2019 DAM INSPECTION REPORT
WOODLAND LAKE DAM

Submitted to:

ORGANIZATION OF WOODLAND LAKE
c/o Anita Grapentien, President
P. O. Box 617
Brighton, MI 48116-0617
agrapentien@comcast.net

Submitted by:

J.E. TIFFANY AND SONS, LLC
1707 N. 39 Road
Manton, MI 49663

November, 2019

TABLE OF CONTENTS

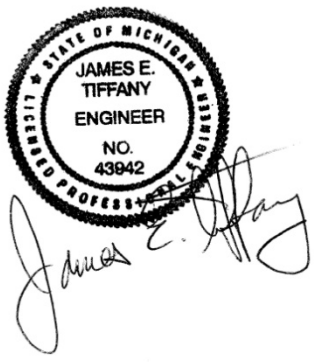
TITLE SHEET

Name of Dam:	Woodland Lake Dam
I.D. Number:	606
County:	Livingston
Location:	Section 19, Town 2N, Range 6E
Stream:	South Ore Creek
Operator:	Ms. Anita Grapentien, President Organization of Woodland Lake P.O. Box 617 Brighton, Michigan 48116-0617 Tel. (810) 229-7894
Hazard Potential Classification:	High Hazard
Evaluation of Dam's Overall Condition: (U.S. Army Corps of Engineers Rating System)	Fair
Inspection Date:	October 9, 2019

Professional Engineer in Responsible Charge of Inspection:

Name:	James E. Tiffany, P.E.
Address:	J.E. Tiffany and Sons, LLC 1707 N. 39 Road Manton, Michigan 49663

Signature & Professional Seal:



CONCLUSIONS AND RECOMMENDATIONS

Introduction

An engineering inspection was performed for the Woodland Lake Dam on South Ore Creek located in Brighton Township, Livingston County on October 9, 2019. This inspection was completed to fulfill the requirements of Part 315 (Dam Safety) of Public Act 451 of 1994. The purpose of this report is to evaluate the condition of the dam based on visual inspection, review of previous inspection reports, and review of plans and other engineering data if available. This report should not be considered an in-depth engineering evaluation. Further detailed investigation and evaluation may be recommended based on the findings of this report.

It is important to note that references to “right” or “left” in this report are based on the orientation of looking downstream and may not correspond with the perspective of right or left of any particular sketch or photograph.

Overall Condition, Summary of Findings

The dam is in good condition overall. The upstream slopes of both the main embankment and causeway embankment are well armored above and below the normal water line to protect the embankment from wave action. The upstream and downstream slopes of both embankments are for the most part covered with trees and heavy brush.

Work is underway to address stability concerns for the "Causeway Embankment". At the time of the inspection, the first phase of work had been completed. A second phase is being planned.

The spillway is in good condition overall and no work is recommended for the spillway at this time.

Computations indicate that at the design flood, the embankments would have a freeboard of approximately 1.1 feet. Based on the limited fetch length for this lake, and limited wave heights, the spillway capacity is deemed to be adequate.

Identification of Deficiencies that could lead to failure of dam

Concerns relative to stability of the causeway embankment, that could lead to failure of the dam, surfaced several years ago. Because not all the recommended work has been completed, the dam's overall condition is listed as "Fair" rather than "Satisfactory".

Prioritization of Recommendations
The following recommendations are made relative to the Woodland Lake Dam:

1) It is recommended that all phases of the work to address the stability issues for the causeway embankment be completed prior to the 2022 inspection.

2) Removal of trees and brush from the dam embankments is strongly encouraged. Tree roots can become potential seepage pathways through an embankment. Large trees that could be uprooted by high winds open up the possibility for voids to be created in the embankment. In addition, brush makes visual inspection difficult and can allow burrowing animals to remain undetected.

3) Continue the previously established monthly monitoring and documentation program as detailed in the 2010 inspection report.

4) It is recommended that an additional trail be mowed: near the downstream toe of the main embankment.

Recommendations for Further Detailed Studies or Investigations
No further detailed studies or investigations are recommended at this time.

PROJECT INFORMATION

Description of Dam, Outlet, Spillway and Other Principal Features
The dam consists of two earth embankments totaling almost 1,500 feet in length. The main embankment, approximately 977 feet in length, runs north/south and contains the spillway. A second embankment, known as the causeway embankment, runs principally east/west and is approximately 460 feet long. The spillway is a fixed crest concrete spillway, 20 feet wide. There is a low level slide gate with concrete discharge tube just outside the left wall of the spillway that can be used for drawing down the lake as necessary. Photographs and sketches are provided in Appendices C and E.

Purpose of the Dam
The purpose of the dam is recreation and aesthetic views for properties on the lake. The lake at normal level is approximately 288 acres.

Summary of Available Background Information
Limited information is available in files located in the Michigan Department of Environment, Great Lakes and Energy (EGLE), Water Resources Division, Hydrologic Studies and Dam Safety Unit. Other information is available from the Organization of Woodland Lake. Apparently, little information is available pertaining to the original construction.

In addition to the regular inspection reports, soils investigations and geotechnical analyses were completed for the main embankment in 1981 and for the causeway embankment in 2010.

Lake level records and observations of the spillway relief wells and of seepage in the toe area of the causeway embankment are available at the Organization of Woodland Lake.

The 2010 dam inspection report provides a good narrative description and listings of other information that have been previously generated for the Woodland Lake Dam.

Reference to Past Inspections
This dam was inspected in 2016 and 2013 by J. E. Tiffany and Sons, LLC and in 2010 by Gary F. Croskey, P.E. Other inspections/reports were completed in 2007, 2004, 2001, 1997, 1994, 1991 and 1978. There is little apparent change in the condition of the dam since the 2016 inspection report.

Date of Construction
The dam was construction about 1928. Subsequent to a 1981 soils investigation and geotechnical analysis, the main embankment was augmented with an additional 40,000 cubic yards of soil to widen the crest, flatten the downstream slope of the embankment and add an elevated bench at the toe.

FIELD INSPECTION

Embankment Observations- Main Embankment

The main embankment consists of two sections, left and right of the concrete spillway. The right section is approximately 820 feet long. The left section is approximately 137 feet long. The embankment has a crest width of at least 20 feet with an upstream slope of about 2 horizontal to 1 vertical and a fairly flat downstream slope of about 3 horizontal to 1 vertical with a bench constructed at the toe that is elevated above the normal ground elevation.

It should be noted that significant areas of the upstream and downstream slope are inaccessible for inspection because of heavy brush and trees. Therefore, the following observations are general observations based on those areas that were observed.

The upstream slope is well armored with poured concrete and rip rap for some distance above and below the normal water line. At the far right there is a wooden seawall protecting the embankment from wave action.

The upstream and downstream slopes are for the most part covered with trees and heavy brush. The crest is mowed periodically. It is recommended that an additional trail be mowed: near the downstream toe of the embankment.

No erosion, cracking, depressions, settlement, beaching or debris were noted on the embankment. No animal burrows were noted on the embankment during this inspection.

Saturated soil and wetland plants were noted about one third of the way up the embankment for about the right half of the embankment. Also saturated soil was noted at the toe area where the main embankment and causeway embankment meet. No seepage flow was noted in these areas. No recommendations, other than continued monitoring, are made at this time for the saturated soil areas.

Embankment Observations- Causeway Embankment

The causeway embankment is approximately 460 feet long. The embankment has a crest width of approximately 25 to 40 feet. A gravel roadway, Causeway Drive, has been constructed along the crest and serves as access to several homes. The upstream slope is about 2 horizontal to 1 vertical with a fairly steep downstream slope of about 1.7 horizontal to 1 vertical.

The upstream slope is well armored with poured concrete and rip rap for some distance above and below the normal water line.

The upstream and downstream slopes are for the most part covered with trees and brush. There is mowed grass on each side of the gravel road along the crest. Removal of trees and brush from the dam embankments is strongly

encouraged. Tree roots can become potential seepage pathways through an embankment. Large trees that could be uprooted by high winds open up the possibility for voids to be created in the embankment. In addition, brush makes visual inspection difficult and can allow burrowing animals to remain undetected.

No erosion, cracking, depressions, settlement, beaching or animal burrows were noted on the embankment. Some woody debris and yard waste were noted in some locations on the downstream slope.

Embankment stability for the causeway embankment has been an issue of concern for several years. Prein & Newhof were hired as engineers to design stability improvements to the causeway embankment. Phase I of this work has been completed with a second (final) phase in the works.

Additional historical information about the stability of the causeway embankment is available in the 2013 inspection report. It is recommended that the Organization of Woodland Lake continue to move forward with the final phase of the causeway embankment work prior to the 2022 inspection.

Low Point Along Hilton Road

At the time of the 2013 inspection, survey shots were taken to determine the elevation of a low point where Hilton Road traverses near the lake at 3559 Hilton Road. The low point there was determined to be approximately elevation 935.19 indicating that water would spill over in this area at a depth of about 8-1/2 inches during the design flood and would likely spill over for anything greater than the 2 percent chance (50 year) peak flood. This does not appear to be a concern for safety of the dam because of a seawall and pavement in the area of the low point and the gradual slope downstream of the low point.

Spillway Observations

The spillway is a concrete open channel spillway with an ogee type crest. The spillway width/weir length is 20 feet. The spillway is stepped to provide energy dissipation. The spillway walls are also concrete.

The spillway is in good condition overall. There are three relief wells in the bottom slab of the spillway approximately 2/3 of the way down. These were installed because of a previous concern about hydrostatic forces below the spillway slab. Organization of Woodland Lake Dam Committee members report that these wells discharge almost no flow when uncapped. The spillway side "training" walls were repaired in 2003 with the unsound concrete being chipped away, additional reinforcing steel being installed and the walls re-surfaced with an application of "shotcrete". The wall surfaces are showing evidence of cracking with some moisture and/or efflorescence exhibited at the cracks. The downstream end of the left wall is significantly deteriorated.

There is a low level slide gate reported to be 30 inches at the upstream end of a concrete tube that conveys water to the downstream end of the left spillway wall and can be used for drawing down the lake if necessary. The slide gate has an operating system with a rising stem that can be used to raise the gate using a lever with a lifting nut. It is reported that this gate is exercised on an annual basis. This was completed just prior to the current inspection. The ceiling of the concrete tube at the downstream end has some spalling.

The lake is immediately upstream of the spillway and the downstream channel is protected from erosion by large rock rip rap.

A pedestrian bridge/catwalk over the spillway is constructed out of steel and is in good condition. There is a chain link fence around the spillway that is also in good condition.

No work is recommended for the spillway at this time.

STRUCTURAL STABILITY

Visual Assessment and Field Observations
Structurally, the dam appears to be sound overall. Please see recommendations relative to the causeway embankment made above.

Results of Calculations if Applicable
None performed.

HYDROLOGIC AND HYDRAULIC CONSIDERATIONS

Hydrologic Design Data, Drainage Area, and Floods of Record

The Michigan Department of Environment, Great Lakes and Energy (EGLE), Water Resources Division, Hydrologic Studies and Dam Safety Unit in e-mail dated June 6, 2019 has provided the following hydrologic information for this dam:

Contributing Drainage Area:	18.5 Square Miles
Two Percent Chance Peak Outflow (50 Year):	210 cfs
One Percent Chance Peak Outflow (100 Year):	270 cfs
Half Percent Chance Peak Outflow (200 Year):	330 cfs

The design discharge for this dam is the Half Percent Chance Peak Flow of 330 cfs.

Evaluation of Spillway Adequacy

Computations indicate that at the design flood, the embankments would have a freeboard of approximately 1.1 feet. Based on the fetch length for this lake, and limited wave heights, the spillway capacity is deemed to be adequate.

Sketches of the spillway dimensions are found in Appendix E and supplemented by photographs in Appendix C.

OPERATION AND MAINTENANCE

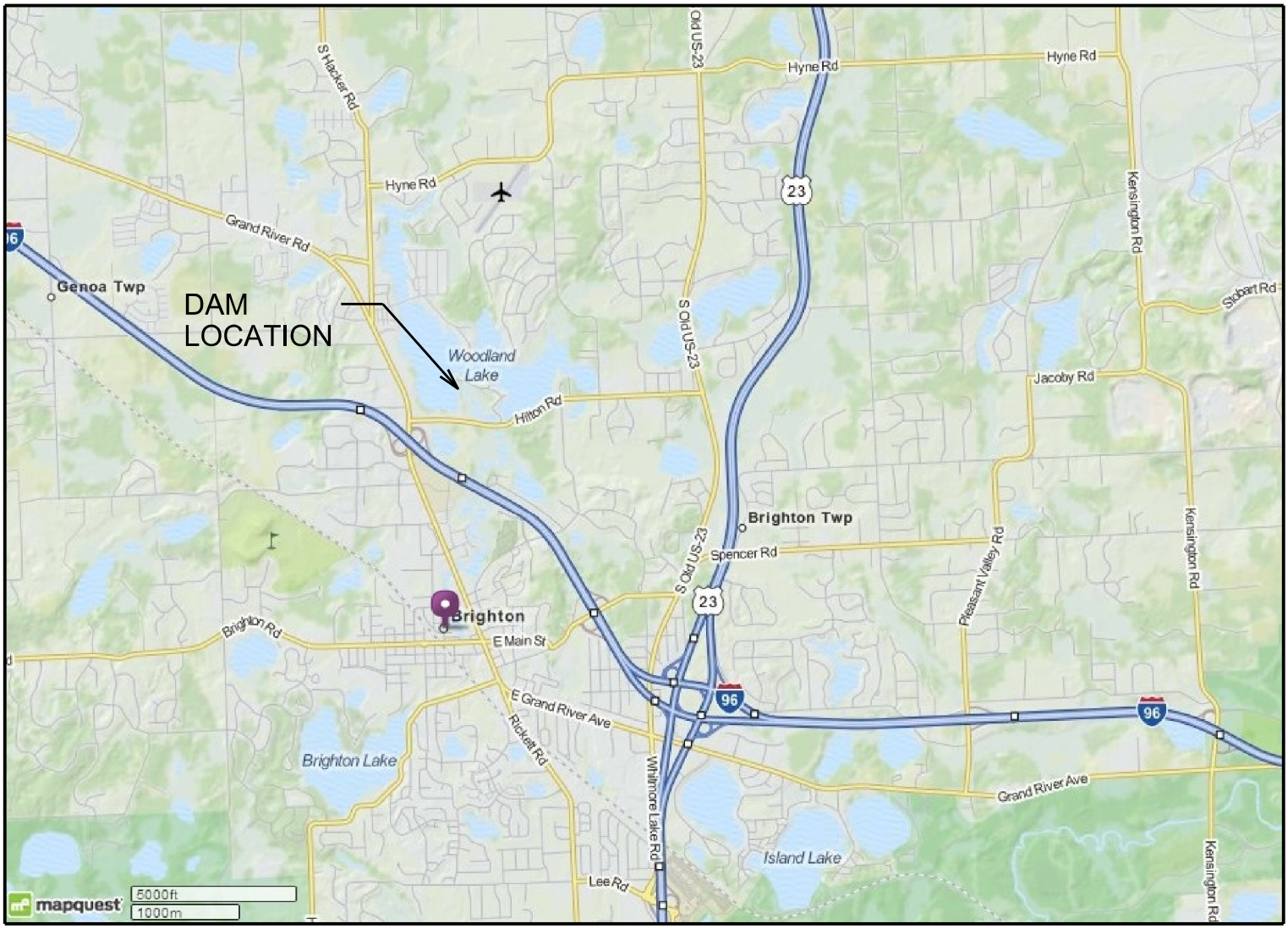
Assessment of Operating Equipment and Procedures

This dam has no operating equipment except the slide gate which appears to be in good condition. The Organization of Woodland Lake has written procedures for operating the spillway valve. They include: with whom the “turning arms” are kept, how to unlock the slide gate and how high to raise the rising stem to allow maximum outflow.

Evaluation of Current Maintenance Plan

There is no formal written maintenance plan for this dam. However, the dam is inspected on a monthly basis.

A. LOCATION MAP


DAM
LOCATION
Genoa Twp
Woodland
Lake
Hyne Rd
Hyne Rd
Hyne Rd
S Hacker Rd
Old US-23
Grand River Rd
Hilton Rd
S Old US-23
23
Kensington Rd
Stobart Rd
Jacoby Rd
Brighton Twp
Spencer Rd
S Old US-23
23
Pleasant Valley Rd
Kensington Rd
Brighton
E Main St
Brighton Rd
E Grand River Ave
Rickett Rd
96
96
Brighton Lake
Whitmore Lake Rd
Grand River Ave
Island Lake
Lee Rd
Kensington Rd
mapquest
5000ft
1000m


CAUSEWAY
EMBANKMENT
WOODLAND
LAKE
SPILLWAY
MAIN
EMBANKMENT
SOUTH
ORE
CREEK
Causeway Dr
Causeway Dr
Oak Knoll Dr
Oak Knoll Dr
Oak Knoll Dr
Woodland
Lake
Hilton Rd
N
mapquest
200ft
100m

B. FIELD INSPECTION CHECKLISTS

DAM INSPECTION AND EVALUATION CHECKLIST

J. E. Tiffany & Sons, LLC

1. Name of Dam: Woodland Lake Dam I.D. No.: 606 Date: October 9, 2019

2. Owner Information:
   - Name: Organization of Woodland Lake
   - Address: P. O. Box 617, Brighton, MI 48116-0617
   - Telephone:

3. Operator Information:
   - Name: Ms. Anita Grapentien, President
   - Address: 3148 Hideaway Beach Dr., Brighton, MI 48114-8970
   - Telephone: (810) 229-7894

3. Location of Dam: Section: 19 Town: 02N Range: 06E

   Twp.: Brighton County: Livingston Stream: South Ore Creek

4. Description of Dam: Earth Embankments with concrete spillway

5. History of Dam (Designed by, Year Constructed, etc.):
   Approximately 1928

6. Prior Inspections: 1991, 1994, 1997, 2001, 2004, 2007, 2010, 2013 and 2016

7. Hazard Potential Classification: High Hazard

8. Inspection Team:

Name	Title	Agency
James E. Tiffany, P.E.	Owner	J.E. Tiffany and Sons, LLC

ENGINEERING DATA

1. Vicinity Map: See Appendix

2. Geology Report: 1978 NDSP Report, 1981 and 2010 Soil Investigations by McDowell and Associates

3. Design Analysis: Analysis for original dam is apparently not available.

4. Plans: Original plans for the dam are apparently not available.

5. Rainfall/Reservoir Records: N/A

6. Other: /

CONSTRUCTION DATA

1. As Builts: N/A

2. Post Construction Surveys: Information available in 1991 and 1996 reports as well as the 1981 and 2010 soils investigations by McDowell and Associates. A 2009 topographic survey by Livingston Engineering is referenced in the 2010 inspection report.

3. Construction History: Original 1928. Apparently no records available.

4. Modification: 1983 main embankment augmentation/stabilization. Repair of spalled spillway walls in 2003/2004. Summer 2016, "Causeway" embankment work, plans by Prein & Newhof, Construction by Bob Myers Excavating of Brighton.

5. Borrow Sources: N/A

OPERATION & MAINTENANCE DATA

1. Operation and Maintenance Plan: None

2. Monitoring Systems: None

3. Impoundment Level Records: Maintained by Organization of Woodland Lake

4. O & M Records: Monthly observation and notes of saturated soil/seepage in causeway embankment toe area by the Organization of Woodland Lake

5. Operating Equipment: Slide gate valve for lake drawdown if necessary.

6. Prior Dam Failures/Reports: None

7. Warning Systems: None 8. Other: /

GENERAL DATA

Elevation- Top of Dam:	937 **	Length of Dam:	≈1,467’
Elevation- Normal Pool:	933	Top Width:	≈20’ *
Current Pool Elevation:	≈933.25	Height: (1)	≈16.9’
Design Flood Elevation:	≈935.9	Current Elev.-Tailwater	≈922
Elevation- Streambed:	≈919		

* Causeway embankment crest widths 25' - 40'

** Elevation of low point along Hilton Road is about 935.19

Benchmark Elevation: 932.94

Benchmark Description: Spillway crest elevation as per 1978 NDSP report. See 2010 inspection report for other benchmarks.

PART 307 INFORMATION (IF APPLICABLE)

Date Elevation Set by Court	N/A
Legal Level	N/A
Drawdown Level	N/A
High Water Mark Elevation	N/A

(1) As Per Part 315 Definition of Height:
Difference in elevation… between the natural bed of a stream or watercourse at the downstream toe of the dam, or, if it is not across a stream channel or watercourse, from the lowest elevation of the downstream toe of the dam, to the design flood elevation or to the lowest point of the top of the dam, whichever is less.

EARTH EMBANKMENTS-MAIN EMBANKMENT

Description and Condition

1. Dimensions/Shape: Earth embankment with mild downstream slope ≈ 977’ long (137' left of spillway and 820' right).

2. Foundation: N/A

3. Upstream/Downstream Slope Description and Condition

ITEM	UPSTREAM	CROWN	DOWNSTREAM
SLOPE	2H:1V	N/A	3H:1V
COVER	Trees, heavy brush, weeds. Mowed grass, left of spillway	Tall grass, weeds	Trees, heavy brush, weeds
TREES/BRUSH	See above	Some trees and brush near edges	See above
RIP-RAP	Concrete armoring, some rip rap. Wood seawall at far right.	/	None
EROSION	None noted	None	None noted
ANIMAL BURROWS	None noted	None noted	None noted
CRACKING	None noted	None noted	None noted
DEPRESSIONS/ SETTLEMENT	None noted	None noted	None noted
SLOUGHS/ BEACHING	None noted	N/A	N/A
DEBRIS	None	None	None
SEEPAGE/ BOILS	N/A	N/A	None noted

NOTES:
A) Saturated soil and wetland plants about 1/3 of the way up the embankment for about the right half of the embankment. Also saturated soil at the toe area where the main embankment and "causeway" embankment meet. No seepage flow noted in these areas.
B) Significant areas of the upstream and downstream slope are inaccessible for inspection because of heavy brush and trees.

4. Embankment/Abutment Junction: N/A 5. Drains: N/A

EARTH EMBANKMENTS-"CAUSEWAY" EMBANKMENT

Description and Condition

1. Dimensions/Shape: Earth embankment with fairly steep downstream slope ≈ 460' long.

2. Foundation: N/A

4. Upstream/Downstream Slope Description and Condition

ITEM	UPSTREAM	CROWN	DOWNSTREAM
SLOPE	2H:1V & steeper	N/A	1.7H:1V
COVER	Mowed grass, heavy brush and trees	Mowed grass ea. side of road.	Heavy brush and trees
TREES/BRUSH	See above	N/A	See above
RIP-RAP	Concrete armoring, some rip rap	/	None
EROSION	None noted	None	None noted
ANIMAL BURROWS	None noted	None	None noted
CRACKING	None noted	None	None noted
DEPRESSIONS/ SETTLEMENT	None noted	None	None noted
SLOUGHS/ BEACHING	Some small areas	N/A	N/A
DEBRIS	None	None	Some woody debris
SEEPAGE/ BOILS	N/A	N/A	Saturated soil or seepage in several locations, but no soil movement or boils observed.

NOTES:

4. Embankment/Abutment Junction: N/A

5. Drains: N/A

SPILLWAYS (OPEN CHANNEL)

Description and Condition

1. Spillway Designation- Principal (and only) Spillway

2. Type, Description, Location, Length, Gates:
Concrete open channel spillway with concrete ogee type overflow, concrete slab and concrete training walls. Spillway width/weir length is 20'. Slide gate and associated concrete discharge tube allows for drawdown as necessary.

3. Inlet Channel (size, condition, erosion, debris/obstructions, erosion protection):
Woodland Lake. No erosion or other problems noted in the spillway inlet area.

4. Discharge Channel (size, condition, erosion, debris/obstructions, erosion protection):
Approx. 50' wide a short distance downstream of spillway. Protected by rip rap in the vicinity of the spillway discharge. No problems with debris or erosion noted.

5. Spillway Channel:

   Training Walls- Concrete is in fair condition. Some cracking and moisture and/or effloresence at cracks. Downstream face, left side is quite deteriorated.

   Concrete Overflow Weir Sill- Appears to be in good condition

   Concrete Weir, Mid Spillway- Appears to be in good condition

   Gates/Stop Logs/Valves and Operations- Slide gate is reported to have been operated very recently and appears to be in good working order. Spalling was noted in 2013 inspection at the ceiling of the concrete discharge tube at the downstream end.

6. Bridge/Piers: N/A

7. Walkways/Railings: Pedestrian bridge/catwalk is constructed of steel and is in good condition

8. Trashrack/Log-boom: N/A

9. Other: Three well points have been installed about 2/3 down in the spillway bottom slab. Two weep drains are installed in the training walls about half way down the spillway and are flowing a dribble. Chain link fence around the spillway is in good condition.

INSTRUMENTATION

Description and Condition

1. Monumentation/Surveys: No monitoring surveys have been undertaken.

2. Observation Wells: No observation wells have been installed.

3. Weirs: None

4. Piezometers: None

5. Staff Gage & Recorder: None

6. Other: /

RESERVOIR

1. Slope: Gentle

2. Bank: Appears to be in good condition.

3. Sedimentation: No comparative surveys.

4. Other: /

C. PHOTOGRAPHS

Woodland Lake

Spillway

Bridge Over Spillway

Right Spillway Wall

Right Spillway Wall

Left Spillway Wall

Downstream End of Left Wall

Slide Gate Operator

Downstream End, Low Level Discharge

Main Embankment-Left of Spillway

Main Embankment-Left of Spillway, Downstream

Main Embankment Shoreline, Right of Spillway

Main Embankment Crest, Right of Spillway

Main Embankment-Downstream Slope, Right of Spillway

Causeway Drive

Causeway Along Shoreline

Causeway Shoreline, Upstream Slope

Saturated Soil, Downstream, Right End of Causeway Embankment

Saturated Soil at Toe of Causeway Embankment

Saturated Soil at Toe of Causeway Embankment

Causeway Embankment Slope Treated with Riprap

D. EGLE FLOOD DISCHARGE CORRESPONDENCE

Gmail

James Tiffany <jamesetiffany@gmail.com>

flood or low flow discharge request (ContentID - 168812)

EGLE-wrd-qreq <EGLE-wrd-qreq@michigan.gov> Thu, Jun 6, 2019 at 5:38 PM
To: "jamesetiffany@gmail.com" <jamesetiffany@gmail.com>

We have estimated the flood frequency discharges requested in your email of May 24, 2019 (Process No. 20190320), as follows:

South Ore Creek at Woodland Lake Dam, Dam ID 606, Section 19, T2N, R6E, Brighton Township, Livingston County, has a total drainage area of 18.9 square miles and a contributing drainage area of 18.5 square miles. The design discharge for this dam is the 0.5% chance (200-year) flood. The 2%, 1%, and 0.5% chance peak outflows are estimated to be 210 cubic feet per second (cfs), 270 cfs, and 330 cfs, respectively. (Watershed Basin No. 15 Huron).

Please include a copy of this letter with your inspection report or any subsequent application for permit. These estimates should be confirmed by our office if an application is not submitted within one year. If you have any questions concerning the discharge estimates, please contact Ms. Susan Greiner, Hydrologic Studies and Dam Safety Unit, at 517-284-5579, or by email at: GreinerS@michigan.gov. If you have any questions concerning the hydraulics or the requirements for the dam safety inspection report, please contact Mr. Luke Trumble of our Dam Safety Program at 517-420-8923, or by email at: TrumbleL@michigan.gov.

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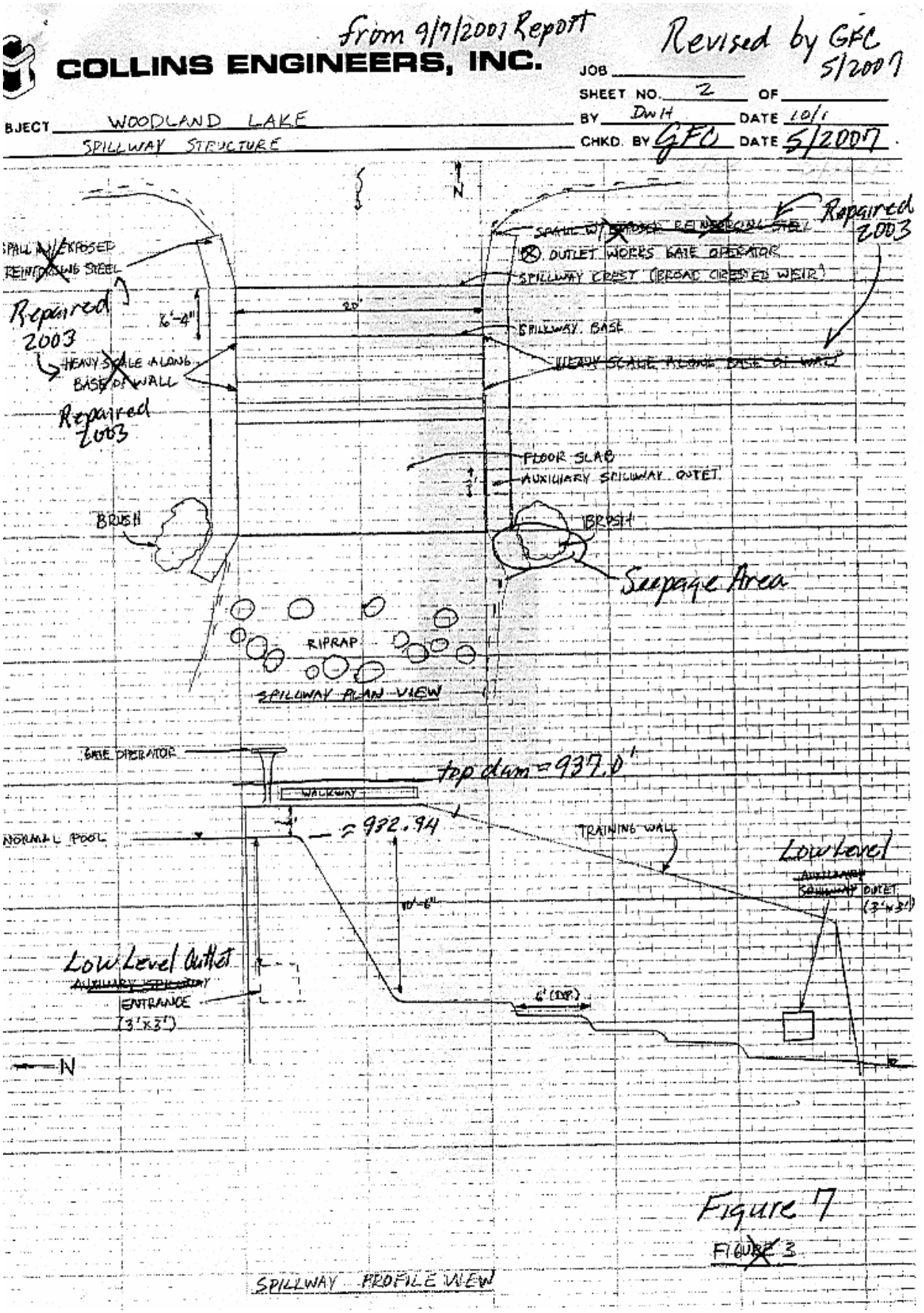
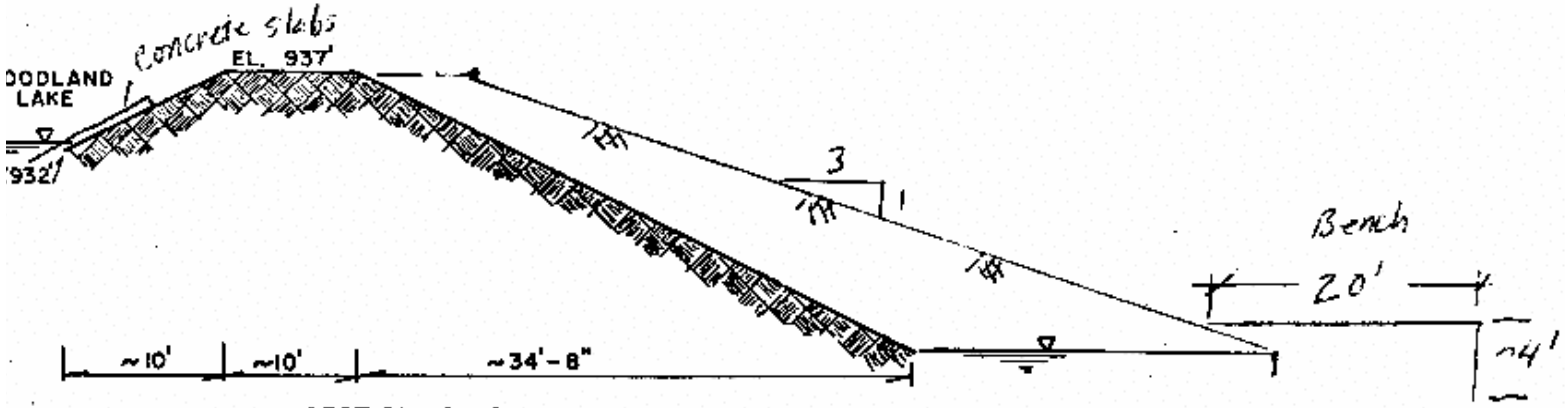
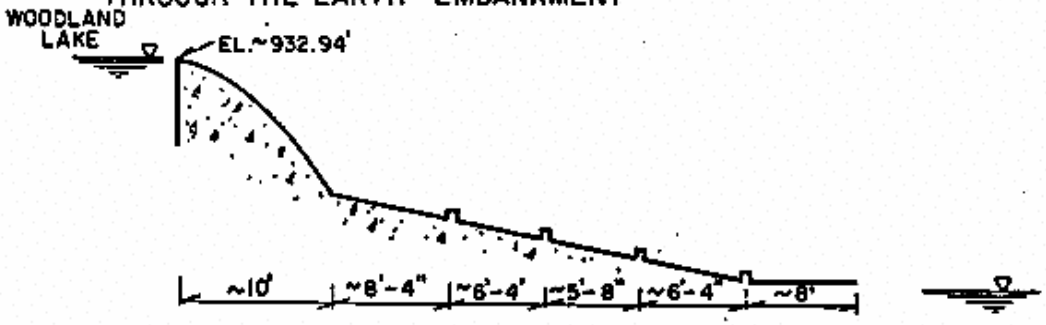
E. SKETCHES, HYDRAULIC COMPUTATIONS

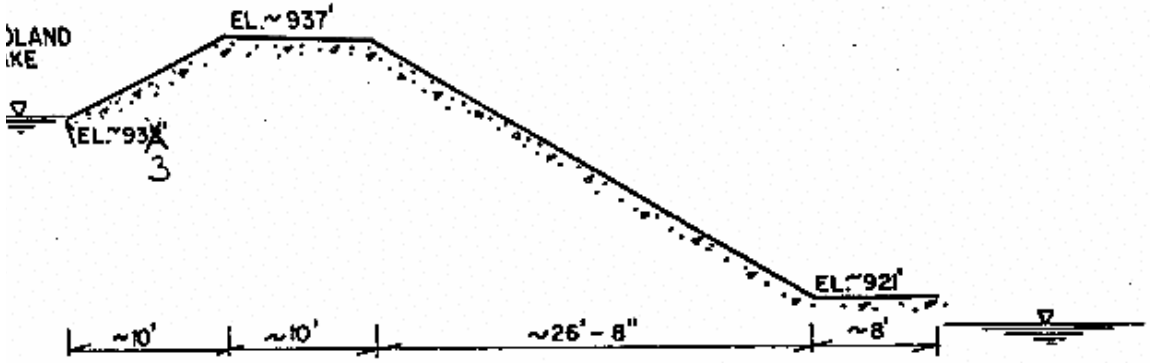

from 9/7/2001 Report
Revised by GFC 5/2007
COLLINS ENGINEERS, INC.
JOB
SHEET NO. 2 OF
BJECT WOODLAND LAKE
SPILLWAY STRUCTURE
BY DWH DATE 10/1
CHKD. BY GFC DATE 5/2007
N
SPALL W/ EXPOSED REINFORCING STEEL
Repaired 2003
OUTLET WORKS GATE OPERATOR
SPILLWAY CREST (BROAD CRESTED WEIR)
20'
6'-4"
SPILLWAY BASE
HEAVY SCALE ALONG BASE OF WALL
Repaired 2003
FLOOR SLAB
AUXILIARY SPILLWAY OUTET
BRUSH
BRUSH
Seepage Area
RIPRAP
SPILLWAY PLAN VIEW
GATE OPERATOR
top dam = 937.0'
WALKWAY
= 932.94
NORMAL POOL
TRAINING WALL
Low Level
AUXILIARY SPILLWAY OUTET (3'W x 3'H)
10'-6"
Low Level Outlet
AUXILIARY SPILLWAY ENTRANCE (3'x3')
4' (TYP.)
N
Figure 7
FIGURE 3
SPILLWAY PROFILE VIEW



SECTION A–A
TYPICAL CROSS SECTION
THROUGH THE EARTH EMBANKMENT



SECTION B–B
TYPICAL CROSS SECTION
THROUGH SPILLWAY AND STILLING BASIN



SECTION C–C
TYPICAL CROSS SECTION
THROUGH THE CONCRETE ABUTMENT

Revised 5/2007 by EFL

1978
NATIONAL DAM INSPECTION PROGRAM
WOODLAND LAKE DAM
TYPICAL CROSS SECTIONS
NOT TO SCALE
FIGURE 4

A R BLYSTRA & ASSOCIATES, LTD.
680 Washington Avenue
HOLLAND, MICHIGAN 49423
(616) 394-0606

JOB Woodland Lake Spillway Capacity
SHEET NO. 1 OF
CALCULATED BY ARB DATE
CHECKED BY GFC DATE 5/11/2007
SCALE

Actual Crest Length is 20 feet

Effective Length, $L = L' - 0.1(N)(H)$ where L' is actual length
N is the number of contractions
H is head on crest

UL ✓ $L = 20 \text{ feet} - 0.1(2)(4 \text{ ft})$
$= 19.2 \text{ feet}$

Crest Coefficient, $C = 3.27 + 0.40(H/P)$ where H is head
P is height of crest above reservoir bottom

$C = 3.27 + 0.40\left(\frac{4}{16}\right) = 3.37$
Use $C = 3.4$ ✓ OK

Discharge Capacity with reservoir at top of dam elevation 937
$H = 4$ feet (Spillway Crest El. 933)

$Q = C L H^{3/2}$
$= 3.4(19.2)(4)^{3/2} = 522 \text{ cfs}$

This is within 23 cfs of the spillway capacity calculated in the 1978 Corps of Engineers inspection report.

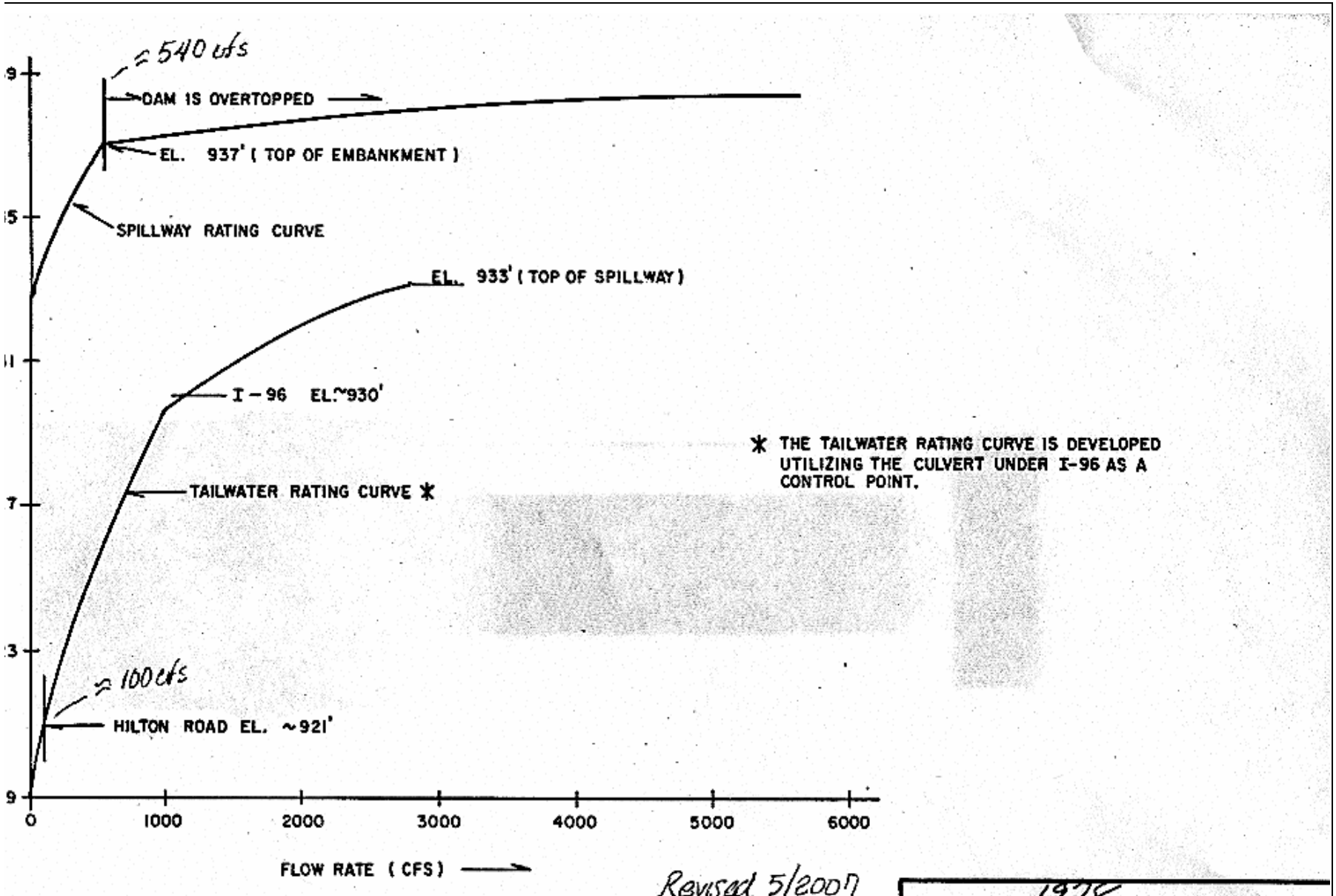
5/11/2007
Check Pond elevation for routed outflow of ≈ 330 cfs

$Q = CLH^{3/2}$

$H = \left(\frac{330}{3.4(19.2)}\right)^{2/3} = 2.94'$

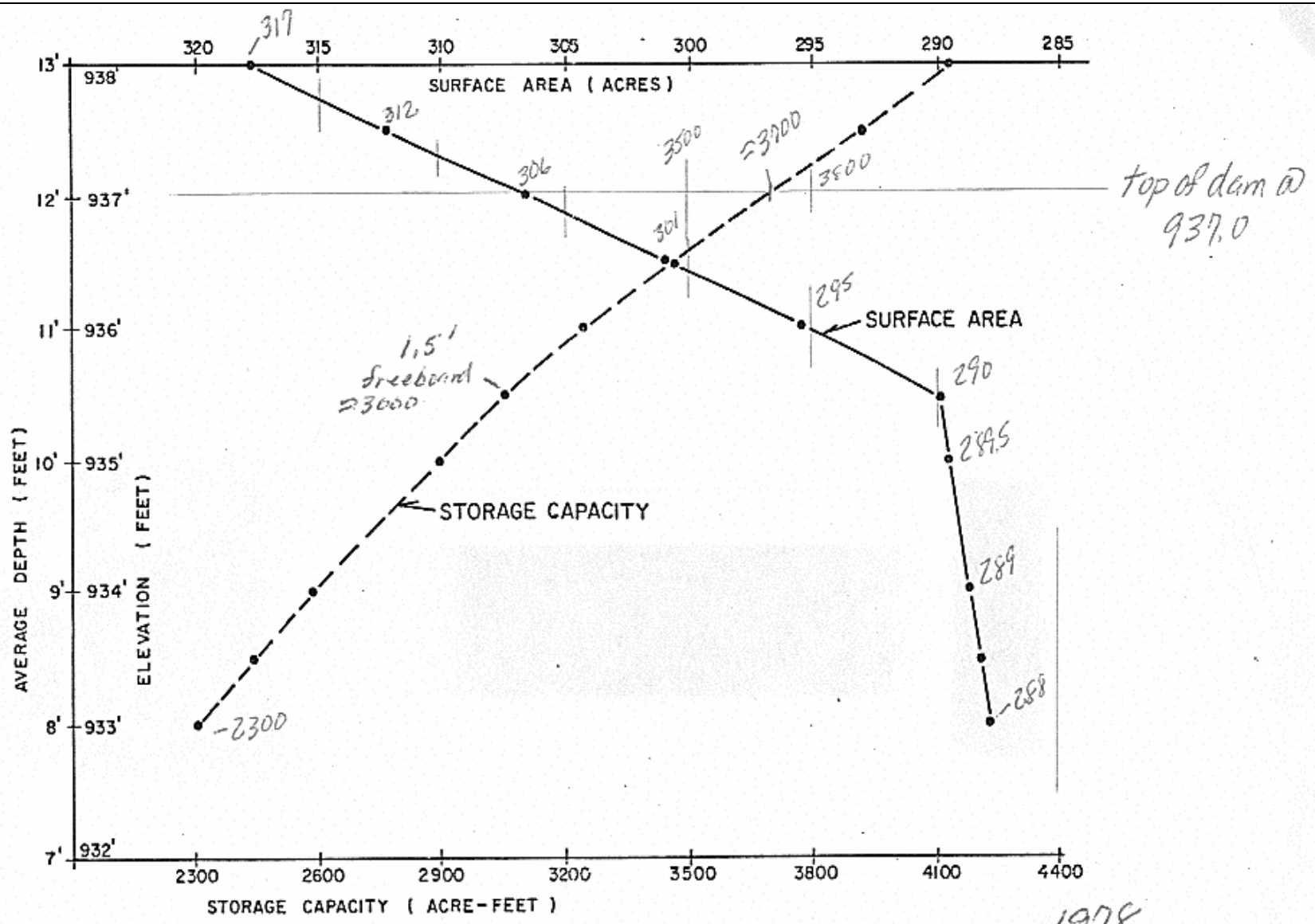
933. ← crest spillway elevation
+ 2.94
935.94
top dam @ 937 − 935.94 = 1.05' freeboard

Figure 9 GFC 5/14/2007



Revised 5/2007
by GFL

1978
NATIONAL DAM INSPECTION PROGRAM
WOODLAND LAKE DAM
SPILLWAY AND TAILWATER
RATING CURVES
FIGURE 5



Revised 5/2007 by GFL

1978

NATIONAL DAM INSPECTION PROGRAM

WOODLAND LAKE DAM

STORAGE CAPACITY AND SURFACE AREA CURVES

FIGURE 6