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January 25, 2023

Livingston County Drain Commissioner's Office
2300 East Grand River Avenue #105
Howell, MI 48843

Attention: Mr. Ken Recker, PE
Chief Deputy Drain Commissioner

Re: Faussett Lake Dam Technical Memorandum

Dear Ken:

This technical memorandum serves as follow up to our review of past inspection reports, previous geotechnical reports, and a site visit by Wade Trim staff at the above-referenced dam on December 22, 2022. In addition, the following documents were provided by Livingston County to assist in the preparation of this memorandum. The documents are:

- Faussett Lake Dam Inspection Report dated May 2017, prepared by Spicer Group
- Geotechnical Evaluation Report: Faussett Lake Dam dated April 2022, prepared by SME

Faussett Lake Dam (Identification No. 307) was constructed in the 1960s by a local family and includes 3.8 square miles of watershed for the lake located in Section 33, T04N, R05E, Deerfield Township, Livingston County, Michigan. The existing dam, regulated by the Dam Safety Unit, Water Resources Division, of the Michigan Department of Energy, Great Lakes and Environment (EGLE) under the authority of Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended (Part 315), is classified as a low hazard dam. The 2017 dam inspection report, required by EGLE, indicates the dam and its appurtenances to be in overall fair condition.

It is our understanding the lake residents may petition the County Drain Commissioner's office to establish a legal lake level under Part 307 of Act 451. This memorandum serves to address the condition of the dam as it exists today, discuss alternatives to improve the dam, and to determine a preliminary engineer's opinion of probable construction costs based on the improvements. This will allow the dam and any appurtenances to function as a legal lake level structure.

Findings of Fact

The dam is an earthen embankment dam, approximately 550 feet in length. The crest of the embankment is approximately ten feet wide minimum. There is a private, unpaved drive that traverses at the base of the embankment in an east-west direction. It provides access to a residence south and west of the dam. The drive connects to Faussett Road, approximately 1,600 feet north. The upstream embankment slope is approximately 1:2 (1 vertical to 2 horizontal), while the downstream slope is approximately 1:3 (see Picture 1). Towards both the east and west ends of the embankment are lower lying areas that serve as emergency spillways. They are grass-covered and are not well defined. The westerly spillway (Picture 2) appears to drain across the private drive and into the wetlands/low lying area north of the embankment. This area then drains into the private drain. The east spillway visually appears to start south and east of the embankment and traverses to the point where the private drive turns from east-west to north-south. As seen in Picture 3, it appears this spillway increases in elevation as it approaches the drive. A thorough topographic survey needs to be completed prior to any design work to ascertain the true condition of this spillway. The hydrology of Faussett Lake will require further investigation as it appears from aerial views of the surrounding area that the lake is fed from a watershed of smaller ponds and lakes, notably Barris Lake to the southeast and ponds east of Mack Road.

Picture 1 - Looking east at embankment.

Picture 2 - West spillway.

Picture 3 - East spillway.

A drop inlet structure, approximately 32 feet from water's edge of the embankment (see Picture 4), is comprised of a vertical 24-inch diameter CMP pipe which connects to a 24-inch diameter CMP pipe that extends towards and under the embankment. At the water surface, there is a metal railing system around the drop inlet, safety buoy, and an operating nut and stem for opening and closing a gate down at the connection to the 24-inch horizontal pipe. It is assumed the gate assists in any necessary lake drawdown. The 24-inch connects to a 36-inch diameter CMP that extends to the north to a concrete headwall[(1)], where it discharges into a private open drain. The open drain connects to the Yellow River Drain north and west of the dam.

The existing concrete headwall was inspected and was found to be in very poor condition. The other item found from the December 2022 inspection is the CMP pipe which is identified as a 36-inch diameter, was measured, and found to be 40-inch wide in the horizontal direction (see Picture 5). It is uncertain if the pipe is actually larger than identified or if the pipe has deflected downward, creating a more oval-shaped pipe with the horizontal as the major axis of 40 inches.

Picture 4 - Drop inlet structure.

Picture 5 - Outlet pipe.

There is an area towards the west end of the embankment, on the downstream side, that is exhibiting continuous seepage through the embankment. It is a large wet and soggy area the day of this inspection and the understanding from the owner, as well as other information provided, is that this area is continuously wet.(1,2) The SME Geotechnical Evaluation referenced herein indicates existing soil conditions at the embankment to be largely "embankment fills," consisting of very loose to medium dense silty sand with clayey sane layers. Below the embankment fills are natural clays that are classified as very stiff to hard consistency. It appears from the geotechnical investigation that rather than utilizing an impermeable clay core for construction of the embankment, loose filles were employed that are leading to the seepage through the embankment. In addition, the groundwater in the embankment varies from 0.2 feet below ground surface to +/- 15 feet below. This is a direct result of the Faussett Lake level impacting the groundwater elevations and helps to verify the indication that water seepage is occurring through the embankment.

<u>Conclusion and Recommendations</u>

Quoting the SME report, *"Based on the soil and groundwater conditions encountered in the borings performed for this evaluation, the source of the seepage water that emanates from the slope face is the reservoir or lake behind the embankment.*

Seepage that emanates from a slope face like the downstream embankment at Faussett Lake Dam is troubling because the presence of such seepage can lead to piping of the embankment soils. Piping is when seepage water that emanates from the slope face also carries with its particles of soil from the embankment. Active piping over time, if not addressed, can lead to internal erosion of the embankment and eventually, a sudden failure of a dam, especially during prolonged high-water levels." In the SME report, there is discussion of two alternatives for minimizing/eliminating the seepage through the embankment. The first is a vertical cut-off wall comprised of either steel sheet piling or a bentonite slurry wall. The second alternative is referred to as a drained buttress on the downstream side of the embankment.

It is our understanding in reviewing information and sketches from SME, the buttress is their preferred alternative as it is allegedly less expensive than the vertical cut-off walls and is easier to construct for a general excavating contractor than the cut-off walls. However, it is the opinion of Wade Trim that the drained buttress wall being placed only in the vicinity of the current seepage area does not address the remaining embankment. Per Soil Boring #3 and #4 in the SME boring logs, they have similar loose, wet sand with clay (embankment fill). In fact, Soil Boring #4 has this material showing from approximately 6 inches below grade to 18 feet below grade. It is our opinion this soil appears to be the conduit for seepage through the embankment and the entire length of the embankment. In addition, the SME report appears to infer that seepage will still occur even with construction of the buttress as they discuss the installation of a below grade collector drain, "…to collect the seepage before it emanates from below the buttress."(1) We are concerned that the buttress may reduce the seepage, but not eliminate it over the long term.

We feel the vertical steel sheet piling is a viable alternative to address the entire 550 feet plus of dam embankment. We concur that the slurry wall is a more involved process. However, driving sheet piling is a less involved process that can be done in a progressive movement across the embankment from east to west. In addition, the sheet pile wall will typically stop the long-term seepage through the embankment allowing for a stable embankment with little to no chance of long-term piping of the soils.

We propose the driving process commence at the east end of the embankment, and "X' number of sheets are driven to calculated embedment along the lake side crest slope. Backfilling between the existing forward slope, top of crest, and the sheeting will be completed. The pile driving equipment would then have a wider platform to work from as it progresses along the top of crest. Once the equipment reaches the west end, it can traverse back across the wider top of embankment to the east, be dismantled, and removed from the site. In addition to the cutoff wall, a lake level control structure can be designed utilizing a sheet piling configuration where a portion of the sheeting is cut off and the top of sheeting is set to the established legal lake level. If a drawdown is also necessary to accommodate a winter lake level, a throttle valve can be installed within the sheeting at the winter lake level in order to perform the drawdown and maintain a winter flow by throttling the valve appropriately. The photograph on the following is an example of a lake level structure employing steel sheet piling. The perimeter dimensions of the structure are sized based on the hydraulic capacity requirements to pass a certain size storm event.

LOOKING NORTHEAST AT LAKE LEVEL CONTROL STRUCTURE

Picture 6

An early Preliminary Engineer's Opinion of Probable Construction Costs has been prepared for the sheet pile cutoff wall alternative. Based on the most recent (Third Quarter 2022) unit costs, this alternative is estimated to be on the magnitude of $600,000-$700,000. While the SME report does not identify an approximate cost for the stone buttress alternative, they infer that relative costs and the fact that more earthwork contractors could bid and build this alternative as compared to the number of piling contractors being able to drive a sheet pile wall, make the buttress less costly. Our concern is that while the stone buttress addresses the seepage at the visible location, it does not address potential seepage occurring along the remaining 500 feet, plus or minus, of embankment that contains the same fill material as the location in question. While the stone buttress appears to be a solution to the immediate problem, it does not address future conditions of seepage elsewhere. This may repeat itself a number of times until the sum of the buttress fixes exceeds the cost of the sheet pile cutoff wall.

Based on the above discussion, it is our opinion that while both the stone buttress and the steel sheet piling will improve the stability of the embankment, the sheet piling cutoff wall will additionally halt the seepage of lake water from continuing to infiltrate its way through the fill material of the embankment and potentially cause future problems of failure. Further, utilizing the steel sheeting structure, a legal lake level can be maintained in a relatively inexpensive manner without the need for a more costly concrete structure requiring a more elaborate construction sequencing in the water. Refer to the Appendix for a typical cross-section for each alternative.

Based on the conceptual cost estimates discussed above, we developed a total project cost estimate as follows:

<u>Project Costs</u>

<u>Engineering</u>

1. Study Phase.. $30,000
2. Design Phase.. $45,000
3. Bidding Phase..$3,000
4. Construction Phase............................... $30,000

Subtotal $108,000

<u>Construction</u>...$650,000
Contingency (20%)...$130,000
Total Estimated Costs.......................................$888,000

If you would like to discuss this technical memorandum, please feel free to contact me. We look forward to the possibility of working with your office on the next phases of this project.

Very truly yours,

Wade Trim Associates, Inc.

Jason R. Kenyon, PE
Senior Vice President

Robert R. Breen, PE
Senior Project Manager

JRK:RRB:jlb
LDC 2008-01F
20230120_FAUSETT LAKE DAM TECH MEMO.DOCX
Attachments

cc: Mr. Tanner Kragenbrink, PE, Wade Trim

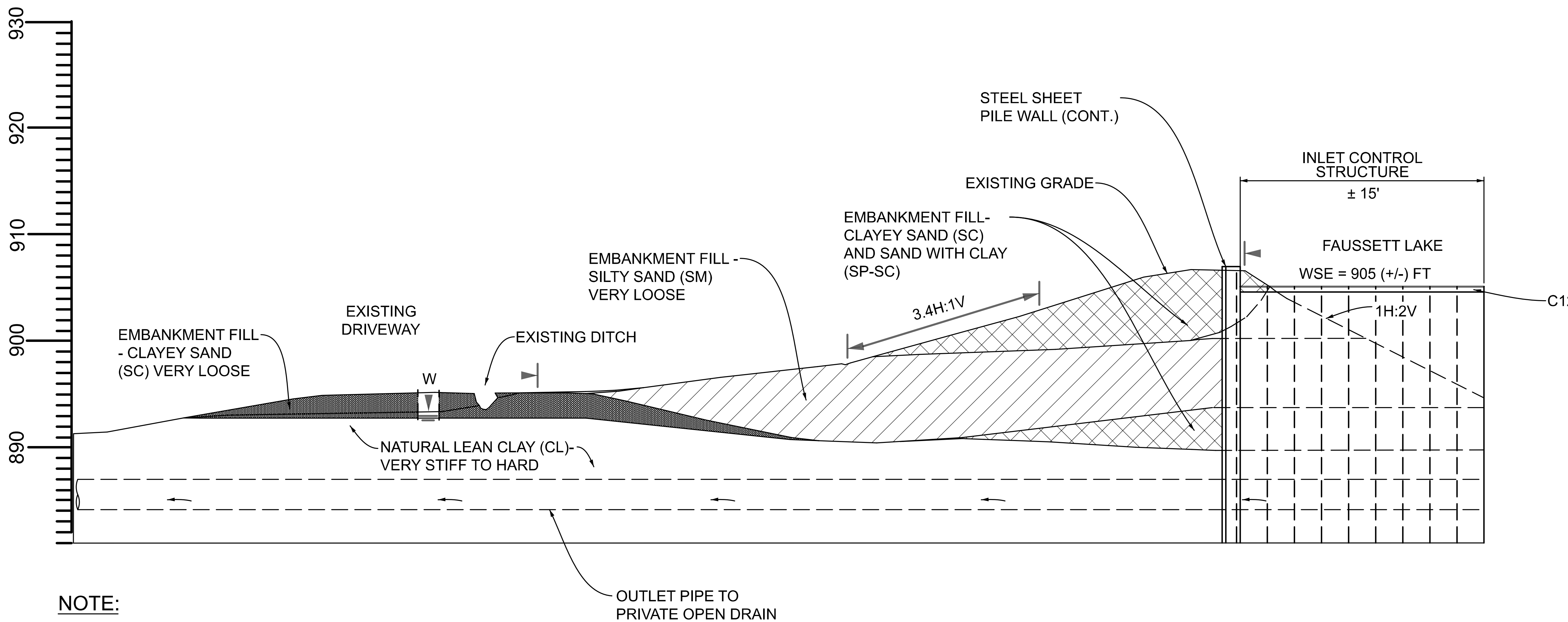
References: (1) Geotechnical Evaluation Report; Faussett Lake Dam; SME; April 7, 2022
(2) Faussett Lake Dam Inspection Report; Spicer Group, Inc.; June 13, 2017

APPENDIX

SHEET PILE CUT-OFF WALL ALTERNATIVE

STONE BUTTRESS ALTERNATIVE

FAUSSETT LAKE DAM PHOTO LOG



NOTE:

SOIL PROFILE SHOWN IS FROM THE GEOTECHNICAL EVALUATION REPORT DATED APRIL 2022

SHEET PILE CUT-OFF WALL ALTERNATIVE

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

WADE TRIM 25251 Northline Rd. Taylor, MI 48180 734.947.9700 www.wadetrim.com

NO SCALE

LDC2008-01F

FILE:

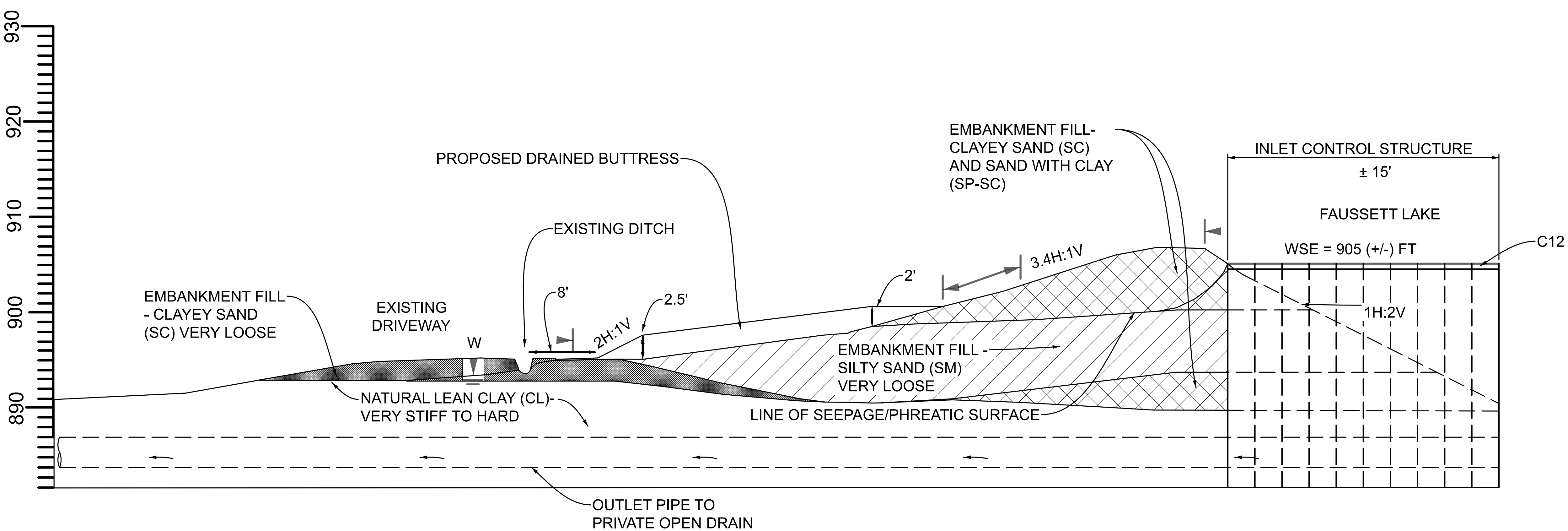
DATE: 01/20/23

FAUSSETT DAM

FAUSSETT DAM SHEET PILE ALTERNATIVE

DRAWING SHEET

SECT



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STONE BUTTRESS ALTERNATIVE

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NO SCALE

LDC2008-01F

FILE:

DATE: 01/20/23

FAUSSETT DAM

FAUSSETT DAM STONE BUTTRESS ALTERNATIVE

DRAWING

SHEET

SECT

WADE TRIM

MEMORANDUM

Faussett Lake Dam Site Investigation
December 22, 2022

Legend
- Existing pipe
- Hand dug ditch
- Flow path
- Seepage area

Figure 1 - Looking north from top of dam at the inlet, 36" drop pipe. Valve on left side of structure.

Figure 2a - Looking west along top edge of dam.

Figure 2b - Looking east along top edge of dam.

Figure 3 - Looking north, low spot lake overflows to the north into ditch.

Figure 4 - Looking north at 24" HDPE culvert.

Figure 5a - Looking south uphill at seepage flow.

Figure 5b - Looking west along road.

Figure 6 - Looking south at emergency overflow area.

Figure 7a - Looking north at lower end of emergency overflow ditch to 12" HDPE/CMP

Figure 8 - Looking east at slope, bank between lake and road is typically wet ,

Figure 9a - Dam outlet, measured 40" CMP, corroding inside and deformed, headwall is falling apart and has sinkhole between road and outlet. Box is the irrigation system used for watering the nearby pumpkin patch, no longer in use.

Figure 9b - Looking north/downstream from outlet.

Figure 10 - Looking east at hand dug ditch to collect seepage flow from lake.