VERMONT
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Dam Safety Inspection Report

Dam Safety Program
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Name: **East Long Pond Dam**
State ID: **252.02** NID ID: **VT00185**
Hazard Class: **High Hazard Potential**

Town: **Woodbury**
Watershed: **Lamoille River**
Stream: **Nichols Brook**

Inspection Details

Inspection date: 08/10/2022 11:11

Inspection type: Periodic	**Weather:** Cloudy, 68F
Inspected by: Benjamin Green, Andrew Sampsell	**Others present:** Mike Sullivan

Dam Safety Recommendations

The following recommendations and remedial measures describe the recommended approach to address current deficiencies at the dam. Maintenance level activities can be performed by the Owner, while Studies and Analyses and Remedial Repair Recommendations will require the services of a qualified professional engineer registered in the State of Vermont who is experienced in dam safety engineering design, permitting, and construction. Remedial repairs will likely require obtaining a Dam Order from the Dam Safety Program.

Overall dam condition:

☐ Satisfactory ☐ Fair ☑ Poor ☐ Unsatisfactory ☐ Not Rated

**See General Information section at the end of report for further details*

Maintenance level recommendations	
General	• Perform an update to the Emergency Action Plan at least every other year and provide the updates to all key contacts. • On a regular basis and following the application of unusual or extreme loading conditions, perform monitoring of the dam and its appurtenances. Report any unsafe condition to the Dam Safety Program.
General embankment	• Establish and maintain vegetation clearing limits a minimum of 15 feet from all portions of the dam. Annually cut and remove grass, weeds, brush, and woody vegetation (but leave stumps) from the dam crest, upstream and downstream slopes, abutments, and downstream areas (beyond the dam toe) to near ground surface. • Continue mow/brush the vegetated surfaces of the embankment once to twice annually. • Once tree stumps are suitably rotten, remove stumps and backfill resulting voids with compacted granular fill. Seed and mulch the ground surface to promote grass cover.
Upstream slope area	• Repair slough in upstream slope located 10 feet to the left of the left auxiliary spillway abutment. • In areas prone to erosion, supplement riprap protection.

Maintenance level recommendations	
Downstream slope area	• Regularly monitor seepage, leakage, and/or wet areas for changes in flow, turbidity, or size.
Spillways	• Maintain the principal and/or auxiliary spillway free of debris to ensure free-flow conditions. • Monitor leakage through the principal spillway weir and at the base of the auxiliary spillway area. • Monitor the performance/condition of the timber shoring on the auxiliary spillway/outlet works discharge channel walls. • Monitor and repair minor concrete cracking and deterioration. • Install additional riprap to protect principals spillway discharge channel bank from erosion.
Low-level outlets	• Test operate the low-level outlet twice yearly to maintain operability and check leakage.

Studies and analysis	
General	• Perform necessary analyses to support either the design of repairs to bring the dam into compliance with current dam safety rules and guidelines, or alternately, dam removal. • Identify emergency construction access routes and also assess alternatives to improve dam access. Evaluate/plan out dam access methods during months with unfavorable weather/access road conditions.
Hydrology and hydraulics/hazard classification	• Perform updated hydrologic and hydraulic analyses of the dam to determine hydraulic adequacy. • Identify alternatives to make the dam hydraulically adequate or capable of safely being overtopped during the Spillway Design Flood. • Evaluate the condition of the low-level outlet and modifications needed to make it operable and reliable.
Operation and maintenance	• Develop an Operations and Maintenance Manual for the dam and provide a copy to the Dam Safety Program for record keeping purposes.
Geotechnical	• Perform a program of subsurface explorations to explore the embankment fill, foundation soil/rock, and groundwater conditions at the dam.
Structural	• Perform a structural inspection of the concrete and masonry elements of the dam.

Remedial repair recommendations
• Based on the studies and analysis recommended above, repair, rehabilitate, or replace the dam to bring it into compliance with current dam safety rules and guidance. Alternatively, consider pursuing dam removal.

Dam Information

Type: Earth **Purpose:** Recreation, Other	**Status:** In Service **Height:** 20 ft **Length:** 260 ft	**Construction date:** 1930
Owner: Hardwick Electric Department *email:* bessary@hardwickelectric.com *Address:* PO Box 516 Hardwick VT 05843 *Phone:* 802-472-5201		
Normal storage: 3,250 ac-ft	**Max storage:** 3,620 ac-ft	
Normal surface area: 177 ac	**Drainage area:** 3.5 sq mi	**Max surface area:** Not determined
Pool elevation during inspection: 6 inches below principal spillway crest.	**Tailwater elevation during inspection:** Appeared normal.	**Normal pool elevation:** El. 1,202.8 (NGVD29 feet)
It's unknown if the dam has been overtopped in the past. It does not appear the dam was overtopped since the last inspection. High rainfall and snowmelt that occurred in 2019 did raise the lake level in East Long Pond but levels were reportedly maintained within near normal ranges.		
Dam **does not** have public road on crest.	Dam **does not** have public bridge.	Dam **does not** have associated dike.
Reservoir shape: Irregular	**Reservoir average depth (ft):** Unknown	**Reservoir observations:**
Shoreline development: ☐ Undeveloped ☑ Semi-developed ☐ Developed ☐ Unknown		
Reservoir slopes: ☑ Mild ☑ Moderate ☐ Steep ☐ Unknown		
Inspection history: The dam was last inspected on October 1, 2020.		

Dam Information

Notes:
The condition rating of the dam from the previous inspection was POOR. The previous inspection report outlined several deficiencies and recommendations. Since the previous inspection the owner has completed the following maintenance:

- Removed brush from the dam embankment down to the stump.
- Removed the failing timber trash rack upstream of the outlet works.
- Installed timber shoring to help support the tilting auxiliary spillway/outlet works masonry walls.

Recommended studies and analysis have not been completed, including a hydrologic and hydraulic study to identify alternatives to make the dam hydraulically adequate, EAP update, nor development of an O&M manual.

Access road to dam
Type: Private camp road
Seasonal access: ☐ Plowed winter ☐ Sanded winter ☐ Maintained in mud season ☐ Passable in all weather conditions ☑ Need high clearance vehicle
Access of emergency/construction equipment: Poor access, requires a high clearance vehicle during summer months, during winter months the road to the dam is not plowed and requires snowmobile/snowshoe access. Difficult access during mud season.
Action required: ☐ None ☑ Monitor ☐ Maintenance ☐ Engineer

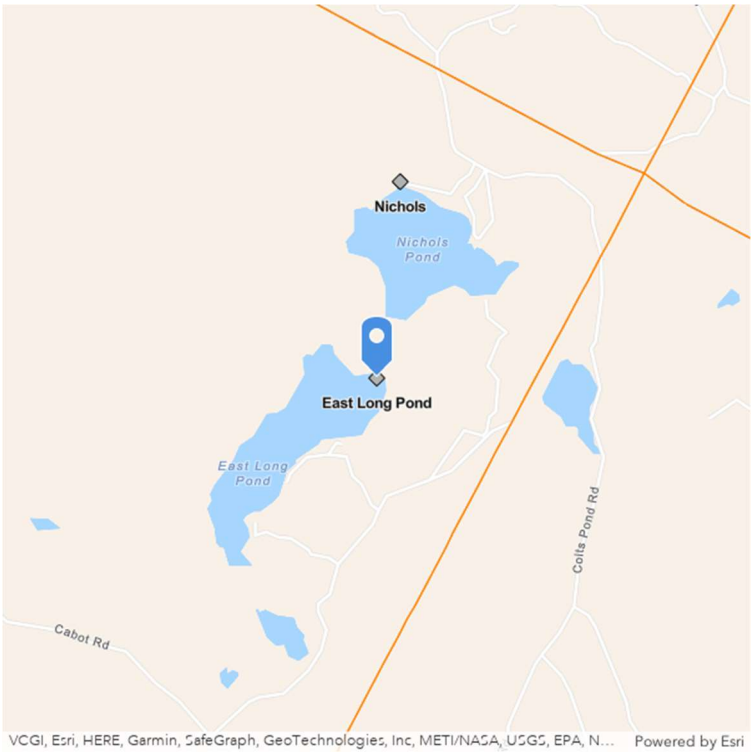
Security	
Device type(s): None observed	Dam has **no** sign of vandalism, trespass, or unauthorized operation.
Action required: ☐ None ☑ Monitor ☐ Maintenance ☐ Engineer	

Public/Inspection team safety at dam	
Confined space entry required: No	Fall protection required: Care must be exercised around the outlet works/auxiliary spillway training walls. Consideration should be given to installing safety fencing in these locations.
Other safety required: None observed.	Public safety consideration: None at this time.
Action required: ☑ None ☐ Monitor ☐ Maintenance ☐ Engineer	

Dam Description/Background

The East Long Pond Dam is an earth embankment dam with a principal spillway, auxiliary spillway, and outlet works. The dam is currently classified as a HIGH hazard potential. According to file information, the dam has a total length of 260 feet and a structural height of 20 feet. The upstream slope is armored with riprap and inclined at approximately 2H:1V. The crest is about 10 feet wide and is at El. 1,204.8 (National Geodetic Vertical Datum of 1929, NGVD29). The downstream slope is inclined at 2H:1V with a boulder toe. The principal spillway consists of an approximately 90-foot-long concrete broad crested weir located to the right of the main embankment with an elevation of approximately El. 1,202.8. The auxiliary spillway is a concrete, trapezoidal shaped, broad crested weir with a bottom length of about 12.5 feet. The auxiliary spillway is located near the middle of the embankment and has a crest at approximately El. 1,203.6. The low-level outlet (LLO) is located below the auxiliary spillway and reportedly consists of two gates that are 2.5 feet by 6 feet that control flow to a 36-inch diameter concrete pipe with an invert at approximately El. 1,186. The drainage area of the dam is 2,223 acres. East Long Pond at normal pool is approximately 177 acres and the normal and maximum storage capacities of the dam are approximately 3,250 acre-feet and 3,620 acre-feet, respectively. The dam was formerly used to store water for hydropower use but is now used solely for recreation. The dam was constructed in 1930 based on design plans by Trojan Engineering Company of New York City.

Dam Location



Emergency Action Plan

EAP **on** file.	**EAP date:** May 31, 2016
If dam is a SIGNIFICANT or HIGH Hazard dam, an up-to-date EAP with dam failure flood hazard inundation map is highly recommended.	

Operation & Maintenance Manual

O&M manual **not** on file.	
Accessibility to outlets or low-level outlet (LLO): From dam crest.	**Frequency of outlet or LLO discharge:** Unknown. According to owner, LLO has not been operated in many years, but the gate is set in the open position several inches.
Frequency of mowing: Unknown. Brushing performed in Fall 2021. Annual mowing/brushing recommended.	**Seasonal drawdown?** ☐ Yes ☑ No
Frequency of dam owner surveillance: Periodic	**Owner surveillance during storm events:** ☐ Yes ☑ No
Operating problems since last inspection: None reported	**History of repairs since last inspection:** None reported

Downstream Hazard Classification

Current classification: High Hazard Potential
The current hazard classification was determined with the support of inundation mapping.

Hydrologic/Hydraulic Data

Drainage Area = 3.5 sq. mi.
Principal Spillway Weir = 1,202.8 (NGVD29 feet)
Auxiliary Spillway Weir = 1,203.6 (NGVD29 feet)
Dam Crest = 1,204.8 (NGVD29 feet)

Based upon the dam's HIGH hazard potential classification the default spillway design flood (SDF) is the probable maximum flood (PMF) based on Federal Guidance used in the State of Vermont.

A hydrologic and hydraulic analysis performed by DuBois & King, Inc. in 2012 indicates the following.

Storm Event	Inflow (cfs)	Outflow (cfs)	Peak WS El.	Freeboard (+) or Overtopping (-)
100-Year	1,313	288	1,203.9	0.9
½ PMF	6,982	3,391	1,206.8	-2.0
Full PMF	16,840	12,009	1,209.8	-5.0

The dam has 2.0 feet of freeboard between the principal spillway crest and the dam crest which does not meet the VT dam safety requirement of 3.0 feet.

The dam is overtopped by 5 feet of water during the spillway design flood which does not meet the VT dam safety requirement of 1.5 feet of freeboard.

Since the dam cannot safely convey the spillway design flood it is considered hydraulically inadequate.

Upstream Slope

General slope inclination: 2H:1V (slopes **are not** within generally accepted stable inclinations, 2.5H:1V or flatter). However, the upstream slope appears stable based on visual observation under current loading conditions.

Additional comments: Slough near left abutment of auxiliary spillway.

Upstream slope protections				Action
Riprap				
Average diameter:				
☐ Type A (18"-30")	☑ Type B (12"-24")	☐ Type C (6"-18")	☐ Type D (3"-12")	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer
Condition:				
☐ Adequate	☐ Displaced	☐ Unraveled		
☑ Sparse	☐ Weathered	☐ Vegetation present		
Comments:				

Upstream slope issues	Action
Slough Approximate width: 3 ft ft Approximate height: 3 ft ft Location: Approximately 10 feet left of the spillway.	☐ None ☐ Monitor ☑ Maintenance ☐ Engineer

Upstream slope images

Crest

Length: 260 ft	**Width:** 8 to 10 feet
Freeboard: Principal spillway to dam crest: 2.0 ft Auxiliary spillway to dam crest: 1.2 ft	
Additional comments:	

Crest issues	Action
No crest issues were observed during inspection.	☑ None ☐ Monitor ☐ Maintenance ☐ Engineer

Crest images

Downstream Slope

Downstream slope appears stable based on visual observation under current loading conditions.

Additional comments: 2 seeps / wet areas to the left of the auxiliary spillway. Iron staining present. Water was cold to the touch (more so than nearby surface puddles), potentially indicative or seepage.

Downstream slope protections				**Action**
Riprap Average diameter:				
☑ Type A (18"-30")	☐ Type B (12"-24")	☐ Type C (6"-18")	☐ Type D (3"-12")	☑ None ☐ Monitor ☐ Maintenance ☐ Engineer
Condition:				
☐ Adequate	☐ Displaced	☐ Vegetation present		
☑ Sparse	☐ Weathered	☐ Unraveled		
Comments:				

Downstream slope issues	**Action**
Uncontrolled seepage	☐ None ☑ Monitor ☐ Maintenance ☐ Engineer

Uncontrolled Seepage					
Flow Rate (gpm):	No active flow detected	Size:	See below photos.	Location:	Left downstream slope near auxiliary spillway
Issues present in area: Rust-colored Deposits					
Action required: ☐ None ☑ Monitor ☐ Maintenance ☐ Engineer					

Seepage Collection Systems	**Number**
There are no seepage collections systems part of this dam.	

Downstream slope images

Seepage Location #1

Seepage Location #2

Instrumentation

No instrumentation found.

Principal Spillway

Spillway type: Weir **Primary material:** Concrete **Weir:** Broad-Crested

Spillway location: Right abutment

Water level measured against principal spillway crest: 6 inches below weir crest. **Erosion control structures**: Rock-Lined Channel

Spillway components:

☐ Anti-vortex plate	☐ Filter Diaphragm	☐ Training Walls
☐ Flashboard	☐ Trashrack	☐ Other:

Additional comments: Leakage was observed through a crack in the principal spillway in two different locations near the center of the concrete crest. Seepage rates were not measured but flow rates appeared to be a steady, moderate flow.

Principal spillway issues				Action
Deteriorating concrete Issues: ☐ Bug holes ☑ Hairline crack ☐ Efflorescence ☑ Spalling	☐ Popouts ☐ Honeycombing ☑ Scaling ☐ Crazed/Map cracks	☐ Isolated crack ☐ Exposed rebar ☐ Disintegration ☐ Other:		☐ None ☑ Monitor ☑ Maintenance ☐ Engineer
Location: Various locations along crest.				
Erosion control riprap Average diameter: ☐ Type A (18"-30") ☑ Type B (12"-24") ☐ Type C (6"-18") ☐ Type D (3"-12")				☐ None ☐ Monitor ☑ Maintenance ☐ Engineer
Condition: ☐ Adequate ☑ Displaced ☐ Vegetation present ☐ Sparse ☐ Weathered				

Principal spillway drains	Number
No drains were observed during inspection.	

Principal spillway images

Auxiliary Spillway

Spillway type: Weir	**Primary material:** Concrete	**Weir:** Broad-Crested
Spillway location: Center of dam		
Water level measured against auxiliary crest: 15 inches below weir crest		**Erosion control structures**: Plunge

Spillway components:

☐ Anti-vortex plate	☐ Filter Diaphragm	☑ Training Walls
☐ Flashboard	☐ Trashrack	☐ Other:

Additional comments: Owner has installed timber shoring between the downstream auxiliary spillway training walls to mitigate the vertical alignment of the walls. Since 2010, inspection reports have noted the right wall leans approximately 2 feet inwards towards the outlet channel, this appeared consistent with current visual observations. The vertical alignment of the walls was not measured but no active movement was observed. The as-built alignment of the walls is unknown. Minor weep in right auxiliary spillway downstream training wall, iron staining present. Water flowing through low level outlet, flow rate not measured, downstream channel is being kept wet.

Number of auxiliary spillways: 1

Auxiliary spillway issues			**Action**
Deteriorating concrete Issues:			
☐ Bug holes	☑ Popouts	☐ Isolated crack	☐ None
☑ Hairline crack	☐ Honeycombing	☐ Exposed rebar	☑ Monitor
☑ Efflorescence	☐ Scaling	☐ Disintegration	☑ Maintenance
☑ Spalling	☐ Crazed/Map cracks	☐ Other:	☐ Engineer
Location: Entire length of spillway			

Auxiliary Spillway Drains	**Number**
No drains were observed during inspection.	

Auxiliary spillway images

Low-Level Outlet

The dam includes a low-level outlet which can be used to drain the pond. The low-level outlet is located in the middle of the auxiliary spillway crest. The low-level outlet consists of a vertical timber bar rack which can be operated by a steel wheel and gear assembly. The low-level outlet was not operated during the inspection, and it has reportedly not been operated in many years. It is reportedly in the open position several inches and it is unknown if the gate is in operable condition.

Low Level Outlet Images

Timber gate, leakage entering tunnel from corrugated metal pipe, also leakage around left and right side of gate.

GENERAL INFORMATION

Website: https://dec.vermont.gov/water-investment/dam-safety

The Dam Safety Program conducts periodic safety inspections of non-federal, non-power dams to determine their condition and the extent to which they pose a potential or actual threat to life, property, and the environment. The condition rating reported herein was based on available data and visual inspection. Detailed investigations/analyses were beyond the scope of this report. It should be realized that the reported condition was based on observations of field conditions at the time of inspection, along with data available to the inspection team. The condition of the dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the reported condition of the dam will continue to represent the condition of the dam in the future. Only through continued care and inspection can there be any chance that unsafe conditions are detected.

Hazard Potential Classifications:

HIGH: Dams where failure or mis-operation will probably cause loss of human life.
SIGNIFICANT: Dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
LOW: Dams where failure or mis-operation results in no probable loss of human life and low economic and environmental losses.
MINIMAL: A dam that meets the LOW hazard definition, above, but is only capable of impounding less than 500,000 cubic feet.

Condition Ratings:

SATISFACTORY: No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
FAIR: No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.
POOR: A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.
UNSATISFACTORY: A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.
NOT RATED: The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

Definitions:

Upstream: The side of the dam that borders the impoundment located up gradient of the dam.
Downstream: The side of the dam opposite the upstream side, located down gradient of the dam.
Right: The area to the right when looking in the downstream direction (also known as “river right”).
Left: The area to the left when looking in the downstream direction (also known as “river left”).
Structural Height-of-Dam: The vertical distance from the lowest point in the stream bed or native ground surface at the downstream toe of the dam to the elevation of the lowest non-overflow section of the dam crest.
Embankment: An artificially constructed feature usually consisting of earth and rock with sloping sides and a flat crest, intended to provide a permanent barrier that impounds or is capable of impounding water.
Dam Crest: The top of the non-overflow portion of the dam.
Abutment: The part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed at the interface with a concrete gravity section.
Normal Pool: The water elevation, reservoir surface area, and reservoir storage capacity that is prevalent at the site or typical under normal, non-storm conditions. Typically, this level is controlled by the principal spillway.

Maximum Pool: The highest water elevation, reservoir surface area, and reservoir storage capacity that could be impounded by the dam, including accumulated sediments, with the water or liquid level at the top of the lowest non-overflow part of the structure or dam crest.
Principal spillway: A structure that maintains normal pool conditions and over which daily non-storm related and flood flows are discharged. Also called a primary or service spillway.
Auxiliary Spillway: The secondary spillway not in use under normal conditions but used when needed to pass flood flows that exceed the capacity of the principal spillway.
Low-level outlet or "LLO": An installed pipe and operable gate or valve typically located in or near the foundation of a dam that can be used to alter water levels, drain the reservoir, or otherwise meet operational or safety needs. Also called a pond drain.
Spillway Design Flood or "SDF": The storm event which the hydraulic capacity of the spillway structure and dam is designed and required to safely pass. Dam safety rules under development are considering the following prescriptive SDF's, Low and Minimal = 100-year Storm, Significant = 1,000-year storm, High = PMF. The use of incremental consequence analysis or risk-informed decision making to evaluate the potential of selecting a smaller/site specific SDF is permitted.
Emergency Action Plan (EAP): A written plan that identifies the area that would likely be inundated by the failure of a dam and identifies the actions that should be taken by the Owner to protect life, property, lifelines, and the environment in the event of a dam failure or threatening condition at the dam. The plan is usually implemented in cooperation with the local, regional, and state emergency personnel.
Operation and Maintenance Plan or "O&M": A plan that provides guidelines for the necessary, regular operation and maintenance activities at a dam.

Complete list of definitions from the Vermont Dam Safety Rule:
https://anrweb.vt.gov/DEC/IronPIG/DownloadFile.aspx?DID=185352&DVID=0