



DEPARTMENT OF
ECOLOGY
State of Washington

2019 Periodic Inspection Report

*Reflection Lake South and North Dams
Spokane County, Washington*

November 2019

DSO File SP55-0050, 0362

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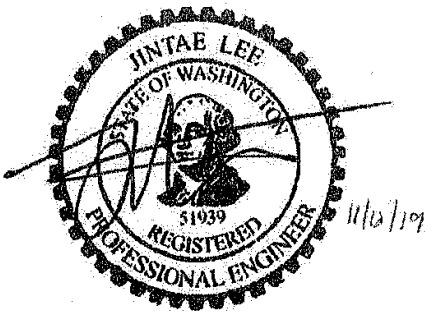
Dam Safety Office guidance information – <https://ecology.wa.gov/Water-Shorelines/Water-supply/Dams>

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2019 Periodic Inspection Report

Reflection Lake South and North Dams Spokane County, Washington

The dam safety inspection of Reflection Lake South and North Dams, engineering analyses, and technical material presented in this report were prepared under the supervision and direction of the undersigned professional engineers, in accordance with RCW 43.21A.064(2).



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Introduction

In accordance with RCW 43.21a.064(2), the Department of Ecology, Dam Safety Office (DSO) has the responsibility and authority to inspect the construction of all dams and other works related to the use of water, and to require necessary changes in construction or maintenance to reasonably assure safety to life and property. This report has been prepared in accordance with this statute.

The purpose of this report is to present the results of an inspection of the Reflection Lake South and North Dams. The report provides some background information and a description of the project; results of the May 8, 2019 inspection; and remedial actions based on the findings.

The issues and maintenance deficiencies found during the inspection are covered at the end of the report under Required Remedial Actions.

Project Information

Background

Reflection Lake is located in Spokane County, approximately 20 miles north of Spokane, within T29N, R44E, Section 19 (South Dam) and Section 20 (North Dam). Access to the site is from Milan Elk Road, which leads to Deer Park Milan Road, then to US Highway 2. The dams impound Sheets Creek, which then leads to the Little Spokane River (Figure 2). Reflection Lake and its dams are owned and operated by the Reflection Lake Community Association.

The primary use for Reflection Lake is recreation for the homeowners living around the lake. It was originally built in 1955 as a sport fishing facility. The dams have been modified several times over the course of several decades to meet State Dam Safety requirements for floods and earthquakes. In 1984 there was an extensive amount of upgrades that were performed on the South Dam, including the construction of the current concrete emergency spillway and raising the height of the South Dam around 4 feet. Plans to raise the North Dam to the same elevation were never carried out. The most recent work included the replacement of the slide gate on the downstream side of the low outlet on the South Dam in 2016. There are two spillways (the primary and emergency spillways) on the South Dam and one spillway (the auxiliary) on the North Dam.

Previous Inspection Summary

The previous periodic inspection was performed on April 9, 2014. The inspection found that the dam is in good physical condition and well maintained and operated. The inspection notified a few minor deficiencies that should be corrected: the mesh screen at the entrance to the emergency spillway should be removed and the emergency spillway should be kept free of all of structures that could potentially obstruct free flow through the spillway. The excessive vegetation around downstream of the emergency spillway outlet should be removed. In addition,

the leakage from low-level outlet and the seep near the left abutment of the South Dam should be monitored and the DSO should be notified of any increase in flow.

Field Inspection

The primary field inspection of the Reflection Lake South and North Dams was performed on May 8, 2019. The Dam Safety inspection team consisted of the following personnel:

Name	Aspects Covered
Jintae Lee, Ph.D., P.E.	Coordinator, Geotechnical
Tom Satterthwaite, P.E.	Hydraulic/Hydrology

Gary Long, Jeff Toffer, Charles Bennett, and Steve Hutchison were present as representatives of the Reflection Lake Community Association during the inspection to provide additional information as needed.

Reservoir

Description: Reflection Lake has a surface area of 54.6 acres at the normal pool elevation of 1839.2 feet. The reservoir impounds about 490 acre-feet at normal pool, and can impound 570 acre-feet at the North Dam crest elevation of 1841.0 feet. The original construction of the reservoir actually consisted of two separate cells, with a separating dike that is now submerged but can be clearly seen in recent aerial photos (see Figure 2). The interior dike created a small cell that likely contained less than 10% of the reservoir contents compared to the southern cell of the reservoir. The height of the interior dike, and current depth of submergence, is currently not available.

The reservoir is primarily filled by springs that are fed by groundwater from the terraces to the east of the project, but also receives a portion of its water directly from stormwater runoff. The springs help maintain the reservoir at a nearly constant elevation throughout the year. Stop-logs are placed in the principal spillway entrance year-round to maintain the lake at approximately 1839.2 feet.

2019 inspection: At the time of the inspection, the reservoir was approximately two inches below the emergency spillway on the South Dam. We observed water flowing from both the primary spillway on the South Dam, as well as from the secondary spillway on the North Dam.

Embankment, Abutments, and Foundations

South Dam. The South Dam is a homogeneous earthfill embankment with a maximum height of 18.7 feet (measured at the toe of the downstream invert of the emergency spillway) and a crest width that varies between 14.5 and 20 feet. Though the dam is considered homogeneous, there is a more recent layer of low permeability soil that was placed on the crest and downstream slope of the dam over the entire length that raised the crest height around 3 feet on average, and

created an approximate downstream slope that varies, but one of the steepest portions of the embankment was measured in 2014 with a ratio of 2.3 horizontal to 1.0 vertical (H:V).

2019 Inspection. An examination of the visible sections of the upstream slope revealed that it was in generally good condition. There were no slides, slumps, erosion, or other unusual conditions noted. No obvious deficiencies were observed on the visible elements of the upstream face of the dam. The upstream slope is protected by a layer of cobbles, which appears to be performing adequately in limiting wave erosion (Photo 3).

The dam crest was also in a good condition, no cracks, sinkholes, settlement, erosion, or other signs of instability (Photo 2).

An examination of the downstream face of the South Dam revealed that it was clear of vegetation to about 15 feet down the slope (Photo 4): After that, there were areas covered with vegetation of varying height, which made inspection of the embankment surface more difficult. We observed no obvious signs of instability, such as cracking, slumps, slides, depressions or sinkholes. However, the downstream slope face needs to be armored since it is a loose condition. We recommended to armor the slope face during the inspection before any erosion or depressions occur.

There was one area of seepage near the left abutment that produced standing water on the embankment (Photo 15). Prior inspections have mentioned the presence of seepage in the general area of the left abutment, going back as far as 1999, and the current seepage is essentially the same as noted in the 2014 inspection report. There was no indication of fine sediment transport through the embankment at the time of inspection, but it is required to monitor this area and any other developing seeps.

North Dam. The North Dam is a homogeneous earthfill structure with a height of 8 feet, a crest width of 24 feet, and a crest length of 300 feet. The dam crest slopes down about 1.5 feet from east to west, with the low point at 1841.0 feet near the west abutment. A paved, county road runs across the dam crest. The upstream slope was inclined at 2H:1V, while the downstream slope is irregular, averaging 1.5H:1V.

2019 Inspection. Our examination of the visible portion of the upstream slope revealed no signs of instability, cracks, slides, depressions or other unusual conditions (Photo 6). The majority of the upstream slope is covered with large boulders and the width of the crest is uneven in length.

The crest of the North Dam likewise exhibited no signs of instability such as depressions, sinkholes or slumps, and the roadway surface appeared well maintained. The asphalt patch indicating the location of the repaired auxiliary spillway looked well constructed, as did the patch for the removed trick-tube outlet near the west abutment of the dam (Photo 5).

Our inspection of the downstream face of the North Dam revealed no signs of cracking, slides or instability (Photo 7). No seepage was noted on the embankment of the North Dam. We found a small area of slumping near the left abutment during the inspection (Photo 16). It is required to patch this area with fill materials and monitor periodically. In general, the DSO should be notified if any signs of slumps or depression in the embankment become evident.

Principal Spillway

Description. The principal spillway for Reflection Lake is located on the right abutment of the South Dam. The spillway was constructed in 1957 according to drawings in DSO records, but there are no field or construction logs. The spillway consists of a 15 foot long, 4-foot deep, by 33-inch wide concrete chute, followed by a 30-inch corrugated metal pipe (CMP) under the dam crest, which discharges into a half-round CMP flume which carries flows down the right abutment. A diversion box is also located at the junction between the pipe and the flume, which can carry flow to a water wheel located on the downstream right abutment. The invert elevation of the floor at the entrance to the chute is 1838.3 feet, and the invert of the CMP entrance is 1838.64. Stop-logs are normally placed in slots in the spillway entrance to maintain the normal pool elevation at 1839.2 feet.

The only known modification to the outlet aside from maintenance and repairs is the addition of a solid metal plate covering the fish screen at the pipe inlet, which can slide vertically with a hinge apparatus. It is our understanding that these plates are used to clear the fish screens of debris.

2019 Inspection. At the time of the inspection, water was flowing in the outlet, approximately 1/3 full (see Photo 9). A visual inspection of the downstream chute revealed that the chute and concrete support were in good condition, with no visible damage or instability. The sliding plate at the spillway entrance appeared to be completely lowered, although water was able to pass through. It should be noted that the metal plates would significantly hinder flow through the outlet. In most cases that will not be an important issue, but should be taken into consideration for significant storm events. It is suggested that this plate be kept in an up position as much as possible.

Emergency Spillway

Description. The emergency spillway is located at the center of the South Dam embankment. The spillway consists of a reinforced concrete open channel, with a width of 10 feet, and an entrance elevation of 1939.8 feet. The sidewalls have a constant height of 4 feet along the 104-foot length of the channel. The downstream end of the channel rests on a concrete end wall, which is founded on bedrock. The spillway discharges into a layer of riprap at the downstream toe of the dam.

2019 Inspection. At the time of the inspection, water was approximately 1-2 inches lower than the spillway entrance. A visual inspection of the spillway structure at the crest and the downstream embankment did not show any signs of failure or instability (see Photos 10 and 11), aside from minor cracking. It is recommended that significant cracks be cataloged and monitored to track long-term settlement or deterioration of the concrete.

Auxiliary Spillway

Description. On the North embankment, the original auxiliary spillway, a 30-inch steel pipe, was replaced in 2006 after serious defects were found during the previous Periodic Inspection. The new spillway pipe is a 24-inch CMP with a stop log gate at the entrance. There are photos of the

construction, although it is not known who from the DSO was present during the construction. There are no design or as-built drawings of the project in DSO records. Similar to the primary spillway, there is a fish screen and adjustable metal plate at the entrance, which we understand was installed in 2009.

2019 Inspection. At the time of the inspection, the spillway pipe was flowing, and the sliding metal plate was covering the entrance, although it is not known if it was fully lowered (see Photo 12). The concrete headwall appeared to be in good condition, with no visible signs of deterioration in the concrete structure. The downstream outlet appeared to be in similarly good condition, with the corrugated metal pipe in good condition (see Photo 13). We noted a small tree in close proximity to the outlet pipe (see Photo 7) which should be removed before its root system starts to damage the outlet pipe. Similar to the Principal Spillway, we recommend that the plate be kept in an up position as much as possible.

Outlet Works

Description. The low-level outlet works for the South Dam are located near the center of the embankment, about 130 feet east of the emergency spillway. The outlet works consist of a 15-inch diameter slide gate, a 115-foot long steel pipe, and a downstream concrete headwall and two gate valves. The upstream gate is accessed by boat, and is normally kept in the open position. The downstream valves consist of a 15-inch gate valve with an 8-inch gate valve immediately downstream, which had been recently replaced in 2016. The downstream valves are normally kept closed, placing the pipe under full reservoir head most of the time.

2019 Inspection. At the time of the inspection, the low-level outlet could not be inspected at the upstream end, but the downstream end was clear of vegetation (see Photo 14). The valves were not opened during the inspection, but appeared to be in good condition.

Evaluation and Analysis

Condition Assessment

Based on observations made during the inspection, the condition assessment of the dam is considered to be **Fair**. This condition assessment is in line with the system used by the National Inventory of Dams (USACE 2008)¹ to classify dams with no existing dam safety deficiencies recognized for normal loading conditions.

Downstream Hazard Assessment

A downstream hazard classification of Hazard Class 1C, *High* down-stream hazard potential is assigned to the South Dam. A downstream hazard classification of Hazard Class 2, *Significant* down-stream hazard potential is assigned to the North Dam. The downstream hazard class is

¹ USACE, National Inventory of Dams, US Army Corps of Engineers, Washington DC. Version 4.0, Page 16. April 2008.

based only on the level of development downstream of the dam, and is not a reflection of the dam's compliance with Dam Safety requirements.

Although there does not appear to be any significant changes to the downstream environment since the last inspection, factors such as an increase in the downstream population, as well as updates to hydrologic or hydraulic information, may necessitate a re-evaluation of the hazard classification level.

Hydrology and Spillway Adequacy

Hydrology. Previous hydrologic studies for Reflection Lake were performed in 1980 to establish precipitation and storm runoff standards based upon the HMR-43 methodology. An updated hydrologic analysis was performed in 1999 in order to incorporate newer standards for developing Inflow Design Flood (IDF), and was based upon NOAA Atlas 2 rainfall data and regional temporal storm distributions developed for Dam Safety's Technical Note 3 Guideline.

For the 2006 Periodic Inspection, a review of the 1999 hydrologic analysis and IDF estimation was performed, and it was found that the assumptions made were still reasonable, and that there had been no significant changes to upstream land usage that may change the runoff hydrograph. At the time, there was an updated rainfall estimation methodology that used gridded rainfall data, but the older rainfall data had been used instead.

As part of the 2019 inspection a review of the prior hydrologic evaluation was performed. This evaluation included the use of GIS based topographic data and aerial photos, which had not been available at the time, as well as the most up to date rainfall data developed for the Technical Note 3, which had been updated in 2009. The results of the evaluation indicate that the methodology used was appropriate, including the use of a 72-hour winter storm with snowmelt runoff as being the critical design storm. Other parameters, such as infiltration rate, appear to be reasonable, as there has been little change in land use over the last 10-20 years. One important piece of information that appears to be inaccurate is the size of the watershed, previously estimated to be 237 acres, had not been evaluated since 1999, and was performed with paper maps being the only source of information. A re-evaluation of watershed size, using digital topographic data, revealed that the watershed size is around 415 acres. As a result, the amount of potential stormwater runoff may be significantly higher than what had been originally estimated.

Spillway adequacy. Over the past 30 years, there have been multiple hydraulic analysis updates for this site due to multiple projects that produced modifications in the outlet capacity of Reflection Lake, such as the installation of the Emergency Spillway on the South Dam and the modification of the outlet on the North Dam. At one point there was a fourth spillway (an 8-inch drop inlet spillway) which had to be removed due to pipe failure.

The current outlet capacity is provided by three spillways, with a concrete open channel spillway in the South dam being the largest of the three. The other two are culvert style spillways, a 30-inch CMP culvert near the right abutment of the South Dam, and a 24-inch CMP culvert near the center of the North Dam. The 24-inch culvert is the most recent addition, and had been a replacement of a 36-inch CMP culvert in the same location. It is not known with certainty if the invert of the 24-inch pipe is the same as the original 36-inch pipe.

The most recent evaluation of hydraulic capacity, performed in 2007, concluded that the minimum freeboard in the reservoir during an IDF event would be around 0.16 feet below the North Dam, and the outflow at this water elevation would be around 48 cfs. This is less than the minimum emergency freeboard of 0.5 feet typically required of new dams by the DSO for dams that are less than 15 feet high. Being an existing dam, the estimated freeboard capacity was considered adequate at the time, and is roughly the same as the 0.20-foot estimate from the 1999 evaluation. Since the South Dam is around 3 feet higher than the North Dam, the estimated freeboard is well above the 0.75 feet required for a dam that is between 15 and 50 feet tall. As an additional note, the new sliding plates that were placed at the inlets of the two culvert spillways have not been evaluated to determine if they significantly reduce the flow of water while they are down. As a general precaution, it is recommended that they be kept in an up position while they are not in use.

Conclusions: Based on our evaluation, which was primarily a review of past data, a new hydrologic analysis will need to be performed in order to produce an updated Inflow Design Flood. Additionally, the capacity of the spillways and the resulting maximum water elevation will be reevaluated. Given the already inadequate freeboard produced by the analysis of the existing outlet system, it is possible that additional remedial action will be required for the Reflection Lake Dams.

Since the DSO performed the prior analysis, we will perform the updated analysis, although the owner at their discretion may hire a professional engineer licensed in the State of Washington to perform the required analysis.

Embankment Stability

As part of the 2019 Periodic Inspection, a review of the previous slope stability analyses of the embankment was performed. This review confirmed that the methodology used in the analysis is still the standard procedure for the DSO; and, that the assumptions as to the properties of the embankment and foundation soils and loading conditions made for the analysis are still appropriate. Based on this review, we believe that this evaluation is still acceptable for the dam, as there have not been changes to the static and seismic loading conditions and to the physical or structural elements of the embankment that guarantee a new evaluation.

The embankment appeared to be well-maintained, and seemed to be performing satisfactorily. No evidence of past or present instability was noted on the embankment. Based on the previous slope stability evaluations and 2019 field observations, the slope stability of the embankments is judged to be adequate at this time.

Operation and Maintenance

Procedures and responsibilities for normal operation of the facility, monitoring and inspection of the dam, and for scheduled maintenance and unscheduled repairs of the dam and related facilities and equipment are described in the Operation and Maintenance (O&M) manual. A written O&M manual for the dam has been prepared and a copy provided to the DSO.

The O&M manual dated 2017 is on file with DSO. The O&M manual needs to be updated with any changes and additional information. If you need any assistance, contact Charlotte Lattimore at (360) 407-6066 or by e-mail at charlotte.lattimore@ecy.wa.gov.

Emergency Preparedness

The Emergency Action Plan (EAP) identifies potential emergency conditions at the dam, prescribes procedures to be followed to minimize loss of life and property damage, and provides a list of actions that may be taken to prevent or slow down failure of the dam. An EAP dated 2016 is on file with DSO; however, the dam owner or their agent responsible for inspecting, operating, and maintaining the dam needs to complete their review of the EAP to confirm its appropriateness and accuracy, and to add any missing information.

Responsible parties need to be familiar with the plan, and aware of their responsibilities in an emergency. For further EAP assistance, please feel free to contact Charlotte Lattimore by electronic mail at charlotte.lattimore@ecy.wa.gov or by telephone at (360) 407-6066.

Annual Inspections

A periodic inspection of the dam on an annual basis should be conducted by the dam owner/operator, and the findings recorded on an inspection form included in the O&M manual. A copy of the completed annual inspection documentation should be submitted to the DSO. Dam Safety has received the completed annual inspection documentation for the past ten years.

Remedial Actions Required

This inspection found that the Great Depression Dam is in satisfactory physical condition. Dam Safety did not observe any particular issues with regard to the physical facilities at the dam. The physical condition of the embankment and overflow spillway appears to be similar to previous dam safety inspections. Our investigation turned up the following maintenance, which will need to be addressed. Please respond with a schedule for completing the tasks listed below within 60 days of the receipt of this report.

1. Provide elevation survey. In order to adequately evaluate the hydraulic capacity of the Reflection Lake outlets, an elevation survey of the outlet structures, including invert elevations will need to be performed by a licensed surveyor. Additionally, an elevation survey will be needed for the dam crests. It is also recommended that a permanent survey benchmark be placed on each dam.
2. Armor slope face of South Dam. The downstream slope face on the South Dam needs to be armored before any erosion or depressions occur.
3. Monitor seepage near left abutment of South Dam. There is a seepage area near the left abutment on the South Dam that produced standing water on the embankment. It is required to monitor this area periodically to determine if there are any significant changes on the amount of water and/or if signs of increased seepage such as bubbles or dirty water flow are present. In the event of any significant changes, the DSO should be notified as soon as

possible to evaluate the situation. An item should be included in the O&M manual for the facility in this regard.

4. Monitor slumping area near left abutment of North Dam. We found a small slumping area near the left abutment on the North Dam. It is required to patch this area with fill materials and monitor periodically. The DSO should be notified with any signs of slump or depression.
5. Update the O&M manual. Please provide any necessary updates for the O&M document for the facility. The manual should be completed and a copy submitted to the Dam Safety Office within 180 days of this report.
6. Update the EAP. Please provide an EAP document with current contacts and any other changes that have been applied. For more detail, please refer to the Emergency Preparedness sections above.

References

Bibliography

USACE. *National Inventory of Dams*, US Army Corps of Engineers, Washington DC. Version 4.0, Page 16. April 2008.

Douglas Johnson and Gustavo Ordonez. *Periodic Dam Safety Inspection Report, Reflection Lake Dam Dams*. Washington State Department of Ecology, Water Resources Program, Dam Safety Office. September 1999.

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Additional Resource Material

Appendix B: Water Resources Program, Dam Safety Section. *Dam Safety Guidelines, Part I: General Information and Ownership Responsibilities*. Washington State Department of Ecology Publication No. 92-55A. July 1992. (available at: <https://fortress.wa.gov/ecy/publications/summarypages/9255a.html>)

Appendix C: Water Resources Program, Dam Safety Section. *Dam Safety Guidelines, Part II: Project Planning and Approval of Dam Construction or Modification*. Washington State Department of Ecology Publication No. 92-55B. February 2008. (available at: <https://fortress.wa.gov/ecy/publications/documents/9255b.pdf>)

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Appendix E: Water Resources Program, Dam Safety Section. ***Dam Safety Guidelines, Part IV: Dam Design and Construction***. Washington State Department of Ecology Publication No. 92-55D. July 1993. (available at:

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Appendix H: Federal Emergency Management Agency. ***Technical Manual for Dam Owners, Impacts of Animals on Earthen Dams***. FEMA Publication No. 473. FEMA. September 2005. (available at:

http://www.swc.nd.gov/pdfs/impacts_animals_earth_fema473.pdf)

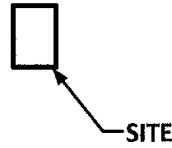
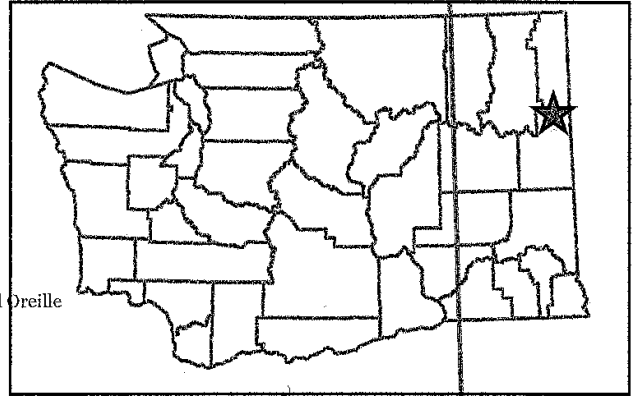
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Appendix J: Water Quality Program. ***2012 Stormwater Management Manual for Western Washington***, (amended Dec. 2014). Washington State Department of Ecology Publication No. 14-10-055. December 2014. (Web: <https://www.ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Stormwater-manuals>.)



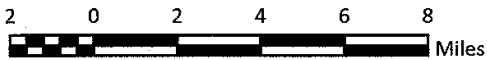
Stevens

Pend Oreille



SITE

Spokane



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

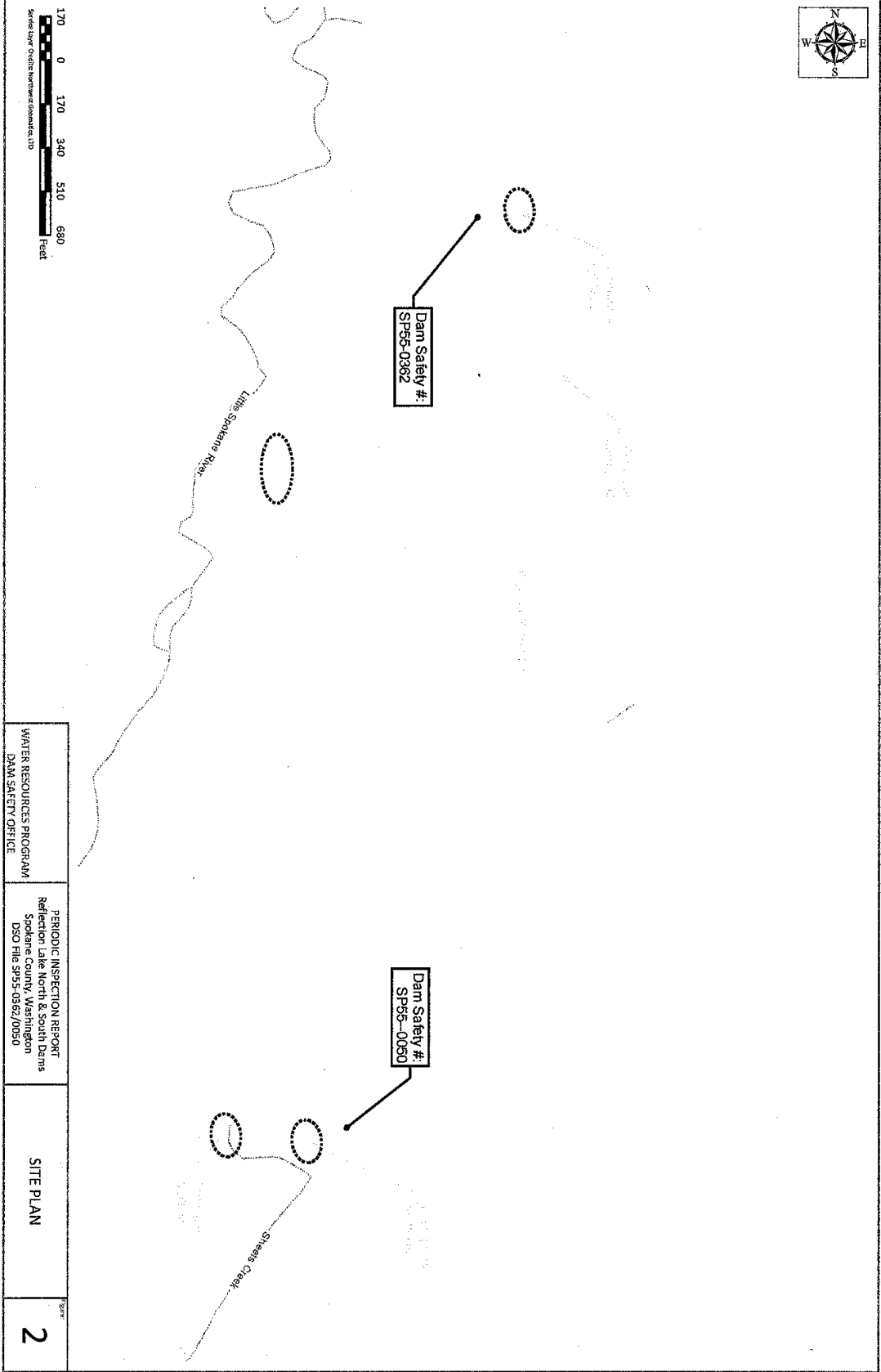
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DSO File SP55-0362/0050

VICINITY MAP

Figure:

1



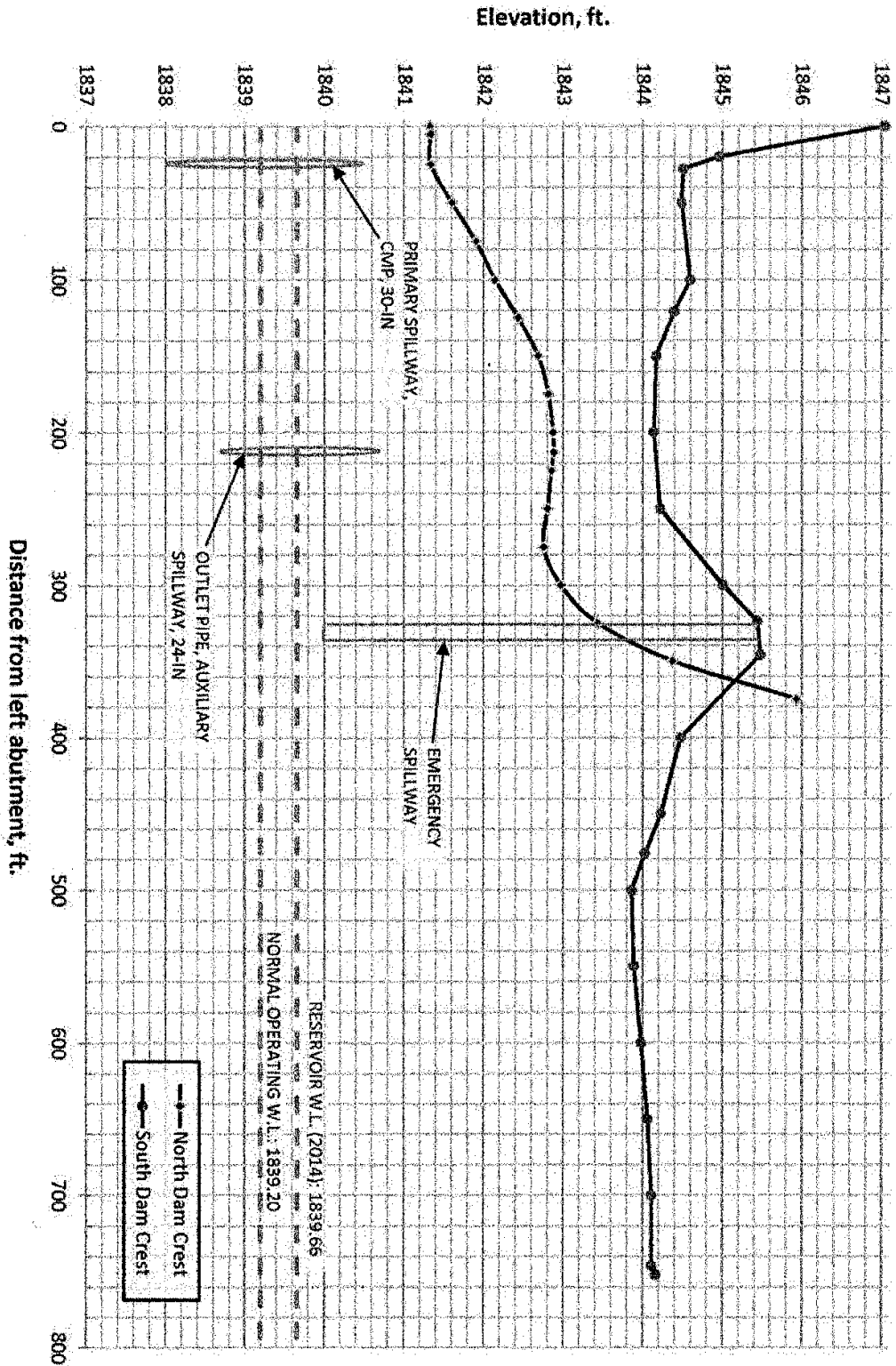
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SITE PLAN

2

Reflection Lake Dams - 2014 Crest Elevation Profiles



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CREST SURVEY
 (2014)

Figure:
3

Appendix A: Project Data Sheet

General

State I.D. Nos.	SP55-0050, 0362
Owner and Operator	Reflection Lake Community Association
Location, Geographic coordinates	Latitude: 48.002773 N; Longitude: 117.283698 E
Construction Completed	1955
Purpose	Recreation for the homeowners
NID Condition Assessment	Fair (inspection date: May 8, 2019)
Downstream Hazard Potential	High, Hazard Class 1C

Reservoir

Watershed	Sheets Creek
Drainage Area	415 acres
Surface Area at Normal Pool Elevation	55 acres
Active Storage at Normal Pool Elevation	490 acre-feet
Maximum Storage at Dam Crest Elevation	570 acre-feet

South Dam Embankment

Type	Homogeneous earthfill embankment
Hydraulic Height	18.7 feet
Crest Elevation	1843.6 feet (1999 elevation survey)
Crest Length	760 feet
Crest Width	14.5-20 feet
Upstream Slope	2H:1V
Downstream Slope	3.5 H:1V

North Dam Embankment

Type	Homogeneous earthfill embankment
Hydraulic Height	8 feet
Crest Elevation	1841 feet
Crest Length	300 feet
Crest Width	24 feet
Upstream Slope	2H:1V
Downstream Slope	1.5H:1V

Emergency Spillway [South Dam]

Type	Reinforced concrete open channel with vertical sidewalls
Location	Center of South Dam
Discharge Capacity	
Overflow Elevation	1,840.0 ft.
Overflow Control Section	Base 10 feet, sides: vertical, 4 ft deep; Length: 30ft; Slope: 0.005 ft/ft
Discharge Channel – section	Base 10 feet, sides: vertical, 4 ft deep
Discharge Channel – profile	104 feet long at slope 0.24 ft/ft,
Inflow Design Flood – Discharge	___ cfs
Inflow Design Flood – Storm	Step 4, ___% PMP; Long, hi int/vol
Inflow Design Flood – Precipitation	24 hr = ___ inch, 72 hr = ___ inch (as calculated per Technical Note 3)
Dimensions	Width: 10 ft, sidewalls: 4 ft, length: 104 ft.

Principal Spillway [South Dam]

Type	Concrete inlet chute, then 30-in. CMP culvert, then 30-in. half-pipe spillway
Location	Right abutment
Overflow Elevation	1,839.2 feet
Discharge Capacity	
CMP inlet Elevation	1,838.0 feet
Outlet Conduit (culvert) – profile	30 feet long, slope: 0.01 ft/ft

Secondary Spillway [North Dam]

Type	24-inch CMP culvert
Location	Northern half of North Dam
Discharge Capacity	
Overflow Elevation	
Outlet Conduit – profile	____ feet long, slope ____ ft/ft

Outlet Works [South Dam]

Type	15 inch diameter steel pipe
Location	center of dam, north of emergency spillway
Discharge Capacity	____ cfs at water level ____ feet
	____ cfs at flow depth ____ feet
Flow Controls	Upstream – slide gate
	Downstream – 15-inch gate valve, then 8-inch gate valve
Intake Elevation	____ feet (pipe invert / centroid)
Outlet Conduit – profile	115 feet long, slope ____ ft/ft
Drawdown Capacity (max drawdown at minimal inflow)	____ feet/day at water level ____ feet ____ feet/day at water level ____ feet



Photo 1: View of Reflection Lake



Photo 2: Reflection Lake South Dam - crest



Photo 3: Reflection Lake South Dam - upstream face



Photo 4: Reflection Lake South Dam - downstream face



Photo 5: Reflection Lake North Dam - crest



Photo 6: Reflection Lake North Dam - upstream face



Photo 7: Reflection Lake North Dam - downstream face



Photo 8: Principal Spillway Entrance on South Dam



Photo 9: Principal Spillway Discharge on South Dam



Photo 10: Emergency Spillway Entrance on South Dam



Photo 11: Emergency Spillway on South Dam, looking upstream



Photo 12: Auxiliary Spillway Entrance on North Dam



Photo 13: Auxiliary Spillway Discharge on North Dam



Photo 14: Low Level Outlet on South Dam



Photo 15: Seepage near the left abutment on South Dam



Photo 16: Slumping area near the left abutment on North Dam