# TITTABAWASSEE RIVER PROJECTS




Desktop Study

Restoration of Hydroelectric Generation at

Secord, Smallwood, Edenville and Sanford Dams

*Prepared by:*

THE ESSEX PARTNERSHIP

*Prepared for:*

**Four Lakes Task Force**

***November 2021***

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# Attachments

## Appendix A – FERC Licensing

## Appendix B – Engineering Assessment

# 1.0 Executive Summary

The Four Lakes Task Force (FLTF) commissioned the Essex Partnership to perform a desktop study of restoring hydroelectric power to the four dams, post May 2020. This study is based on the premise that the FLTF will continue to incur all costs associated with rebuilding and operating the dams under their Part 307 obligations. The study evaluates the feasibility of restoring hydroelectric power as a means of generating revenues which could be used to help offset the cost of maintaining the dams going forward.

Restoring hydroelectric power would place the dams under FERC jurisdiction and require the hydro projects to obtain FERC licenses, a complex process that would take five years or longer and cost between $14 and $73 million dollars. Under federal jurisdiction, rebuilding the dams would have to be done according to FERC dam safety criteria, which would increase costs, extend the construction process and delay refilling the lakes.

This study evaluated two scenarios, rehabilitating the existing equipment, and constructing new powerhouses with all new equipment. Each scenario was evaluated using mid-range FERC costs (Base Case) and the extreme low end of the FERC cost range (Best Case). The study assumed that the restoration of the Dams to manage Lake Levels were funded from sources other than hydropower revenue

Redeveloping hydroelectric power at the four dams is not economically feasible under any of the scenarios evaluated. Even under the Best-Case scenario, rehabilitating the existing facilities and assuming low FERC costs, revenues would have to increase on the order of two times for the projects to just break even over the 20-year study period.

# 2.0 Introduction and Purpose

This report presents the results of a desktop study performed by The Essex Partnership (Essex) to evaluate the feasibility of restoring hydropower at four dams operated by the Four Lakes Task Force, Secord, Smallwood, Edenville and Sanford. It draws on information prepared as part of two previous related studies:

1. In 2019, working with Essex and Gravity Renewables, Inc., FLTF evaluated the feasibility of a third party operating the four hydropower facilities to help offset the costs of maintaining the lakes at their legal lake levels. The study was based on operating the projects under existing FERC licenses, Consumers Energy (CE) Interconnection Agreements, and Power Purchase Agreements.
2. After the May 2020 flood FLTF commissioned Essex to evaluate the viability of the Secord and Smallwood hydroelectric plants as self-sustaining business enterprises. This study included the revenues from operating the hydroelectric facilities and the costs to

repair and restore the dams. The study concluded that hydropower revenues would be insufficient by a wide margin to restore the dams to their legal lake levels.

This study evaluates the feasibility of restoring hydropower at all four dams in the post May 2020 conditions. Unlike the 2020 study, which included the costs to restore the dams, this study assumes FLTF will restore the four dams to their legal lake levels under Part 307, and therefore the costs to restore the dams have been excluded from the analysis. It also incorporates observations made by Essex in its October 2020 inspection of the powerhouses and equipment, and subsequent inspections of the powerhouses, dams, and waterways that were performed by GEI and the Spicer Group. No new field work or equipment inspections were performed specifically for this study.

## 3.0 Background

The FLTF dams and powerhouses, were all originally constructed in 1924 as part of Wolverine Power Corporation (Wolverine) portfolio of hydroelectric projects along a 39-mile reach of the Tittabawassee River. Details regarding each of the four projects are tabulated below, starting with the most upstream project, Secord, and proceeding downstream to Sanford.

**Project Details**

| Project | Installed Capacity (MW) | % of Total MW | Drainage Area Sq. Miles | Head (ft) Summer Pond | Historic MWH | % of Total MWH |
|---|---|---|---|---|---|---|
| Secord | 1.2 | 10% | 190 | 46 | 4,323 | 13% |
| Smallwood | 1.2 | 10% | 308 | 28 | 3,137 | 9% |
| Edenville | 4.8 | 47% | 932 | 44 | 17,898 | 52% |
| Sanford | 3.3 | 33% | 968 | 26 | 8,750 | 26% |
| Totals | 10.5 | 100% | - | - | 34,108 | 100% |

Wolverine owned and operated the four projects until June 2004, when the projects were sold to Synex Michigan, LLC – later renamed Boyce Hydro. Boyce Hydro generated power from all four projects until September 2018 when the Federal Energy Regulatory Commission (FERC) revoked the license for Edenville citing a continued lack of compliance with repair requests and failure to meet safety standards. The remaining three licensed projects continued to operate up until the May 19, 2020, flood. FERC terminated the remaining three licenses by an implied surrender order on May 20, 2021.

# 4.0 FERC Licensing

Operating hydropower facilities at the FLTF dams would require obtaining a federal license issued by the Federal Energy Regulatory Commission (FERC) in accordance with the Federal Power Act (FPA). Obtaining a license from FERC is a comprehensive multi-year regulatory process that requires review by federal and state regulators, Indian tribes, non-government organizations (NGOs) and the public. The process requires a minimum of 5 years and often can take significantly longer depending on the engineering, environmental, cultural, and other resource issues involved.

We estimate that the capital cost (CAPEX) associated with licensing hydropower at the FLTF dams could range from $14.3 to $73.2 million, as shown in the table below. This estimated cost includes the cost of the licensing process itself, development of anticipated resource management plans and implementation of protection, mitigation, and enhancement measures (PM&Es). The cost estimate does not include the cost of obtaining or installing hydropower equipment, restoring the powerhouse structures, or rebuilding the dams.

**Estimated Cost of FERC Licensing ($1,000's)**

| LICENSE CATEGORIES | LOW | MID | HIGH |
|---|---|---|---|
| LICENSING | 7,900 | 10,700 | 20,400 |
| RESOURCE MGMT PLANS | 1,600 | 2,400 | 4,800 |
| PM&Es | 4,800 | 16,800 | 48,000 |
| TOTALS | $14,300 | $29,900 | $73,200 |

Recognizing that there is considerable uncertainty in the licensing process, due to the multi-party nature of the process, unknown study requests, and unforeseen engineering and resource issues, the above estimates band the range of costs from "Low" (minimal resource issues, studies, and license conditions), to "High" (shoreline management plans, recreation facilities, fish passage facilities, wetlands mitigation, environmental funds, etc.).

Beyond the capital costs required to obtain a FERC license, there will be annual costs to operate and maintain (OPEX) the programs, resource protection, mitigation, and enhancement measures that are conditions of the new license. The estimated annual OPEX is $2.5 million but could range from $1.1 million to $7.4 million per year, depending on the conditions associated with the new license order.

The estimated licensing CAPEX and OPEX costs were allocated across the four projects on an installed capacity basis. If the projects were licensed individually the CAPEX costs would be measurably higher.

Pursuit of a FERC license would also likely cause significant delays to reconstruction of the Edenville and Sanford dams, and the construction and replacement of spillway gates at all Four Lakes dams. The current expected funding schedule could also be threatened or delayed until new licenses have been issued to the Counties by FERC. This could potentially delay refilling the Four Lakes by an additional 5 years or more. A detailed description of the FERC licensing process, resource issues at the four lakes, potential license conditions and their associated costs is presented in Appendix A.

## 5.0 Restoration of the Hydroelectric Facilities

As of November 2021, the status of the four hydrogenating powerplants is as follows:

- The generating units at Secord, Smallwood and Sanford have been idle for more than 1-½ years. The two Edenville generating units were idle prior to being inundated by the May 2020 flood. They have not operated for more than 3 years.
- The powerhouses at Edenville and Sanford are in the process of being partially demolished as part of interim efforts to stabilize the two dams.
- The electrical interconnection agreements with Consumers Energy for all four plants are effectively terminated.

A desktop engineering assessment was performed to determine the capital improvements that would be needed to restore hydroelectric generation at the four projects. Two scenarios were investigated for each of the four plants.

1. Rehabilitate Existing Powerhouses. This scenario assumes that the existing powerhouses would remain in place and the equipment would be repaired/replaced as necessary to bring the plants into a condition suitable for continued operation. As noted above, the Edenville and Sanford powerhouses are in the process of being partially demolished, and they may be incorporated whole or in part into the new spillways of the rebuilt dams. The existing powerhouse scenarios for Edenville and Sanford may not be physically feasible and are included as hypothetical analyses of what a low-cost option would look like.
2. Construct New Powerhouses. This scenario assumes that the existing powerhouses would be demolished, new powerhouses would be constructed, and all-new, more efficient turbine generators would be installed. For purposes of this analysis, we assumed the new powerhouse option would have the same hydraulic capacity of the existing powerhouses.

Estimates of capital expenditures were developed for each of the above two scenarios and are tabulated below. All costs are in year 2021 dollars.

**Estimated Capital Costs ($1,000's)**

| Project | Rehab Existing Powerhouses | Construct New powerhouses |
|---|---|---|
| Secord | 1,835 | 6,265 |
| Smallwood | 745 | 6,105 |
| Edenville | 7,145 | 12,410 |
| Sandford | 3,685 | 11,120 |
| Totals | $13,410 | $34,108 |

The electrical interconnection agreements with Consumers Energy at all four plants were signed in 1923 with an initial expiration period of 99 years. They were set to expire in 2022 but were effectively terminated with the Surrender of the FERC licenses and inability to produce power.

Secord, Edenville and Sandford connect to the Consumers sub-transmission system and the new interconnections were estimated to cost $1.25 million, which represents a sizable portion of the total cost for redeveloping hydroelectric power. Smallwood connects to the Consumers distribution system, which is at a much lower voltage, was estimated to cost $250,000. These estimates were developed by Consumers in March 2020, before the flood damaged the dams. The March 2020 Consumer estimates likely understate the cost of the new interconnections – but were used for this analysis as a simplifying assumption for screening purposes.

Estimates of annual operating and maintenance (O&M) expenses for the hydroelectric facilities were developed from Boyce's historic O&M cost records. These costs were allocated across the four plants on an installed capacity basis, adjusted to remove expenses associated with operating the dams and spillway gates, and refined to account for cost savings that would be realized with the all-new equipment and powerhouse scenarios.

**Estimated Annual O&M Costs ($1,000's)**

| Project | Installed Cap. (kw) | % of Total | Boyce O&M ($1,000s) | O&M Rehab ($1,000s) | O&M New ($1,000s) |
|---|---|---|---|---|---|
| Secord | 1,200 | 10% | 137 | 107 | 96 |
| Smallwood | 1,200 | 10% | 137 | 107 | 96 |
| Edenville | 4,800 | 47% | 549 | 489 | 440 |
| Sandford | 3,300 | 33% | 377 | 347 | 312 |
| Totals | 10,500 | 100% | $1,200 | $1,050 | $945 |

In addition to the above reoccurring annual costs, we assumed minor equipment overhauls would be performed every 15 years. For turbine overhauls we allowed $75,000 for fixed blade turbines, $100,000 for double regulated turbines, and $75,000 for all generators.

The above costs are based on all four hydro projects being operated by a single entity. If the projects are operated by multiple entities, then the total costs to operate the four projects would be noticeably higher. A detailed discussion of the engineering assessment is presented in Appendix B.

For this study, Boyce's historic energy production data were adjusted to account for efficiency improvements associated with the equipment overhauls and the all-new equipment. ZRC Capacity values were obtained from partially executed May 2020 agreements between Boyce and Consumers.

**Energy and Capacity**

| Project | Installed Capacity (kw) | 12-Year Historic MWH | % of Total MWH | Rehab MWH | New MWH | Capacity (ZRC-Yr.) |
|---|---|---|---|---|---|---|
| Secord | 1,200 | 4,323 | 13% | 4,539 | 4,755 | 1.0 |
| Smallwood | 1,200 | 3,137 | 9% | 3,294 | 3,451 | 0.9 |
| Edenville | 4,800 | 17,898 | 52% | 18,793 | 19,688 | 2.9 |
| Sandford | 3,300 | 8,750 | 26% | 9,188 | 9,625 | 2.4 |
| Totals | 10,500 | 34,108 | 100% | 35,813 | 37,519 | 7.2 |

## 6.0 Financial Analysis

The economic feasibility of each hydroelectric restoration scenario was evaluated using a discounted cash flow analysis (DCF). The analysis was performed using a pre-tax, unlevered (cash on cash) cashflow model to calculate Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA), Net Present Value (NPV), and payback period. This methodology is commonly used in the hydropower industry to evaluate acquisitions, new development projects and improvement projects.

For our base case model, we chose a 20-year study period – which is typical for a private investor and consistent with the two previous studies. We assumed the licensing process would be completed in 5 years. For simplicity, we performed an overnight analysis and assumed all capital costs associated with licensing and restoring hydroelectric generation would be incurred in year one of the study, *i.e.*, 2026. The capital cost estimates described above are in 2021 dollars and were escalated at 2% per year to 2026 dollars.

The Power Purchase Agreements (PPAs) with Consumers Energy are no longer in effect. Consumers Energy advised that capacity and energy from the projects would be valued at full avoided cost rates, which are approximately one third lower than the subsidized rates ($40/MWH vs. $60/MWH) of the expired PPAs. According to data filed by Consumers in their February 2021 U-20165 filing, full avoided cost rates for 2025 are projected to be as follows.

**Forward Pricing**

| COMMODITY | 2025 | FORECAST |
|---|---|---|
| Avoided Capacity Cost ($/ZRC-yr) | $66,623 | Flat |
| Avoided Energy Cost ($/MWh) | $40.63 | 2% escalation |

Consumers subsequently indicated the above avoided cost rates are expected to decline over time. For purposes of this analysis, we assumed avoided capacity cost would remain flat and avoided energy rates would escalate at 2% per year. The above rates were combined with the estimated MWH of energy production and ZRC capacity values to compute annual revenues for each project. Financial modeling results for each of the two scenarios are presented below.

## *6.1 Scenario 1 – Mid-range FERC Costs, Rehabilitation of Existing Powerhouses*

Scenario 1 evaluates the feasibility of rehabilitating the existing powerhouses and equipment assuming a middle of the road FERC licensing effort is required. The mid-range estimated costs for FERC licensing were allocated across the four projects on an installed capacity basis and included in the discounted cash flow analysis, summarized below.

**Rehabilitate Existing, Mid-Range FERC Costs**

| | 20-Year NPV ($1,000's) | | | | | |
|---|---|---|---|---|---|---|
| Project | Revenues | Hydro CAPEX | Hydro OPEX | FERC CAPEX | FERC OPEX | Total |
| Secord Rehab | 2,966 | (1,876) | (1,412) | (3,493) | (3,581) | (7,397) |
| Cumulative NPV | 2,966 | 1,090 | (322) | (3,815) | (7,397) | |
| Smallwood Rehab | 2,266 | (762) | (1,412) | (3,493) | (3,581) | (6,982) |
| Cumulative NPV | 2,266 | 1,505 | 93 | (3,401) | (6,982) | |
| Edenville Rehab | 11,468 | (7,304) | (6,262) | (13,973) | (3,581) | (19,653) |
| Cumulative NPV | 11,468 | 4,164 | (2,098) | (16,072) | (19,653) | |
| Sanford Rehab | 6,249 | (3,767) | (4,570) | (9,607) | (3,581) | (15,276) |
| Cumulative NPV | 6,249 | 2,482 | (2,088) | (11,694) | (15,276) | |

All four projects fail to break even over the 20-year study period and result in cumulative net present value (NPV) penalties ranging from $7.4 million to $19.7 million. Closer examination of the table (from left to right) reveals two of the projects (Secord and Smallwood) produce sufficient revenues to cover their Hydro CAPEX costs and one project (Smallwood) produces enough revenue to cover both the Hydro CAPEX and OPEX costs. After covering the Hydro costs none of the projects produce sufficient revenues to cover any FERC costs.

## 6.2 Scenario 2 – Mid-range FERC Costs, All New Powerhouses & Equipment

Assuming the same FERC costs as Scenario 1, this case evaluates the feasibility of restoring hydroelectric power with all new powerhouses and equipment. In addition to the higher costs incurred with all new and powerhouses and equipment, this analysis also accounts for lower O&M costs and the increase in energy production that would be realized with the all-new, more efficient equipment. The results are tabulated below.

**All New Powerhouses and Equipment, Mid-Range FERC Costs**

| 20-Year NPV ($1,000's) | | | | | | |
|---|---|---|---|---|---|---|
| Project | Revenues | Hydro CAPEX | Hydro OPEX | FERC CAPEX | FERC OPEX | Total |
| Secord New | 3,076 | (6,405) | (1,289) | (3,493) | (3,581) | (11,693) |
| Cumulative NPV | 3,076 | (3,329) | (4,618) | (8,111) | (11,693) | |
| Smallwood New | 2,346 | (6,241) | (1,289) | (3,493) | (3,581) | (12,259) |
| Cumulative NPV | 2,346 | (3,895) | (5,184) | (8,677) | (12,259) | |
| Edenville New | 11,924 | (12,687) | (5,661) | (13,973) | (3,581) | (23,979) |
| Cumulative NPV | 11,924 | (763) | (6,424) | (20,397) | (23,979) | |
| Sanford New | 6,472 | (11,368) | (4,066) | (9,607) | (3,581) | (22,150) |
| Cumulative NPV | 6,472 | (4,896) | (8,962) | (18,568) | (22,150) | |

The increase in revenues and the lower OPEX costs are not sufficient to offset the higher CAPEX costs of the all-new powerhouses and equipment. The four projects produce cumulative NPV penalties ranging from $11.7 million to $24 million over the 20-year study period.

## 6.3 Sensitivity Analyses

Scenarios 1 and 2 were reevaluated using the extreme low end of the FERC cost range for the Licensing Process, Resource management Plans, PM&E Measures and Post Licensing Annual FERC O&M Expenses. The discounted cash flow analysis was revised to back calculate the

revenue multiplier that would be required for the projects to break even (*i.e.*, produce a zero NPV) over the 20- year study period.

### *6.3.1 Rehabilitate Existing, Low FERC Costs*

This case evaluates the feasibility of rehabilitating the existing powerhouses and equipment, assuming a minimal licensing effort and low FERC CAPEX and OPEX costs, as shown in the table below.

**Rehabilitate Existing, Low FERC Costs.**

| Project | 20-Year NPV ($1,000's) | | | | | | Rev Multp 0 NPV |
|---|---|---|---|---|---|---|---|
| | Revenues | Hydro CAPEX | Hydro OPEX | FERC CAPEX | FERC OPEX | Total | |
| Secord Rehab | 2,966 | (1,876) | (1,412) | (1,671) | (1,576) | (3,568) | 2.2 |
| Cumulative NPV | 2,966 | 1,090 | (322) | (1,993) | (3,568) | | |
| Smallwood Rehab | 2,266 | (762) | (1,412) | (1,671) | (1,576) | (3,154) | 2.4 |
| Cumulative NPV | 2,266 | 1,505 | 93 | (1,578) | (3,154) | | |
| Edenville Rehab | 11,468 | (7,304) | (6,262) | (6,683) | (1,576) | (10,357) | 1.9 |
| Cumulative NPV | 11,468 | 4,164 | (2,098) | (8,781) | (10,357) | | |
| Sanford Rehab | 6,249 | (3,767) | (4,570) | (4,594) | (1,576) | (8,258) | 2.3 |
| Cumulative NPV | 6,249 | 2,482 | (2,088) | (6,682) | (8,258) | | |

None of the four projects produce enough revenue to offset the lower FERC costs. Compared to Scenario 1 above (Mid -range FERC Cost and Rehabilitate Existing), the magnitude of the NPV penalty is reduced by approximately half with the Low FERC Costs scenario. But even under this optimistic scenario revenues, would have to increase between 1.9 to 2.4 times for the projects to just break even over the 20-year study period. Even if the expired PPAs were still in effect with subsidized rates (approximately $60/MWH vs. $40/MWH), revenues would still fall short by approximately 50%.

### *6.3.2 All New Powerhouses and Equipment, Low FERC Costs*

This sensitivity case evaluates Scenario 2, All-New Powerhouse & Equipment, using the extreme low end of the FERC cost range.

**All New Powerhouses and Equipment, Low FERC Costs.**

| 20-Year NPV ($1,000's) | | | | | | | Rev Multp 0 NPV |
|---|---|---|---|---|---|---|---|
| Project | Revenues | Hydro CAPEX | Hydro OPEX | FERC CAPEX | FERC OPEX | Total | |
| Secord New | 3,076 | (6,405) | (1,289) | (1,671) | (1,576) | (7,864) | 31 |
| Cumulative NPV | 3,076 | (3,329) | (4,618) | (6,289) | (7,864) | | |
| Smallwood New | 2,346 | (6,241) | (1,289) | (1,671) | (1,576) | (8,431) | 43 |
| Cumulative NPV | 2,346 | (3,895) | (5,184) | (6,855) | (8,431) | | |
| Edenville New | 11,924 | (12,687) | (5,661) | (6,683) | (1,576) | (14,683) | 16 |
| Cumulative NPV | 11,924 | (763) | (6,424) | (13,107) | (14,683) | | |
| Sanford New | 6,472 | (11,368) | (4,066) | (4,594) | (1,576) | (15,132) | 29 |
| Cumulative NPV | 6,472 | (4,896) | (8,962) | (13,556) | (15,132) | | |

Compared to Scenario 2 (All New Powerhouses and Mid-range FERC costs), the lower FERC costs scenario reduces the cumulative NPV penalty by approximately one third, ranging from $7.9 to $15.1 million. Revenues would need to increase between 16 and 43 times for the All-New Powerhouses and Mid-range FERC costs scenario to just break even over the 20-year study period.

## 7.0 Conclusions

This desktop study evaluated two alternatives to restore hydroelectric power to the four dams: rehabilitating the existing facilities and constructing all new powerhouses with new equipment. Either approach would place the generating facilities and dams under FERC jurisdiction – requiring the projects to obtain and operate under FERC licenses. For each restoration option two licensing scenarios were evaluated, mid-range FERC costs, or expected outcome, and the extreme low end of the FERC cost range, or best case.

Excluding any and all costs to restore or operate the dams and with our optimistic assumptions about the costs of the new interconnections with Consumers, redeveloping hydroelectric power at the four dams is not economically feasible under any of the scenarios evaluated. Under the best-case scenario, rehabilitating the existing facilities and low FERC costs, revenues would have to increase on the order of two times for the projects to just break even over the 20-year study period. Even if the expired PPAs with subsidized rates ($60/MWH vs. $40/MWH) were still in effect, revenues would still have to increase by approximately 50% for the rehabilitation projects to just break even.

# TITTABAWASSEE RIVER PROJECTS

Desktop Study
Restoration of Hydroelectric Generation at
Secord, Smallwood, Edenville and Sanford Dams

## Appendix A
## FERC Licensing Assessment

*Prepared by:*

THE ESSEX PARTNERSHIP

*Prepared for:*

**Four Lakes Task Force**

***November 2021***

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# Executive Summary

Installing hydropower facilities at Secord, Smallwood, Wixom, and Sanford Lakes (collectively the "Four Lakes") would require obtaining a federal license issued by the Federal Energy Regulatory Commission (FERC) in accordance with the Federal Power Act (FPA). This report provides background on the FERC licensing process, outlines key drivers of cost, describes issues that could be expected in licensing the Four Lakes and provides an estimated cost range to obtain and implement a FERC license.

Obtaining a license from FERC involves a complex multi-year regulatory process that requires review by federal and state regulators, Indian tribes, non-government organizations (NGOs) and the public. The process requires a minimum of 5 years and often can take significantly longer depending on the engineering, environmental, and cultural issues involved.

We estimate that the cost associated with licensing hydropower at the Four Lakes would range from $14.3 to $73.2 million, as shown in the table below. This cost estimate includes the cost of the licensing process itself, development of anticipated resource management plans and implementation of protection, mitigation, and enhancement measures (PM&Es). The cost estimate does not include the cost of obtaining or installing hydropower equipment, or restoring the powerhouse structures.

| | COST ESTIMATE ($1,000's) | | |
|---|---|---|---|
| LICENSE CATEGORIES | LOW | MID | HIGH |
| LICENSING | 7,900 | 10,700 | 20,400 |
| RESOURCE MGMT PLANS | 1,600 | 2,400 | 4,800 |
| PM&Es | 4,800 | 16,800 | 48,000 |
| TOTALS | 14,300 | 29,900 | 73,200 |

The cost estimate presented above is based on standard industry practices, our knowledge of the project area and existing conditions and our experience licensing other similar sized hydropower facilities. While there is a standard regulatory process, there is considerable uncertainty due to the multi-party nature of the process, unknown study requests, and unforeseen engineering and resource issues.

The FERC licensing process requires extensive agency and stakeholder consultation and examination of potential impacts associated with restoring hydropower, including impacts to water quality, terrestrial and aquatic resources, endangered species, soils and shoreline erosion, aesthetics, recreation, cultural resources, land management and socioeconomics (see Attachment A).

Beyond the capital costs required to obtain a FERC license, there are additional anticipated operations and maintenance costs related to the programs, resource protections, mitigation, and enhancements that are license conditions. Additionally, the pursuit of a license would likely cause significant delays to reconstruction of the Edenville and Sanford Dams and the construction and replacement of spillway gates at all Four Lakes dams. Current expected funding schedule would also likely be threatened or delayed until new "original" licenses have been issued to the Counties by FERC. This could potentially delay refilling the Four Lakes by an additional 5 years or more.

# 1.0 Introduction

Gladwin and Midland Counties (Counties) have taken ownership of the properties within their respective County borders that once formed the Boyce Hydro, LLC hydropower business. Four Lakes Task Force (FLTF), on behalf of the Counties, is currently working to restore the dams, and thus the legal lake levels of Secord, Smallwood, Wixom, and Sanford Lakes (Four Lakes) per Part 307, Inland Lakes, of Michigan Natural Resource and Environmental Protection Act. P.A. 451 of 1994 as amended (Part 307).

Some parties have expressed interest in examining opportunities to install hydroelectric power facilities at the restored dams to generate revenue that would off-set some of the cost associated with reconstructing and maintaining the restored dams. Since Boyce Hydro, LLC has surrendered or had its Federal Energy Regulatory Commission (FERC) operating licenses revoked, the Counties do not have active licenses that enable them to operate hydropower at the Four Lakes. FLTF would need to apply for original operating licenses from FERC to reconstruct new generating facilities or rehabilitate existing generating facilities in order to reestablish hydropower operations at some or all of the facilities.

A major difference between state and federal jurisdiction is that Section 10(a)(1) of the Federal Power Act (FPA), often referred to as the comprehensive development requirement of the FPA, states that any project licensed must be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the benefit of multiple public uses. The FERC is required to consider enhancements for recreation, cultural resources, environmental resources and balance these with power generation interests. Under state jurisdiction there is no requirement for comprehensive development. Attachment B provides more details on State versus Federal jurisdiction.

This report describes the process, risks, and estimated costs to obtain a FERC license to operate hydropower facilities at all four lakes.

# 2.0 FERC Licensing Overview

The reintroduction of hydropower at each of the four dams would require filing applications for original licenses with FERC under the requirements of 18 CFR, Part 4, Subpart G, §461. The process of hydroelectric project licensing is formulated by prescriptive federal regulations and laws. FERC regulates non-federal hydroelectric facilities under the Federal Power Act of 1920 and then 1935, codified in 16 U.S.C. §§ 791 to 823d.

Hydroelectric project licensing is generally considered as a 5-year process; however, it is common for it to extend for longer periods of time depending on the complexity of the hydroelectric project, resource issues, and the ability of the stakeholders (who often have conflicting interests) to develop acceptable solutions to issues or proposals raised during the process.

Applicants typically spend years performing engineering evaluations for the development of hydroelectric infrastructure including long term project economics, investment risk, feasibility studies, potential resource impacts, land acquisitions, and legal aspects of the project prior to starting the FERC license application process.

Once a decision to move forward with the FERC licensing process is made, the prospective applicant performs due diligence to develop its Pre-Application Document (PAD) that explains its proposal for the development of the site by describing its location, the design and drawings of the proposed facilities, and the environmental, recreational, and cultural/historical resources that are present. The PAD may

also include documents from resource agencies that describe flora, fauna, soil conditions, and any existing or proposed studies that the applicant determines are essential for the development of a credible license application. The PAD and a Notice of Intent to seek a license start the licensing calendar clock that triggers specific required licensing related actions. Additional detail regarding the FERC licensing process is provided in Attachment A.

## 3.0 Drivers of Licensing Costs

Licensing costs are greatly affected by administrative processes that guide company and consultant staff when carrying out the project, including, meetings with state and federal agencies, preparing required documents (such as the PAD, study plans, study reports, Preliminary License Proposal (PLP), Final License Application (FLA); addressing stakeholder comments; conducting project resource studies; and completing the development of Protection, Mitigation, and Enhancement measures (PM&Es) to address resource impacts from the planned hydropower facilities.

Additionally, an applicant may choose to engage in settlement agreement negotiations with state and federal agencies. These negotiations can be conducted at any time during the process prior to filing the FLA. The FERC reviews study findings and conducts its own National Environmental Policy Act (NEPA) evaluations of applicant filings and issues operating licenses that stipulate conditions that must be met throughout the term of the license(s). Per the comprehensive development requirement of the FPA, FERC establishes these conditions to balance the applicant's proposed operations with the Project's impacts to cultural, historic, recreational and environmental resources. FERC's license review process can be protracted depending on the situations and issues at hand.[1]

Potential cost drivers for licensing are:

- Current & Desired Project State – Development of a Pre-Application Document that describes the proposed project setting, facilities, proposed power operations, environmental, cultural-historic, archaeological, and recreational resources as well as land uses and any proposed Project changes such as new generating capacity, dam installations, fishway installations, or other PM&Es that are anticipated by the applicant.
- Impact & Resource Studies – Resource studies including their scoping, development, execution, reporting, and related PM&Es comprise the majority of licensing costs.
- Licensing Administration – Facilitating the licensing process including the cost of industry and subject matter experts who consult with all parties throughout the five-year licensing period as well as assist the applicant regarding the oversight, execution, and interpretation of studies. Strategic planning, economic evaluations, study reviews, correspondence with stakeholders are all coordinated and performed with the assistance of industry professionals (typically consultants).
- Management Plans – Developing and use of Management Plans to drive continued study obligations and or collaboration with agencies (Debris Management, Historic Places Management Plan, Cultural Resources Management Plan, Archaeological Management Plans,

[1] https://news.bloomberglaw.com/environment-and-energy/permit-delays-dam-up-hydro-projects-relicensing-costs-millions

[2] https://www.chelanpud.org/rr_relicense/glance/General.htm

Shoreline Management, Recreation Management Plans, Water Quality Management Plans, others) extend both the duration of licensing and raise the cost of implementing license conditions.

- Fisheries Issues – Design and construction costs of fishways for the reestablishment of historic migratory fish runs are usually quite expensive, from $2 million to $20 million dollars per site[1, 2] or more depending on the size of the dams and rivers, fish species that are targeted for passage at the dams, the type of turbines proposed, and the fishway's design capacity (numbers of fish utilizing the facilities). Resident fish have been recently emphasized by federal and state fisheries agencies, including downstream passage and the installation of exclusionary devices. The design, construction, and operation of fishways are typically the most expensive and labor-intensive conditions required in license orders. Fishways typically are constructed using best practices to meet the requirements established by the agencies and applicant. There is still an exposure, however, for expensive future changes to the constructed facilities, operations, and maintenance practices during the term of the license. Fish turbine mortality, entrainment, and impingement studies, both for migratory and resident fish, can be quite costly if field studies are required.
- Property Issues – Shoreline Management Plans (SMP) are required by FERC when the numbers of upland property owners and others who surround and project lands and use the lands for their non-power related purposes. The development of these plans can be quite involved and expensive, addressing commercial and private sales of Project lands, leasing, and licensing of Project lands for non-project purposes (marinas, boat launches, docks, patios, boathouses, gazebos, decks, and other structures); provisions for environmental protections along the lake shorelines (i.e., native planting or natural growing buffer zones); shoreline "sea wall" construction requirements for upland property owners; tree cutting policies and permissions; septic system requirements; utilities rights of way and uses; etc.
- Project Recreation – Extensive public use may require the development of Recreation Management Plans (RMP) that are crafted based on the evaluation of recreation use (e.g., conflicting uses on the lake surfaces, crowding, sufficient entry points for the public, adequate facilities for public access for parks, lakes, trail systems, fishing access, whitewater access, ADA access, trash removal, bathrooms, picnic facilities, etc.). Special water releases at run-of-river facilities can augment river boating opportunities found during dry periods. Fishing versus boating conflict is typical at many hydroelectric projects and the process to resolve their opposing interests can consume considerable time and money during a licensing project. Both the SMP and the RMP can also be quite expensive and require extensive staff involvement during their study, development, and implementation. Their implementation also involves active management over the 30-to-50-year license period.
- Environmental Resources – Erosion/Invasive Species/Endangered Species/Wetland Management Plans address PM&Es that are typically required as a result of licensing. Examples of related PM&Es are rip rap, hydroseeding, plantings, and other methods to protect shorelines from high river flow velocities and reservoir fluctuations; removal of invasive plant species by hand, chemical applications or the use of mechanical weed harvesters to control aquatic weed growth, reservoir drawdowns to protect shorelines from freeze-thaw damage and to control weed growth; protections and active management of endangered species including barricading of areas, removal of competing species, habitat optimization; wetlands monitoring and

eradication of invasive species, and changes to proposed hydro operations to protect environmental resources.

- Riverbed – Macroinvertebrate studies may be required to understand the impacts caused from fluctuating flow releases at hydroelectric dams to macroinvertebrates, snails, worms, mussels, and other species that are a part of the benthic river community.
- Aesthetics – Aesthetic flows and landscaping are often reviewed by the agencies for recreation benefit. Releases over rock formations, spillways, other gate locations that optimize the aesthetics of the river are commonly studied and required as part of the license term conditions.
- Environmental Funds – The establishment of multi-million-dollar Environmental funds for agencies to address environmental issues that relate to Project impacts. These funds usually are applied to address specific Project impacts in the Projects areas of impact but also have been used to address out of watershed issues.
- Land Transactions – Other forms of mitigation can include applicant land and/or easement purchases to provide environmental or recreational protections or enhancements. Land is also transferred or gifted to others for conservation or preservation purposes. These costs can reach into the millions of dollars.
- Operations Modeling – Economic modeling of storage reservoirs with proposed reservoir fluctuations associated with operations or Project profitability are also common required studies for FERC staff review. Flow & economic modeling are useful in understanding the financial impacts to the applicant from various proposed initiatives by licensing project participants.
- Protection, Mitigation, and Enhancement (PM&E) – Licensing process studies are used to determine potential impacts from proposed hydropower operations, including its facilities within the project's established boundaries. Typically FERC license orders contain conditions to eliminate or reduce impacts and to provide additional project resource improvements. Some conditions are not fully developed at the time of license order issuance and are later identified in resource management plans that are collaboratively developed with stakeholders, agencies, and the applicant.
- Operations & Maintenance (O&M) – Once a license order has been issued, licensees must implement the terms of the license that require labor, contractors, materials, and processes to develop and execute implementation plans. These costs may be related to new recreation areas, fishways, endangered/threatened species protections, wetlands, invasive weed control, debris management, cultural/historic/archaeological aspects, and others. These costs are in addition to the O&M costs associated with the dams, powerhouses, and hydro equipment.

# 4.0 Four Lakes Licensing

Hydroelectric developments have their own set of unique resource issues that must be addressed as part of any FERC licensing proceeding. In particular, the Four Lakes are located immediately adjacent to many upland properties that have provided significant land use and recreation activities for decades. As a result of the May 2020 flooding that led to the failure and damaging of the Four Lakes dams, there were associated adverse impacts to the environmental and recreation resources along the Tittabawassee and tributary rivers.

A licensing effort for the Four Lakes sites would need to address many of the aforementioned resource issues including water quality; wetlands; aquatic habitat; protected, threatened, and endangered species; fisheries; macroinvertebrates; recreation; cultural and historic management. Combined, these factors drive up the complexity, duration, and cost of licensing the Four Lakes.

FLTF can choose to file one, two, three, or four FERC license applications for the Four Lakes system of lakes. Filing for individual licenses creates increased costs for duplication of efforts in both administrative and process activities, yet it would allow for future flexibility with the assets. Regulators and resource agencies typically favor licensing all of the projects together,which is less expensive and helps in coordinating studies in a more comprehensive way. Table 1 below presents an estimated range of costs to pursue a single license for Four Lakes, including cost estimates for each major environmental resource category.

**Table 1 – Estimated costs to apply for one FERC license for all four lakes**

| | COST ESTIMATE ($1,000's) | | |
|---|---|---|---|
| LICENSING STUDY CATEGORIES | LOW | MID | HIGH |
| Aquatic Habitat | 400 | 600 | 1,200 |
| Cultural/Historic/Archae./Tribal | 400 | 600 | 1,200 |
| Environmental | 2,000 | 2,600 | 5,200 |
| Fisheries | 1,200 | 1,400 | 2,800 |
| Recreation & Dev | 0.4 | 1.0 | 2,000 |
| Shoreline Development & Use | 0.6 | 0.8 | 1,600 |
| Sub-Totals | 5.0 | 7.0 | 14,000 |
| Applicant/Licensee Admin. | 1.6 | 1.9 | 3,000 |
| Contingency 20% | 1.3 | 1.8 | 3,400 |
| Totals | 7,900 | 10,700 | 20,400 |

Specific factors affecting the cost of licensing for FLTF and the Counties are as follows:

- Damaged Projects – The extent of impacts to the Project resources from the May 2020 flooding and resulting dam failures and damages to structures in the Four Lake watershed are greater than typical resource issues found during the licensing or relicensing of hydropower projects (e.g., erosion in drawn down lake and river sections, bottomland scouring, fisheries species displacement, changing extent of wetlands, endangered species habitats changes, recreation disruption and changes, debris management, new woody and ground cover growth on bottomlands). Given the flat topography and the number of backwatered tributaries, the

amount of mitigation required to protect river reaches from erosion and environmental damage during refill is expected to be quite extensive and expensive.

- Fisheries Interest – Interest by resource agencies to establish fish passage facilities at Sanford and possibly other dams in the Four Lakes system could add millions of dollars to the cost of each licensing project. While there are limited migratory fish species available for upstream passage (historically Lake Sturgeon, White Sucker, and Walleye from Lake Huron), resource agencies still seek out the provision of fish passage for resident and eel species. FERC regulations require license applications to contain a State of Michigan water quality certification, evidence of a pending request for certification, or evidence that the state has waived certification. Fishway prescriptions can be made by the State of Michigan in their 401 WQC process associated with licensing, by FERC under Section 10(j) of the FPA, or by the Fish and Wildlife Service (FWS) under Section 18 of the FPA that compels FERC to require fish passage based on Department of Interior prescriptions. License conditions often reserve agency prescriptive rights to require fish passage facilities based on resource needs and changing river situations. Therefore, the actual design and construction of fishways do not necessarily begin immediately upon receipt of the new license issuance and can be delayed based on the degree of downstream available habitat, and the lack of migrating fish successfully traveling upstream over one or more downstream dams (e.g., Dow Dam). Note that a natural fishway has been proposed for construction at the Dow Dam that is located downstream of Sanford Dam in Midland, Michigan. This fishway is planned to be built out of rocks that are laid out in an elongated sloping ramp that will simulate natural river streams. This type of fishway is unlikely to be required by the agencies at Sanford as the Sanford Dam is 26 feet high and the targeted species slated to be passed upstream would likely be unable to negotiate the gradient required. Additionally, the agencies have concerns over the passage of Lamprey Eel, invasive species, and diseased fish into the Four Lakes. The construction of fish ladders or elevators for upstream passage would likely be the best designs for the site. Fish elevators and retention facilities have been used to prevent undesirable fish species and diseased fish from entering upstream waters. The use of tank trucks to move desirable migrant fish to upstream impoundments is common in the beginning of restoration programs.
- Recreation Changes – The lengthy time needed to reestablish lake levels for the Four Lakes (especially Wixom and Sanford Lakes) has changed recreation use within the previously watered lake areas. Also, access to the lake waters has been compromised due to the loss or damage to the dams with exposed mud flats between the shoreline and watered areas. At Wixom and Sanford Lakes, power boating and boat-based fishing no longer thrive as they had when the two lakes were full. Opportunities for paddling newly exposed natural river reaches for whitewater boating purposes have been created due to the recent establishment of riverine flow regimes. Riverine environments typically increase shoreline angling use and reduces boat fishing use. Once the lakes have been refilled, recreation that was once prevalent at the Four Lakes would be expected to return. Previously, FERC required Boyce Hydro to provide recreation access and facilities under its operating license, however, not all of the required recreation sites were developed. Studies during FERC licensing will reexamine the recreation features of each project to determine if new recreation facilities and features are needed thereby creating additional capital and operations related costs over the course of the license. A Recreation Management Plan would likely be required for the Four Lakes, one that

reviews and analyzes all recreation uses so that key issues are identified, and important protections, mitigation, and enhancements can be put into place.

- Vegetative Growth – The presence of mudflats in the Wixom and Sanford Lakes and exposed shorelines in Secord and Smallwood Lakes may create needs for additional environmental studies and likely require mitigation of impacts before and after returning the lakes to their pre-flood water levels. FLTF currently manages the bottomland vegetation with the assistance of the public and resource agencies. However, the change from a lake to the current, more riverine environment has likely caused impacts to fish species composition and numbers, macroinvertebrate populations, riverbed turbidity during rainfall events, aquatic plant species, wetland sizes and presence, and other environmental elements within the former lake boundaries. The impacts to these resources have created a new environment for the bottomlands that will be affected by a return to historic water levels.
- Shoreline & Land Management – Hydroelectric projects, under the oversight of FERC, that have significant adjacent residences and businesses that abut their Project Boundaries, are required to manage lands within the Project Boundaries by creating a Shoreline Management Plan (a comprehensive plan to manage the multiple resources and uses of the project's shorelines in a manner that is consistent with license requirements and project purposes) and by following the standard land use article that FERC includes in most, if not all, licenses. The standard land use article gives licensees broader authority to authorize relatively routine non-project uses and occupancies (e.g., riprap, small boat docks, etc.) without FERC approval. This authority may only be exercised if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and environmental values of the project. Currently, the municipalities, counties, and the state are responsible for shoreline and land management for the properties that are adjacent to the Four Lakes. In a contemporary licensing proceeding, it is very likely that a comprehensive Shoreline Management Plan would accompany the standard land use article as a condition of the license issuance. This means that a standard for shoreline uses would be created for each of the developments if licensed separately or an overall standard would be set for all four of the lakes, one that would be best managed by a single entity. Shoreline Management Plans are known to include the requirement for buffer zones around lakes that stipulate the planting of native plants and trees or the requirement to let the land grow naturally (no mow provisions); the establishment of sea wall criteria that prevent shoreline erosion from boat wakes and high flows (the use of rip rap is common); oversight on stormwater discharges, tree removal permitting, dock locations and orientations, patio and pathway construction, septic system requirements, and other land use situations/conflicts. The ongoing cost of operating, administering, and maintaining credible Shoreline Management Plans can be quite significant, including office and field staff to oversee SMP policies, procedures, legal action, land use records, data administration (via information technology tools), etc.
- New Management Plans – The establishment of licenses at the Four Lakes will set in motion FERC-ordered conditions that require the development of comprehensive management plans and related initiatives to address resource impacts, as outlined above. These plans are created via consultation with relevant stakeholders after FERC has issued the license(s) and must be reviewed and approved by FERC (potentially with FERC modification).

  Resource Management Plans (Plan) are developed with varying levels of participation by owners, consultants, resource agencies, governmental officials, non-governmental

organizations, and the public. The intensity of involvement, effort, and the scope of work required for developing a plan that resolves a given resource topic can vary depending on the complexity and sensitivities present. I.e., a less intensive amount of investigation and discussion with stakeholders might determine that a particular resource need could be addressed by implementing a low scope of work for developing the Plan compared to situations with many issues and related aspects that needed to be addressed by the owners and stakeholders.

In some instances, there may only be one or two realistic paths to resolving resource issues, resulting in only one or two Plan development scenarios with their respective Plan development costs. For example, the Plan that satisfies the low intensity end of the effort/cost spectrum may also sufficiently serve as the mid-range Plan or even the high-range Plan if no additional related factors are expected to further complicate the Plan's development. However, as situations become incrementally more complicated, they will likely create more discussion, investigation, time, effort, and costs. Most plans will create immediate and/or long-term requirements that will impact operations and maintenance costs throughout the term of the license.

Table 2 below presents estimated costs for each of the anticipated resource management plans that would need to be developed.

**Table 2 – Estimated costs for preparing resource management plans likely to be required as conditions of a new FERC license**

| | COST ESTIMATE ($1,000's) | | |
|---|---|---|---|
| RESOURCE MANAGEMENT PLANS | LOW | MID | HIGH |
| Shoreline | 100 | 300 | 500 |
| Recreation | 200 | 300 | 500 |
| Cultural/Historic/Archaeological | - | 100 | 200 |
| Erosion | 100 | 200 | 400 |
| Debris | 100 | 100 | 200 |
| Water Quality | 100 | 100 | 300 |
| Invasive Species Monitoring | 100 | 100 | 200 |
| Fishways | 200 | 200 | 400 |
| Fisheries Inventory | 100 | 100 | 200 |
| Endangered Species | 100 | 200 | 200 |
| Off-site Wetlands Mitigation | 100 | 100 | 300 |
| Environmental Fund | - | 100 | 200 |
| Land & Easement Granting | 100 | 100 | 400 |
| Sub-Totals | 1,300 | 2,000 | 4,000 |
| Contingency 20% | 300 | 400 | 800 |
| Totals | 1,600 | 2,400 | 4,800 |

- Settlement Agreements – In the case of Four Lakes, it is likely that there will be many stakeholders with many varying interests that could come together to create a licensing related settlement agreement that optimizes the interests of the parties as a whole. It is quite common for applicants, agencies, and stakeholders to develop settlement agreements in parallel with

the licensing schedule. Settlement agreements are reviewed by FERC and considered for inclusion as license terms by FERC, at least the portions of the agreement that FERC has regulatory interest in. Other parts of the settlement agreements that lie outside of FERC's regulatory authority and purposes are held between the settlement agreement parties. The settlement agreements are typically filed around the time of the Final License Application so that FERC can include settlement agreement language in their license order conditions.

- Flow Regime – In October 1988, FERC set seasonal minimum flows and specified the allowed operating range for the Four Lakes Projects. This authorized 0.7-foot daily fluctuation (3.0-foot in the winter) allowed Boyce Hydro to participate in the Midcontinent Independent System Operator (MISO) Capacity Market and to protect shoreline environs and structures (headwalls, dock systems, etc.). Licensing will again bring the operating range under agency review with the possibility of a tighter operating range being prescribed by the agencies. If this were to occur, the capacity market revenue could be lost, as well as a portion of the annual energy production revenue.
- Water Quality – The State of Michigan has water quality standards that must be met by the licensees with respect to the licensees' operations. For sites with dams, dissolved oxygen (DO), temperature (T), and conductivity are typical water quality parameters that must be monitored for compliance with state standards. Four Lakes must ensure that its operations are compliant, therefore, additional monitoring of these parameters may be required for inflow into the lakes, lake water columns, and project discharges. If the actual conditions do not meet state standards, mitigation and/or enhancement measures may be required, such as air injections, oxygen diffuser or weir facilities, top water spillage, lower water column releases, diversion baffles or screens, air induction, water recirculation machinery, etc.
- Reconstruction – Future hydropower operations at the Four Lakes involving capital projects associated with reconstruction of the dams, powerhouses, turbines and appurtenant structures would fall under FERC's purview and would be expected to increase costs and lengthen the ongoing Four Lakes restoration construction processes. FLTF would need to have a FERC license to begin construction of the new facilities before the construction could commence, therefore, the current reconstruction schedule could be delayed for years. Operating requirements (regulatory, dam and watershed, resource mitigation and enhancements, additional federal agency interventions) are expected to be more robust and costly under the regulatory authority of FERC as compared to requirements and oversight from the State of Michigan and other agencies.
- Protection, Mitigation, and Enhancement Measures (PM&Es) – FERC will evaluate PM&Es proposed by the applicant and stakeholders and subsequently prescribe license conditions that must be followed by the licensee to balance the resources and mitigate issues. The following table lists PME and one-time operations and maintenance cost categories and their respective costs that are anticipated as a result of electing to move forward with hydropower at the Four Lakes. Table 3 presents cost estimates for anticipated PM&Es.

**Table 3 – Estimated costs for complying with protection, mitigation, and enhancement (PM&E) measures anticipated as conditions of a new FERC license**

| | COST ESTIMATE ($1,000's) | | |
|---|---|---|---|
| PM&E | LOW | MID | HIGH |
| Shoreline | 100 | 200 | 1,000 |
| Recreation | 200 | 800 | 2,000 |
| Cultural/Historic/Archaeological | 100 | 200 | 500 |
| Erosion | 300 | 800 | 2,000 |
| Debris | 100 | 300 | 1,000 |
| Water Quality | 100 | 300 | 2,000 |
| Invasive Species Monitoring | - | 100 | 500 |
| Fishways | 3,000 | 9,000 | 20,000 |
| Fisheries Inventory | - | 100 | 500 |
| Endangered Species | 100 | 200 | 500 |
| Off-site Wetlands Mitigation | - | 500 | 3,000 |
| Environmental Fund | - | 1,000 | 4,000 |
| Land & Easement Granting | - | 500 | 3,000 |
| Sub-Totals | 4,000 | 14,000 | 40,000 |
| Contingency 20% | 800 | 2,800 | 8,000 |
| Totals | 4,800 | 16,800 | 48,000 |

In addition to the above capital expenditures - FLTF would incur increased costs to operate and maintain new fishways, environmental monitoring, shoreline management, recreation management, and other conditions of the new license order. Like the capital costs, the annual O&M expenses vary depending on the specific resource and the scope of the Protection, Mitigation and Enhancement measures stipulated in the conditions of the new license order.

Essex developed itemized cost estimates for the additional annual O&M expenses that would be incurred as a result of the new license orders. Estimates were developed for the three sensitivity categories listed above to band the scope of the Protection, Mitigation and Enhancement measures that could be stipulated in the conditions of the new license order.

**Table 4 – Estimated costs to operate and maintain facilities and other license compliance activities associated with anticipated terms and conditions of a new FERC license**

| | COST ESTIMATE ($1,000's) | | |
|---|---|---|---|
| O&M IMPLEMENTATION COSTS | LOW | MID | HIGH |
| Shoreline | 200 | 400 | 800 |
| Recreation | 100 | 200 | 400 |
| Cultural/Historic/Archaeological | - | 100 | 200 |
| Erosion | - | 100 | 400 |
| Debris | 100 | 200 | 500 |
| Water Quality | 100 | 100 | 500 |
| Invasive Species Monitoring | 100 | 200 | 400 |
| Fishways | 200 | 300 | 800 |
| Fisheries Inventory | - | 100 | 200 |
| Endangered Species | 100 | 100 | 200 |
| Off-site Wetlands Mitigation | - | 100 | 600 |
| Environmental Fund | - | 100 | 800 |
| Land & Easement Granting | - | 100 | 400 |
| Sub-Totals | 900 | 2,100 | 6,200 |
| Contingency 20% | 200 | 400 | 1,200 |
| Totals | 1,100 | 2,500 | 7,400 |

## 5.0 Conclusions

The FERC licensing process is complex, requiring the applicant to manage large numbers of stakeholder and agency issues and assume the risk of potentially expansive study scopes that may lead to additional studies, time, and costs. The process requires applicants to invest time, effort, and funds with a high degree of risk and uncertainty in the outcome.

Upon license issuance, the applicant (now a "licensee") is often burdened with expensive federal and state license conditions such as the development of resource management plans, specifically, the establishment of shoreline and recreation management plans, water quality monitoring plans, and others; the construction of resource protection, mitigation or enhancement structures such as fishway passage facilities (upstream/downstream); and the development of new recreation enhancements. License conditions may also result in the loss of reservoir operating ranges and new instream flow requirements that impact power generation.

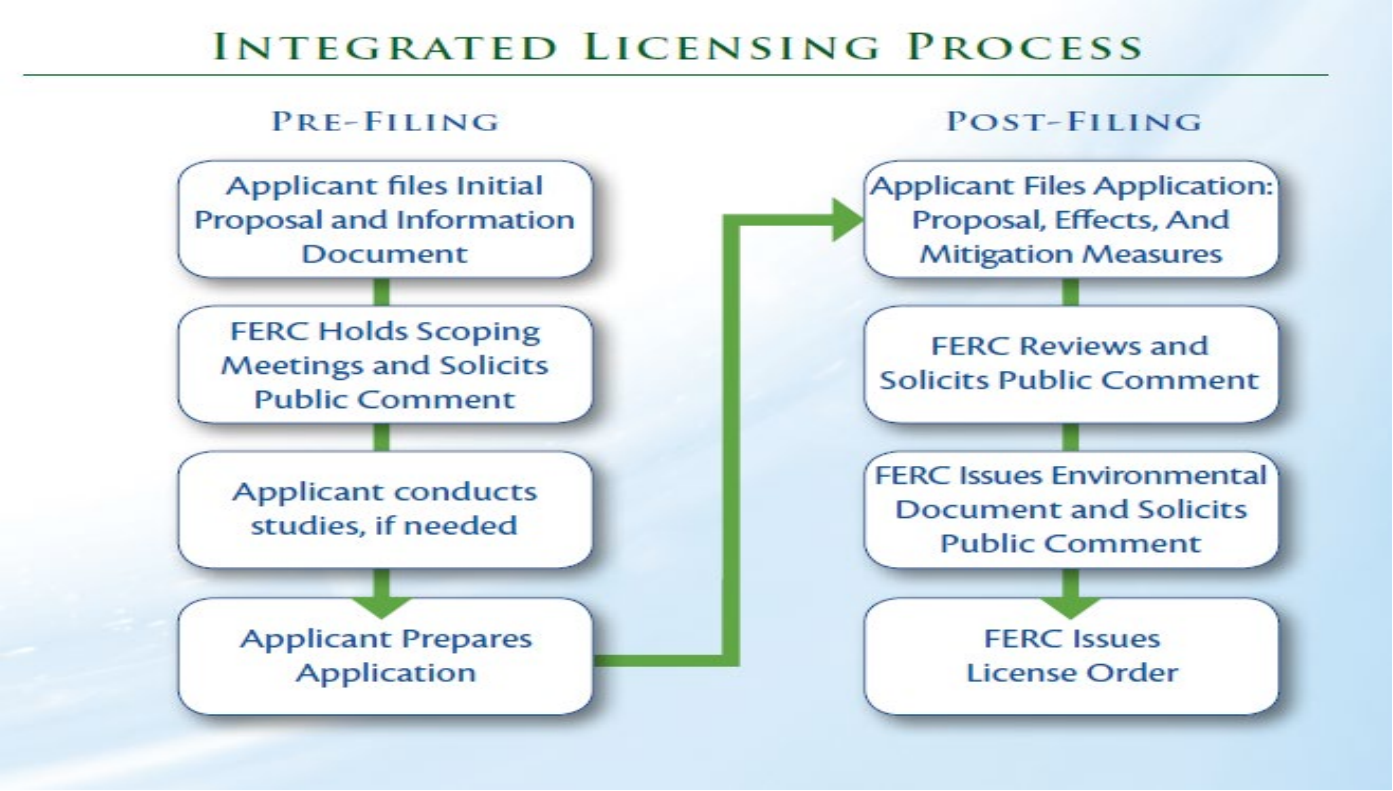
FERC licensing of the Four Lakes is anticipated be an expensive and lengthy process due multiple resources involved, the number of resources that have been affected by the dam failures and lowered lake levels, and the number of stakeholders involved. The expected cost of licensing and addressing natural resource needs range from $14.3 to $73.2 million for the four lakes combined.

Seeking a hydropower license at the Four Lakes would also cause significant delays in the reconstruction of the Edenville and Sanford Dams and the construction and replacement of spillway gates at all Four Lakes dams. There are also financial risks in the restoration and modification of the dams and spillways

(above and beyond those envisioned under state oversight or under non-power use of the lakes and facilities), powerhouses, switchyards, and generating equipment. Furthermore, there is significant uncertainty regarding the conditions that would be included in the operating license(s).

## Attachment A – FERC Licensing Process

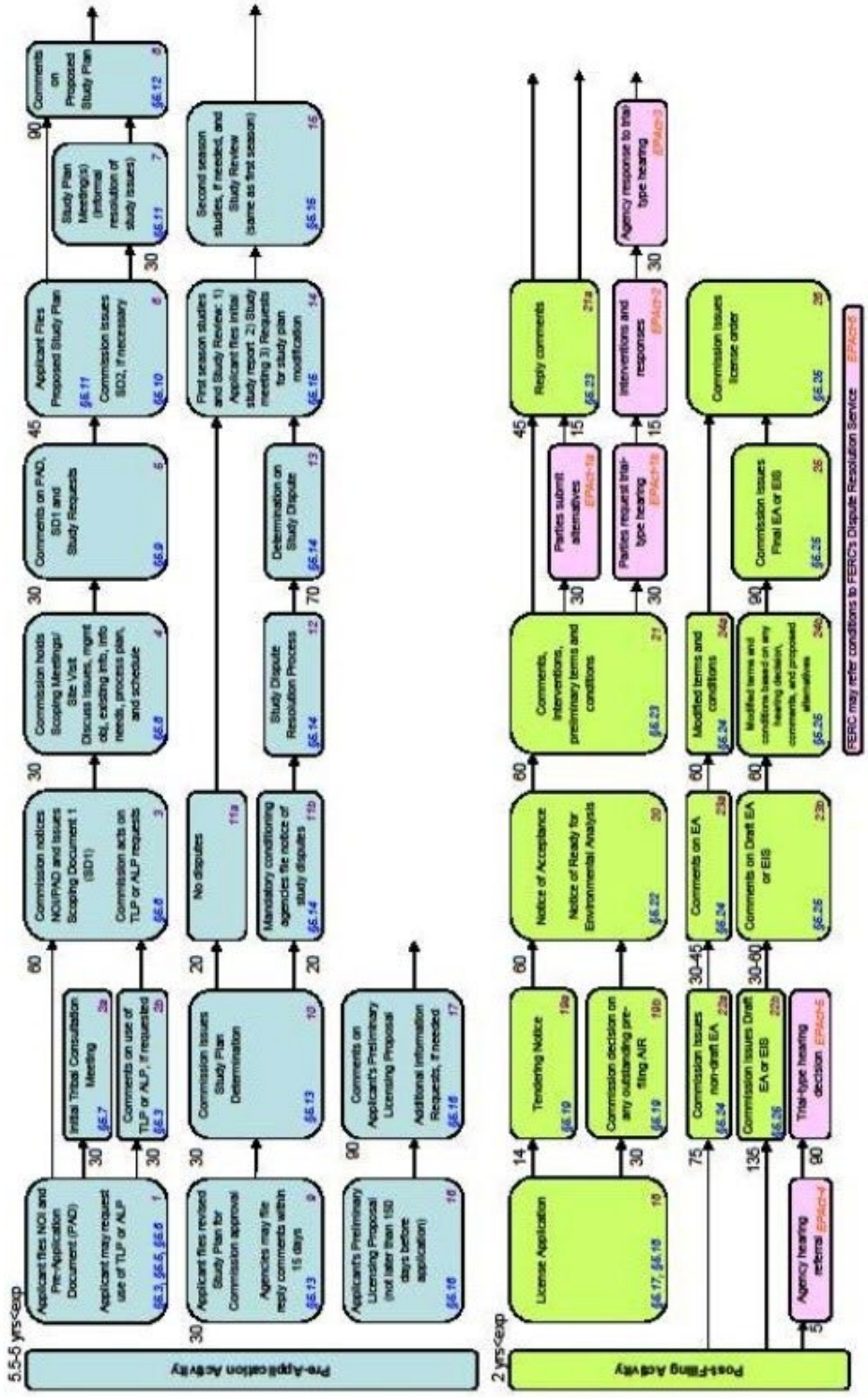
FERC has determined that the Integrated Licensing Process (ILP) is the default process for applicants to use when seeking a license for hydroelectric installations, therefore, for the purposes of this report, it is assumed that FLTF would use the ILP if the Counties decide to apply for FERC licenses for the Four Lakes hydroelectric projects. The ILP and other licensing processes are timeline driven and are designed to create many consultation opportunities for stakeholders, agencies, and others. The graphic below shows the key milestones and flow of the ILP process.




As noted above, the ILP is comprised of prescriptive steps that are based on a set timeline. A more detailed figure (below) summarizes the ILP chronology of steps and their associated durations. The numbers between the boxes indicate the number of days between steps. The number at the lower right corner of each box indicates the sequence step number. The number on the lower left is the Federal Power Act reference section for the activity. The blue-grey boxes show the pre-Application filing steps while the pink and green boxes show the post-Application steps.

# Flow Chart for ILP

**Integrated Licensing Process and Section 241 of the Energy Policy Act of 2005**




*Section 241 of the Energy Policy Act of 2005 in pink.

The following is an overview of the work to be completed throughout the ILP process.

Year 1 - *First 6 months*: This period is for the identification of studies necessary for the development of sufficient information for determining the actual or potential impacts from the existing or proposed Project operations and are detailed in the applicant's Proposed Study Plan (PSP) that is submitted to FERC.

Year 1 – *Second 6 months*: FERC reviews the PSP and seeks agency and public comment regarding the list of applicant proposed studies. The applicant addresses stakeholder comments regarding the PSP and submits a Revised Study Plan (RSP) to FERC allowing for an additional opportunity for stakeholders to provide comments on this latter plan. FERC will evaluate the RSP, consider stakeholder comments and will issue a Study Plan Determination and Final Study Plan (FSP). Formal disputes can be processed at this time for particular studies while acceptable 1st Season studies are underway. If disputes exist, FERC will oversee the dispute and issue its Determination on Study Dispute.

Year 2 – Applicant conducts FSP resource studies and develops the Initial Study Report for dissemination at the Initial Study Report (ISR) meeting with the stakeholders.

Year 3 – Applicant conducts 2nd Year studies, if necessary, holding an Update Study Meeting towards the end of the year. The applicant develops a Preliminary (Draft) Licensing Proposal (PLP) that includes proposed hydroelectric operations, impacts of operations on resources and proposed mitigation. After considering comments and disagreements, the applicant files its Final License Application (FLA).

Years 4 & 5 – FERC reviews the FLA considering the full range of federal regulations (including NEPA requirements), responsibilities, interests, proposed operations, potential impacts, study results, and the official licensing record to prepare to issue the applicant an original license for hydroelectric operations for the next 30 to 50 years; a license that is conditioned with protections, impact mitigations, and resource enhancements.

Beyond License Issuance – The original license conditions typically require the licensee to develop management plans in consultation with relevant agencies and other stakeholders. These plans dictate how project resources will be managed to the satisfaction of FERC. The licensee will have ongoing responsibilities for land and shoreline management, recreation management, water quality management, soil and erosion protections, endangered and threatened species protections, debris management, etc.

Other factors that can affect the length of licensing are:

- Process Complexity – Licensing of hydroelectric projects is very complex and involves a rigorous set of activities for all involved parties. Complicated situations that need to be resolved between numerous agencies and stakeholders with differing interests are often technical and/or resource specific thereby requiring frequent meetings and extended time to develop consensus. Licensing processes involve many stakeholder groups, the public, municipalities, Native American Tribes, and federal and state agencies in the provision of resource related comments, public consultation meetings, submittal reviews, resource studies, and potential settlement agreements, that are subject to FERC reviews, determinations, and issuances.

- Studies – Applicants are required to study their impacts on Project resources and therefore need to develop study plans for review by all stakeholders. Once the scope of studies has been

confirmed by FERC, applicants work with involved stakeholders and subject matter experts (usually consultants) to conduct studies over a one-to-two-year period. Study reports are developed and reviewed by the stakeholders and the resource agencies for comment. The filing date of the Notice of Intent to seek an original license starts the licensing process and the timing of the study seasons. Studies are performed when impacts to the resources can be best studied, therefore seasonal timing may leave only one season available for studying the Project resources. A second season of study often occurs when abnormal weather prevents the applicant from obtaining quality information during the first study season or when additional information is needed to bolster the quality of study data and content.

- Disputes – Licensing regulations contain a dispute resolution process that may be initiated when agreement on the scope of studies or study plans cannot be reached by the applicant, stakeholders, and agencies thereby delaying the start of specific studies. There is the potential for legal action by agencies or other involved parties that could and have greatly extended licensing durations.
- License Application Creation – The development of the Preliminary License Proposal or Draft License Application and the Final License Application are administratively burdensome. These documents use study information to formulate applicant proposals for balancing proposed project operations with protecting and enhancing of Project resources and mitigating Project resource impacts.
- Regulatory Review – FERC has a role in ensuring that licensing terms meet its purposes as required by regulation or policy, therefore, the agency reviews filings and makes determinations as to the completeness of the license application, including time for the issuance of FERC additional information requests and studies that the applicant must undertake and file with FERC.
- Management Plans – Post-license studies and development of management plans are common and necessary, resulting in extended periods of consultation and licensee involvement.
- Lengthy License Duration – Original licenses have term lengths between 30 and 50 years to reduce the licensee's financial exposure from changing regulatory requirements over the license period. Long license periods provide stakeholders and agencies with significant incentives to become very diligent in determining potential Project impacts and to seek out substantive changes to Project license conditions for the protection of public interests over this long license term.
- License Reopeners – The agencies will insert license reopener clauses in their prescriptions or in license settlement agreements to establish an avenue to change or add to the licensee's obligations throughout the license period. These clauses also introduce significant periods of licensee involvement and financial exposure that may not have anticipated when first determining to go forward with their licensing effort.

# Attachment B – State Versus Federal Jurisdiction

Currently, Four Lakes reconstruction activities, including construction or modification of dams and dam operation and maintenance, are occurring under local and state jurisdiction, with EGLE serving as the lead agency. Development of hydropower would require that the dams come under federal jurisdiction.

A major difference between state and federal jurisdiction is that Section 10(a)(1) of the Federal Power Act (FPA), often referred to as the comprehensive development requirement of the FPA, states that any project licensed must be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the benefit of multiple public uses. The FERC is required to consider enhancements for recreation, cultural resources, environmental resources and balance these with power generation interests. Under state jurisdiction there is no requirement for comprehensive development.

Other requirements associated with federal jurisdiction under FERC include:

- The Electric Consumers Power Act of 1986, as amended requires FERC to assess hydropower project impacts on all environmental and social issues and consider both power and non-power resource values during the licensing process.
- FPA Section 18 states that the FERC must require the construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of Interior or Commerce. These prescriptions are mandatory and must be included in the license.
- Section 10(a)(2)(A) of the FPA requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Qualifying comprehensive plans that are filed with the FERC and are applicable to the waterway where a proposed project is located must be reviewed by FERC staff to determine whether the project would be consistent with the plans.
- FPA Section 10(j) requires that any license issued must include conditions to protect, mitigate damages to, and enhance fish and wildlife related habitat. Conditions are to be based on recommendations from federal and state fish and wildlife agencies.
- Section 401 (a)(1) of the Clean Water Act requires an applicant for a FERC license to obtain certification (or a waiver of certification) from the appropriate state pollution control agency verifying compliance with the CWA before FERC can issue a license for the project. The conditions of a water quality certification become mandatory conditions of any license issued. The 401 Water Quality Certification (WQC) conditioning includes determining reservoir operating levels, bypassed river reach minimum flows, project minimum flows, invasive plant monitoring and eradication, water quality parameters, resource monitoring and reporting.
- The Endangered Species Act's Section 7 requires federal agencies to ensure their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat for those species. If any proposed licensing action may affect listed species, FERC must prepare a Biological Assessment (BA) and may consult with the Fish & Wildlife Service or National Marine Fisheries Service prior to preparing a BA or the NEPA EIS or EA.
- Section 106 of the National Historic Preservation Act requires applicants to identify all historic properties within a proposed action's Area of Potential Effects and assess the action's effects on these resources. If the effects are determined to be adverse, then a Historic Properties Management Plan (HPMP) would need to be created, one that specifies measures needed to avoid, reduce, or mitigate these effects. Consultations with relevant entities are required in the

development of the HPMP and the Programmatic Agreement (PA) that results. The PA satisfies FERC's consultation requirements under Section 106.

- In conjunction with section 4(e), the National Environmental Policy Act (NEPA) sets forth matters that the Commission must consider in reviewing a license application. Equal consideration must be given to power development, energy conservation, fish and wildlife impacts, recreation impacts, other aspects of environmental quality, cultural resources, as well as beneficial development uses such as irrigation, flood control, and water supply.

The additional regulatory requirements associated with federal jurisdiction typically lead to extended project timelines and increased costs for the owners of hydroelectric facilities that are typically not borne by owners of dams without hydroelectric facilities.

# TITTABAWASSEE RIVER PROJECTS

Desktop Study
Restoration of Hydroelectric Generation at
Secord, Smallwood, Edenville and Sanford Dams

## Appendix B
## Engineering Assessment

*Prepared by:*

THE ESSEX PARTNERSHIP

*Prepared for:*

**Four Lakes Task Force**

***November 2021***

# Contents

# 1.0 Introduction and Purpose

This engineering assessment is one component of a desktop study performed by The Essex Partnership (Essex) to examine the feasibility of restoring hydropower at the four dams operated by the Four Lakes Task Force (FLTF) – Secord, Smallwood, Edenville and Sanford.

The study evaluates the feasibility of restoring hydropower at the four dams in their post May 2020 condition. The study utilizes existing available information from Essex's prior studies, Essex October 2020 visual inspection of the powerhouses and equipment, and subsequent inspections of the powerhouses, dams, and waterways that were performed by GEI and the Spicer Group. No new field work or equipment inspections were performed specifically for this study.

# 2.0 Background and Assumptions

As of September 2021, the status of the four hydrogenating powerplants is as follows:

- The generators at Secord, Smallwood and Sanford have been idle for more than 2-½ years. The generators at Edenville have not operated for more than 3 years.
- The powerhouses at Edenville and Sanford are in the process of being partially demolished as part of interim efforts to stabilize the two dams.
- FERC licenses for all four projects have been terminated and are no longer in effect.
- The electrical interconnection agreements with Consumers Energy at all four plants were signed in 1923 with an initial expiration period of 99 years. They will all expire in 2022.

In order to restore generation at the four projects, certain capital improvements would be needed to place the generating equipment into proper working order again. In addition, all four plants would need to be licensed by the Federal Energy Regulatory Commission (FERC) and have new interconnection agreements negotiated with Consumers Energy. These activities would need to begin well in advance of when actual generation could occur. For purposes of this Assessment, Essex assumed 2026 as the in-service-date for re-establishing generation at the four projects under new FERC licenses and Interconnection Agreements.

## *2.1 Restoration Scenarios*

Two scenarios were investigated for the four plants.

1. Rehabilitate Existing Powerhouses. This scenario assumes that the existing powerhouses would remain in place and the equipment would be repaired/replaced as necessary to bring the plants into a condition suitable for continued operation. As noted

above, the Edenville and Sanford powerhouses are in the process of being partially demolished, making these two cases hypothetical analyses.

2. Construct New Powerhouses. This scenario assumes that the existing powerhouses would be demolished, new powerhouses would be constructed, and all-new, more efficient turbine generators would be installed.

The estimates of capital expenditures and operating costs developed for each of the above two scenarios are limited to the scope of work required to generate electrical power. They do not include any costs to repair or rebuild the dams, any improvements that may be required to bring the dams into compliance with current dam safety regulations, or the costs to operate and maintain the dams.

## 2.2 FERC Relicensing

Restoring hydropower to the dams would bring the projects under FERC jurisdiction. This would require going through the licensing process to obtain new licenses and put restoration of the dams under FERC dam safety regulations. The licensing process and the associated costs are covered in detail in Appendix A. Restoration of the dams under FERC dam safety regulations would extend the schedule and increase the cost of restoration. These two factors were not included in the analysis.

## 2.3 Consumers Energy Interconnection Agreement

New interconnection agreements with Consumers Energy would be needed in order to reconnect the output of the generators to the grid. Conditions of the new agreements would require the generating stations to conform to current industry standards, which would require the replacement of protection, transformers, and high-voltage interconnection equipment. Essex used the costs presented by Consumers Energy in their March 13, 2020 letter to estimate the cost for upgrading the interconnection facilities to current industry standards.

The estimated interconnection costs for Edenville, Secord and Sanford are five times higher than Smallwood. The reason for the difference is that Smallwood connects to a Consumers Energy 8.32 kV distribution network whereas the three other projects connect at sub-transmission voltages of 48kV and 66 kV.

## 2.4 Operation and Maintenance Expenses (OPEX)

Boyce Hydro had a 2019 OPEX budget for operating all four projects of $1,200,000. Essex allocated the costs to each project based on installed capacity, escalated to 2021 dollars and the subtracted $30,000 of operating costs per dam to develop an operating budget for each refurbished powerplant. Budgets for the refurbished plants were reduced by 10% to estimate the O&M costs for the all-new facilities.

**Operation and Maintenance Cost Estimate**

| Project | Installed Capacity (kw) | % of Total | Boyce O&M ($1,000s) | Essex O&M ($1,000s) | O&M New ($1,000s) |
|---|---|---|---|---|---|
| Secord | 1,200 | 10% | 137 | 107 | 96 |
| Smallwood | 1,200 | 10% | 137 | 107 | 96 |
| Edenville | 4,800 | 47% | 549 | 489 | 440 |
| Sandford | 3,300 | 33% | 377 | 347 | 312 |
| Totals | 10,500 | 100% | 1,200 | 1,050 | 945 |

The above estimates specifically exclude the operational costs for the dams, reservoirs and spillway gates and assumes all four hydro projects are operated by a single entity. If the projects are operated by multiple entities, then the total costs to operate the four projects would be higher.

## *2.5 Energy and Capacity*

To account for efficiency improvements, historic generation was increased by 5% and 10% respectively to estimate energy production for the rehab and all-new powerhouse scenarios. Values for Resource Adequacy Capacity were obtained from partially executed agreements between Boyce and Consumers as of May 19, 2020.

**Energy and Capacity**

| Project | Installed Capacity (kw) | 12-Year Historic MWH | % of Total MWH | Rehab MWH | New MWH | Capacity (ZRC-Yr.) |
|---|---|---|---|---|---|---|
| Secord | 1,200 | 4,323 | 13% | 4,539 | 4,755 | 1.0 |
| Smallwood | 1,200 | 3,137 | 9% | 3,294 | 3,451 | 0.9 |
| Edenville | 4,800 | 17,898 | 52% | 18,793 | 19,688 | 2.9 |
| Sandford | 3,300 | 8,750 | 26% | 9,188 | 9,625 | 2.4 |
| Totals | 10,500 | 34,108 | 100% | 35,813 | 37,519 | 7.2 |

# 3.0 Secord Restoration

## *3.1 Scenario 1 – Rehabilitation of Existing Powerhouse*

### *3.1.1 CAPEX*

The turbine-generator was not inundated during the May 2020 flood and appears to have suffered little damage. Our understanding is that the powerhouse has been kept dry and heated during the winter months. Based on the above, we assumed the existing turbine-generator could be re-used. For purposes of this study, we assumed the turbine would require a minor unit overhaul, the generator would need to be cleaned and tested, along with other miscellaneous repairs and testing. In addition, new headgates and trashracks would be installed as described in the "Detailed Condition Assessment" performed by the Essex Partnership in October 2019.

Essex's total estimated CAPEX to rehabilitate Secord, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $1,835,000, expressed in Y2021 dollars. Our estimated cost to rehabilitate the existing powerhouse and equipment is itemized below.

**Secord Rehabilitation Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 Minor Unit OH | $75,000 |
| 2 | Generator No. 1 Minor OH | $75,000 |
| 3 | Controls and Protection System Replacement - NEW | $100,000 |
| 4 | Trashracks - NEW | $90,000 |
| 5 | Headgates - NEW | $60,000 |
| 6 | Consumers Power Interconnection Costs | $1,250,000 |
| 7 | General clean-up, repairs and testing | $25,000 |
| 8 | Engineering | $160,000 |
| 9 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$1,835,000** |

### *3.1.2 OPEX*

The fixed O&M cost is estimated be $107,000 per year, expressed in Y2021 dollars. We calculated this value by deducting $30,000 for spillway gate operations from Boyce's historic O&M cost. In addition, a cost of $150,000 (Y2021 dollars) has been added to the OPEX for a minor unit overhaul after 15 years of operation in Y2040.

### 3.1.3 Energy Production

Average annual energy production for the rehabilitated station is estimated to be 4,539 MWH. We calculated this value by increasing Boyce's 12-year historic energy production by 5% to account for the anticipated increase in efficiency from the minor unit overhaul.

## 3.2 Scenario 2 – Construction of a New Powerhouse

### 3.2.1 CAPEX

For purposes of this study Essex assumed the new powerhouse would be configured with a single, double-regulated Kaplan turbine having the same hydraulic capacity as the existing unit and operating in run-of-river mode. Run-of-river operations would simplify the licensing process and a double-regulated unit would provide better efficiency over the operating range. Essex estimates the runner diameter would be 4.8 feet in order to achieve a discharge of 480 cfs at 46 feet of head. The new powerhouse would be complete with new gates, trashracks, electrical switchgear, relaying and controls.

Essex's total estimated CAPEX for an all-new powerhouse and equipment, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $6,265,000, expressed in Y2021 dollars. Our estimated cost for the new powerhouse and equipment is itemized below.

**Secord New Powerhouse and Equipment Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 - NEW | $1,400,000 |
| 2 | Generator No. 1 - NEW | $1,000,000 |
| 3 | Switchgear Replacement - NEW | $120,000 |
| 4 | Controls and Protection System Replacement - NEW | $175,000 |
| 5 | Trashracks - NEW | $90,000 |
| 6 | Headgates - NEW | $60,000 |
| 7 | Powerhouse (Civil Works, Lighting, HVAC) - NEW | $1,500,000 |
| 8 | Plant ac and dc distribution systems - NEW | $150,000 |
| 9 | Consumers Power Interconnection Costs | $1,250,000 |
| 10 | Engineering | $520,000 |
| 11 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$6,265,000** |

### 3.2.2 OPEX

The fixed O&M cost is estimated be $96,000 per year, expressed in Y2021 dollars. We arrived at this number by reducing Boyce's historic O&M cost by 10% to account for the all-new powerhouse and equipment and then deducting $30,000 for spillway gate operations. In addition, a cost of $175,000 (Y2021 dollars) has been added to the OPEX for a minor unit overhaul after 15 years of operation in Y2040. The cost of the minor unit overhaul is estimated to be $25,000 more than the rehabilitation scenario because of the complexities of the double-regulated Kaplan turbine.

### 3.2.3 Energy Production

Average annual energy production for the all-new station is estimated to be 4,755 MWH. We calculated this value by increasing Boyce's 12-year historic energy production by 10% to account for the anticipated increase in efficiency from the new powerhouse, water passages and equipment.

# 4.0 Smallwood Restoration

## 4.1 Scenario 1 – Rehabilitation of Existing Powerhouse

### 4.1.1 CAPEX

Improvements at Smallwood are similar to those described at Secord. The turbine-generator should be able to be re-used provided that the powerhouse has been kept dry and heated during the winter. Only a minor unit overhaul, generator cleaning and testing, and some clean-up, repairs and testing are anticipated. In addition, new headgates and trashracks would be installed as described in the "Detailed Condition Assessment" performed by the Essex Partnership in October 2019.

Essex's total estimated CAPEX to rehabilitate Smallwood, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $745,000, expressed in Y2021 dollars. This is $1.08 million less than the Secord estimate due to the lower cost of connecting to the CE 12.8kV distribution system – instead of the CE sub-transmission system. Our estimated cost to rehabilitate the existing powerhouse and equipment is itemized below.

**Smallwood Rehabilitation Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 Minor Unit OH | $75,000 |
| 2 | Generator No. 1 Minor OH | $75,000 |
| 3 | Controls and Protection System Replacement - NEW | $100,000 |
| 4 | Trashracks - NEW | $90,000 |
| 5 | Headgates - NEW | $60,000 |
| 6 | Consumers Power Interconnection Costs | $250,000 |
| 7 | General clean-up, repairs and testing | $25,000 |
| 8 | Engineering | $70,000 |
| 9 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$745,000** |

### *4.1.2 OPEX*

Like Secord, the fixed O&M cost is estimated be $107,000 per year, expressed in Y2021 dollars. We calculated this value by deducting $30,000 for spillway gate operations from Boyce's historic O&M cost. In addition, a cost of $150,000 (Y2021 dollars) has been added to the OPEX for a minor unit overhaul after 15 years of operation in Y2040.

### *4.1.3 Energy Production*

Average annual energy production for the rehabilitated station is estimated to be 3,294 MWH. We calculated this value by increasing Boyce's 12-year historic energy production by 5% to account for the anticipated increase in efficiency from the minor unit overhaul.

## *4.2 Scenario 2 – Construction of a New Powerhouse*

### *4.2.1 CAPEX*

For this study Essex configured the new Smallwood powerhouse the same as Secord, with a single, double-regulated Kaplan turbine having the same hydraulic capacity as the existing unit and operating in run-of-river mode. Essex estimates the runner diameter would be 6.6 feet in order to achieve a discharge of 7200 cfs at 28 feet of head. The new powerhouse would be complete with new gates, trashracks, electrical switchgear, relaying and controls.

Essex's total estimated CAPEX for an all-new powerhouse and equipment, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $6,105,000, expressed in Y2021 dollars. This is only $160,000 less than the estimate for Secord, because most of the savings resulting from the interconnection costs would be offset by higher equipment costs for the larger diameter turbine. Our estimated cost for the new powerhouse and equipment is itemized below.

**Smallwood New Powerhouse and Equipment Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 - NEW | $2,250,000 |
| 2 | Generator No. 1 - NEW | $1,000,000 |
| 3 | Switchgear Replacement - NEW | $120,000 |
| 4 | Controls and Protection System Replacement - NEW | $175,000 |
| 5 | Trashracks - NEW | $90,000 |
| 6 | Headgates - NEW | $60,000 |
| 7 | Powerhouse (Civil Works, Lighting, HVAC) - NEW | $1,500,000 |
| 8 | Plant ac and dc distribution systems - NEW | $150,000 |
| 9 | Consumers Power Interconnection Costs | $250,000 |
| 10 | Engineering | $510,000 |
| 11 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$6,105,000** |

#### *4.2.2 OPEX*

The fixed O&M cost is estimated be $96,000 per year, expressed in Y2021 dollars. We arrived at this number by reducing Boyce's historic O&M cost by 10% to account for the all-new powerhouse and equipment and then deducting $30,000 for spillway gate operations. In addition, a cost of $175,000 (Y2021 dollars) has been added to the OPEX for a minor unit overhaul after 15 years of operation in Y2040.

#### *4.2.3 Energy Production*

Average annual energy production for the all-new station is estimated to be 3,451 MWH. We calculated this value by increasing Boyce's 12-year historic energy production by 10% to account for the anticipated increase in efficiency from the new powerhouse, water passages and equipment.

# 5.0 Edenville Restoration

## *5.1 Scenario 1 – Rehabilitation of Existing Powerhouse*

#### *5.1.1 CAPEX*

The turbine-generators at Edenville were inundated during the May 2020 flood. The turbines can be reconditioned and placed back into service with a major unit overhaul. However, all the electrical apparatus, including the generators, were inundated and need to be replaced. Replacement of the generators would require modifications to the powerhouse roof to permit a crane lift of the generators. In addition, new headgates and trashracks should be installed as

described in the "Detailed Condition Assessment" performed by the Essex Partnership in October 2019.

Because the powerhouse was inundated during the flood, an allowance for civil repairs; demolition; general clean-up; replacement of the in-plant electrical distribution system; and, new HVAC equipment is included in the estimate.

Essex's total estimated CAPEX to rehabilitate Edenville, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $7,145,000, expressed in Y2021 dollars. Our estimated cost to rehabilitate the existing powerhouse and equipment is itemized below.

**Edenville Rehabilitation Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 Major Unit OH | $187,500 |
| 2 | Generator No. 1 - NEW | $1,500,000 |
| 3 | Turbine No. 2 Major Unit OH | $187,500 |
| 4 | Generator No. 2 - NEW | $1,500,000 |
| 5 | Switchgear Replacement - NEW | $180,000 |
| 6 | Controls and Protection System Replacement - NEW | $350,000 |
| 7 | Trashracks - NEW | $225,000 |
| 8 | Headgates - NEW | $150,000 |
| 9 | Powerhouse (Civil Works, Lighting, HVAC) - ReHAB | $500,000 |
| 10 | Plant ac and dc distribution systems - NEW | $175,000 |
| 11 | Consumers Power Interconnection Costs | $1,250,000 |
| 12 | Roof Modifications for Crane | $150,000 |
| 13 | Demolition | $125,000 |
| 14 | General clean-up, repairs, and testing | $75,000 |
| 15 | Engineering | $590,000 |
| 16 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$7,145,000** |

### *5.1.2 OPEX*

Fixed O&M cost for the Edenville rehabilitated facility is estimated be $489,000 per year, expressed in Y2021 dollars. We calculated this value by deducting a total of $60,000 for gate operations at the Edenville and Tobacco spillways from Boyce's historic O&M cost. In addition, a cost of $300,000 (Y2021 dollars) has been added to the OPEX for minor overhauls to the two units ($150,000 per unit) after 15 years of operation in Y2040.

### 5.1.3 Energy Production

Average annual energy production for the rehabilitated station is estimated to be 18,793 MWH. Like the other rehabilitated stations, we calculated this value by increasing Boyce's 12-year historic energy production by 5% to account for the anticipated increase in efficiency from the minor unit overhauls.)

## 5.2 Scenario 2 – Construction of a New Powerhouse

### 5.2.1 CAPEX

If a new powerhouse is to be constructed, Essex recommends it be built to contain one fixed blade turbine and one double-regulated Kaplan turbine operating in run-of-river mode. The double-regulated unit would be more efficient over the range of flows for run-of-river operations. Essex estimates the diameter of the turbine runner to be 7.1 feet in order to match the present 2,100 cfs hydraulic capacity of the station at 44 feet of head. The new powerhouse would be complete with new gates, trashracks, electrical switchgear, relaying and controls.

Essex's total estimated CAPEX for an all-new powerhouse and equipment, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $12,410,000, expressed in Y2021 dollars. Our estimated cost for the new powerhouse and equipment is itemized below.

**Edenville New Powerhouse and Equipment Cost Estimate**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 - NEW | $1,900,000 |
| 2 | Generator No. 1 - NEW | $1,500,000 |
| 3 | Turbine No. 2 - NEW | $2,400,000 |
| 4 | Generator No. 2 - NEW | $1,500,000 |
| 5 | Switchgear Replacement - NEW | $180,000 |
| 6 | Controls and Protection System Replacement - NEW | $350,000 |
| 7 | Trashracks - NEW | $225,000 |
| 8 | Headgates - NEW | $150,000 |
| 9 | Powerhouse (Civil Works, Lighting, HVAC) - NEW | $1,750,000 |
| 10 | Plant ac and dc distribution systems - NEW | $175,000 |
| 11 | Consumers Power Interconnection Costs | $1,250,000 |
| 12 | Engineering | $1,030,000 |
| 13 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$12,410,000** |

### 5.2.2 OPEX

The fixed O&M cost is estimated in Appendix B to be $240,000 per year, expressed in Y2021 dollars. In addition, a cost of $325,000 (Y2021 dollars) has been added to the OPEX for minor unit overhauls to two units after 15 years of operation in Y2040. The cost of the minor unit overhauls is estimated to be $25,000 more than the rehabilitation scenario because one of the units is a double-regulated Kaplan turbine.

### 5.2.3 Energy Production

Average annual energy production for the all-new Edenville Station is estimated to be 19,688 MWH. We calculated this value by increasing Boyce's 12-year historic energy production by 10% to account for the anticipated increase in efficiency from the new powerhouse, water passages and equipment.

# 6.0 Sanford Restoration

## 6.1 Scenario 1 – Rehabilitation of Existing Powerhouse

### 6.1.1 CAPEX

During the May 2020 flood, flood waters in the Sanford powerhouse reached only slightly above the generator floor. Therefore, the generators were not inundated and suffered only modest water damage. We assumed the turbine-generators can be reconditioned and placed back into service.

The switchgear assemblies on the generator floor were likewise not inundated and suffered no water damage during the flood. These assemblies are new and should be salvaged if either the existing power house is retained or a new powerhouse is constructed.

As noted in the "Detailed Condition Assessment" performed by the Essex Partnership in October 2019, the following additional rehabilitation activities would be required:

- Unit 1, which is the newest unit, would only require a minor unit overhaul.
- Units 2 and 3 would each have a major unit overhaul and generator rewinds performed to restore them into serviceable condition. Major unit overhauls would require modifications to the powerhouse roof to enable a crane lift of the generator rotating parts.
- New headgates and trashracks.

Since the lower levels of the powerhouse were flooded and allowance has been included in the cost estimate for civil repairs; demolition; general clean-up; replacement of the in-plant electrical ac/dc distribution system; and, new HVAC equipment.

Essex's total estimated CAPEX to rehabilitate Sanford, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $3,685,000, expressed in Y2021 dollars. Our estimated cost to rehabilitate the existing powerhouse and equipment is itemized below.

**Sanford Rehabilitation Cost Estimates**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 Minor Unit OH | $75,000 |
| 2 | Generator No. 1 Minor OH | $75,000 |
| 3 | Turbine No. 2 Major Unit OH | $150,000 |
| 4 | Generator No.2 Rewind | $150,000 |
| 5 | Turbine No. 3 Major Unit OH | $150,000 |
| 6 | Generator No. 3 Rewind | $150,000 |
| 7 | Trashracks - NEW | $270,000 |
| 8 | Headgates - NEW | $180,000 |
| 9 | Powerhouse (Civil Works, Lighting, HVAC) - ReHAB | $500,000 |
| 10 | Plant ac and dc distribution systems - NEW | $175,000 |
| 11 | Consumers Power Interconnection Costs | $1,250,000 |
| 12 | Roof Modifications for Crane | $150,000 |
| 13 | Demolition | $50,000 |
| 14 | General clean-up, repairs and testing | $50,000 |
| 15 | Engineering | $310,000 |
| 16 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$3,685,000** |

### *6.1.2 OPEX*

The fixed O&M cost is estimated be $347,000 per year, expressed in Y2021 dollars. We calculated this value by deducting $30,000 for spillway gate operations from Boyce's historic O&M cost. In addition, a cost of $475,000 (Y2021 dollars) has been added to the OPEX for minor unit overhauls to three units, 2 fixed-blade turbines ($150,000 each) and one double-regulated Kaplan turbine ($175,000) after 15 years of operation in Y2040.

### *6.1.3 Energy Production*

Average annual energy production for the rehabilitated Sanford station is estimated to be 9,188 MWH. Like the other rehabilitated stations, we increased Boyce's 12-year historic energy production by 5% to account for the anticipated increase in efficiency from the minor unit overhauls.)

## 6.2 Scenario 2 – Construction of a New Powerhouse

### 6.2.1 CAPEX

For purposes of this study Essex reconfigured the new powerhouse to two units, instead of three units as the original powerhouse. This would simplify construction and reduce capital and O&M costs. The first unit at Sanford would be the almost-new, double-regulated turbine/generator salvaged from the existing powerhouse. This unit was installed in 2014 and is in excellent condition. The second unit at Sanford would be an all-new, larger fixed-blade turbine. Essex estimates that the diameter of the new turbine runner would need to be 9.5 feet in order to achieve a discharge of 1,427 cfs, which is equivalent to the total discharge capacity of the two existing units. This configuration has the same hydraulic capacity as the existing three-unit powerhouse and would be efficient for run-of-river operations.

The switchgear, controls and protection presently installed in the powerhouse can be salvaged and re-used in the new powerhouse. However, headgates, trashracks, station service equipment (i.e., lighting, ac/dc distribution, HVAC) would be new.

Essex's total estimated CAPEX for an all-new powerhouse and equipment, including the costs for the new CE interconnection agreement and excluding FERC licensing costs, is $11,120,000, expressed in Y2021 dollars. Our estimated cost for the new powerhouse and equipment is itemized below.

**Sanford New Powerhouse and Equipment Cost Estimates**

| Item No. | DESCRIPTION | Costs |
|---|---|---|
| 1 | Turbine No. 1 - NEW | $1,400,000 |
| 2 | Generator No. 1 - NEW | $750,000 |
| 3 | Turbine No. 2 - NEW | $2,500,000 |
| 4 | Generator No. 2 - NEW | $2,000,000 |
| 5 | Trashracks - NEW | $225,000 |
| 6 | Headgates - NEW | $150,000 |
| 7 | Powerhouse (Civil Works, Lighting, HVAC) - NEW | $1,750,000 |
| 8 | Plant ac and dc distribution systems - NEW | $175,000 |
| 9 | Consumers Power Interconnection Costs | $1,250,000 |
| 10 | Engineering | $920,000 |
| 11 | **Hydro Plant Overnight Costs, Y2021 Dollars** | **$11,120,000** |

### 6.2.2 OPEX

The fixed O&M cost is estimated in Appendix B to be $312,000 per year, expressed in Y2021 dollars. The O&M cost for the new powerhouse scenario is lower than the rehab scenario

because the number of units has been reduced from 3 to 2. A cost of $325,000 (Y2021 dollars) has been added to the OPEX for minor unit overhauls to two units (1 fixed-blade turbines and one double-regulated Kaplan turbine) after 15 years of operation in Y2040.

### *6.2.3 Energy Production*

Average annual energy production for the reconfigured, all-new Sanford Station is estimated to be 9,625 MWH. Boyce's 12-year historic energy production was increased by 10% to account for the anticipated increase in efficiency from the new powerhouse, water passages and equipment.