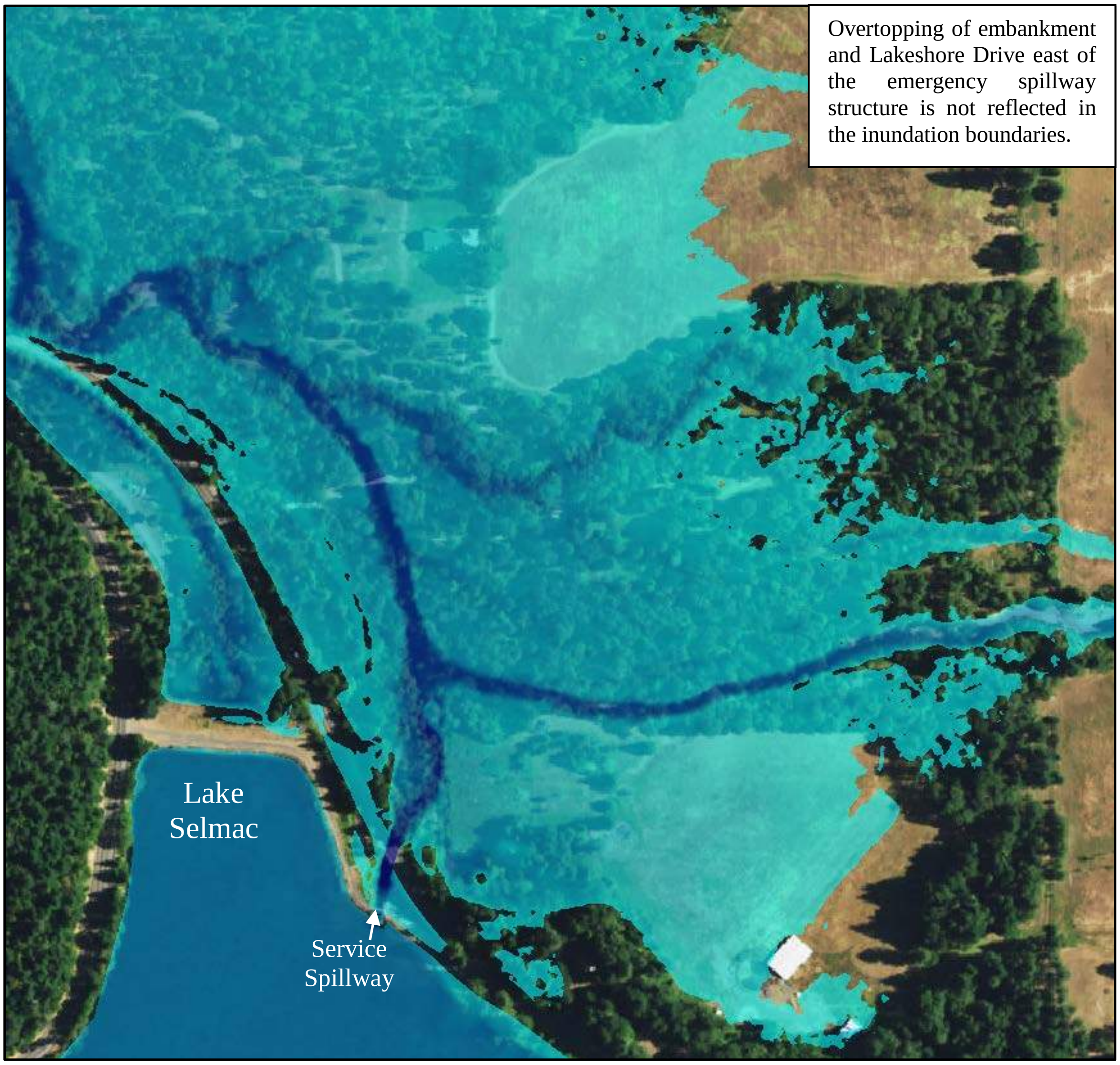


Figure 3-4. Existing Conditions flood inundation extents of the PMF event

3.3 Mid-level Outlet Alternatives

The existing low level outlet for McMullen Creek Dam has been abandoned. According, there is currently no means of lowering the reservoir pool below the service spillway crest elevation in an emergency. The OWRD has a requirement that reservoir pools must be capable of being lowered 5 feet over a 5 day period for average base flow conditions. The average annual base flow for McMullen Creek was estimated to be 36 cfs using the base flow measured for USGS Gage 14375100, *Sucker CR BL L Grayback CR NR Holland, OR*.

Accordingly, a design for a proposed mid-level outlet is required. The location of the proposed mid-level outlet structure is shown in Figure 3-5. The mid-level outlet would remain closed majority of the time, and it would only be used to lower the reservoir pool during non-flood event. Two general alternatives were considered.

Figure 3-5. Mid-level outlet structure location

The first alternative is a gravity outlet system where the structure consists of an inlet structure, pipe conduit, and an outlet structure. The inlet structure will consist of a trashrack structure, concrete vault, and control valve. The pipe conduit material could be either be steel, concrete, or HDPE. Pipe diameters ranging from 36 to 48 inches were considered with lower invert elevations (high head) required for smaller pipe diameters.

An energy dissipation outlet structure would be required at the end of the pipe conduit. The second alternative considered was a pump station that could pump 48,000 GPM (104 cfs) for a maximum head of about 21.2 feet. This alternative would require a pump station and outlet structure at the end of the discharge pipe. Altogether, ten specific mid-level outlet alternatives were evaluated. A summary of the mid-level outlet alternatives is summarized in Table 3-3.

Various configurations for control valves were considered for each pipe diameter. Depending on the pipe diameter, one to four smaller opening sizes were considered to control the releases from the dam. The outlet pipe diameter ranges from 36 to 48 inches. The pipe could be steel, HDPE, or concrete. Two different approaches can be considered at the outlet of the pipe. The first energy dissipator alternative considered is the use of a USBR Type VI Impact Structure (USBR, 1984). This type of structure is shown in Figure 3-6 and the dimensions of the structure for each pipe outlet are provided in Table 3-4. The second alternative is the use of a weir structure (FHWA, 2006). The weir structure would be created by raising the west wall of the outlet

Table 3-3. Summary of McMullen Creek Dam Mid-Level Outlet Alternatives

Alternative	Type	Diameter (in)	Length (ft)	U/S Invert Elevation (ft)	Max Discharge (cfs)	Max Outlet Velocity (ft/s)
1a	Pipe with one (1) 36" Knife Gate Control Valve	36	72.0	1378.3	125	17.7
1b	Pipe with four (4) 18" Control Valves					
1c	Pipe with three (3) 21" Control Valves					
1d	Pipe with two (2) 24" Control Valves					
2a	Pipe with one (1) 42" Knife Gate Control Valve	42	65.2	1380.5	144	15.0
2b	Pipe with four (4) 21" Control Valves					
2c	Pipe with three (3) 24" Control Valves					
3a	Pipe with one (1) 48" Knife Gate Control Valve	48	62.5	1381.2	172	13.7
3b	Pipe with two (2) 24" Control Valves					
4	Pump Station	-	-	-	104 cfs (about 48,000 GPM)	14.7

Notes:

(1) Outlet pipe material could be made of either steel, HDPE, or concrete.

(2) All of the alternatives are capable of lowering the reservoir 5 feet below the service spillway crest over 5 days.

channel. The use of baffle blocks could be incorporated into this approach to dissipate the initial releases from the structure.

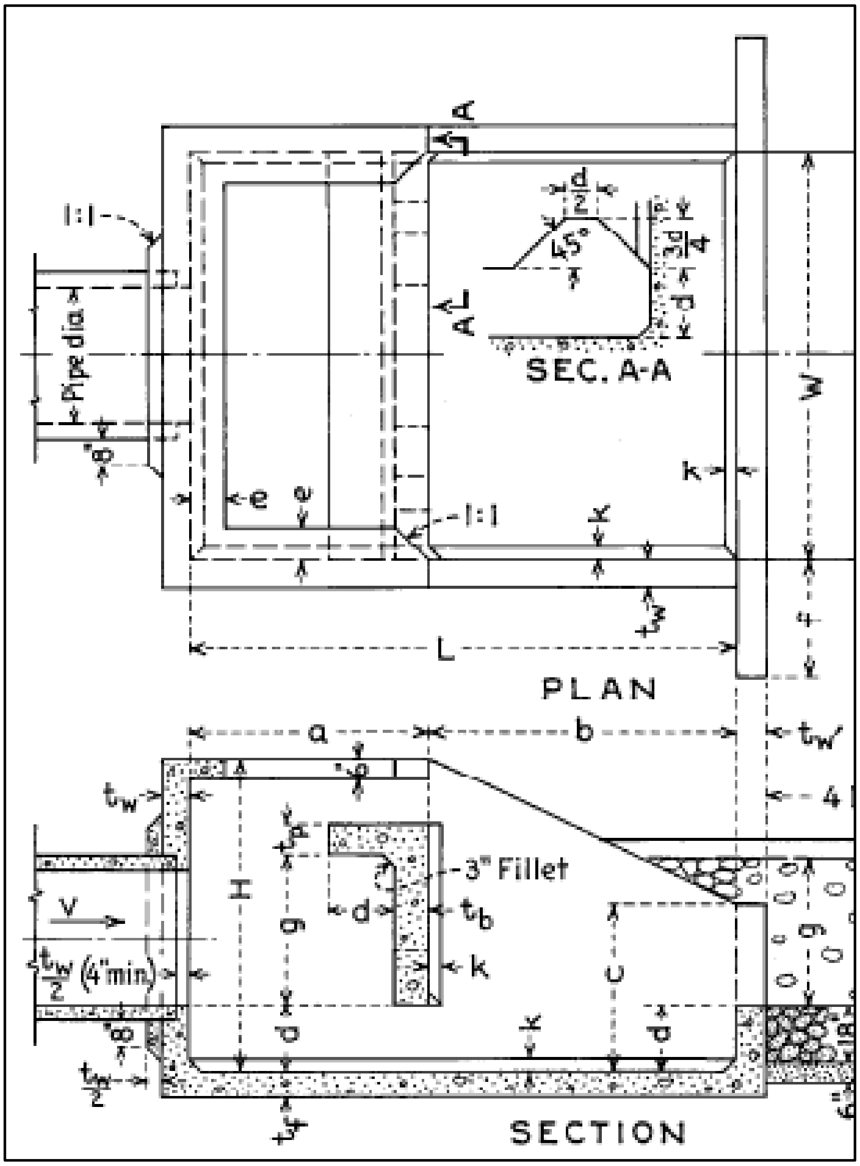


Figure 3-6. USBR energy dissipator for mid-level outlet structure (USBR, 1984)

Table 3-4. Mid-Level Outlet USBR Energy Dissipator Dimensions

Variable	Alternative 1 (36-inch Pipe)	Alternative 2 (42-inch Pipe)	Alternative 3 (48-inch Pipe)
W (ft)	9.25	10.50	11.75
H (ft)	7.25	8.00	9.00
L (ft)	12.33	14.00	15.67
a (ft)	5.25	6.00	6.75
b (ft)	7.08	8.00	8.92
c (ft)	3.83	4.42	4.92
d (ft)	1.58	1.75	2.00
e (ft)	0.67	0.83	0.83
f (ft)	3.00	3.00	3.00
g (ft)	3.50	3.92	4.42
tw (in)	7.0	8.0	9.0
tf (in)	7.5	8.5	9.5
tb (in)	8.0	9.0	10.0
tp (in)	8.0	8.0	8.0
K (in)	3.0	4.0	4.0

3.4 Spillway Modification Alternatives

The analysis of the existing conditions indicates that the McMullen Creek Dam embankment would be overtopped for the 1% AEP event if the gates are in a closed position during the event and the PMF event if the gates are open during the event. Ten alternatives to safely convey the PMF inflow hydrograph were evaluated. The only constraint related to the possible alternatives is that the current minimum pool elevation set by the existing service spillway gate sill (1389.64 ft) cannot be lowered. A brief discussion of each alternative is provided below, with general information summarized in Table 3-5.

Alternative 1. Alternative 1 (Figure 3-7) involves raising the embankment crest and resurfacing the existing emergency spillway structure. The embankment would have to be raised about 3.9 feet if the spillway gate remains open during the winter runoff season and about 5.0 feet if the gate remains closed.

Alternative 2. Alternative 2 (Figure 3-8) consists of modifying the existing emergency spillway from a broad crest to a more efficient ogee type spillway (Figure 3-9). The ogee crest would have a length of about 118 feet and the same elevation as the existing spillway structure. The embankment would have to be raised about 3.3 and 4.2 feet if the spillway gate is open or closed, respectively.

Alternative 3. Alternative 3 (Figure 3-10) consists of providing a new inlet structure for the service spillway and lengthening the crest of the existing emergency spillway from 92.5 to 113.3 feet. The new inlet structure would have the same gate configuration as the existing structure. The length of the inlet structure walls would be increased from about 53.8 feet to 78.6 feet.

Table 3-5. Summary of McMullen Creek Dam Spillway Alternatives

Alternative	Description	Spillway		Emergency Spillway		
		El (ft)	Length (ft)	El (ft)	Length (ft)	Type
Exist	Existing Conditions	1395.64	53.8	1396.34	92.5	Broad Crest Weir
1	Raise Embankment	1395.64	53.8	1396.34	92.5	Broad Crest Weir
2	Ogee Crest	1395.64	53.8	1396.34	118	Ogee Crest
3	Revised Spillway Configuration	1395.64	78.6	1396.34	113.3	Broad Crest Weir
4	Additional Emergency Spillway Length	1395.64	53.8	1396.34	168.3	Broad Crest Weir
5	Combination of Alternatives 3 and 4	1395.64	78.6	1396.34	168.3	Broad Crest Weir
6	Alt 5 with Elevations Lowered by 1 feet	1394.64	78.6	1395.34	168.3	Broad Crest Weir
7	Alt 6 with Ogee Crest at Original Emergency Spillway Location	1394.64	78.6	1395.34	168.3	Ogee Crest
8	Obermeyer Weir on Main Spillway	1384.64	53.8	1396.34	92.5	Broad Crest Weir
9	Obermeyer Weir on Main Spillway and Emergency Spillway	1384.64	53.8	1391.34	118	Obermeyer Weir
10	Alt 9 with Ogee Crest at Emergency Spillway Location	1384.64	53.8	1391.34	118	Obermeyer Weir/Ogee Crest

The length of the emergency spillway crest would be increased from 92.5 feet to 113.3 feet by changing the side slopes to 1 Horizontal (H) to 2 Vertical (V) on both sides of the structure. The embankment would have to be raised about 3.3 or 4.3 feet if the spillway gate is open or closed, respectively.

Alternative 4. This alternative (Figure 3-11) involves increasing the emergency spillway length by 50 feet by providing a new overtopping structure on the west side of the service spillway. The additional emergency spillway structure would have the same elevation as the existing emergency spillway structure. The embankment would have to be raised about 3.1 feet or 3.9 feet if the spillway gate is open or closed, respectively.

Alternative 5. Alternative 5 (Figure 3-12) is a combination of Alternatives 3 and 4. The embankment would have to be raised about 2.7 feet or 3.5 feet if the spillway gate is open or closed, respectively.

Alternative 6. This alternative is the same as Alternative 5 except the elevation of the emergency spillway and service spillway inlet walls are lowered by 1 foot. This alternative would lower the maximum allowable summer pool elevation by 1 foot, but would not impact the minimum pool elevation set by the existing service spillway gate sill. The embankment for this alternative would have to be raised by an average height of about 1.8 if the spillway gate is open and 2.6 if the gate is closed.

Alternative 7. Alternative 7 (Figure 3-13) is the same as Alternative 6 except the original emergency spillway is modified to have an ogee crest. The embankment for this alternative would have to be raised by an average height of about 1.6 if the spillway gate is open and 2.2 if the gate is closed.

Alternative 8. Alternative 8 (Figure 3-14) consists of using an Obermeyer Gate (Figure 3-15) on the main spillway and modifying the existing emergency spillway to have a length of about 113 feet. The Obermeyer gate system is a patented, bottom hinged, spillway gate with many unique attributes. These attributes include: (1) accurate automatic pool level control even under power failure conditions; (2) modular design that simplifies installation and maintenance; (3) a gate supported by an inflatable air bladder; (4) a thin profile which efficiently passes flow, ice and debris; (5) no intermediate piers; (6) low cost of installation; and (7) rugged steel gate panels. The Obermeyer Gate would also serve as the mid-level outlet structure, so the invert of the service spillway outlet channel inlet would have to be lowered about 3.8 feet. The height of the gate would be about 11 feet. The revised profile of the channel is shown in Figure 3-16. The embankment for this alternative would have to be raised by an average height of about 3.6 feet.

Alternative 9. Alternative 9 (Figure 3-17) consists of using Obermeyer Gates on both the main spillway and the emergency spillway. The Obermeyer Gate for the main spillway will be the same gate proposed for Alternative 8. The Obermeyer Gate would be 5 feet tall. The invert of the emergency spillway would be lowered to an elevation of 1391.34 feet. The embankment for this alternative would have to be raised by an average height of about 0.5 feet (the maximum increase at the existing low spot near the west abutment would be about 1.6 feet).

Alternative 10. Alternative 10 (Figure 3-17) is the same as Alternative 9 except the emergency spillway will have an ogee shape. The embankment for this alternative would have to be raised by an average height of about 0 feet (maximum increase of the low spot near the west abutment would be about 1.0 feet).

Alternatives 1 through 7 were evaluated for the 1% and 0.2% AEP events and the PMF event with the spillway gate both open and closed. For Alternatives 8 through 10, the Obermeyer main spillway gate was initially closed and then opened at a rate of 0.1 feet per minute shortly after the start of the flood event. For Alternative 9 and 10, the Obermeyer emergency spillway gates was closed until the water surface elevation reached 1395 feet, when it then opened at a rate of 0.1 feet per minute. The results of the evaluation are summarized in Table 3-6, Table 3-7, and Table 3-8, respectively.

The PMF outflow from the dam for all of the alternatives will be less than for Existing Conditions. However, the distribution of the outflow will be changed for each alternative with an increase for both the service and emergency spillway. The total PMF outflow for the Existing Conditions and each alternative is provided in Table 3-9. It should be noted that water will overtop Lakeshore Drive for all of the alternatives.

Figure 3-7. McMullen Creek Dam Alternative 1

Figure 3-8. McMullen Creek Dam Alternative 2

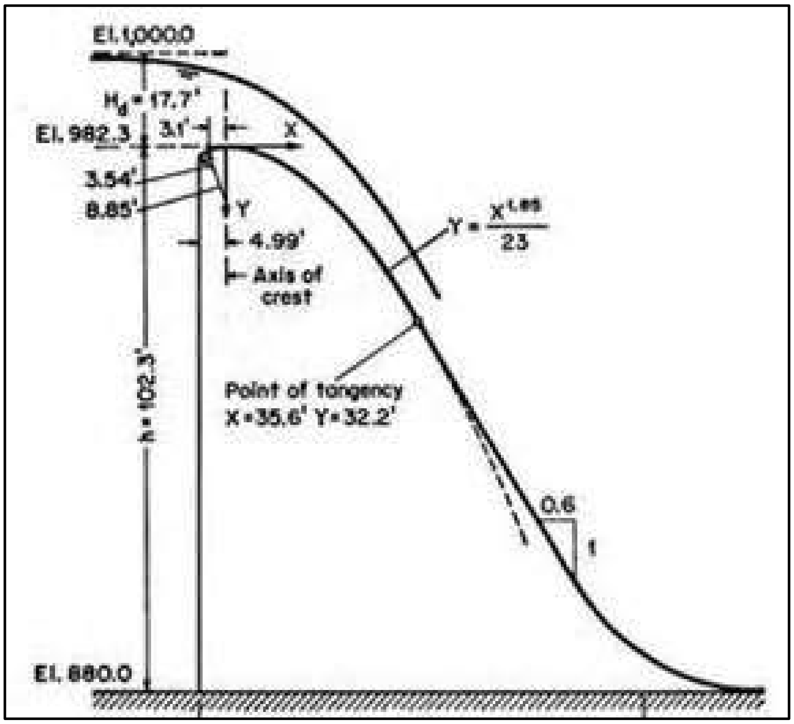


Figure 3-9. Typical profile of ogee type spillway

Figure 3-10. McMullen Creek Dam Alternative 3

Figure 3-11. McMullen Creek Dam Alternative 4

Figure 3-12. McMullen Creek Dam Alternative 5 and 6

Figure 3-13. McMullen Creek Dam Alternative 7

Figure 3-14. McMullen Creek Dam Alternative 8

Figure 3-15. Obermeyer spillway

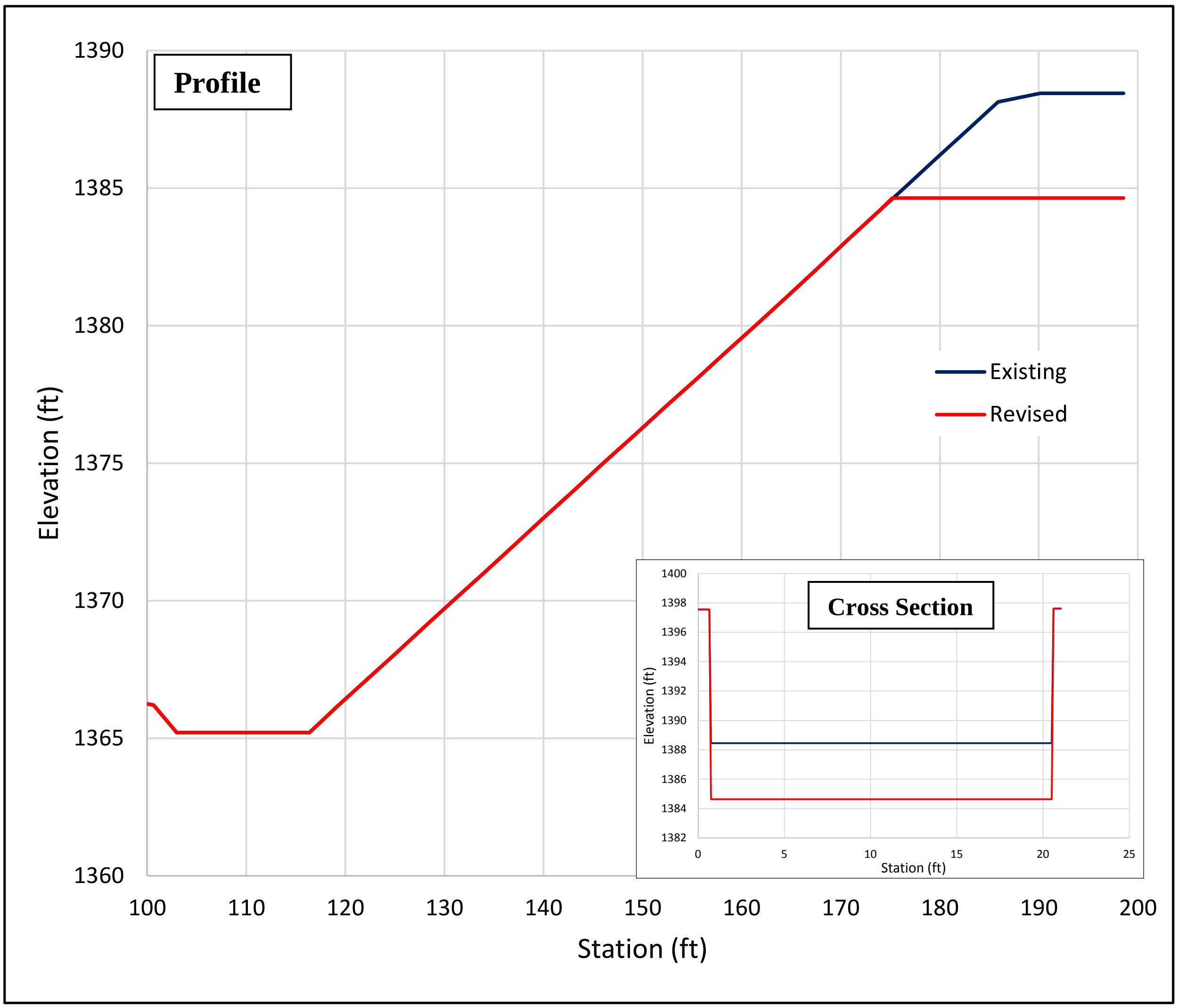


Figure 3-16. Change in main spillway for Alternative 8

Figure 3-17. McMullen Creek Dam Alternatives 9 and 10

Table 3-6. HEC-RAS Results for Proposed Spillway Alternatives (PMF Event)

Alternative	Gate Condition	Maximum Reservoir Elevation (ft)	Average Increase in Embankment Height (ft)(1)	Maximum Outflow (cfs)		
				Service Spillway	Emergency Spillway	Total
1	Open	1402.71	3.90	5,475	6,125	11,600
	Closed	1403.80	4.99	3,770	7,854	11,624
2	Open	1402.11	3.30	5,040	6,847	11,887
	Closed	1402.98	4.17	3,221	8,679	11,900
3	Open	1402.14	3.33	6,157	5,634	11,791
	Closed	1403.10	4.29	4,640	7,140	11,780
4	Open	1401.87	3.06	4,873	7,065	11,938
	Closed	1402.72	3.91	3,051	8,875	11,926
5	Open	1401.50	2.69	5,601	6,478	12,079
	Closed	1402.30	3.49	3,917	8,127	12,044
6	Open	1400.63	1.82	9,532	6,730	16,262
	Closed	1401.40	2.59	9,297	8,337	17,634
7	Open	1400.36	1.55	5,126	7,113	12,239
	Closed	1401.04	2.23	3,473	8,778	12,251
8	-	1402.41	3.60	5,900	5,682	11,582
9	-	1399.27	0.50	3,798	7,971	11,769
10	-	1398.67	0.0(2)	3,446	8,525	11,971

Notes:

(1) Average Increase in Embankment Height based on 1 foot of freeboard per OWRD criteria.

(2) Low spot near the west abutment would have to be raised a maximum height of 1 foot.

Table 3-7. HEC-RAS Results for Proposed Spillway Alternatives (0.2%AEP Event)

Alternative	Gate Condition	Maximum Reservoir Elevation (ft)	Freeboard (ft)[1]	Maximum Outflow (cfs)		
				Service Spillway	Emergency Spillway	Total
1	Open	1397.59	6.12	2,342	419	2,761
	Closed	1399.41	5.39	1,186	1,895	3,081
2	Open	1397.51	5.60	2,304	492	2,796
	Closed	1399.14	4.84	1,061	2,053	3,114
3	Open	1397.42	5.72	2,421	400	2,821
	Closed	1399.03	5.07	1,425	1,687	3,112
4	Open	1397.47	5.40	2,285	528	2,814
	Closed	1398.98	4.74	986	2,145	3,131
5	Open	1397.33	5.17	2,371	490	2,861
	Closed	1398.72	4.58	1,232	1,916	3,148
6	Open	1396.76	4.87	2,981	705	3,686
	Closed	1397.93	4.47	2,981	1,962	4,943
7	Open	1396.73	4.63	2,211	819	3,030
	Closed	1397.83	4.21	1,156	2,024	3,181
8	-	1397.26	6.15	2,718	252	2,970
9	-	1397.21	3.06	2,697	290	2,987
10	-	1397.21	2.46	2,693	299	2,992

Notes:

(1) Freeboard between maximum reservoir elevation and dam crest.

Table 3-8. HEC-RAS Results for Proposed Spillway Alternatives (1%AEP Event)

Alternative	Gate Condition	Maximum Reservoir Elevation (ft)	Freeboard (ft)$^{(1)}$	Maximum Outflow (cfs)		
				Service Spillway	Emergency Spillway	Total
1	Open	1396.77	6.94	1,849	73	1,922
	Closed	1398.85	5.95	933	1,357	2,289
2	Open	1396.75	6.36	1,835	98	1,933
	Closed	1398.64	5.34	841	1,477	2,317
3	Open	1396.71	6.43	1,871	78	1,949
	Closed	1398.52	5.58	1,115	1,205	2,320
4	Open	1396.75	6.12	1,831	106	1,937
	Closed	1398.5	5.22	784	1,551	2,335
5	Open	1396.69	5.81	1,858	102	1,960
	Closed	1398.27	5.03	974	1,379	2,353
6	Open	1396.21	5.42	2,091	404	2,495
	Closed	1397.5	4.9	2,286	1,369	3,655
7	Open	1396.22	5.14	1,696	434	2,130
	Closed	1397.42	4.62	923	1,475	2,398
8	-	1395.95	7.46	2,149	0	2,149
9	-	1395.95	4.32	2,149	0	2,149
10	-	1395.95	3.72	2,149	0	2,149

Notes:

(1) Freeboard between maximum reservoir elevation and dam crest.

Table 3-9. Changes in Maximum PMF Outflow for Proposed Spillway Alternatives

Alternative	Service Spillway	Emergency Spillway	Other(1)	Total
Gate Open				
Existing	4,345	3,858	4,546	12,749
1	5,475	6,125	2,496	11,600
	26.0%	58.8%	-	-9.0%
2	5,040	6,847	2,853	11,887
	16.0%	77.5%	-	-6.8%
3	6,157	5,634	2,392	11,791
	41.7%	46.0%	-	-7.5%
4	4,873	7,065	2,190	11,938
	12.1%	83.1%	-	-6.4%
5	5,601	6,478	2,130	12,079
	28.9%	67.9%	-	-5.3%
6	5,373	6,730	2,168	12,103
	23.7%	74.4%	-	-5.1%
7	5,126	7,113	2,388	12,239
	18.0%	84.4%	-	-4.0%
8(2)	5,900	5,682	2,335	11,582
	35.8%	47.3%	-	-9.2%
9(2)	3,798	7,971	2,377	11,769
	-12.6%	106.6%	-	-7.7%
10(1)	3,446	8,525	3,765	11,971
	-20.7%	121.0%	-	-6.1%
Gate Closed				
Existing	2,262	4,312	6,229	12,803
1	3,770	7,854	3,242	11,624
	66.7%	82.2%	-	-9.2%
2	3,221	8,679	3,726	11,900
	42.4%	101.3%	-	-7.1%
3	4,640	7,140	2,945	11,780
	105.2%	65.6%	-	-8.0%
4	3,051	8,875	2,604	11,926
	34.9%	105.8%	-	-6.8%
5	3,917	8,127	2,490	12,044
	73.2%	88.5%	-	-5.9%
6	3,783	8,337	2,516	12,120
	67.3%	93.4%	-	-5.3%
7	3,473	8,778	2,792	12,251
	53.6%	103.6%	-	-4.3%

Notes:

1. Other discharge for Existing Conditions corresponds to flow over the embankment and area east of the emergency spillway. Other discharge for the alternative corresponds to flow overtopping Lakeshore Drive.
2. Alternatives 8 through 10 have Obermeyer gates that are closed at start of the storm and then open at a rate of 0.1 feet per minute.

The water surface profiles from the steady flow models are shown in Figure 3-18 for the 0.2% AEP event and in Figure 3-19 for the PMF event. As stated earlier, Lakeshore Drive will be overtopped for the PMF event for all of the alternatives. Lakeshore Drive will not adversely impact the flow over the service or emergency spillway structures. Figure 3-19 shows that the Lakeshore Drive bridge would be overtopped for Alternatives 4, 6, and 7. A comparison of the inundation extents for Existing Conditions and Alternative 7 (alternative with largest outflow) is shown in Figure 3-20. The comparison shows that the inundation extents for the alternatives will not be significantly different than the extents for the Existing Conditions.

The hydraulic analysis results indicate that the maximum water surface elevations and outflow for the PMF event would be significantly influenced by whether the service spillway gate is open or closed. Therefore, the preliminary cost estimate was completed for each alternative assuming that the gate is open. The gate should be open during the winter runoff season (between November 15^{th} and March 30^{th}). A summary of the estimated project costs is provided in Table 3-10. A more detailed cost estimate is provided in Appendix B.

Table 3-10. Preliminary Project Cost

Alternative	Construction	Mid-Level Outlet	Project Development	Contingency	Total Cost
1	$1,300,000	$250,000	$390,000	$520,000	$2,730,000
2	$1,410,000	$250,000	$420,000	$560,000	$2,910,000
3	$1,700,000	$250,000	$510,000	$680,000	$3,410,000
4	$1,470,000	$250,000	$440,000	$590,000	$3,020,000
5	$1,930,000	$250,000	$580,000	$770,000	$3,800,000
6	$1,750,000	$250,000	$520,000	$700,000	$3,490,000
7	$1,710,000	$250,000	$510,000	$680,000	$3,420,000
8	$1,990,000	$0	$580,600	$770,000	$3,290,000
9	$2,310,000	$0	$650,000	$900,000	$3,840,000
10	$2,090,000	$0	630,000	840,000	$3,560,000

3.5 Recommended Alternative

Based on a review of the hydraulic characteristics, risks, and cost associated with each alternative, Alternative 1 is considered to be the recommended alternative. As previously stated, the maximum water surface elevations and outflow during the PMF event would be significantly influenced by whether or not the main spillway gate is open or closed. It is recommended that the gate be left open during the winter runoff season (between November 15^{th} and March 30^{th}).

The recommend alternative for the mid-level outlet is Alternative 3a, which consist of a 48-inch outlet controlled by a 48-inch knife valve. The mid-level outlet would only be used to lower the reservoir pool during non-flood event.

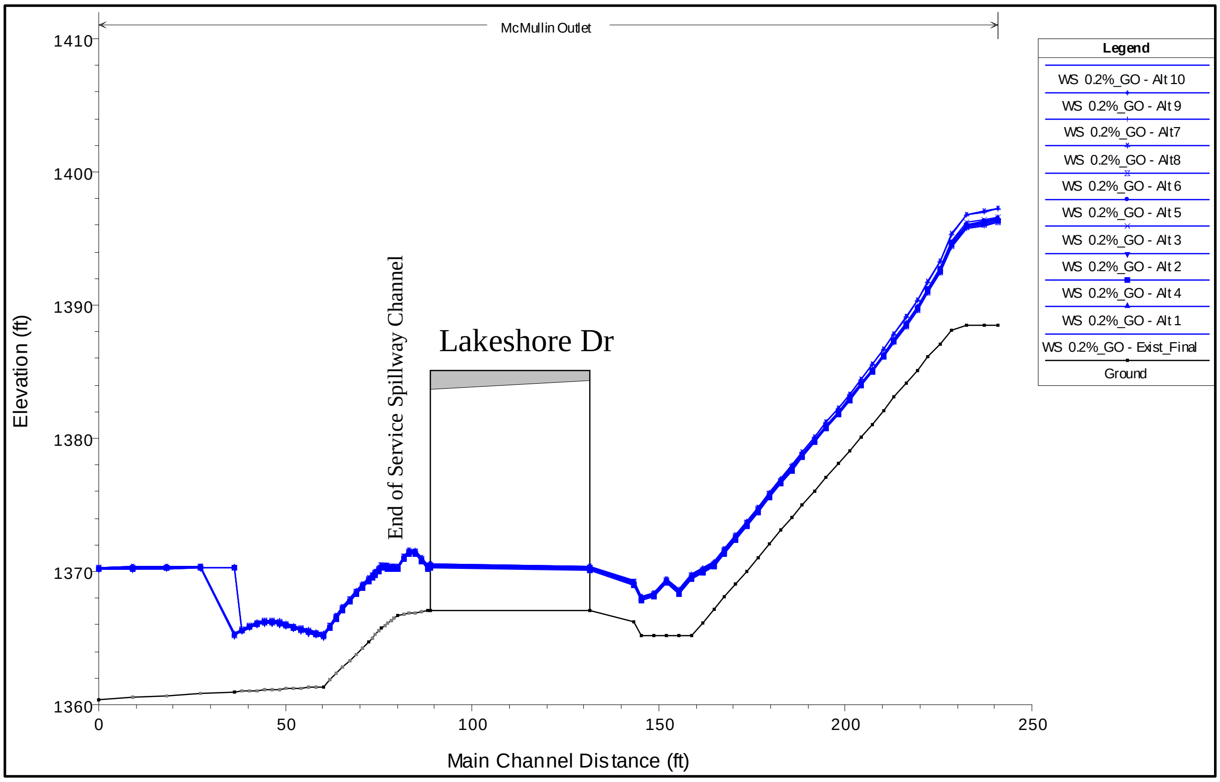


Figure 3-18. 0.2% AEP water surface profile of the service spillway alternatives (Gate Open)

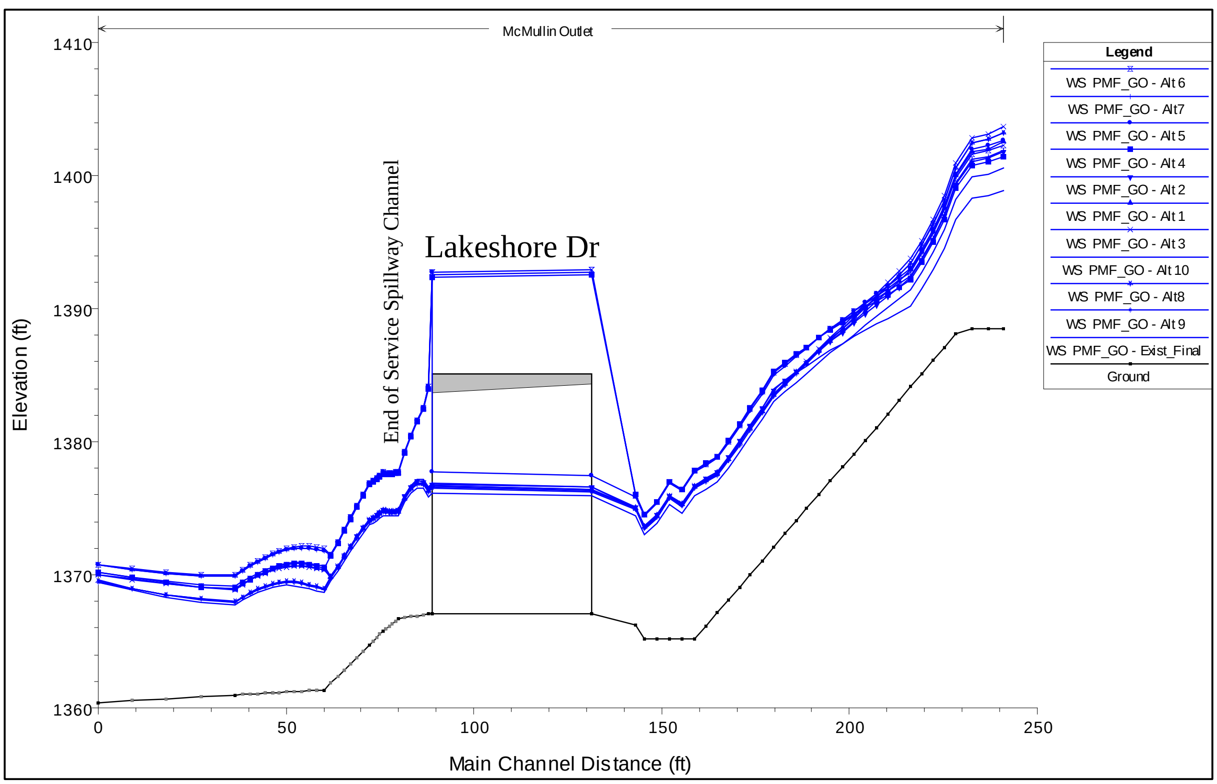


Figure 3-19. PMF water surface profile of service spillway alternatives (Gate Open)

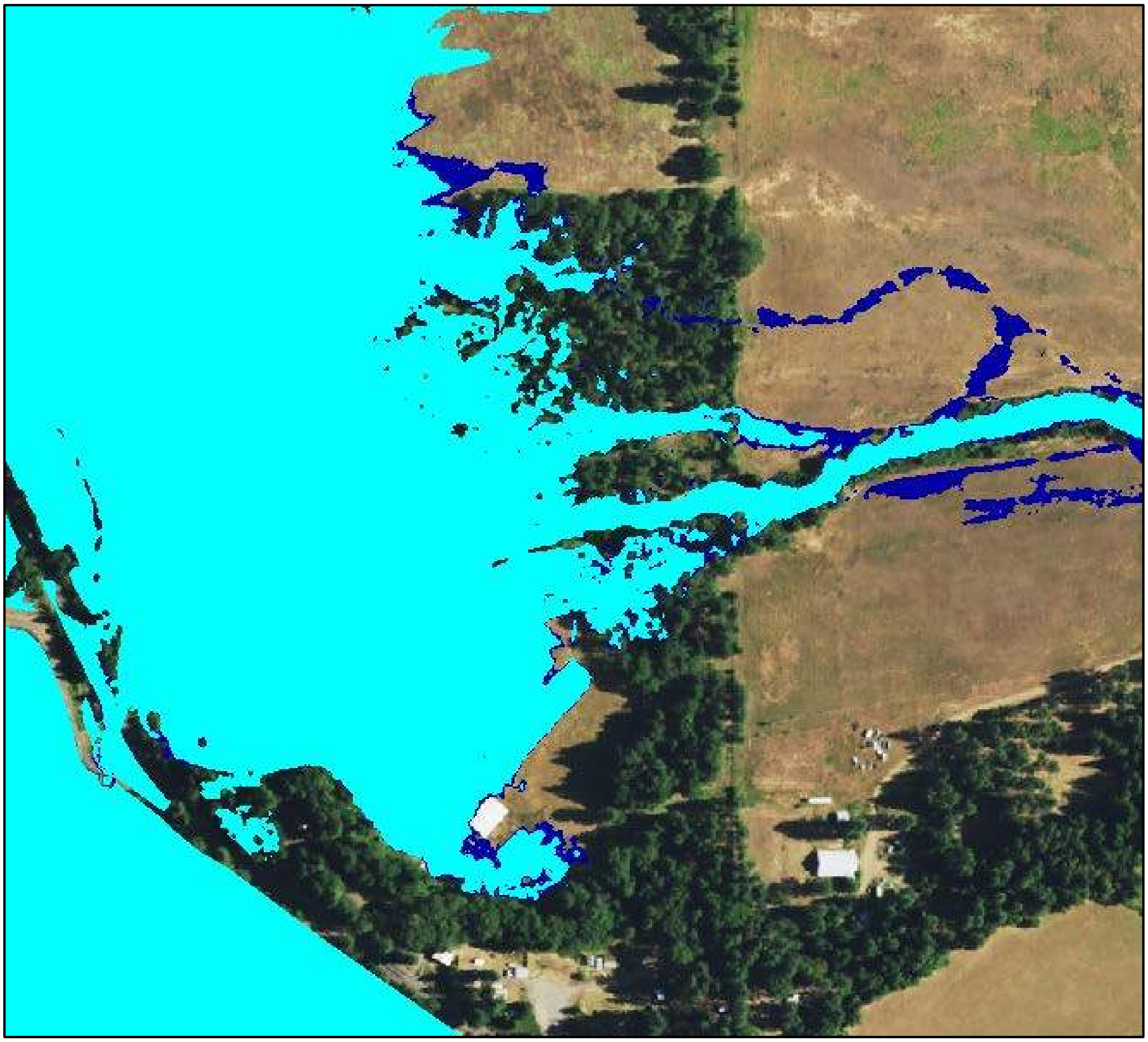


Figure 3-20. Comparison of PMF inundation extents downstream of Lake Selmac for Existing Conditions (light blue) and Alternative 7 (dark blue)

3.6 Erosion Protection Design

The flow in the main spillway channel will be extremely turbulent and has very high velocity. The HEC-RAS model results indicates that the existing structure will not cause a hydraulic jump to occur within the structure. Modifications to the channel are being proposed for the Lakeshore Drive Bridge replacement project. Therefore, the proposed channel modifications were reflected in the HEC-RAS model. The analysis of the proposed channel modifications indicate that a hydraulic jump will not occur within the channel and the flow leaving the channel will have extremely high velocities (greater than 30 ft/s), resulting in a high potential for pronounced erosion downstream of the structure. During the field reconnaissance, bed rock was observed at the downstream end of the outlet channel. The bed rock may resist erosion that could undermine the channel. However, because of the undesirable flow conditions, it is recommended that the end of the spillway channel modifications be keyed into the existing bed rock, and the proposed rock apron be grouted with large boulders protruding into the flow.

4 Summary

McMullen Creek Dam forms Lake Selmac in Josephine County, Oregon. The existing dam was built in 1960 and is operated by the Josephine County Parks Department. Lake Selmac is used mainly for recreation. The outlet channel from the McMullen Creek Dam service spillway and emergency spillway is crossed by Lakeshore Drive. Replacement of the Lakeshore Drive Bridge is required. Various deficiencies in the existing dam, dam outlet works and dam spillways have been identified by the OWRD. Necessary improvements to the dam and appurtenant structures include:

(1) Development of a plan to restore the dam crest height reduced by settlement, erosion or other factors – Selected alternative includes raising the embankment to provide 1 ft of freeboard during the PMF event (Section 3.4).

(2) Abandonment of an existing inoperable low level outlet through the dam – Low level must be capped and filled. It was assumed that this action has already been performed.

(3) Design of a mid-level outlet structure through the dam – Selected alternative includes a mid-level outlet structure that can lower the reservoir pool 5 ft below the service spillway crest elevation over 5 days (Section 3.3).

(4) Design of a PMF capable spillway, due to an expected future High Hazard dam designation – Proposed spillway channel meets this requirement (Section 3.5).

(5) Design of new surfacing for the emergency spillway outlet channel - Selected alternative includes re-surfacing the emergency spillway channel (Section 3.4).

A hydrology analysis was completed using HEC-HMS to develop the McMullen Creek Dam inflow hydrographs for the 1% and 2% AEP and PMF flood events. Information about the hydrology analysis is provided in Chapter 2 of this report.

A hydraulic analysis of McMullen Creek Dam was completed using HEC-RAS to determine the maximum reservoir elevation for the 1% and 0.2% AEP flood events and to assess the overtopping potential for the PMF flood event. The analysis of existing conditions indicated that the McMullen Creek Dam embankment would be overtopped for the 1% AEP event if the gates are closed and the PMF event if the gates are open. Several alternatives to safely convey the PMF inflow hydrograph were evaluated.

Based on a review of the hydraulic characteristics, risks, and cost associated with each alternative, the recommended spillway improvement alternative is Alternative 1 (Figure 3-7), which involves raising the embankment crest and resurfacing the existing emergency spillway structure. This recommendation is based on the assumption that the proposed modifications would not adversely impact the embankment stability. A Geotechnical Engineer must be involved in the design of the raised embankment to ensure that the dam embankment is stable during seismic activities. If stability of the embankment cannot be achieve or there is a significant increase in cost to achieve stability, than additional evaluation should be conducted to determine if Alternative 10 would be a more viable alternative due to minimal increase in the embankment (limited to the west side of the embankment). The maximum water surface elevations and outflow during the PMF event would be significantly influenced by whether or not the service spillway gate is open or closed. It is recommended that the gate be open during an extreme flood event. This requirement could be achieved by having the gate remain open during the winter season between December 1st and March 30th. Information about the hydraulic analysis and the alternatives is provided in Chapter 3.

Chapter 3 also contains information related to a proposed mid-level structure and proposed recommendations for erosion control measures at the downstream end of the spillway channel. The recommend alternative for the mid-level outlet is Alternative 3a, which consist of a 48-inch outlet controlled by a 48-inch knife valve. The mid-level outlet would remain closed majority of the time, and it would only be used to lower the reservoir pool during non-flood event.

5 References

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APPENDIX A

FIELD RECONNAISSANCE PHOTOGRAPHS

Photo 1. Looking east along McMullen Creek Dam embankment from the west side near Reeves Creek Road

Photo 2. Looking southeast towards emergency spillway structure

Photo 3. Looking northwest at the area downstream of the emergency spillway structure

Photo 4. Looking northwest along the crest of the emergency spillway structure

Photo 5 Close-up of emergency spillway structure

Photo 6. Looking southeast at the area downstream of the emergency spillway structure

Photo 7. Looking at the radial gate for the service spillway structure

Photo 8. Looking north at the service spillway channel and Lakeshore Drive bridge

Photo 9. Looking south at the service spillway channel downstream of the radial gate structure

Photo 10. Looking southeast at the service spillway channel downstream of the radial gate structure

Photo 11. Looking northwest at the erosion of the embankment from waves

Photo 12. Looking south at McMullen Creek downstream of the Lakeshore Drive bridge

Photo 13. Pan view (Photos 13 and 14) of the rock revetment located immediately downstream of the service spillway channel

Photo 14. Pan view (Photos 13 and 14) of the rock revetment located immediately downstream of the service spillway channel

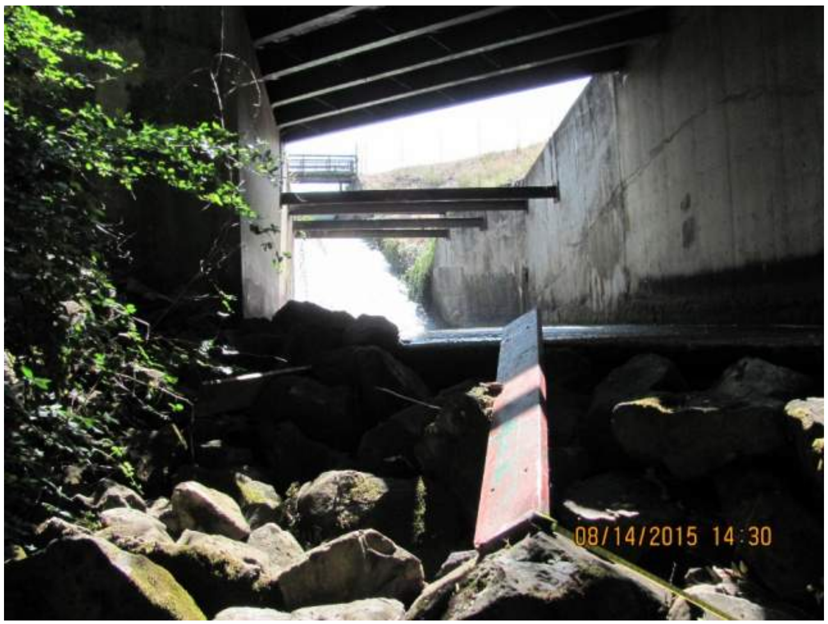

Photo 15. Looking north at downstream end of the service spillway channel

Photo 16. Looking at the bedrock material that exists underneath at the downstream end of the service spillway channel

APPENDIX B

PRELIMINARY COST ESTIMATES

McMullen Creek/Lake Selmac Dam Spillway Improvements
for
Josephine County, Oregon
November, 2015
Class 5 (Concept Screening) Opinion of Probable Construction Cost (OPCC)

					1. Raise Dam 3.9'		2. Raise Dam 3.3' and Construct 118' OG section in Existing Spillway		3. Raise Dam 3.3' and Construct New Outlet		4. Raise Dam 3.1' and Add New 50' Section of Overflow Spillway North of the Existing Spillway		5. Raise Dam 2.7', Construct New Outlet at Tainter Gate, and Add New 50' Section of Overflow Spillway		6. Raise Dam 1.8', Construct New Outlet at Tainter Gate, and Add New 50' Section of Overflow Spillway, and Lower Existing Spillway 1'		7. Raise Dam 1.6', Construct New Outlet at Tainter Gate, Add New 50' Section of Overflow Spillway, and Construct OG Section in Existing Spillway		8. Construct Obermeyer Gate Weir in Existing Spillway at Tainter Gate. Raise Dam 3.8'.		9. Construct Obermeyer Gate Weir in Existing Spillway at Tainter Gate and Emergency Spillway. Raise Dam 0.5'.		10. Construct Obermeyer Gate Weir w/ OG shape in Existing Spillway at Tainter Gate and Emergency Spillway. Raise West Side of Dam 1.0'		Mid Level Pipe Outlet (Add to Altertatives 1-7)	
Item No.	ODOT Spec No.	Item	Unit Price	Unit	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price
10	00210	Mobilization	10% of Items No. 20 - 140	LS	1	$118,000	1	$128,000	1	$155,000	1	$134,000	1	$175,000	1	$159,000	1	$155,000	1	$181,000	1	$210,000	1	$190,000	1	$48,000
20	00280	Erosion and Sediment Control	$25,000	LS	1	$20,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000	1	$25,000		$0
30	00290	Environmental Protection	$20,000	LS	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000		$0
40	00320	Clearing and Grubbing (face of dam)	$7,500	Acre	1.50	$11,300	1.40	$10,500	1.40	$10,500	1.40	$10,500	1.30	$9,800	1.25	$9,300	1.25	$9,300	1.50	$11,250	1.25	$9,300	0.50	$3,800		$0
50	00330	Subgrade Excavation (top and Face of Dam)	$15	CY	3725	$55,900	3600	$54,000	3600	$54,000	3550	$53,300	3475	$52,100	3300	$49,500	3300	$49,500	3650	$54,743	3300	$49,500	1750	$26,300		$0
60	00330	Course Granular/Rock Fill Dam (top and face of dam)	$50	CY	15300	$765,000	12950	$647,500	12950	$647,500	12175	$608,800	10700	$535,000	7800	$390,000	7325	$366,300	14900	$744,985	4850	$242,500	4250	$212,500		$0
70	00390	Riprap Protection (lake side face and top of dam)	$75	CY	3475	$260,600	3225	$241,900	3225	$241,900	3150	$236,200	2975	$223,115	2675	$200,600	2650	$198,700	3400	$254,965	2275	$170,600	350	$26,300		$0
80	00330	Emergency Spillway Excavation	$50	CY		$0		$0		$0		$0		$0	150	$7,500		$0		$0		$0		$0		$0
90	00445	48" Diameter Pipe for Mid Level Outlet	$1,500	LF		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	50	$75,000
100	00500	Reconstruct Existing Outlet at Tainter Gated Spillway	$500,000	LS		$0		$0	1	$500,000		$0	1	$500,000	1	$500,000	1	$500,000	1	$500,000	1	$500,000	1	$500,000		$0
110	00500	Construct OG Section w/Foundation	$2,000	LF		$0	118	$236,000		$0	168	$336,000	168	$336,000	168	$336,000	168	$336,000		$0		$0		$0		$0
120	00500	Construct Obermeyer Weir w/ Foundation	$7,500	LF		$0		$0		$0		$0		$0		$0		$0	20	$150,000	138	$1,035,000	138	$1,035,000		$0
130	00500	Mid-Level Inlet and Outlet Structure	$400,000	LS		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	1	$400,000
140	00640	Aggregate Base (for new dam top road)	$50	CY	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700	975	$48,700		$0
		Construction Estimate Subtotal				$1,300,000		$1,412,000		$1,703,000		$1,473,000		$1,925,000		$1,746,000		$1,709,000		$1,991,000		$2,311,000		$2,088,000		$523,000
		Mid-Level Pipe Outlet Subtotal				$523,000		$523,000		$523,000		$523,000		$523,000		$523,000		$523,000		$0		$0		$0		
		Project development (design and construction engineering, contract administration, etc.) @ 30%				$390,000		$423,600		$510,900		$441,900		$577,500		$523,800		$512,700		$597,300		$693,300		$626,400		
		Construction Contingency @ 40%				$520,000		$564,800		$681,200		$589,200		$770,000		$698,400		$683,600		$796,400		$924,400		$835,200		
		Total Class 5 OPCC Estimate				$2,733,000		$2,923,000		$3,418,000		$3,027,000		$3,796,000		$3,491,000		$3,428,000		$3,385,000		$3,929,000		$3,550,000		

Notes 1 Dam improvements based on spillway gate open in hydraulic anaylsis.

ATTACHMENT 3

2015 DAM INSPECTION REPORT

Oregon
Kate Brown, Governor

Water Resources Department
725 Summer St NE, Suite A
Salem, OR 97301
(503) 986-0900
Fax (503) 986-0904

April 3, 2015

Doreen Ferguson
Josephine County Parks
125 Ringuette St.
Grants Pass, OR 97527

Re: McMullin Creek Dam (M-46) – Inspection Summary

This dam was inspected on March 23, 2015. I performed the inspection with Kathy Smith, Doreen Ferguson, Josh Sabota and others from Josephine County were also there for the inspection. The Water Resources Department conducts inspections of the dam's exterior surfaces to identify conditions that might affect the safety of the dam. This expedited inspection also included an evaluation of recent damage to the overflow spillway. Dams are assigned a hazard rating based on downstream hazard to people and property, not on dam condition. McMullin was just reclassified as a high hazard dam.

Summary: Vegetation control and maintenance of the radial gate structure on this dam has been very good. However, a potential serious issue occurred during a recent moderate rainstorm, and this issue may indicate that the spillway cannot safely pass future flood events. Concern with the low level conduit remains, as it is not able to be opened or closed, and is leaking an unknown but relatively small volume of water. Both issues call for an engineering determination of alternatives to return the dam to a safe condition.

Results of Inspection:


Discussion at primary and overflow spillway

The timing of this inspection was expedited based on an e-mail from county parks employee Josh Sabota. A section of the concrete lining of the spillway channel had been removed by recent storm flows, and this resulted in a hole at the junction of the two channels.

Spillway discharge channels

The hole is located where the principal and overflow spillway converge. Note the steel beams bracing the spillway discharge channel walls. These beams have been in place for some time, and were installed because the walls were moving. The flow seen is the photo above was only through the radial gate, as the overflow spillway was not flowing. The road bridge seen in the background is scheduled for replacement so there should be an opportunity to work on the connected spillway at the same time.

Loss of spillway protective slab

The photos above show the location of the damaged concrete spillway slab. A hole up to 3 feet deep has been scoured below the slab at the junction with the spillway discharge channel retaining wall. This has exposed the soil under the slab, which at this location consisted of pebbles in a silty-clay matrix. This soil is highly erodible if subjected to flowing water. This appears to be a serious safety issue with the overflow spillway.

Entrance to overflow spillway

The reservoir level was 4.5 feet below the dam crest when inspected. Minimum freeboard was 3.2 feet, which is not adequate. The crest of the overflow spillway (control section) is narrow and uneven. Because of this, flood flows can concentrate on a specific location and might rapidly wear down the approach section. The depth of the reservoir near this area is unknown, but if it is deep it is a major concern. In addition, it is likely the overflow portion of the spillway is undersized for the inflow design flood of a high hazard dam, which is the probable maximum flood.

Radial gate control and gears

The primary spillway is controlled by a radial lift gate. The lift cables were replaced since the last inspection and can be operated by one person, Josh Sabota demonstrated this as we arrived. The access to the gate controls are reasonable secure, and the gate wheel can be locked with a secure chain. This is the only part of the spillway that is functioning correctly.

Grid reinforcing of spillway channel

The concrete liner of the overflow spillway is in very poor condition. In some locations, the concrete was lightly reinforced with the wire mesh shown above. The mesh is exposed in places, and has rusted through in some locations. The concrete liner is now at the end or beyond its useful life.

Wave erosion on upstream face

Former control for low level conduit

There is wave erosion that is narrowing the crest of the dam in a few locations close to the spillways. We discussed placement of rip rap as maintenance for this wave erosion in the locations where waves have eroded a significant amount of embankment material. A shallow layer of 6-12 inch diameter rip rap should be sufficient.

Most of the dam does not have significant wave erosion; there is no erosion around the remains of the control for the low level conduit shown in the photo on the right. These controls have been non-functional for a long time, so there is no way to easily lower the reservoir level in an emergency.


Crest and downstream slope

Maintenance and control of vegetation on this dam is outstanding. The low grass protects the dam from erosion, and allows for observation of all exposed dam surfaces. It also allows identification of seepage. No seepage, other than the conduit was observed during the inspection. No significant animal burrows were observed. Trees have been cleared so that they are restricted off the abutments and well off the dam. No signs of embankment instability were observed.

Outlet of low level Conduit

The conduit shown is a 14 inch diameter thin steel pipe on the drawings. It is badly corroded at the outlet. As can been seen in the photo above, water on the left side of the photo and around the conduit is fairly clear, indicating leakage through the conduit. As long as the conduit is submerged, the rate of leakage is unknown.

As we discussed on site, an Emergency Action Plan (EAP) is critical for this dam, and we will draft one for your review.

Additional engineering measurements and analysis are needed to determine repairs needed to keep McMullin Creek Dam safe. An engineer qualified in hydraulics and spillways should perform this work. This dam is now a safety priority for Oregon's dam safety program and as such, we should be able to assist the county in funding the rehabilitation. At a minimum this will include: spillway design, addressing the conduit, and determining the probable maximum flood in order to ensure the dam is safe consistent with its high hazard rating.

Recommendation(s):

1. Bring on a qualified engineer to develop alternatives that allow the spillway to safely pass the design flood, and to ensure the conduit cannot result in uncontrolled leakage through the dam.
2. Place rip rap on the upstream face to replace embankment lost to erosion and to prevent additional wave erosion.
3. Continue excellent vegetation maintenance on the dam.
4. Work with OWRD and the Josephine County Emergency Manager on an Emergency Action Plan that addresses the current condition and the need to open the radial gate during projected wet periods.

We use a standard inspection form, and a copy of the field inspection sheet for this dam is attached. Thanks again for meeting with Kathy and I on site. Please let me know if you have any questions about this inspection, and we will stay in contact on additional analysis of the safety of the dam, and necessary repairs.

Sincerely,

Keith Mills, P.E., Dam Safety Engineer
(503) 986-0840
Cell (541) 706-0849

C: Brenda Bateman, Technical Services Division Administrator
Kathy Smith, Watermaster District 14
Dam Safety File M-46

State of Oregon
Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1271
(503) 986-0900

Dam Safety Inspection Form

Name of Dam: McMullin File #: M-46

Height: 33 ft. Storage: 2000 ac. ft. Permit:R-5552 NID #: OR-00513

Hazard: ☐ Low ☐ Significant ☒ High ☐ **Request Inundation Analysis for change**

Inspector(s):Mills, Smith Watermaster District: 14

Others on site:Doreen Ferguson and many others

Date: 3-23-15 Weather: Cold showers

Prior Inspection Date:4-30-13 Issues from prior inspection: Condition of radial gate, non functional conduit, hazard

Expedited Re-inspection Needed: ☒ Next Inspection Date: 2015

Rating Criteria: *5-Very good; 4-Adequate 3-Maintenance or minor repair needed*
2-Serious repair needed; 1- ***Urgent dam safety issue – action now - Contact dam owner and dam safety engineer directly***

I. Dam	☒ **Earth** ☐ **Rock** ☐ **Concrete** ☐ **Other**	**Rating**
Up. Slope	Vegetation, Animals, Erosion, Wave Action, Depression, Whirlpool adjacent erosion	3
Crest	Width, Surfacing, Vegetation, Trampling, Depression, Cracks, Breaching narrowed in places	3
Down. Slope	Vegetation, Animals, Erosion, Seepage, Leak (muddy), Bulge, Depression, Slide low grass	5
R. Abutment	Vegetation, Animals, Erosion, Seepage, Leak (muddy) trees back correctly	4
L. Abutment	Vegetation, Animals, Erosion, Seepage, Leak (muddy) trees back correctly	4
Toe	Vegetation, Erosion, Seepage, Leak (muddy), Boil low grass	4
Seepage/leak flow	Right 0 gpm Center 0 gpm Left 0 gpm Other 0 gpm (use comment)	4
Auxiliary dike (s)	☒ No ☐ Yes ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ over 5	-
Comments:		

II. Reservoir	**Pool elevation: -4.5**	**Point of Reference**: crest	**Rating**
Minimum freeboard	Vertical distance debris from debris line to crest 3.2 ft.		3-
Floating Debris/Trash	☐ Clean ☐ Around reservoir ☐ Near spillway		4
Log Boom	☐ Not needed ☐ Present ☐ Needed ☐ Deterioration ☐ Ineffective		-
Unusual Conditions	☐ None ☐ Active Landslide ☐ Wildfire in Watershed ☐ Other (comments)		3
Comments:	recent high water		

III. Toe Drains #	NA								
Flow (gpm)									
Damage									
Sediment									
Rating									

IV. Conduit	Control: ☐ Manual ☐ Power ☐ Other ☒ Conduit Control missing		Rating
Inlet	☒ Submerged ☐ Debris on Trash Rack ☐ Deterioration		-
Trickle tube	☒ None ☐ Screened ☐ Blockage ☐ Deterioration		-
Control/Stem	☐ Operable ☐ Damaged ☐ Missing Not functional		2
Valve(s) cycling	☐ Frozen ☒ unknown ☐ past year ☐ frequent		3
Size: 14"	Material thin steel	Condition badly deteriorated	2
Outlet Structure	☐ Overgrown ☐ Clean ☐ Pressurized ☒ Leaking gpm		3
Secondary outlet	☐ Yes ☒ No Type Diameter in.		-
Comments:	needs to be grouted		

V. Spillway	☐ Earth ☐ Rock ☒ Concrete ☒ Other	Rating
Modifications	☐ None ☐ Reduction in capacity ☐ Feature not on design	
Approach Channel	☒ Clear ☐ Trees/brush ☐ debris ☐ erosion	4
Control Section	Width Depth ☐ Concrete ☐ Rock ☐ Soil ☐ Culvert ☒ Unstable	4
Flashboards/Gate	☐ None ☐ In place ☒ operational ☐ deteriorated	4+
Discharge Channel	☐ Clear ☐ Trees/brush ☒ leakage ☒ headcutting (feet approaching control section, depth feet.)	2
Stilling basin	☒ N/A ☐ Functional ☐ Minor Erosion ☐ Severe Erosion/Undercutting	-
Aux. Spillway	☒ Yes ☐ No (use comments below)	2
Comments:	Has gate and overflow, all issues with overflow and discharge channel	

VI. Access and Security		Rating
Vehicle access	☒ Public road ☐ all weather road ☐ dirt road ☐ cross country	4
Fencing, signage	☐ Remote ☒ Gate ☐ Secure Fence ☐ Camera ☐ Uncontrolled	4
New Structure below dam	Dwelling ft Paved public road ft Other sig building ft	-
Emergency Action Plan	☐ Not required ☐ Completed at dam (dated) ☒ None	**
Comments:	Just needed because of new rating - we will draft for your review	

Instrumentation data reviewed: ☒ N/A ☐ Yes ☐ No

Other:

ATTACHMENT 4

JOSEPHINE COUNTY PARKS DEPARTMENT
LETTER OF SUPPORT

Josephine County, Oregon

Board of Commissioners: Cherryl Walker, Keith.Heck, Simon Hare

PARKS DEPARTMENT
Sarah Wright, Parks Manager
125 Ringuette Street / Grants Pass, OR 97527
(541) 474-5285 / FAX (541) 474-5288
E-Mail: parks@co.josephine.or.us

January 27, 2016

Dear Oregon Water Resource Department,

Lake Selmac was dreamed up in 1959 by two men who desired to find a lake where they could take their grandchildren and teach them how to fish. Since there were no ideal lakes close enough to home, they started a plan to build their own. Through their determination and volunteer efforts, the lake was built and officially dedicated in 1961. At the time, it became the only lake in Oregon built for one purpose: *Recreation.*

Josephine County Parks still to this day believes in the importance of recreation and the many benefits that it provides to both individuals and the community as a whole. Parks and recreational opportunities help to create healthy individuals; there have been studies showing significant correlations to reductions in stress, lower blood pressure, and perceived physical health to the length of stays in parks. The lake also helps to increase the quality of life in the community, as well as proving a gathering place for friends and family, which promotes social interaction. The community also benefits from the lake attracting people to the area, which generates money for the local economy, resulting in providing jobs to residents.

Lake Selmac spans over 160 acres and provides lots of recreational opportunities; it is a destination for outdoor enthusiasts. The lake offers overnight camping for both those coming with tents and those traveling in an RV. Families can enjoy activities such as hiking, fishing, boating, sailing and swimming. The lake has great fishing and is designated as a trophy bass lake by the Oregon Department of Fish and Wildlife. Twice, the Oregon record bass has been caught out of the lake!

Lake Selmac is the only lake in Josephine County. Although there are a few ponds in the area, the closest waterway for boating, other than the Rogue River, are Galesville Reservoir (63.5 miles away in Douglas County), Applegate Lake (58.2 miles away in Jackson County), and Lake Earl (67.8 miles away in Del Norte County, CA).

Josephine County Parks hopes that the original dream of providing fishing and recreational opportunities to the residents of our County is here for many more generations. The only way to do this is to ensure that the dam that creates our lake is properly maintained. Repairs are currently needed for the dam, specifically to the spillway and the bridge that is attached to it. We hope that the importance of this project is realized and that funds will be secured for the needed repairs.

If you have any questions about Lake Selmac, please don't hesitate to contact me directly.

Sincerely,

Sarah Wright

JOSEPHINE COUNTY, OREGON
SINCE 1856
PROUD TO BE THE BEST

Josephine County, Oregon

Board of Commissioners: Simon Hare, Keith Heck, Cherryl Walker

PUBLIC WORKS
Robert Brandes, Director
201 River Heights Way, Grants Pass, OR 97527
(541) 474-5460 / FAX (541) 474-5475
TDD# (800) 735-2900

February 3, 2016

Selection Committee,

This letter is in support of the Water Conservation, Reuse and Storage Feasibility Grant Application recently submitted by Josephine County Public Works to the Oregon Water Resources Department. Matching grant funding in the amount of $73,000 has been identified and is available through the Josephine County Economic Development Account/Fund. Use of these funds for the feasibility study will require County Board of Commissioners approval following the award of the feasibility grant. County match funding will be available no later than May 1, 2016 pending final County Commission approval.

Sincerely,

Charles DeJanvier, PE
County Engineer
Josephine County Public Works Department