UPSTREAM FISH PASSAGE
CONCEPTUAL ALTERNATIVES STUDY - PHASE 1
PRELIMINARY STUDY REPORT
BRUNSWICK HYDROELECTRIC PROJECT
FERC NO. 2284

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LIST OF ABBREVIATIONS AND DEFINITIONS

ASCE	American Society of Civil Engineers
BWPH	Brookfield White Pine Hydro LLC
cfs	Cubic feet per second
CFD	Computational Fluid Dynamics
EDF	Energy Dissipation Factor
FERC	Federal Energy Regulatory Commission
FTA	Free the Andro
ILP	Integrated Licensing Process
Licensee	Brookfield White Pine Hydro, LLC
M	Million
ME	Maine
MDMR	Maine Department of Marine Resources
MW	Megawatt
NGVD29	National Geodetic Vertical Datum of 1929
NMFS	National Marine Fisheries Service
NLF	Nature-Like Fishway
NOI	Notice of Intent
O&M	Operations and Maintenance
PAD	Pre-Application Document
Project	Brunswick Hydroelectric Project (FERC No. 2284)
RSP	Revised Study Plan
SD1	Scoping Document 1
SPD	Study Plan Determination
sqm	Square mile
3D	Three-dimensional
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1 INTRODUCTION

Brookfield White Pine Hydro LLC (BWPH or Licensee) is licensed by the Federal Energy Regulatory Commission (FERC) to operate the 19-megawatt (MW) Brunswick Hydroelectric Project (Project) (FERC No. 2284). The Project is located on the Androscoggin River in the towns of Topsham and Brunswick, Maine and straddles the border between Cumberland and Sagadahoc counties. The original license was issued on February 9, 1979, and expires on February 28, 2029.

BWPH is using FERC's Integrated Licensing Process (ILP) as established in Title 18 Code of Federal Regulations, Part 5. BWPH filed a Pre-Application Document (PAD) and Notice of Intent (NOI) to seek a new license for the Project on February 21, 2024.[1] The PAD provides a description of the Project, including its structures, operations, and potentially affected environmental resources.

BWPH distributed the PAD and NOI simultaneously to Federal and state resource agencies, local governments, Native American tribes, members of the public, and others thought to be interested in the relicensing proceeding. Following the filing of the PAD, FERC prepared and issued Scoping Document 1 (SD1) on April 16, 2024. FERC also held agency and public scoping meetings and a site visit on May 7, 2024. The FERC Process Plan and Schedule provided agencies and interested parties with an opportunity to file comments on the PAD and SD1 and request studies by June 20, 2024. FERC issued Scoping Document 2 on July 29, 2024.

BWPH filed a Proposed Study Plan on August 2, 2024, and held study plan meetings on August 28 and October 9, 2024. The Revised Study Plan (RSP) was filed in accordance with the ILP schedule on December 2, 2024. FERC issued a Study Plan Determination (SPD) on December 30, 2024. Specific to fisheries resources, BWPH proposed in the RSP to conduct an Upstream and Downstream Fish Passage Alternatives Study, which was approved without modification in the SPD.

This report presents the results of Phase 1 of the upstream fish passage alternatives portion of the study, including goals and objectives, methods, results, summary, and variances (if any) from the FERC approved study plan. Phase 1 consists of an alternatives analysis, which included agency and other stakeholder consultation and a desktop review of available information. This report summarizes the screening level evaluation of alternatives that was conducted in consultation with resource agencies[2] and other stakeholders (Phase 1).

The results of the upstream passage related studies (Phases 1 and 2) will be used to identify the appropriate protection, mitigation, and enhancement measures, as necessary, for improving upstream fish passage at the Project and will also provide FERC with the information needed to conduct its National Environmental Policy Act analysis, which will inform conditions to be contained in the new FERC license.

[1] https://elibrary.ferc.gov/eLibrary/filelist?accession_Number=20240221-5163.

[2] For the purpose of this study, the term "resource agencies" refers to the Maine Department of Marine Resources (MDMR), National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS).

2 GOALS AND OBJECTIVES

The goal of the study is to determine conceptual options and expected performance for improved upstream passage that will reduce delay, improve passage efficiency, and improve survival for migrating blueback herring, alewives, American shad, Atlantic salmon, and sea lamprey (collectively, the "target species").

The Upstream Fish Passage Conceptual Alternatives Study employs a phased approach to assess the viability of alternatives for improvement of upstream migratory fish passage identified by BWPH in consultation with the resource agencies and other stakeholders. Phase 1 of the evaluation, addressed in this report, presents the initial screening of alternatives to identify which alternatives warrant a more detailed feasibility level review in Phase 2.

Phase 1 of the study, presented herein, consists of a conceptual level assessment of layout, functionality, effectiveness, and constructability as a high-level fatal flaw analysis. A draft screening matrix assessment was reviewed with resource agencies and other stakeholders in a virtual meeting on March 5, 2026. The goal of the meeting was to review the upstream alternatives matrix and discuss initial resource agency and stakeholder input to identify alternatives that will be advanced to a more detailed Phase 2 evaluation.

Phase 2 of the evaluation will develop more detailed conceptual designs, cost estimates, and include three-dimensional (3D) Computational Fluid Dynamics (CFD) modeling of selected Phase 2 alternatives. The 3D CFD modeling will evaluate the flow field and hydraulic conditions that result from each alternative under the proposed configurations. Specifically, the Phase 2 CFD comparisons are anticipated to inform the following:

- effectiveness of meeting U. S. Fish and Wildlife Service (USFWS) upstream fish passage design criteria;
- effectiveness of meeting Project passage objectives for the target species,
- effectiveness of balancing environmental and power generation resources; and,
- identification of red-flag hydraulic conditions.

3 PROJECT DESCRIPTION AND STUDY AREA

3.1 Project Description

The Project is located on the Androscoggin River at the head-of-tide at approximately river mile 6 in the Towns of Brunswick and Topsham, ME. The Project straddles the border between Cumberland and Sagadahoc counties. The Project dam is the first dam on the mainstem of the Androscoggin River. The dam and powerhouse span the Androscoggin River immediately above the U.S. Route 201 bridge connecting Topsham and Brunswick, ME, at a site originally known as Brunswick Falls. The dam was constructed across the falls in a North-South orientation, with river-left being the northern abutment.

The Project structures include a 830-foot-long and 40-foot-high concrete gravity dam with a gate section containing two Tainter gates and an emergency spillway; an intake and a powerhouse containing three turbine-generating units with an authorized rating of 19.0 MW. The Project also has a vertical slot upstream fishway, a downstream fish bypass, a 21-foot-high fish barrier wall between the dam and Shad Island, and a 3-foot-high by 20-foot-long concrete fish barrier weir across Granny Hole Stream in Topsham. The Project impoundment is approximately 4.5-mile-long and 175-acres, with a gross storage capacity of 125 acre-feet.

The powerhouse, constructed in 1983, is integral with the dam and located on the right bank (southern embankment) of the river (Brunswick shoreline). The powerhouse is approximately 125-feet-wide and 135-feet-long and constructed of concrete substructure and brick masonry. The powerhouse contains one vertical and two horizontal propeller turbine-generators.

The concrete intake structure is integral with the dam and powerhouse and is approximately 110 feet long and has a maximum height of 65 feet, and the top elevation of intake structure deck is 55.0 feet, NGVD29.[3]

The powerhouse intake is screened by steel trashracks with 3.5-inch clear bar spacing. Unit 1 has three intake panels, and Units 2 and 3 each have one panel. A trashrack-covered sluice opening for downstream fish passage is located adjacent to the Unit 2 and Unit 3 intakes. The trashracks are mechanically cleaned.

The Project has three turbine generators with a combined installed generator capacity of 19.0 MW having a total combined hydraulic capacity of 7,475 cubic feet per second (cfs). Unit 1 is a vertical propeller turbine/generator rated at 12 MW and has a hydraulic capacity between a minimum of 2,741 cfs to a maximum of 5,075 cfs. Units 2 and Unit 3 are horizontal propellor turbine/generators each rated at 3.765 MW with a hydraulic capacity of 1,200 cfs.

3.2 Project Hydrology

The drainage area at the Project is 3,437 square miles (sqm) having an average annual inflow to the Project of approximately 7,018 cfs.

Flows from the Upper Androscoggin River Storage System, including Mooselookmeguntic Lake (Upper Dam), Richardson Lake (Middle Dam), Aziscohos Lake, and Umbagog Lake (Errol Dam) are used to augment Androscoggin River flows during low flow periods and to provide flood control during high flow periods. Outflow from the Storage System is managed in cooperation with downstream hydroelectric power generators to provide a relatively uniform flow regime.

The U.S. Geological Survey (USGS) operates a streamflow gaging station (USGS gage number 01059000 Androscoggin River near Auburn, ME) approximately 21.5 miles upstream of the Project dam. This gage

[3] All references to elevations in this document are to the United States Geological Survey National Geodetic Vertical Datum of 1929 (NGVD29) unless otherwise noted.

has a drainage area of 3,263 sqm and has been in operation since 1928. Annual and monthly flow duration curves are presented in Figures A-1 to A-5, located in Appendix A. The period of January 1987 – December 2025 was analyzed to reflect current hydrological conditions as affected by upstream hydroelectric project operations. Table 1 shows the calculated monthly summary of the flow data. The mean annual daily inflow for this period is about 7,002 cfs. The peak streamflow at the Project during this period was approximately 104,911 cfs on April 2, 1987. The peak streamflow for the period of record at the USGS Auburn gage is about 135,000 cfs on March 20, 1936. Streamflow is normally at its peak throughout the spring during snowmelt, while short-term inflow depends in part upon upstream hydropower project storage operations and in part upon numerous intervening tributary river and stream inflows to the mainstem of the river.

Table 1: Daily Average Streamflow (cfs) at Brunswick Dam 1987 – 2025

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	1,675	1,791	1,907	2,876	1,675	1,517	1,348	1,338	1,106	1,296	1,654	1,612
Max	36,340	24,226	44,872	104,911	65,201	61,514	31,073	40,869	48,137	48,348	42,660	74,681
Median	5,014	4,740	6,794	12,851	9,059	4,961	3,455	2,876	2,633	3,718	5,440	5,540
Average	5,820	5,091	8,266	16,090	10,769	6,598	4,846	3,850	3,282	5,374	6,796	7,230

3.2.1 Fish Passage Season Hydrology

USFWS (2019) guidelines recommend fish passage systems to be designed and operated to provide safe, timely, and effective passage across the full fish passage season flow range, bounded by approximately the 95% exceedance flow (low flow) and the 5% exceedance flow (high flow).

Fish passage season hydrology for the Project is based on analysis of daily flow data from 1987 to 2025, for the May 1 to Nov 15 upstream passage period. This period defines the flow range required for fish passage operation, which indicates that the 95% exceedance flow is 1,747 cfs, the median fish passage flow is 3,967 cfs, and the 5% exceedance flow is 16,838 cfs.

4 LITERATURE REVIEW OF POTENTIAL ALTERNATIVES

BWPH conducted a literature review to identify upstream passage alternatives, and modifications implemented at other hydroelectric projects for diadromous species present at the Project, and applicable emerging technologies. BWPH summarized the results in an alternatives screening matrix. On March 5, 2026, BWPH met with representatives from USFWS, National Marine Fisheries Service, Maine Department of Marine Resources, and other stakeholders to solicit input on the alternatives identified through the literature review, as well as other alternatives that may be applicable to the Project.

A meeting summary is provided in Appendix B. Resource agencies and other stakeholders provided comments on the screening matrix and the proposed alternatives for the next phase of the study. Appendix B also contains a response matrix summarizing the comments received and BWPH's response as well as a copy of the resource agency comment letters.

4.1 Alternatives Identified for Further Analysis

Based on the literature review and initial screening level analysis, BWPH identified the following passage alternatives for further analysis as part of this Upstream Fish Passage Conceptual Alternatives Study.

- Alternative U1, Modification of Existing Vertical Slot Ladder
- Alternative U2, Vertical Slot Ladder on the South Side of the Powerhouse
- Alternative U3, Fish Lift on the South Side of the Powerhouse
- Alternative U4, Fishheart System
- Alternative U5, Nature-Like Fishway (NLF) river left channel

Each alternative identified above is further discussed in Section 6, Alternatives Evaluation.

4.2 Alternatives Eliminated from Phase 1 Evaluation

Upstream fish passage alternatives that were eliminated from further analysis, owing to critical issues identified during the literature review and screening level analysis, included the following:

1. No Action Alternative (Maintain Existing Conditions and Operations): This alternative was eliminated from further consideration due to the low effectiveness of the existing fishway.

2. Vertical Slot Fishway on the North Side of the Powerhouse: This alternative was eliminated from further consideration due to the limited real estate available between the powerhouse and Shad Island and impacts to the flood discharge spillway capacity.

3. Fish Lift on the North Side of the Powerhouse: This alternative was eliminated from further consideration due to the limited real estate available between the powerhouse and Shad Island, impacts to the flood discharge spillway capacity, and operations and maintenance issues.

4. Traditional Pool and Weir Fishway: This alternative was eliminated due to agency preference for vertical slot fishways.

5. New Denil Fishway: This alternative was eliminated due to the anticipated design population at Brunswick exceeding the capacity of this style of fishway (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).

6. Alaskan Steeppass Fishway: This alternative was eliminated due to the anticipated design population at Brunswick exceeding the capacity of this style of fishway (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).

7. Whooshh System: This alternative was eliminated due to the experimental nature of the technology and the limited success for American shad passage at prior on-site demonstrations.

8. NLF Bypass Channel around Left Abutment, Topsham Side of the Dam: This NLF alternative was eliminated due to the significant size of the required footprint, the extent of the channel wall construction, the limited amount of real estate available along the Topsham (river left) shoreline, the required demolition of portions of the left abutment, new spillway bridge requirements (across the NLF channel), interferences with ownership and public bridge structures, and complicated construction and operations and maintenance (O&M) access requirements along the NLF. This NLF alternative was eliminated in favor of Alternative U5.

5 METHODOLOGY AND EVALUATION CRITERIA

To support the Phase 1 screening process, alternatives identified by BWPH, resource agencies, and other stakeholders as potentially viable for meeting the Project's upstream migratory fish passage objectives were screened against the evaluation criteria described below to determine their suitability for advancement to Phase 2 investigations.

Assessing each alternative against a common set of evaluation criteria allows for comparison on a relative basis. Accordingly, each alternative was initially evaluated qualitatively against the following eight criteria: 1) passage effectiveness, 2) safety, 3) equipment longevity, 4) risk and uncertainty, 5) constructability, 6) construction cost, 7) operation and maintenance requirements, and 8) impacts on generation. These criteria were identified as key factors for assessing the feasibility and effectiveness of proposed upstream fish passage methods. Alternatives that generally satisfy the criteria are advanced for more detailed evaluation during Phase 2, which may include 3D CFD modeling, preliminary engineering design, and cost estimating. Alternatives that do not sufficiently satisfy the criteria are excluded from further consideration.

A description of each criterion is provided below, and the qualitative screening results are summarized in the evaluation matrix presented in Appendix C.

5.1 Passage Effectiveness

Estimated overall passage effectiveness is a primary component of selecting upstream fish passage measures. Specific effectiveness of individual components are equally important criteria, but the criterion of passage effectiveness is intended to consider the overall effectiveness of the collective measures of a given alternative. While the effectiveness of any upstream fish passage measure(s) will ultimately be a product of many factors (e.g., site conditions, target species behavior, etc.), existing information for each measure was used to provide an opinion of estimated overall effectiveness specific to the Project. Qualitative effectiveness estimates of high, moderate, and low were assigned to each of the various alternatives based on ranges of potential percent effectiveness as follows:

- High: 90-100 percent
- Moderate: 75-90 percent
- Low: <75 percent

5.2 Safety

The safety of each alternative considers the additional risks (high, moderate, low) of the alternative on operating and maintenance personnel relative to the existing operating conditions, as well as to dam safety impact considerations.

Risks to operating and maintenance personnel include:

- Site access risks, immersion, or fall hazard risks
- Sudden water release/surges
- Confined space access requirement
- Mechanical hazards
    - Moving equipment
    - Hoists or lifts
    - Equipment failure or falling loads

- Electrical hazards
    - Electrical components
    - Circuit, wiring, and grounding
- Environmental
    - Weather
    - Night/day access
- Manual handling
    - Moving equipment
    - Net, basket, fish handling
    - Debris handling

Dam safety considerations considered in this evaluation include:

- Hydraulic and Hydrologic safety
    - Impacts to spillway adequacy
    - Spillway hydraulics (capacity, control, tailwater effects)
    - Impacts on flood conveyance and routing
    - Flow transitions and energy dissipation
    - Changes to outlet works discharge characteristics
    - Erosion risk upstream/downstream or along abutments
    - Required storage operations
    - Potential for overtopping under extreme events
- Structural Stability, impact of any modification on structural stability and adequacy

5.3 Equipment Longevity

Qualitative relative rankings of equipment longevity (high, moderate, low) were assigned to each passage alternative based on the anticipated service life, durability, and reliability of the primary components required for long-term implementation. These qualitative rankings reflect professional judgment informed by experience with similar passage systems at hydroelectric facilities in the Northeast and elsewhere on the East Coast, and consider the cumulative effects of hydraulic loading, debris and ice exposure, corrosion, abrasion, operational complexity, the need for seasonal installation and removal, as well as the frequency and intensity of operational demands.

Alternatives involving permanent civil or structural features with limited moving parts generally exhibit longer service lives and greater durability, while systems that rely on mechanical equipment, complex controls, or seasonally installed/removed components may experience accelerated wear and higher replacement needs. Equipment longevity is closely linked to long-term maintenance requirements, life cycle costs, and the likelihood of unplanned outages or repairs and therefore is an important factor in evaluating the overall sustainability and practicality of each passage alternative.

5.4 Risk and Uncertainty

The qualitative ranking of risk and uncertainty (high, moderate, low) is intended to evaluate the degree of technical, biological, operational, and construction-related unknowns associated with each passage alternative. This criterion considers the reliability of expected performance given site-specific hydraulic conditions, debris and ice loading, operational complexity, and interactions with existing powerhouse and

dam infrastructure. Alternatives that rely on proven technologies, well-documented performance at similar facilities, and simple biological or engineering principles generally carry lower risk and uncertainty.

In contrast, alternatives involving untested configurations, unknown conditions, complex mechanical systems, or increased O&M demands are more likely to introduce higher levels of risk and uncertainty.

Risk and uncertainty also reflect potential challenges related to permitting, constructability, and the ability to adaptively manage unforeseen conditions, and are therefore important considerations in assessing the overall feasibility and reliability of passage alternatives.

Qualitative estimates of high, moderate, and low risk were assigned to each of the various alternatives to provide a relative comparison of risk and uncertainty.

5.5 Constructability

Constructability evaluates the feasibility and complexity of constructing a particular passage alternative, given site-specific constraints. This criterion considers factors such as access for construction equipment and materials (as well as O&M), ownership, constraints, worker safety, required river flow conditions, in-water work limitations, staging and laydown, interferences, temporary works such as cofferdam or dewatering needs, integration with existing dam and powerhouse infrastructure, and the extent of modifications to existing station operation. Alternatives that can be constructed using standard construction methods, minimize in-water work, and avoid interference with critical Project operations are generally considered more easily constructible (i.e. “easy” effort). In contrast, alternatives requiring complex sequencing, specialized construction techniques, extended generation outages, significant in-water work, or work in challenging hydraulic or limited-access areas are associated with more difficult construction (i.e. a “difficult” effort). Constructability is an important consideration in evaluating the overall practicality of passage alternatives. Qualitative estimates of easy, moderate, and difficult were assigned to each of the various alternatives to provide a relative comparison of their constructability.

5.6 Construction Costs

Estimates of constructed costs were not prepared in this Phase 1 effort. Construction Costs are based on qualitative estimates as high, moderate, and low assigned to each of the various alternatives based on their relative constructability and the potential value of their estimated construction cost.

- High: > $8M
- Moderate: > $5M but < $8M
- Low: < $5M

5.7 Operation and Maintenance Costs

O&M costs, also known as recurring costs, are an important consideration for any permanent fish passage measures. This is an especially useful category for decision making purposes when combined with equipment longevity and construction costs.

The O&M cost criterion was assessed in relative terms: high, moderate, or low. These opinions were based on professional engineering judgment and experience of deploying various structures and equipment in rivers throughout the United States, along with input from BWPH operations staff. The qualitative estimates of high, moderate, and low were assigned to each of the various alternatives based on the following ranges of potential value of the estimated O&M costs.

- High: > $100,000/year
- Moderate: > $30,000 but < $100,000/year
- Low: < $30,000/year

5.8 Impact to Generation

Impacts to Project generation were assessed in relative terms: high, moderate, or low.
The alternatives evaluated for this study are expected to have varying impacts on Project generation depending on the flows utilized through the generating units or through the fish passage facilities.

- High: > $100,000/year
- Moderate: > $30,000 but < $100,000/year
- Low: < $30,000/year

6 ALTERNATIVES EVALUATION

As part of Phase 1 of the Upstream Fish Passage Conceptual Alternatives Study, BWPH conducted an initial screening of upstream fish passage alternatives, including those identified by resource agencies and additional variations developed by BWPH.

As part of initial screening, BWPH evaluated several key attributes, including passage effectiveness, safety, equipment longevity, risk and uncertainty, constructability, construction cost, operation and maintenance requirements, and impacts on generation, as described previously. The results were summarized in a Draft Alternatives Evaluation Matrix, which was presented to the agencies and other stakeholders on March 5, 2026. The matrix has subsequently been updated to include the Nature-like Fishway Alternatives discussed during the meeting and is provided in Appendix C.

The following sections describe the primary alternatives considered in the evaluation and assess their suitability for advancement to Phase 2 investigations. Alternatives that were considered but not advanced for detailed evaluation are also discussed.

6.1 Alternative U1 - Modification of Existing Vertical Slot Ladder

This alternative involves modifying the existing vertical slot fishway (as shown in Figure U1 in Appendix D) to improve overall passage effectiveness for the target species. The existing fishway consists of 42 pools, each approximately 8.5 feet wide by 10 feet long, connected by 11-inch-wide vertical slots. The facility was designed with a maximum drop of 12 inches per pool.

The fishway currently provides a conveyance flow of approximately 30 cfs and a supplemental attraction flow of 70 cfs, resulting in a total attraction flow of 100 cfs. Supplemental attraction flow is delivered through a floor diffuser located near the fishway entrance.

The extent and feasibility of potential modifications will need to be determined through further engineering analysis, CFD modeling, and the results of ongoing field studies. However, several modifications have been identified for consideration.

One potential modification is reducing the conveyance flow through the fishway to reduce the Energy Dissipation Factor (EDF) within the fishway. The EDF is in units of foot-pounds per second per cubic foot, and the existing EDF value ranges from approximately 2.8 to 4.9, with an EDF of approximately 4.0 under normal operating conditions. This exceeds the USFWS recommended maximum EDF of 3.15 for American shad passage. Reducing the conveyance flow to approximately 20 cfs could decrease EDF values to a more acceptable range and improve passage conditions.

Another potential modification is an increase in attraction flow at the fishway entrance. Due to the configuration of the existing facility, increasing attraction flow through the fishway itself is not considered feasible. However, installation of a ramped entrance diffuser, similar to that used at the Scotland Fishway[4], may provide an opportunity to increase attraction flow near the entrance. Additional bathymetric and hydraulic investigations would be required to assess constructability and determine the amount of flow that could be added. Even with these improvements, total attraction flow would likely remain below the USFWS recommendation of 5 percent of powerhouse discharge (i.e., 375 cfs).

Modifying the fishway configuration may also improve effectiveness. USFWS guidance recommends a minimum slot width of 18 inches for American shad passage. Increasing slot widths within the existing fishway would require larger pool dimensions to maintain acceptable hydraulic conditions; however,

[4] Scotland Dam Hydroelectric Project (FERC No. 2662) on the Shetucket River in Windham, Connecticut, owned by FirstLight Power.

expansion of the existing structure is constrained by site limitations. As an alternative, converting the facility to a pool-and-chute fishway configuration could improve passage performance. In addition, reducing pool lengths from 10 feet to 8 feet could allow approximately 10 additional pools to be incorporated within the existing alignment, reducing the drop per pool from 12 inches to approximately 9 inches.

Potential improvements to internal fishway hydraulics were also identified. The existing 180-degree turning pool located at the downstream end of the fishway may contribute to passage inefficiencies, although available effectiveness data do not clearly demonstrate that it is problematic at this site. Increasing the size of the turning pool could further reduce the EDF, provide additional resting area for fish, and potentially improve overall passage efficiency.

The existing floor diffuser may also warrant modification. Recent studies have identified floor diffusers as potential areas of concern within fishways due to localized hydraulic conditions that may affect fish movement. Although replacing the existing floor diffuser with a wall diffuser is not considered feasible because of site space constraints, hydraulic conditions could potentially be improved through the addition of baffles, porosity plates, or turning vanes.

Additional modifications that may improve fishway performance include replacing the existing chamfered wooden corners with radiused steel plate or concrete to smooth and improve hydraulic transitions and reduce turbulence. Extending the fishway entrance downstream to accommodate an overshot-style entrance gate may also enhance attraction flow and operational flexibility. Installation of flow-induction pumps near the fishway entrance could further improve attraction conditions in the tailrace area.

Finally, improvements to the existing trap, sort, and truck facility could be considered as part of this alternative. Potential modifications would be developed and evaluated based on operational requirements and performance objectives.

6.1.1 Evaluation of Criteria

The following sections evaluate Alternative U1 against the set of criteria established during stakeholder consultation. These criteria reflect the project's key objectives (including passage effectiveness, safety, longevity, risks, constructability, cost, operation and maintenance, and impacts to generation) and provide a consistent basis for comparing alternatives. These criteria capture the primary technical, operational, and economic considerations guiding the study and serve as the basis for comparing the relative merits of each alternative.

6.1.1.1 Passage Effectiveness

Passage effectiveness of this alternative is considered to be low to moderate.

A 2022 study conducted by Normandeau Associates (NAI) found that river herring exhibited an entrance efficiency of 37.5%, with an overall internal fishway efficiency of 33.3%. As the overall passage effectiveness depends on the cumulative success of fish progressing through each stage of passage, low efficiencies in either attraction or internal fishway performance can substantially reduce total effectiveness. Passage performance for American shad was even lower, with only 2.4% of tagged fish entering the attraction flow field, and no tagged fish successfully entering the fishway. These results suggest that both fishway attraction efficiency and internal passage conditions are limiting factors that reduce overall passage effectiveness.

Several factors have been identified that could improve fishway effectiveness. Reducing conveyance flow would likely improve hydraulic conditions within the fishway and increase internal passage efficiency. Similarly, increasing supplemental attraction flow could make the entrance more detectable to migrating

fish and improve entrance efficiency. In addition, the existing fishway's relatively small pool sizes limit its theoretical passage capacity compared to a modern vertical-slot fishway design. Together, these findings indicate that hydraulic and structural modifications may be needed to achieve higher passage efficiencies and better support upstream fish migration at the site.

6.1.1.2 Safety

Low Risk. There are minimal changes to O&M that would affect safety.

6.1.1.3 Equipment Longevity

The longevity is considered low for Alternative U1. The majority of the existing fishway facility was built in 1983 would remain in place. The anticipated longevity of cast-in-place reinforced concrete is generally over 75 years[5], and the existing structures are now approximately 45 years old.

6.1.1.4 Risks and Uncertainty

The risks and uncertainties are considered high for a number of reasons:

- Use of ramped entrance diffusers at other projects is limited, therefore documented success of this measure is also limited.
- The existing upstream fishway may need to be shut down for a portion of the season to facilitate construction. Construction measures, special scheduling, or implementation of interim fish passage measure will be required to address risks.
- It is unlikely that these modifications would improve effectiveness enough to meet the USFWS guidelines.
- Extension of the turning pool may be limited by property boundary or bridge easements.

6.1.1.5 Constructability

Constructability of this alternative is considered moderately difficult due to the extent of in-water work and associated site constraints. A temporary cofferdam would likely be required in the tailrace at the fishway entrance to isolate the work area and facilitate modifications to the existing fish passage facility. A separate cofferdam within the headpond would be necessary to support construction of the attraction water intake structure under dewatered conditions. In addition, installation of the new attraction water pipeline may be challenging due to routing constraints and potential conflicts with existing site features and infrastructure. Collectively, these construction requirements are expected to increase project complexity and necessitate careful construction staging and sequencing.

6.1.1.6 Construction Costs

Construction costs for this alternative are considered to be moderate, reflecting the range of civil, mechanical, and fishway-related improvements required.

Major cost components include construction of a ramped entrance diffuser and extension of the fishway entrance channel to improve fish attraction and passage conditions. Additional costs are associated with the installation of an overshot entrance gate and a new dewatering gate to enhance operational flexibility and facilitate maintenance activities.

The alternative also includes construction of a new attraction water system, consisting of a new attraction water intake structure and associated attraction water pipeline. Further costs would be required for the

[5] ASCE 2007, Civil Works for Hydroelectric Facilities, Guidelines for Life Extension

installation of flow induction pumps to improve attraction, along with modifications to internal fishway baffles and the existing floor diffuser to improve hydraulic performance within the fishway. Rehabilitation work to the fishway bends including replacement of existing wooden chamfered corners may also be necessary.

6.1.1.7 Modifications to the existing trap, sort, and truck facility would be required to accommodate the proposed fishway improvements and support continued fish passage operations. Operations and Maintenance

The O&M costs for this alternative are considered to be low to moderate.

O&M activities would include additional periodic raking and cleaning of the new attraction water intake to remove debris and maintain adequate hydraulic performance. The proposed improvements are not expected to affect parking areas, powerhouse access, or commercial traffic, thereby minimizing impacts on routine facility operations.

As a result, the alternative is anticipated to have relatively modest long-term operation and maintenance costs.

6.1.1.8 Impacts to Generation

The impacts to power generation associated with this alternative are anticipated to be moderate. There will be generation losses associated with the increased fishway attraction flows, but are likely to be less than for a new vertical slot fishway or fish lift.

6.2 Alternative U2 Vertical Slot Ladder on South Side Powerhouse

Alternative U2 consists of the construction of a new, larger vertical slot fishway (as shown in Figure U2 in Appendix D) designed to accommodate a maximum operating head of approximately 40 feet. The new fishway would take the place of the existing fishway and require demolition of the existing fishway prior to construction of the new fishway. The new fishway would be configured with a 9-inch drop between pools, resulting in an estimated 52 pools to provide adequate hydraulic conditions and facilitate upstream passage for target species. Pool dimensions would be governed by the required slot width, with American shad passage criteria dictating a minimum slot width of 18 inches. Based on this slot width, each pool would be approximately 12 feet wide and 15 feet long.

In addition to the new fishway, this alternative would require construction of a new trap, sort, and truck facility to support fish handling, monitoring, and transport operations. The new fishway entrance location and design would be informed by the CFD modeling proposed for Phase 2 of the study and the results of ongoing field studies.

6.2.1 Evaluation of Criteria

The following sections evaluate Alternative U2 against the set of criteria established during previous project meetings. These criteria reflect the project's key objectives (including passage effectiveness, safety, longevity, risks, constructability, cost, operation and maintenance, and impacts to generation) and provide a consistent basis for comparing alternatives. These criteria capture the primary technical, operational, and economic considerations guiding the study and serve as the basis for comparing the relative merits of each alternative.

6.2.1.1 Passage Effectiveness

The passage effectiveness of this alternative is moderate to high.

Increased attraction flow and revised layout of the fishway entrance is expected to improve entrance efficiency by enhancing the ability of migrating fish to locate and enter the facility. Internal fishway performance would also be improved through the elimination of floor diffusers, which can create hydraulic conditions that impede fish movement, and by reducing the drop between pools, thereby creating more favorable passage conditions. In addition, the larger pool dimensions would increase the overall capacity of the fishway and provide improved resting and passage opportunities for target species.

Several factors may limit overall effectiveness. The increased length may also require greater energetic expenditure by migrating fish, potentially contributing to fatigue, delayed passage, or fallback, thereby further reducing overall passage effectiveness. The layout would also require multiple switchbacks, which may decrease passage effectiveness for certain species, particularly American shad, which can be sensitive to complex fishway alignments.

Despite these challenges, the alternative would provide volitional passage. Combined with the updated trap, sort, and truck facility the proposed new system would provide overall flexibility and adaptability. Overall, the proposed improvements are expected to significantly enhance fish passage performance relative to existing conditions while maintaining a moderate to high level of effectiveness.

6.2.1.2 Safety

Low Risk. There are minimal changes to O&M that would affect safety.

6.2.1.3 Equipment Longevity

The longevity of equipment for this alternative is considered high as this will be a new installation.

6.2.1.4 Risks and Uncertainty

The risks and uncertainties associated with this alternative are considered to be moderate.

A significant project risk is that construction would require the existing upstream fishway to be taken out of service for multiple fish passage seasons, affecting fish passage operations during the construction period and requiring careful coordination of construction sequencing, temporary fish passage measures, and regulatory requirements. In addition, the available footprint for the proposed facility may be constrained by existing property boundaries and bridge easements. These site limitations could influence the final layout and design of the fishway, potentially increasing design complexity and affecting constructability. Also, the depth, water velocities, substrate type, available space, and length of shoreline to be dewatered all contribute to challenging conditions for installation of a cofferdam in the tailrace. Further investigation and contractor input will be required to confirm the feasibility of the required cofferdam.

6.2.1.5 Constructability

Constructability of this alternative is considered difficult due to the extensive in-water work, demolition requirements, and site constraints associated with the proposed improvements and the limited available space.

Construction of the new fishway would require installation of a large cofferdam within the tailrace to provide a dewatered work area for excavation and civil construction activities. As noted above, further investigation and contractor input will be required to confirm the feasibility of the required cofferdam. The project would also necessitate the complete demolition of the existing fishway prior to construction of the new facility, adding complexity to construction sequencing and increasing the overall scope of work. The proposed improvements would have a relatively large construction footprint, which could affect adjacent

site operations and require careful management of work zones and access routes for project operation and local businesses.

Additional challenges may include the need for a support of excavation structure to maintain the stability of the existing access road/construction area while construction activities are underway. A separate cofferdam within the headpond would also be required to facilitate construction of the new attraction water intake structure and fishway exit. Furthermore, construction activities may temporarily impact access to the powerhouse, requiring detailed coordination with facility operations to minimize disruptions. Collectively, these factors contribute to a high level of construction complexity and make this one of the more difficult alternatives to implement.

6.2.1.6 Construction Costs

Construction costs for this alternative are considered to be high due to the extensive civil, structural, and fish passage infrastructure required.

The primary cost component is the construction of a new vertical slot fishway, which represents a substantial investment given its size, length, associated hydraulic features, and temporary cofferdams and foundation preparation. Additional costs would be incurred for the installation of a new attraction water system, including both a new attraction water intake structure and the associated attraction water pipeline required to deliver attraction flow to the fishway entrance. The alternative would also require construction of a new trap, sort, and truck facility to support fish handling, monitoring, and transport operations. Collectively, the scale and complexity of these improvements contribute to a high overall construction cost for the alternative.

6.2.1.7 Operations and Maintenance

The O&M costs for this alternative are considered to be moderate.

Operational requirements would be generally similar to those of the existing facility, allowing operators to rely on established procedures and maintenance practices. However, the larger fishway would contain a greater number of pools, increasing the extent of routine inspection, cleaning, and maintenance activities required to ensure proper operation. Additional maintenance would also be associated with periodic raking and debris removal at the new attraction water intake to maintain adequate flow conditions and prevent blockages. Further, operation and maintenance activities may have greater impacts on parking areas, powerhouse access, and commercial traffic due to the location and footprint of the proposed facilities. Collectively, these factors contribute to a moderate level of long-term operation and maintenance costs.

6.2.1.8 Impacts to Generation

The impacts to power generation associated with this alternative are considered high. This alternative has increased attraction flow requirements, which divert water away from power production. The proposed attraction flow of 5 percent of the station's generating capacity is approximately 375 cfs. This flow would be unavailable for power production during periods when the fishway is in operation, resulting in a direct reduction in generation compared to existing conditions. Also, there is potential for impact to project generation due to one or more of the hydro units being taken offline temporarily during construction of the tailrace cofferdam and potentially long term due to conflict with the cofferdam layout.

6.3 Alternative U3 Fish Lift on South Side of Powerhouse

This alternative would involve constructing a new fish lift immediately south of the existing vertical slot fishway (as shown in Figure U3 in Appendix D) to improve upstream fish passage and accommodate projected restoration goals. The fish lift hopper would be designed and sized to efficiently handle the anticipated target populations, including approximately 130,000 American shad, 600 Atlantic salmon, and 4.6 million river herring. The entrance layout, location, and design would be informed by the CFD modeling proposed to be completed during Phase 2 of the study and the results of ongoing field studies.

In addition to the fish lift, this alternative would require the construction of a new trap, sort, and truck facility to support fisheries management operations, including the collection, handling, sorting, and transportation of fish to upstream habitats as needed. Together, these facilities would provide a solution capable of meeting long-term species recovery and migration objectives.

6.3.1 Evaluation of Criteria

The following sections evaluate Alternative U3 against the set of criteria established during previous project meetings. These criteria reflect the project's key objectives (including passage effectiveness, safety, longevity, risks, constructability, cost, operation and maintenance, and impacts to generation) and provide a consistent basis for comparing alternatives. These criteria capture the primary technical, operational, and economic considerations guiding the study and serve as the basis for comparing the relative merits of each alternative.

6.3.1.1 Passage Effectiveness

This alternative is considered to have high passage effectiveness for upstream fish passage, although it would not provide volitional passage.

The proposed modifications would increase attraction flow and a revised fishway entrance, improving the ability of fish to locate and enter the facility. Internal fishway efficiency would also be enhanced through the elimination of floor diffusers, reducing hydraulic complexity and creating more favorable passage conditions. In addition, the overall length of the fishway would be reduced, decreasing the distance fish must travel within the structure and improving passage performance. Reduced energetic expenditure for fish (because they are being lifted) likely outweighs any benefit of a purely volitional fishway for a dam of this height. Collectively, these improvements are expected to result in a highly effective fish passage and increased passage efficiency for target species. The improvements include the construction of a new trap, sort, and truck facility to enhance the flexibility and adaptability of operation.

6.3.1.2 Safety

This alternative is considered to present moderate safety risk due to the relatively large number of mechanical systems and operational components.

The fish lift would incorporate multiple gates, moving parts, and mechanical equipment that require regular operation, inspection, and maintenance to ensure reliable performance. As a result, the potential for mechanical failures or operational disruptions is greater than for less complex passage alternatives. In addition, the operation of the fish lift and hopper system introduces additional safety considerations, requiring specialized procedures and safeguards for personnel involved in lifting, handling, and maintenance activities. While these risks are addressed through proper design, maintenance, and operational protocols, the overall complexity of the system results in a moderate level of operational safety risk.

6.3.1.3 Equipment Longevity

The longevity of equipment for this alternative is considered high as this will be a new installation of a new fish lift and trap, sort, and truck facilities. The remaining portion of the existing fishway can be left in place and should not require significant maintenance.

6.3.1.4 Risk/Uncertainty

The risks and uncertainties associated with this alternative are considered to be low to moderate.

Construction of the new fish lift would likely require the existing upstream fishway to be taken out of service for at least one migration season to facilitate tie-ins and construction activities, resulting in temporary interruption of normal passage operations. Also, the depth, water velocities, substrate type, and available space all contribute to challenging conditions for installation of a cofferdam in the tailrace. Further investigation and contractor input will be required to confirm the feasibility of the required cofferdam. Once operational, the facility would rely on mechanical equipment that is subject to periodic maintenance and potential equipment failures. Although mechanical malfunctions could result in temporary outages during portions of the passage season, these risks are generally well understood and can be mitigated through redundancy, routine off-season maintenance, and established operational procedures. Overall, the anticipated risks are limited in duration and scope and are not expected to substantially affect the long-term performance or benefits of the alternative.

6.3.1.5 Constructability

The constructability of this alternative is considered moderate due to the combination of in-water construction activities, demolition requirements, and site constraints associated with the proposed improvements.

Construction of the fish lift would require installation of a cofferdam in the tailrace to provide a dewatered work area; however, this cofferdam would be smaller than that required for a new vertical slot fishway because the majority of the proposed fish lift structure would be located on the landside of the existing fishway. As noted above, further investigation and contractor input will be required to confirm the feasibility of the required cofferdam. Portions of the existing fishway would need to be demolished to accommodate the new facilities, while the remaining sections would be abandoned in place following construction. A support of excavation system would also be required to maintain support for the existing access road during excavation and construction activities. Additional in-water construction would occur in the headpond, where a cofferdam would be needed to facilitate installation of the attraction water intake structure and fishway exit. Construction activities may also temporarily affect access to the powerhouse, requiring careful planning and coordination to minimize operational disruptions. These considerations introduce a moderate level of construction complexity, but the challenges are considered manageable with appropriate design, sequencing, and construction management practices.

6.3.1.6 Construction Costs

Construction costs for this alternative are considered to be high due to the civil, structural, mechanical, and fish passage infrastructure required to implement the proposed improvements.

Major cost items include the construction of a new fish lift, which would require specialized civil, structural, and mechanical systems to safely and efficiently transport fish upstream. This alternative also requires installation of a new attraction water pipeline and construction of a new attraction water intake structure to provide effective fish attraction to the lift entrance. However, in Phase 2 of this study consideration may be given to the use of the existing turbine discharge to augment attraction flow, potentially reducing the need

for a new attraction water pipeline and intake. A new trap, sort, and truck facility would need to be constructed to provide fish handling, sorting, monitoring, and transport operations.

6.3.1.7 Operation and Maintenance Costs

Operation and maintenance costs are anticipated to be high for this alternative, owing to the complexity of the fish lift system and associated infrastructure.

Fish lifts contain numerous mechanical and electrical components, including elevators, gates, hoists, pumps, and control systems, all of which require routine inspection, maintenance, repair, and periodic replacement to ensure reliable operation. In addition, the proposed attraction water intake would require regular raking and cleaning to remove debris and maintain adequate flow conditions, resulting in increased operation and maintenance requirements.

This alternative could also create operational challenges by affecting existing parking areas, powerhouse access, and commercial traffic patterns. These impacts may require additional coordination, site management, and maintenance activities to ensure safe and efficient operations around the facility. To improve fish handling and monitoring capability and flexibility, a secondary lift could be incorporated, similar to the system used at the Milford Hydroelectric Project on the Penobscot River. While this feature would allow some level of species pre-sorting and operational flexibility, it would also add infrastructure and equipment that would require additional maintenance and associated operating expenditures.

6.3.1.8 Impacts to Generation

The impacts to power generation associated with this alternative are considered high. This alternative has increased attraction flow requirements, which divert water away from power production. The proposed attraction flow of 5 percent of the station's generating capacity is approximately 375 cfs. This flow would be unavailable for power production during periods when the fishway is in operation, resulting in a direct reduction in generation compared to existing conditions. Also, there is potential for impact to project generation due to one or more of the hydro units being taken offline temporarily during construction of the tailrace cofferdam and potentially long term due to conflict with the cofferdam layout.

6.4 Alternative U4 Fishheart System

This alternative would involve installation of a Fishheart floating fish collection system in the tailrace downstream of the powerhouse (as shown in Figure U4 in Appendix D) to provide upstream fish passage. The Fishheart system is a floating, in-water fish passage technology that uses a barge-mounted pump system to attract, collect, and transport fish over the dam or to a sorting/holding facility. Pumped flow creates an attraction current that guides fish into two or more collection pipes suspended below the barge. Once fish enter the system, an electronic video system records and identifies the size, type, and number of fish. After a pre-determined number of fish or time has passed, the entrance to the collection pipe is closed and the flow to the collection pipe is redirected into a transport pipe that carries the fish over the dam or to a sorting/holding tank. Typically, floating guide nets or picket leads (such as used at two separate study sites in Connecticut and South Carolina) are positioned downstream of the floating collection barge and used to direct fish toward the attraction flow and collection pipe entrances to improve collection efficiency.

Deployment of the Fishheart system is performed through on-site assembly followed by mobilization with a large crane to the tailrace, where the system is secured with cables and positioned for operation. Deployment may alternatively involve placing the assembled system in the river downstream and maneuvering it upstream into the tailrace by barge. Operation and maintenance (O&M) consists primarily of the seasonal installation, operation, removal, servicing, and on-site seasonal storage and maintenance of system components. Seasonal deployment and retrieval may require the use of a large crane or barge-assisted handling equipment to safely deploy the system in and out of the tailrace. Operation of the system

is performed from a local control and monitoring trailer or building, while operating maintenance is performed by boat access to the deployed system. Under this alternative, fish collected by the Fishheart system could either be transported directly upstream of the project or routed to the existing trap, sort, and truck facility for handling, sorting, and management. Direct passage would provide a streamlined means of moving fish upstream, while routing fish to the trap, sort, and truck facility would allow for monitoring, collection, examination, and management actions as needed. Implementation of this alternative would require modifications and improvements to the existing trap, sort, and truck facility to support the Fishheart system operations. Facility upgrades may include modifications to fish handling infrastructure, collection and transfer equipment, operational controls, and access improvements necessary to efficiently receive, process, and transport fish collected by the Fishheart system. These improvements would help ensure that the existing facility can effectively accommodate the new collection technology and support long-term fish passage operations.

6.4.1 Evaluation of Criteria

The following sections evaluate Alternative U4 against the set of criteria established during previous project meetings. These criteria reflect the project's key objectives (including passage effectiveness, safety, longevity, risks, constructability, cost, operation and maintenance, and impacts to generation) and provide a consistent basis for comparing alternatives. These criteria capture the primary technical, operational, and economic considerations guiding the study and serve as the basis for comparing the relative merits of each alternative.

6.4.1.1 Passage Effectiveness

The Fishheart collection system represents an innovative approach to upstream fish passage; however, it is considered an experimental technology. While resource agencies have expressed interest in its potential application, its effectiveness for collecting and passing the target species at this site has not yet been fully demonstrated and continues to be evaluated through ongoing studies and field deployments. There is some uncertainty regarding collection efficiency, species-specific performance, biological capacity, and long-term effectiveness compared to more traditional fish passage technologies.

One advantage of the Fishheart system is its floating, modular design, which allows the system to be deployed and repositioned to varying locations within the tailrace as needed to optimize attraction flow and fish collection performance. This flexibility enables operators to adapt the system to changing hydraulic conditions and fish behavior patterns, potentially improving effectiveness over time. In addition, the system can be expanded through the installation of additional "satellite" collection entrances at strategic locations within the tailrace. These supplemental entrances could increase the area influenced by attraction flow and provide additional opportunities for fish to locate and enter the passage system.

The Fishheart system could also be deployed as a supplemental fish passage measure alongside a construction site providing temporary fish passage, or along the existing fishway rather than as a complete replacement. In this role, the system could provide additional collection capacity, help address passage bottlenecks, and potentially improve passage success for species that do not efficiently locate or utilize the existing fishway. This operational flexibility could allow the technology to be implemented incrementally while its effectiveness for target species is further evaluated.

6.4.1.2 Safety

This alternative is considered to have a High risk related to safety.

Implementation of the Fishheart alternative would introduce several operator and site safety considerations associated with installation, operation, and maintenance activities. Deployment of the Fishheart system would require both crane and boat/barge access to position the floating collection unit and guidance netting

within the tailrace. Installation activities are complicated by the presence of overhead powerlines and structures near the powerhouse and tailrace requiring planning, coordination, and adherence to established safety procedures during crane operations to minimize risks to public, personnel, and equipment.

Routine operation and maintenance of the system would also require periodic access to the floating structure and associated guidance nets. Maintenance activities may involve the use of boats and personnel working on or near the water to inspect, adjust, clean, and repair the guide net system. These activities would expose operators to additional safety risks associated with working over water and in flowing river conditions.

Operator safety concerns would be expected to increase during periods of elevated river flows. Higher flow conditions could make access to the Fishheart system and guide nets more difficult, create hazardous boating conditions, and increase the potential for damage to floating infrastructure. Fishheart recommends removal of equipment at the end of the passage season and for high flow/flood events, increasing the frequency of use of heavy cranes and equipment handling. As a result, implementation of this alternative would require development of comprehensive safety procedures, including protocols for crane operations, vessel use, work near energized electrical facilities, and maintenance activities during varying hydraulic conditions. The elevated safety risk is associated primarily with operation and maintenance activities rather than construction.

6.4.1.3 Equipment Longevity

The Fishheart system is expected to provide moderate to high equipment longevity, although the lifespan of individual components will vary.

Mechanical equipment, including pumps, motors, controls, and other moving parts, will require periodic maintenance, repair, and eventual replacement as a result of normal operational wear. These components are generally expected to have a moderate service life compared to the more durable structural elements of the system. In contrast, the floating barge structure, piping, and other major non-mechanical components are anticipated to be robust and long-lived when properly maintained.

A key advantage of the Fishheart system is that it is removed from service at the conclusion of each migration season and undergoes a comprehensive inspection and overhaul before redeployment. This annual maintenance cycle allows worn or damaged components to be repaired or replaced proactively, and is expected to help maintain system reliability and extend the overall service life of the equipment.

This alternative also benefits from the reuse of existing infrastructure. The current trap, sort, and truck facility would continue to be utilized, and potentially upgraded, minimizing the need for additional long-term fish handling infrastructure. The existing fishway would be abandoned in place.

Overall, the combination of durable structural components, routine seasonal refurbishment, and continued use of existing facilities supports a favorable long-term outlook for equipment longevity under the Fishheart alternative.

6.4.1.4 Risk/Uncertainty

The Fishheart system is considered experimental and is considered to have a moderate to high level of risk and uncertainty relative to more established fish passage technologies due to the limited amount of performance data currently available and the need for additional testing under a variety of site conditions.

While the Fishheart has shown promise as a novel fish collection and transport system, its effectiveness for target species and site-specific hydraulic conditions remains an area of ongoing evaluation. As a result, there is greater uncertainty regarding long-term biological performance and operational reliability

compared to conventional fish passage facilities with more extensive operating histories. This may result in the need for temporary (or back-up) fish passage measures to meet regulatory requirements.

A key source of uncertainty relates to the fish collection method itself. The Fishheart system relies on two submerged pipe entrances to collect fish, and some species, such as American shad, may be reluctant to enter confined pipe openings. This behavioral response could reduce collection efficiency and overall passage effectiveness for certain target species. Recent testing at FirstLight's Tunnel Hydroelectric Project has had some successes with shad in their second season of operation, but this information has not been published to date.

The system operates using relatively low attraction flows compared to traditional fish passage facilities. While this approach reduces the potential for lost Project generation, it may limit the system's ability to attract fish under certain hydraulic conditions or in areas where competing flows from the powerhouse and spillway are present.

There is uncertainty regarding the system's biological performance, particularly for species with limited documented experience using this technology. Continued testing, monitoring, and adaptive management would likely be required to confirm effectiveness and optimize system operation. Although the modular and adjustable nature of the Fishheart system provides opportunities to refine performance over time, the technology currently carries a higher degree of uncertainty than more conventional fish passage alternatives with proven applications at similar facilities.

6.4.1.5 Constructability

The constructability for this option is considered relatively easy.

As a floating modular system, installation would require minimal in-water construction and substantially reduce the duration and complexity of construction activities. The alternative would avoid extensive excavation, concrete work, and structural modifications typically associated with permanent fish lifts or fish ladders, thereby reducing construction risks, environmental disturbances, and potential impacts to ongoing project operations.

Another advantage of this alternative is its ability to utilize existing facilities and infrastructure. The Fishheart system could be integrated with the existing trap, sort, and truck facility, limiting the need for new fish handling facilities and reducing overall construction requirements. Additionally, the existing upstream fish passage facility could remain operational during installation, commissioning and effectiveness testing of the Fishheart system, minimizing disruptions to existing fish passage operations. Overall, the limited construction footprint, reduced in-water work, and ability to leverage existing facilities contribute to a favorable constructability assessment for the Fishheart alternative.

6.4.1.6 Construction Costs

The construction costs associated with the Fishheart alternative are considered low relative to conventional upstream fish passage facilities. The primary capital cost would be the purchase and installation of the Fishheart system, including the floating collection barge, pumps, piping, control systems, guidance netting, anchorages, and associated fish transport equipment. Provisions for periodic large crane access will be required. A new small building/enclosure near the fishway will be required for the control and monitoring systems.

Additional construction activities would be limited to the installation of anchor points and mooring infrastructure required to securely position the Fishheart system within the tailrace. Compared to traditional fish passage structures, these improvements would require minimal in-water construction and a relatively small construction footprint.

This alternative would also require modifications to the existing trap, sort, and truck facility to support Fishheart operations. These improvements may include upgrades to fish handling, transfer, sampling stations, and operational equipment needed to receive and process fish collected by the system. Because the alternative relies on a modular floating system and makes use of existing fish passage infrastructure, overall construction costs are expected to remain relatively low.

6.4.1.7 Operation and Maintenance Costs

The O&M costs associated with the Fishheart alternative are considered moderate.

The system includes the incorporation of integrated cameras, monitoring and communications equipment including artificial intelligence technology that can provide real-time fish monitoring, fish species identification, data collection, and sorting capabilities. While these features have the potential to reduce manual handling requirements and improve operational efficiency, the effectiveness and accuracy of automated species sorting under site-specific conditions remain uncertain.

Routine maintenance requirements are expected to be focused on the guidance net system and the seasonal nature of Fishheart operations. Guidance nets may present maintenance challenges during portions of the upstream migration season due to debris accumulation, changing flow conditions, hydraulics, anchorage, and the need for periodic inspection and adjustment to maintain effective fish guidance. The system also requires annual installation and removal, and removal for high flow events, which may require specialized equipment (such as a large crane), resulting in recurring logistics and labor and equipment costs that would not be associated with a permanent fish passage structure.

Operational flexibility is another important consideration. The Fishheart system is removed seasonally and also typically removed during high-flow events to protect equipment and maintain safe operating conditions which may require temporary storage until conditions improve. In addition, the floating collection unit may need to be relocated within the tailrace if monitoring indicates that fish attraction and collection performance is not meeting expectations, or another location is more desirable. These activities contribute to the overall O&M burden but also provide opportunities for adaptive management and system optimization.

Unlike some structural fish passage alternatives, the Fishheart system would not permanently affect parking areas, powerhouse access, or commercial traffic patterns. As a result, the alternative avoids many of the indirect operational and maintenance challenges associated with facility access and site logistics. Overall, the combination of routine equipment maintenance, guidance net upkeep, seasonal installation and removal, storage, and operational flexibility results in a moderate O&M cost rating for the Fishheart alternative.

6.4.1.8 Impacts to Generation

The impacts to generation are considered to be low.

This alternative has no water use that bypasses flow from generation, where water for the system relies on pumped water from the tailrace. The sorting and handing facilities may need an independent water supply which could be pumped from the tailwater or diverted from headpond. Aside from potential bypass flows for the sorting facility, the energy impact to the site would be the electrical use for the system, which is expected to be relatively low.

6.5 Alternative U5 NLF - Proposed by Free the Andro (FTA)

This alternative was identified by FTA and was not identified initially as an alternative. Prior to development of this alternative, another NLF alternative was considered which would have been a bypass channel around the left abutment on the Topsham shoreline, but was eliminated from conceptual assessment

due to the required footprint, riverside canal wall construction, the limited amount of real estate available along the Topsham shoreline, the required demolition of portions of the left abutment, and bridge access requirements to span the NLF to provide for spillway gate O&M. Also, the entrance for the previous NLF alternative needed to be located 1,100 feet downstream of the powerhouse on the opposite riverbank, which could have adversely affected overall fish passage attraction.

The FTA NLF concept (as shown in Figure U5 in Appendix D) includes dividing the river with a new 1,600 foot long spillway wall, creating (1) a power canal on river-right feeding water to the powerhouse, and (2) a 1.6% sloped NLF channel on river-left with the dam and radial gates removed or bypassed. Excavation and grading of the NLF channel would be required to provide the desired bed slope. A series of weirs would be required at the upstream location to create a controlled headpond elevation and be hardened against ice and debris with additional weirs throughout the NLF to control depths and velocities to meet fish passage guidelines. Excavation would be anticipated near the NLF entrance around Shad Island, to provide passage up through the 10 to 12 foot tall Shad Falls. At the target grade, the excavation would likely be extensive. Bedrock excavation in the new power canal will likely be required to control velocities and headlosses. New gates adjacent to the powerhouse may be required to help manage ice and debris.

6.5.1 Evaluation of Criteria

The following sections evaluate Alternative U5 against the set of criteria established during previous project meetings. These criteria reflect the project's key objectives (including passage effectiveness, safety, longevity, risks, constructability, cost, operation and maintenance, and impacts to generation) and provide a consistent basis for comparing alternatives. These criteria capture the primary technical, operational, and economic considerations guiding the study and serve as the basis for comparing the relative merits of each alternative.

6.5.1.1 Passage Effectiveness

The overall passage effectiveness of the proposed NLF alternative for upstream fish passage is considered to be moderate to high. This rating reflects a combination of factors influencing fish attraction to the facility entrance and the anticipated performance of the fishway itself once fish successfully locate and enter the passage.

A primary factor limiting overall effectiveness is the location of the fishway entrance relative to the dam's primary attraction flows at the powerhouse and spillway. The proposed entrance (similar to the previous NLF bypass channel alternative) is located approximately 1,100 feet downstream of the dam and on the opposite bank from the primary river flow path through the Project powerhouse. This separation may reduce attraction efficiency, particularly for migratory species such as alosines that typically orient toward the strongest available flows when seeking upstream passage routes. The distance from the dam and the location outside of the primary attraction flow field may result in some delay or reduced success in locating the fishway entrance. The NLF entrance location and design would be informed by the CFD modeling proposed to be completed during Phase 2 of the study and the results of ongoing field studies.

Passage effectiveness within the NLF is expected to be high. NLFs generally provide hydraulic and physical conditions that mimic natural environments, allowing a broad range of species and life stages to migrate upstream. Although the NLF will incorporate numerous pools and resting areas, its relatively long passage route may increase energetic demands on migrating alosines. Consequently, while passage success may be high, the additional energy expenditure associated with traversing the facility could influence overall biological effectiveness.

Implementation of the alternative will also require substantial modification of the existing pools, ledges, and channel features downstream of the dam along Shad Island. These modifications will be necessary to create and maintain a minimum-flow channel that provides a suitable route for migrating alosines

The NLF is expected to provide highly effective upstream passage for fish that locate the facility, the overall effectiveness of the alternative is moderated by potential attraction limitations associated with the entrance location.

6.5.1.2 Safety

Safety risks associated with the NLF alternative are considered to be low to moderate.

A key component of the alternative is the construction of a new spillway wall extending through a substantial portion of the river channel to separate the NLF from the powerhouse flows and existing spillway facilities. Given its function in conveying and controlling flows, this spillway wall structure would serve as a primary hydraulic feature of the project and would be designed to meet applicable FERC engineering and dam safety requirements. With proper geotechnical investigation, structural design, and construction quality control, the new spillway wall is expected to provide a safe and reliable component of the overall project infrastructure.

The NLF will require demolition of the existing dam and spillway, gated spillway and north dam abutment. Design will need to include adequate spillway capacity to safely pass the Inflow Design Flood without causing unacceptable upstream flooding or increasing dam safety risks. Meeting this requirement may require the installation of additional spillway gates, the use of pneumatic crest gates or other crest-control structures, while also accounting for any discharge capacity contributed by the NLF during high-flow events. Detailed hydraulic modeling would be required during design to demonstrate that the modified project can safely convey flood flows under a range of operating conditions satisfying applicable dam safety criteria and providing a stable NLF channel.

6.5.1.3 Equipment Longevity

Equipment longevity would be moderate to high

The NLF would be constructed using concrete, durable stone, cobble, large riprap, and natural rock materials. The longevity of these materials is generally expected to be high. However, similar to natural river systems, portions of the channel may be susceptible to damage or displacement during extreme flood events and from flood-borne debris.

The new dam segments, spillway structures, and gates would be constructed primarily of reinforced concrete and steel and designed for long-term service. As an example, new spillway gates are typically designed for a service life exceeding 50 years and can remain in operation well beyond that period with appropriate inspection, maintenance, and rehabilitation.

The components of a NLF alternative are expected to provide a high degree of durability and long-term reliability, with periodic maintenance primarily focused on gate systems and restoration of channel materials following major flood events.

6.5.1.4 Risk/Uncertainty

The risks and uncertainties associated with the NLF alternative are considered to be moderate to high.

There is uncertainty regarding the construction of the proposed spillway channel wall, which spans a large distance and would require substantial in-water work within the river channel. Due to the extensive footprint of the conceptual layout for the NLF, the duration of the project construction would span multiple seasons, requiring significant construction sequencing and staging. In-water construction activities of this nature are subject to federal, state, and local permitting requirements and will require measures to avoid, minimize, or mitigate environmental impacts during construction. While permitting challenges are not expected to

preclude implementation of the alternative, they could influence project schedule, construction methods, and overall project cost.

An area of uncertainty relates to the entrance effectiveness and attraction flows. The proposed NLF entrance area is relatively large compared to conventional fishway entrances and may require concentrated attraction flows to effectively guide migratory fish to the facility. Meeting applicable fish attraction criteria may require construction of a minimum-flow channel or other hydraulic features designed to improve attraction flow patterns and direct fish movement away from the tailrace and toward the fishway entrance, which will be challenging to construct through the existing falls.

Another area of uncertainty relates to the NLF performance. The length of the NLF approaches one half mile at an average slope of 1.6%. As discussed above, Phase 2 of the study will consider the energetic requirements for species and impacts on migrants.

Related to energetics is an uncertainty regarding the constructed and long-term conditions for water depths and velocities throughout the NLF and variations in those parameters with flows and time. A review of studied NLF's should be included in Phase 2 evaluations.

6.5.1.5 Constructability

The constructability of the NLF alternative is considered to be difficult due to the scale of the proposed modifications, the extent of in-water work required, and the challenges associated with constructing major hydraulic structures within an active river channel over multiple seasons.

A significant constructability challenge is the construction of the proposed spillway NLF/canal wall, which would require dewatering and extensive in-water foundation preparation and structural construction. These activities would be performed in a dynamic river environment and would be susceptible to interruptions from elevated river flows, storm events, and seasonal conditions. Cofferdams, temporary flow diversions, and other water control measures will be required to facilitate construction and maintain safe working conditions, while continuing to deliver water to the powerhouse for power generation.

The proposed spillway canal wall would extend approximately 1,600 feet through the river channel and could not reasonably be constructed in a single phase. Instead, construction would likely require multiple staged construction sequences, including temporary dewatering and flow-routing measures. The need to maintain river conveyance, project operations, and site access throughout construction would add complexity to project planning and execution.

Construction of the NLF would require substantial excavation and fill operations to create the fishway channel and establish the desired hydraulic profile suitable for fish passage. Construction would involve the excavation, placement, and grading of large quantities of material, including structural fill, cobble, riprap, and large rock for the weirs and embankment stabilization.

Overall, the NLF alternative presents significant construction challenges due to the extensive in-water work, phased construction requirements, large-scale excavation and fill activities, and the need to manage river flows throughout the construction period. As a result, the constructability of this alternative is considered difficult when compared to other upstream fish passage alternatives.

6.5.1.6 Construction Costs

The construction cost of the NLF alternative is considered to be high due to the extensive demolition, temporary construction, cofferdams, bedrock excavation, fill, hydraulic structure construction, and river channel modifications required to implement the alternative.

A major cost component is the demolition and removal of portions of the existing dam within the NLF channel, including the existing spillway, gated spillway structures, and associated appurtenances. Demolition activities within and adjacent to the river channel would require specialized construction methods, temporary water control measures, and careful sequencing to maintain project safety and river conveyance throughout construction.

The most significant construction element is the approximately 1,600-foot-long concrete spillway wall that would split the river between the river-right power canal to the powerhouse and the river-left NLF channel. This spillway wall would function as a canal wall and spillway component of the project, passing high flows into the NLF. The wall would be required to meet applicable FERC dam safety requirements. The wall would require construction in the dry, substantial foundation preparation, reinforced concrete construction, and extensive quality assurance and quality control measures, resulting in a significant construction cost.

The NLF would require substantial earthwork to establish the desired channel alignment, profile, and hydraulic characteristics necessary for effective fish passage. This work would include excavation, fill placement, channel stabilization, and installation of large rock and riprap features throughout the fishway to provide the depths and velocities to meet guidelines for fish passage. The need for bedrock excavation near the NLF entrance and under the new bridge in the area known as Shad Falls (at the downstream side of Shad Island) would increase the cost of the earthwork portion of the project. Bedrock excavation in an active river environment typically requires specialized equipment, controlled blasting or mechanical rock removal methods, and extensive environmental protection measures. This site has further complications of adjacent bridge structures, old mill buildings, and residences, where vibration control during excavation will be critical. These excavation activities can represent a significant cost and schedule driver for the project.

Implementation of the alternative would also likely require new spillway gates to replace lost discharge capacity and to provide operational flexibility for managing flows, debris, and ice at the powerhouse. The design, fabrication, installation, and integration of new gated spillway facilities would represent a substantial additional project cost.

The combined costs for the major dam modifications, significant cofferdaming, demolition of existing structures, extensive reinforced concrete construction, new spillway gates, bedrock excavation, and large-scale channel grading likely makes the NLF alternative the most expensive upstream fish passage alternative under consideration.

6.5.1.7 Operation and Maintenance Costs

The O&M costs associated with the NLF alternative are considered to be low to moderate.

While the NLF components would have relatively few mechanical components compared to conventional technical fish passage facilities, ongoing inspection and maintenance of the channel and associated appurtenances would be necessary to ensure long-term performance.

Debris management requirements are expected to be relatively low given the width of the channel, however debris loads and accumulation on the upstream weirs will be evaluated in Phase 2. The broad channel geometry and open nature of the NLF should allow much of the floating debris and sediment load to pass through the facility without significant accumulation. As a result, routine debris removal efforts are anticipated to be less intensive than those associated with more confined fishway designs. However, seasonal installation and removal of a debris boom would likely be required to direct floating debris away from the power canal entrance and the NLF entrance to maintain effective operation.

Routine inspections would be required to document the condition of the fishway channel, spillway wall, bank protection measures, and associated structures. Periodic monitoring would help identify erosion, settlement, rock displacement, debris accumulation, or other maintenance needs before they affect fish passage performance or project safety.

Because the NLF would convey a portion of river flows, including some high-flow and flood events, the channel is inherently more susceptible to flood-related impacts than conventional concrete fishways. Extreme flow events and debris impacts may result in localized scour, movement of rock and channel materials, bank erosion, or damage to channel features that are important for fish passage. Consequently, post-flood inspections and, when necessary, maintenance and restoration activities would be required following significant high-flow events to ensure that the channel continues to function as designed.

Again, O&M costs are expected to be low to moderate, reflecting the limited mechanical equipment associated with the NLF and relatively modest routine maintenance requirements. The primary O&M considerations are periodic inspections, debris boom management (if used), and occasional repair or restoration of channel features following major flood events.

6.5.1.8 Impacts to Generation

The generation impacts associated with the NLF alternative are considered to be high.

The alternative would require a dedicated flow allocation to support fish passage, introduce additional hydraulic losses within the project, and may alter downstream tailwater conditions, all of which could affect project generation performance.

The proposed NLF flow of 5 percent of the station's generating capacity is approximately 375 cfs. This flow would be unavailable for power production during periods when the fishway is in operation, resulting in a direct reduction in generation compared to existing conditions. The NLF fishway is likely to operate year-round at some flow rate, possibly operated at a lower flow outside the fish passage season. To accomplish this off-season flow reduction might require a flow control weir at the upstream weir of the NLF, and a low flow channel within the main NLF channel.

The “split” of the NLF and the new power canal may result in headloss along the power canal to the powerhouse, resulting in lower operating headpond elevations at the dam during certain flow conditions. Any reduction in available gross head would affect turbine efficiency and decrease generation output.

In addition, the NLF alternative is expected to require new spillway gates to replace lost spillway capacity (at the north dam abutment) and the capacity to manage flows, debris, and ice. The existing spillway gate discharge is isolated from the tailrace[6], however discharge from new spillway facilities may influence tailwater elevations downstream of the powerhouse. Increased tailwater levels will reduce the net hydraulic head available for power generation and can result in reduced turbine output. The magnitude of the impacts would depend on gate configuration, operating procedures, river flow conditions, and the interaction between spillway releases and powerhouse discharges. Detailed hydraulic and generation modeling would be required during Phase 2 of this study to quantify these effects and evaluate impacts to the Project and opportunities to minimize generation losses while maintaining effective fish passage performance.

[6] The existing 21-foot-high fish barrier wall between the dam and Shad Island isolates spillway discharge to the north channel along Topsham to below the tailrace.

7 PHASE 1 SUMMARY AND PHASE 2 EVALUATION

While Phase 1 was initially intended to identify a limited number of alternatives for advancement, the evaluation process identified multiple viable alternatives that do not exhibit fatal flaws and represent differing approaches to fish passage at the Project. These alternatives include upgrades to the existing facilities, replacement of the fishway with a new vertical slot fishway, a fish lift, a Fishheart floating fish passage system, and a NLF channel. Each alternative presents unique advantages, tradeoffs, and uncertainties that cannot be fully resolved through conceptual-level screening.

Phase 1 cost evaluations were not developed, and cost considerations are limited to qualitative rankings (low, moderate, high) based on engineering judgment. These qualitative assessments are not sufficient to support investment-level or licensing decisions. Given the potentially significant differences in capital cost, operation and maintenance costs, and generation impacts among the alternatives, development of preliminary (Class 4 or 5) cost estimates in Phase 2 is necessary to inform decision-making.

Phase 1 evaluations were conducted at a conceptual level and, while sufficient for identifying fatal flaws, cannot reliably predict detailed hydraulic performance. Many of the critical uncertainties identified in Phase 1, such as flow distribution, velocities, attraction effectiveness and efficiency, are inherently dependent on 3-D CFD analysis.

As a result, advancing all remaining viable alternatives into Phase 2 is warranted to ensure a comprehensive, transparent, and technically defensible evaluation process. Eliminating additional alternatives at this stage, based solely on qualitative screening, would risk prematurely excluding options that may ultimately provide the best balance of biological performance, constructability, cost, and operational impacts once evaluated in greater detail.

Accordingly, advancing the full suite of viable alternatives into Phase 2 aligns with the study objectives. The Phase 2 effort incorporating CFD modeling, and development of preliminary cost estimates, will provide the technical and economic basis necessary to support a fully informed and defensible evaluation of upstream fish passage alternatives.

8 REFERENCES

ASCE (American Society of Civil Engineers). (2007). Civil Works for Hydroelectric Facilities: Guidelines for Life Extension and Upgrade. Reston, VA: American Society of Civil Engineers.

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Normandeau Associates, Inc. (NAI). 2022. Fish passage effectiveness study for Brunswick Hydroelectric Project.

United States Fish and Wildlife Service (USFWS). 2019. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts.

APPENDIX A–FLOW DURATION CURVES

Figure A-1. Annual Flow Duration Curve (1987-2025)

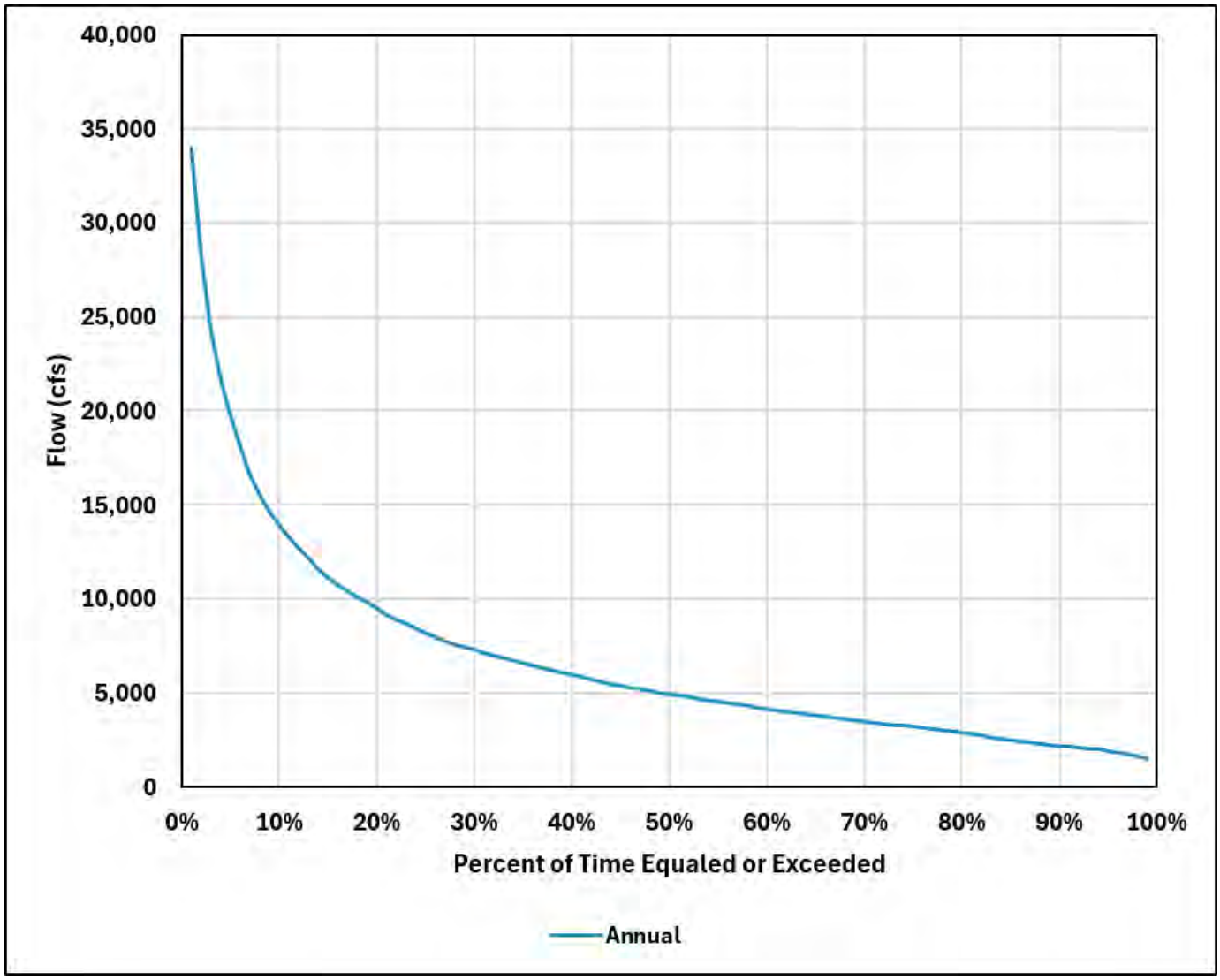


Figure A-2. January, February, and March Flow Duration Curve (1987-2025)

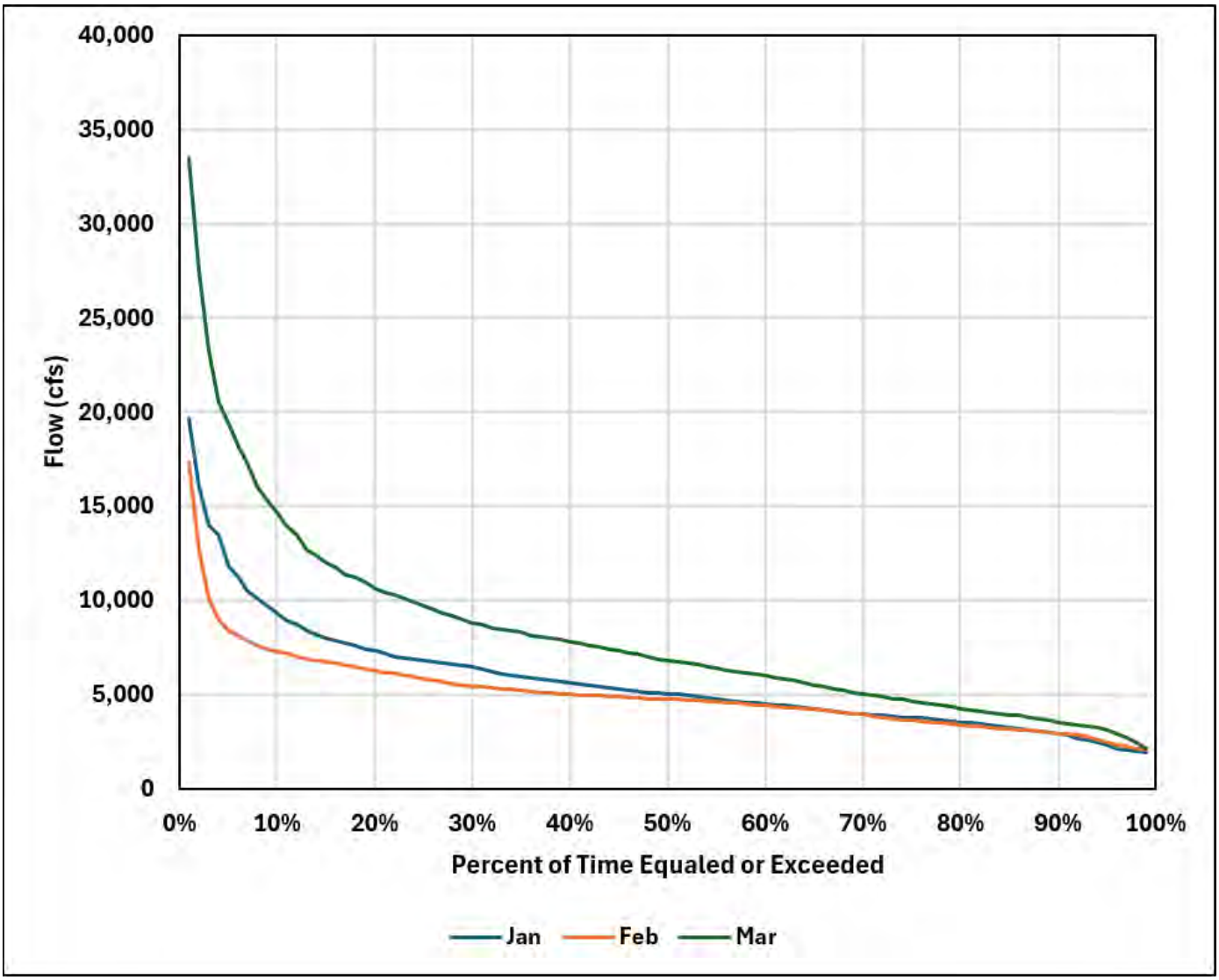


Figure A-3. April, May, and June Flow Duration Curve (1987-2025)

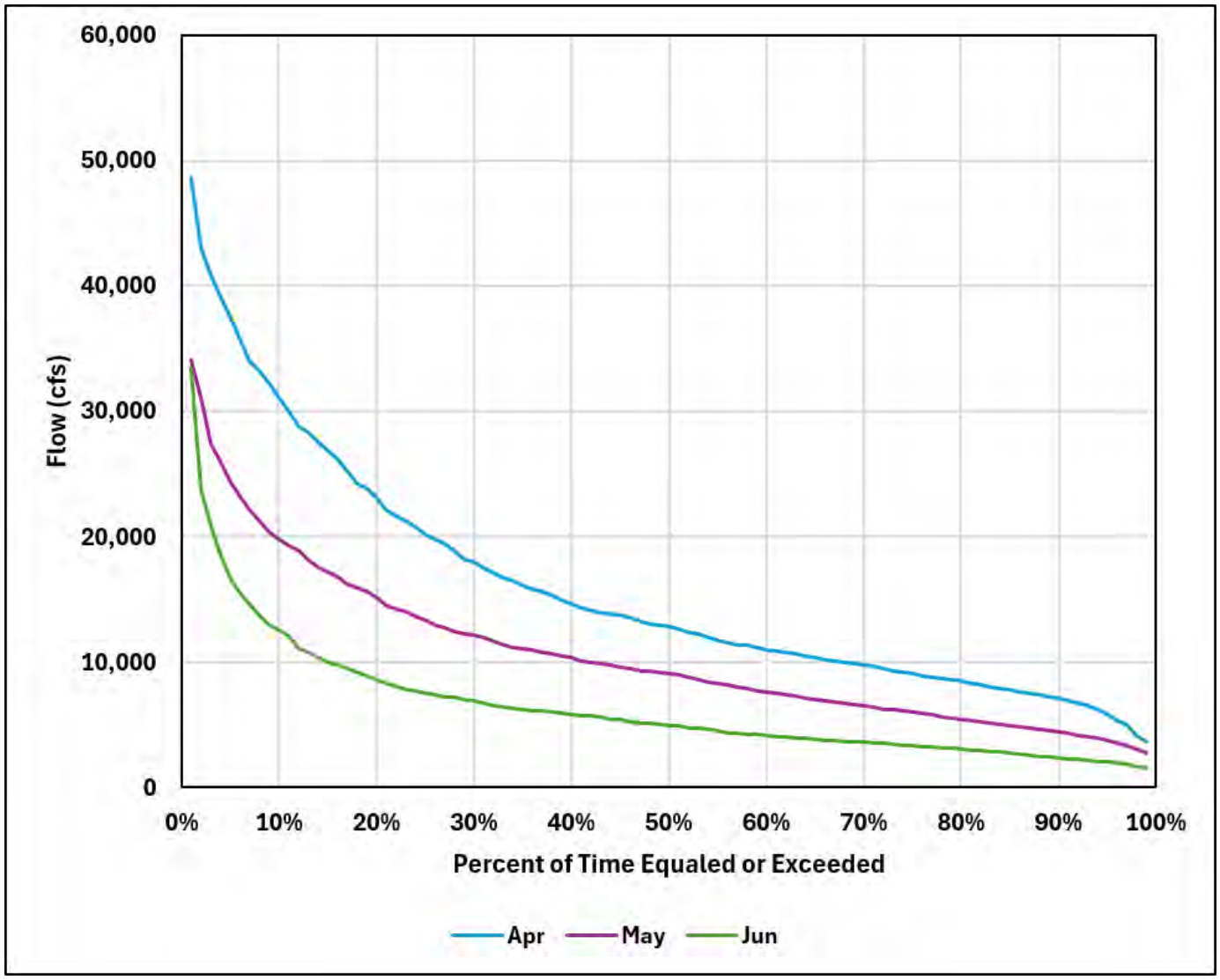


Figure A-4. July, August, and September Flow Duration Curve (1987-2025)

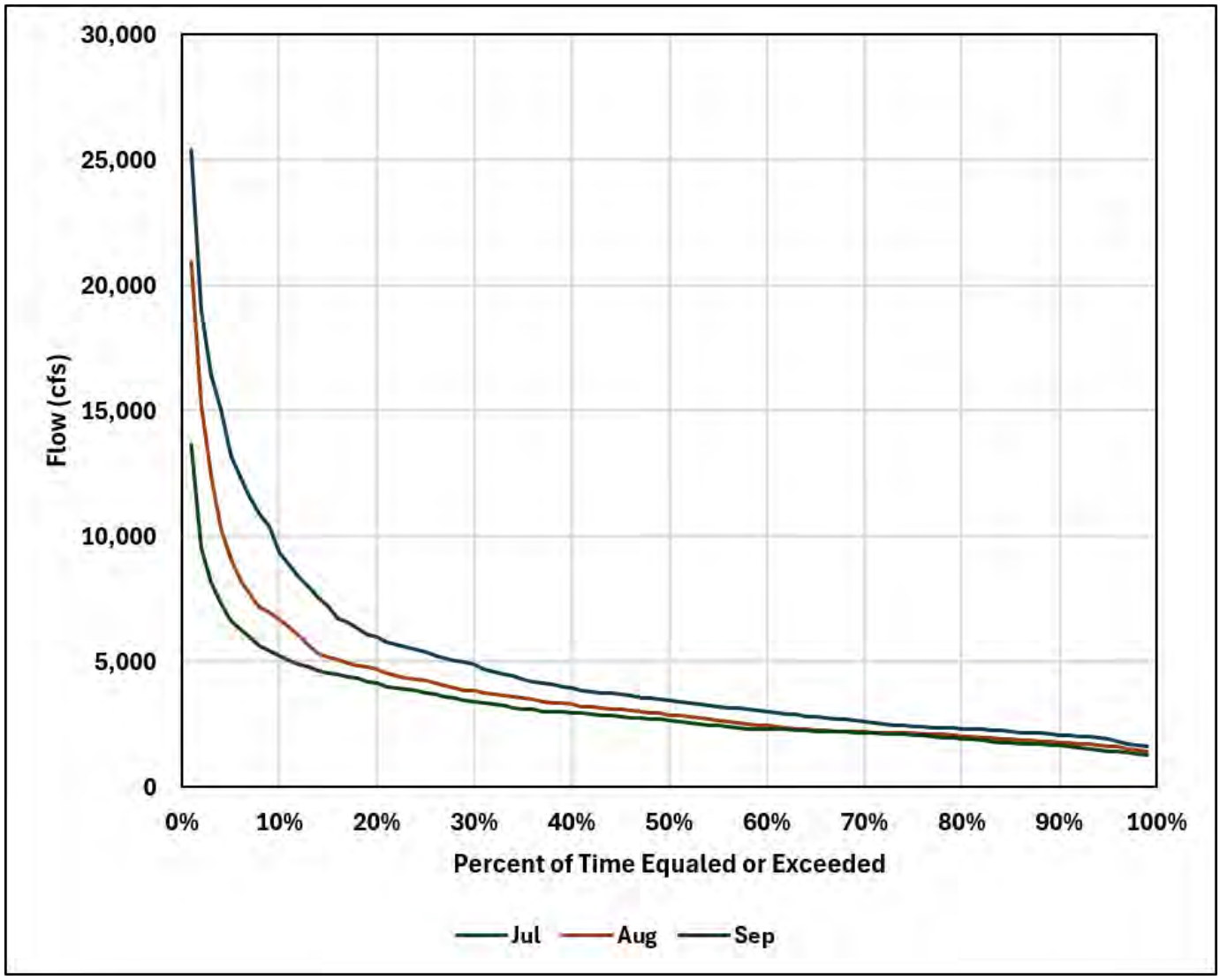
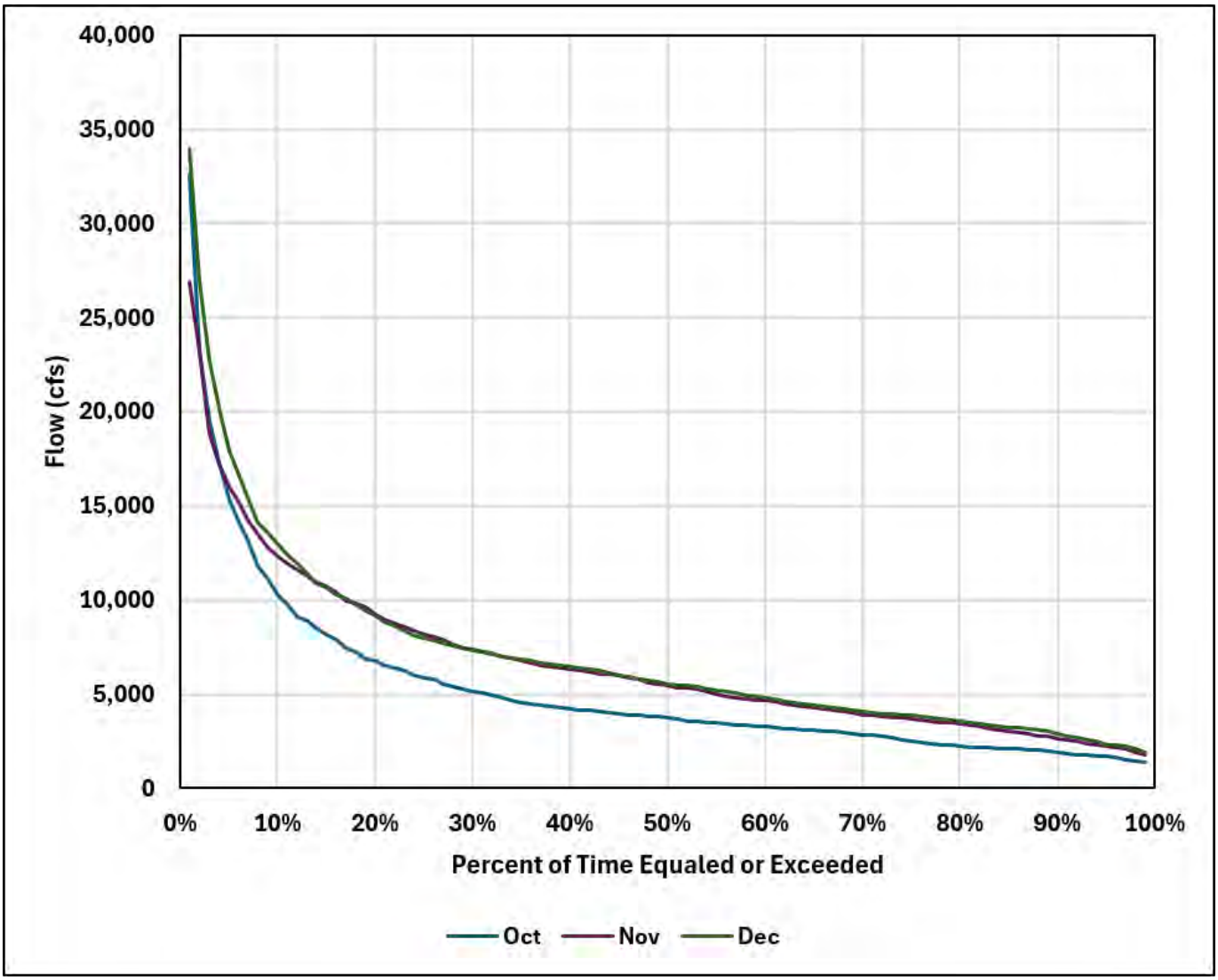


Figure A-5. October, November, and December Flow Duration Curve (1987-2025)



APPENDIX B–CONSULTATION RECORD

MEETING SUMMARY

BRUNSWICK HYDROELETRIC PROJECT

FERC NO. 2284

UPSTREAM FISH PASSAGE ALTERNATIVES MEETING

March 5, 2026

ATTENDEES:

Mike Scarzello	Brookfield Renewable
Adam Brown	Brookfield Renewable
Matthew Leblanc Sr	Brookfield Renewable
Lucas Stiles	Kleinschmidt Associates
Ralph Nelson	Kleinschmidt Associates
Kirk Smith	Gomez and Sullivan
Kali Shores	Gomez and Sullivan
Lars Hammer	Maine Department of Marine Resources (MDMR)
Casey Clark	MDMR
Don Dow	National Marine Fisheries Service (NMFS)
Kimberly Spiller	United States Fish and Wildlife Service (USFWS)
Ed Friedman	Friends of Merrymeeting Bay (FOMB)
Chip Spies	Free the Andro Coalition (FTA)
Vladamir Douhovnikoff	FTA
John Lichter	FTA

Kirk Smith opened the meeting and outlined the objectives and agenda. The purpose of this meeting was to present and screen potential upstream fish passage alternatives at the Brunswick Project, building upon the January 27, 2026 session that focused on downstream alternatives. Prior to the meeting, participants received an alternatives matrix and conceptual sketches to support the discussion (Attachment 1). The upstream fish passage alternatives matrix was developed by Brookfield based on a literature review of potential applicable technologies that have been implemented at other

hydroelectric projects, as well as any applicable new technologies. The literature review resulted in the identification of approximately 12 alternatives for upstream passage, which have been preliminarily narrowed down by Brookfield to 4 alternatives to be analyzed in a more detailed feasibility assessment to be conducted over the course of 2026.

The objective of this meeting is to consult with resource agencies, review the upstream fish passage alternatives matrix, and obtain concurrence on the alternatives to be carried forward for further detailed evaluation in the feasibility assessment.

Lucas Stiles led a discussion of the alternatives contained in the upstream fish passage matrix. Lucas began by providing a brief overview of the Project features and layout (i.e., powerhouse, spillway, impoundment, etc.).

Alternative U1: Modification of Existing Vertical Slot Ladder

Lucas Stiles began by describing the existing ladder which is located between the powerhouse and Frank J. Wood Bridge on river right (looking downstream). The entrance is located next to Unit 1. The fishway has a 180-degree bend just after the entrance, before extending downstream, where it contains another 180-degree bend before continuing back upstream to a sorting facility. The fishway can also pass fish volitionally into the impoundment through an exit flume that exits immediately adjacent to the intake for Unit 1. There are 42 pools (each 8.5 ft wide × 10 ft long) with 11-inch vertical slots that are designed with a 12-inch drop. There is a 30 cfs conveyance flow through the fishway plus 70 cfs of supplemental attraction flow that is discharged near the entrance via a floor diffuser for 100 cfs of total flow through the system. Lucas stated that one of the primary issues with the existing fishway is the low attraction flow relative to the 5% of maximum turbine capacity (approximately 375 cfs) guidance contained in the USFWS engineering guidelines; modifications to the existing fishway should focus on this variable.

For the first alternative (see Attachment 1), there are not many ways to significantly increase attraction flow through the existing floor diffuser; however, an angled ramp could be installed just downstream of the fishway entrance gate to diffuse additional attraction water. This additional attraction flow would be supplied via a new intake structure located adjacent to the existing exit flume. The feasibility of this needs to be

validated using bathymetry data and analyzing the space/area available to determine how much additional flow could be achievable. Lucas went on to say that the Energy Dissipation Factor (EDF) for the existing fishway ranges from 2.8 to 4.9 depending on the tailwater elevation. Under typical operations the EDF is around 4.0. Current guidelines specify that the EDF should be approximately 3.15 for American Shad. The conveyance flow would need to be reduced to drop EDF levels in the existing fishway. Lucas stated that the existing vertical slot width is 11 inches, which is narrow for American Shad. However, the existing fishway could be modified to a pool-and-chute configuration which would eliminate the narrow slot width and improve the passage route. Modifying the fishway type would also allow shortening the pools to 8 feet in length, which would allow an additional 10 pools to be added to the fishway, reducing the drop between pools to 9 inches. Other modifications that could be considered include enlarging the downstream turning pool near the 180-degree bend to further reduce the EDF in the turning pool, replacing the wooden corner baffles with curved steel plates or concrete to improve bend hydraulics, extending the entrance and fitting it with an overshot-style entrance gate (similar to Milford Hydroelectric Project), adding flow induction pumps to increase attraction flow near the entrance, and updating the sorting facility to enhance usability.

John Lichter stated that an effort in the early 2010s to install flow induction pumps/impellers at the ladder entrance to increase attraction flows did not appear to improve fishway efficiency. John also noted that he worked with Bowdoin students who installed cameras near the entrance which showed a "curtain" of bubbles/turbulence produced from Unit 1 in front of the fishway entrance and this appeared to confuse American Shad and prevent them from entering the fishway. In addition, John stated that previous underwater camera observations showed American Shad congregating about 100 to 150 feet downstream of the current fishway entrance. John said in 2016 when Unit 1 was shut down for maintenance approximately 1,000 American Shad passed the fishway, which is one of the highest passage counts in recent times.

Lucas Stiles acknowledged that they were aware of the anecdotal information about the fish "milling" areas and stated that Kleinschmidt planned to review pump specifications to determine if any advancements in technology might yield a different result for any

effort to increase attraction flow near the entrance. Additionally, Lucas said that Brookfield will be analyzing the results of the Project Interactions Telemetry study to be completed in 2026 and CFD hydraulic modeling results to assess tailrace hydraulics to determine if extending the fishway entrance to another location (e.g., further downstream) made sense.

Casey Clark said that MDMR considers the public viewing window in the fishway a community priority that should be maintained in any future design modifications; however, it should be considered secondary to increasing the performance of the fishway. Casey also noted that the planned overshot gate would be affected by channel and tidal variability.

Don Dow asked if the vertical slots in the fishway were 9 inches instead of 11 inches but added either way they are too small especially for American Shad. Don also said that an understanding of the biomass and design capacities of the fishway as well as updated population targets need to be developed.

Lucas Stiles stated that the existing drawings show 11 inches for the vertical slot size, but he will attempt to verify this via another source. Lucas said that prior population numbers for the fishway design capacity came from a draft management plan for the Androscoggin River developed by MDMR. Don suggested reviewing the NMFS management plan for the Androscoggin River for that information as well.

Ed Friedman asked if the new license would contain conditions to allow for flexibility and adaptive management so that modifications can be made if performance standards are not met. Kirk Smith explained that most modern FERC licenses typically include effectiveness testing, performance standards, and modifications measures if targets are not met.

Alternative U2: New Vertical Slot Fishway (South side of Powerhouse)

Lucas Stiles stated that this concept uses 18-inch vertical slots per USFWS engineering guidance with 12 foot wide by 15 foot long pools, for a total of 52 pools, with a 9 inch drop per pool (see Attachment 1). This alternative would also include a new attraction flow intake near the exit flume and a wall diffuser located near the fishway entrance that discharges at a low velocity. This alternative would also include an overshot-style

entrance gate and a new trap-and-sort facility. Lucas stated there are challenges associated with the alternative including multiple 180 degree bends and switchbacks along the fishway, full demolition of the existing fishway will be required before construction begins, large cofferdams will be needed during construction, and support of excavation structure will be required to maintain access to the mill building and powerhouse. Construction likely will span multiple seasons which will affect the ability to provide uninterupted upstream passage at the Project.

Lars Hammer asked whether there was flexibility to extend the fishway entrance downstream for all alternatives. Lucas stated that shifting the entrance downstream is possible but doing so must avoid restricting powerhouse flows, this is likely more feasible with any new-build alternative rather than modifying the existing structure.

Don Dow stated that he does not prefer this option, as he would consider 24-inch vertical slots more ideal at a first-dam on the river site, but the available footprint makes that impractical and results in too many switchbacks for reliable passage.

Alternative U3: New Fish Lift on South Side of Powerhouse

Lucas stated that this alternative includes the construction of a new fish lift, which would include a lower entrance channel with a wall diffuser (see Attachment 1). The hopper would lift fish to an exit flume for volitional entry to the impoundment. This alternative also includes a crowder and a small trap along with a new sorting facility. Lucas said that the entrance location could be shifted downstream, if necessary, following analysis of the Project Interactions Telemetry Study and CFD Modeling Study results.

Don Dow stated that he preferred the fish lift option. Don recommended delivering the attraction flow upstream of the hopper. He suggested moving the entrance to the previously discussed congregation area downstream and, if feasible, discharging the hopper contents into the existing exit flume. Don also suggested using a dedicated attraction flow source rather than the existing fishways.

Lucas Stiles stated that he is open to assessing the discharge-to-existing flume geometry, but notes that it will be challenging. He agreed that attraction flow source should not rely on the current fishway intake.

Casey Clark stated that the final entrance siting should await the results of the Project Interactions Telemetry Study and noted that some evidence suggests American Shad often approach all the way upstream to the mid-powerhouse area, then travel in a counterclockwise direction downstream past the current entrance without stopping. Casey also suggests considering over-unit entrances, like the Safe Harbor Project, if this is supported by the Project Interactions Telemetry Study results.

Don Dow commented that although he places a lot of weight on behavioral studies, he still wants to include observation and judgment and the CFD Modeling Study to guide the selection.

Casey also asked why portions of the existing ladder might be abandoned in place. Lucas Stiles explained that leaving sections in place to act as cofferdams, reduce cost and schedule as well as shorten the fishway outage window.

Alternative U4: New FishHeart System with Guidance Nets

Lucas said Alternative 4 consists of the FishHeart technology, which includes a floating barge and capture system that is anchored in the tailrace and includes guidance nets (see Attachment 1). This alternative can discharge to the existing exit flume or to a sorting facility but must be removed annually and for extreme high-water events. The deployment and removal would require crane access under the existing overhead transmission lines. A major operation and maintenance concern for this alternative is debris loading on the fish guidance nets. Lucas Stiles also said that there is limited attraction flow associated with this alternative compared to the 5% of maximum turbine capacity (approximately 375 cfs) guidance contained in the USFWS engineering guidelines.

Don Dow states that he is skeptical that the system can provide the capacity to accommodate a river herring run of several million fish. He is supportive of evaluating it, but not as a stand-alone solution.

Casey Clark added concerns about the interactions of the system's guidance nets with downstream migratory fish movements and sturgeon spawning and requested an analysis of flow-duration to quantify percentage of time the system would be out of service due to high flow and/or floods.

Other Alternatives: Nature-Like Fishway (Right-Bank Bypass Around Dam)

Lucas Stiles stated that Brookfield also conducted a preliminary analysis of two Nature-Like Fishway alternatives (see Attachment 1). The initial concept creates a 100-foot-wide channel extending from below the Frank J. Wood bridge upstream around the spillway infrastructure to the impoundment. The total length would be about 1,800 feet with a 2.2% slope to pass 375 cfs (5% of station capacity). This alternative would require isolation walls and partial left dam abutment demolition, and a new bridge across the NLF to access the spillway gates. There are dam safety considerations with this NLF alternative, regarding access, spillway capacity, and stability of structures. Placement of the fishway would be on private parcels. The NLF entrance is located across the river and approximately 1,100 feet downstream of the powerhouse attraction flow. Competing attraction flows may lessen effectiveness of the NLF entrance.

Don Dow requested that the report document why this option is eliminated if screened out, with drawings and constraints included. He noted recent Frank J. Wood bridge replacement as well as concerns about construction under and around the bridge and cutting into roadway embankments as challenges.

Other Alternatives: In-Channel Nature-Like Fishway (River-Left Split-Channel via Shad/Goat Islands)

Lucas Stiles explained that this concept includes demolishing and modifying the spillway from Shad Island to the left-bank and building a new spillway wall up to Goat Island (see Attachment 1). This would also include constructing a 2,500 foot long (1.6% slope) Nature-Like Fishway along the river left portion of the river. The major technical challenges of this alternative include large cofferdams, spill capacity/ice/debris passage, substantial rock excavation (at downstream end), substantial in river fill (at upstream end), and shoreline grade adjustments. Downstream passage protection measures at the powerhouse would still be required since the Nature-Like Fishway entrance cannot exclude potential entrainment from the turbines.

Vladimir Douhovnikoff suggested carrying this option forward through costed feasibility given stakeholder interest. Don Dow stated his support for advancing this alternative to feasibility assessment level development despite also acknowledging that Nature-Like

Fishways are not proven universally superior to technical fishways. Don would like to better understand the earthwork and spill modifications that would be required from an engineering and cost perspective.

Lucas Stiles stated that one concern with the Nature-Like Fishway alternatives is the location of the entrance is far downstream of the powerhouse, and fish may not be attracted to it. Lars Hammer reports seeing many river herring and some American Shad congregated below Shad Falls during a stranding survey with no spill across the Tainter gates. Ed Friedman suggested deliberate Tainter gate flow pulses coupled with acoustic monitoring to test whether attraction shifts toward the left channel from other areas (e.g., just downstream of the powerhouse). Kirk Smith suggested that the Project Interactions Telemetry Study might be a better method to determine fish attraction in this area, as well as other areas below the Project.

Vladimir Douhovnikoff addressed the fact that dam removal was not on the matrix or a topic of discussion in this meeting whereas it did come up at the previous January meeting. Mike Scarzello responded by saying that Brookfield is not going to be removing the dam and is committed to relicensing. In addition, Mike stated that FERC stated in the NEPA Scoping Document as well as the Study Plan Determination that analysis of the dam removal alternative was not necessary. Mike said that FERC's policy is that dam removal is not considered, if reasonable protection and mitigation measures can be implemented as part of any new license. Vladimir responded that understanding the result from the no dam alternative would be beneficial to be able to evaluate the other alternatives in the matrix. Mike suggested that Vladimir submit his comments in writing.

Next Steps and Requests

Kirk Smith said the meeting summary will be circulated with attachments of the matrix and conceptual sketches and any written comments should be submitted to Brookfield by April 6, 2026.

Attachment 1-Upstream Fish Passage Alternatives Matrix and Conceptual Sketches

Draft Alternatives Review – Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
U1	**Modification of Existing Vertical Slot Ladder**	-This alternative would include modifying the existing vertical slot fishway to improve overall effectiveness. -The existing fishway has (42) 8.5-foot-wide by 10-foot-long pools with 11-inch slots. -The fishway was designed for a maximum drop per pool of 12 inches. -The ladder has a conveyance flow of 30 cfs and a supplemental attraction flow of 70 cfs for a total attraction flow of 100 cfs. The supplemental attraction flow is provided via a floor diffuser near the entrance. -The extent and feasibility of the modifications will be determined based on additional analysis and CFD modeling. Some potential modifications include: • Decreasing conveyance flow. The EDF (Energy Dissipation Factor) for the existing pools ranges from ~2.8 to 4.9 and is 4.0 at normal conditions. This is above USFWS's recommendation of 3.15 for American Shad. Reducing conveyance flow to ~ 20 cfs would bring the EDF down to acceptable levels. • Increasing supplemental attraction flow. Due to the geometry of the existing facility, it's not feasible to increase the supplemental attraction flow through the existing fishway. To supplement the attraction flow, a ramped entrance diffuser similar to the one at the Scotland fishway may be able to be installed in front of the entrance. Review of the bathymetry in this area is required to assess the feasibility and determine amount of flow that could be provided. Total attraction flow will still likely be less than 5% of station discharge which is what's recommended by USFWS. • Modifying the fishway type. USFWS recommends a minimum slot width of 18 inches for American Shad. Increasing the slot width also requires that the pool size increases to maintain the hydraulic performance of the fishway. Increasing the pool sizes is not feasible due to the	<u>Low/Moderate</u> -A telemetry study of river herring conducted by NAI in 2022 showed an entrance efficiency of 37.5% and an overall internal effectiveness of 33.3%. A similar study for American shad in 2022 showed that only 2.4% of the tagged fish entered the attraction flow field and no fish entered the fishway. -Reducing conveyance flow would improve internal fishway hydraulics and improve internal efficiencies. -Increased supplemental attraction flow would improve entrance efficiency. -Smaller pool sizes mean a lower theoretical capacity than a new vertical slot fishway. -Overshot entrance gate should improve entrance efficacy. -Provides volitional passage (not currently operated due to invasive species).	<u>Low Risk</u> -Minimal changes to operating conditions.	<u>Low</u> -The bulk of the existing facility which was built in 1983 would remain in place.	<u>High</u> -Use of ramped entrance diffuser is limited. -The existing upstream fishway may need to be shut down for a portion of the season to facilitate construction. -Its unlikely that these modifications would improve effectiveness enough to meet the standards that the agencies will likely require. -Extension of the turning pool may be limited by property boundary or bridge easements.	<u>Moderate</u> -A small cofferdam near the fishway entrance would be required to facilitate potential modifications. -A cofferdam in the headpond would be required to facilitate construction of the attraction water intake structure. -Routing of new attraction water pipe may be difficult.	<u>Moderate</u> - Construction of ramped entrance diffuser. -Construction of entrance channel extension. -Installation of overshot entrance gate. -Installation of new dewatering gate. -Installation of flow induction pumps. -Modifications to internal fishway baffles. -Modifications to existing floor diffuser. -Replacement of wooden chamfers. -Installation of new attraction water pipe. -Construction of new attraction water intake. -Modifications to trap, sort, and truck facility.	<u>Low/Moderate</u> -Additional raking/cleaning of new attraction water intake. -No impact on parking, powerhouse access, or commercial traffic. -Vertical slot fishways are typically less complicated to maintain and operate. Pool and weir systems require more frequent operational adjustments for varying headwater and tailwater levels	<u>Moderate</u> -Additional losses due to increased attraction flow (likely to be less than a new vertical slot or fish lift).

Draft Alternatives Review – Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
		site constraints. Modifying the fishway to a pool and chute style fishway may improve passage for shad. Additionally reducing the length of the pool from 10 feet to 8 feet would allow you to add 10 additional pools, reducing the drop per pool to 9 inches. • Increasing the size of the turning pool. It's unclear from the effectiveness testing that has been completed if the 180-degree turning pool at the downstream end of the fishway is problematic, but these have been an issue at other projects. Increasing the size of the tuning pool to further reduce the EDF and providing additional room for fish to rest could improve internal efficiencies. • Modifying the existing floor diffuser. Some recent studies have indicated that floor diffusers can be an area of concern in fishways. Due to the geometry of the existing facility, it is not feasible to replace the existing floor diffuser with a wall diffuser, but it may be possible to improve the hydraulics at the floor diffuser by adding baffles, porosity plates, or turning vanes. • Replacing the existing chamfered wooden corners with radiused steel plate or concrete. • Extending the existing entrance downstream to allow for an overshot style entrance gate to be installed. • Installation of flow induction pumps near the fishway entrance. • Modify/Improve the existing trap, sort, and truck facility (Discuss with Brookfield).								
U2	**New Vertical Slot Ladder on South Side of the Powerhouse**	-This alternative would include constructing a new larger vertical slot fishway with a 9-inch drop per pool. Based on the maximum fishway operating head at the site (~ 40-feet), a vertical slot fishway with a 9-inch drop per pool would require approximately 52 pools. -The required pool size is based on the slot width. The minimum required slot width for American shad is 18 inches which results in a 12-foot-wide by 15-foot-long pool.	Moderate/High -Increased attraction flow would improve entrance efficiency. -Elimination of floor diffusers would improve internal fishway efficiency.	Low Risk -Similar operating procedures as the existing facility.	High -New fishway. -New trap, sort, and truck facility.	Moderate -Would likely require the existing upstream fishway to be shut down for multiple passage seasons to facilitate construction. -Footprint may be limited by property	Difficult -A large cofferdam in the tailrace would be required to facilitate construction of the fishway. -Complete demolition of the existing fishway would be required.	High -Construction of new vertical slot fishway. -Installation of new attraction water pipe. -Construction of new attraction water intake.	Moderate -Similar operating conditions to existing facility. -More pools to maintain. -Additional raking/cleaning of	High -Additional losses due to increased attraction flow.

Draft Alternatives Review – Upstream Fish Passage at the Brunswick Project

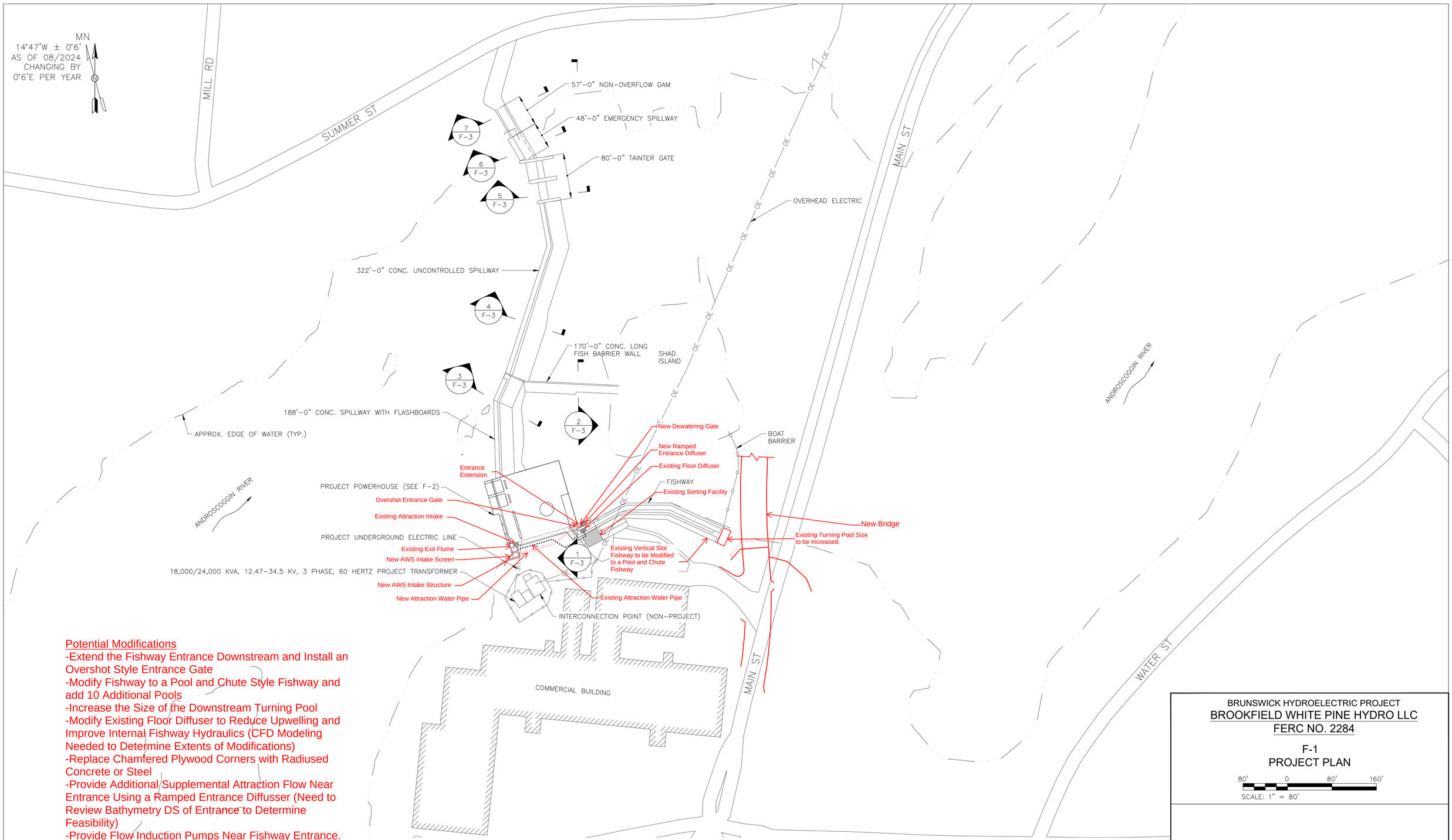
ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
		-This alternative would require the construction of a new trap, sort, and truck facility.	-Reduced drop per pool would improve internal fishway efficiency. -Larger pool sizes would increase the capacity of the fishway. -Length of the fishway may result in some fallback which would impact internal fishway efficiency. -Multiple switchbacks required could reduce effectiveness particularly for shad. -Would provide volitional passage.			boundary or bridge easements.	-Large impact area. -An SOE (support of excavation) structure to support the existing access road while the new facility is built would be required. -A cofferdam in the headpond would be required to facilitate construction of the attraction water intake structure and fishway exit. -Construction could impact access to the powerhouse.	-Construction of new trap, sort, and truck facility.	new attraction water intake. -Impacts parking, powerhouse access, and commercial traffic.	
U3	**New Fish Lift on South Side of Powerhouse**	-This alternative would include constructing a new fish lift to the south of the existing vertical slot fishway. -The hopper would be sized to accommodate the anticipated design population size (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring). -This alternative would require the construction of a new trap, sort, and truck facility.	High -Increased attraction flow would improve entrance efficiency. -Elimination of floor diffusers would improve internal fishway efficiency. -Length of fishway is reduced which should improve internal efficiency. -Would not provide volitional passage.	Moderate Risk -Additional safety requirements associated with hopper lifting and fish lift operation.	High -New fish lift. -New trap, sort, and truck facility. -Remaining portion of existing fishway to be abandoned in place.	Low -Would likely require the existing upstream fishway be shut down for one passage season to facilitate construction. -Mechanical failures can result in the fishway being down for portions of the passage season.	Moderate -A cofferdam in the tailrace would be required to facilitate construction of the fishway. The cofferdam would be smaller than the one needed for the vertical slot fishway since most of the new fish lift would be on the land side of the existing fishway. -Portions of the existing fishway need to be demolished to facilitate construction. The remaining portion of the structure would be abandoned in place. -An SOE (support of excavation) structure to support the existing access road while the new facility is built would be required.	High -Construction of new fish lift. -Installation of new attraction water pipe. -Construction of new attraction water intake. -Construction of new trap, sort, and truck facility.	High -Fish lifts are more complex and have more mechanical components that need to be maintained. -Additional raking/cleaning of new attraction water intake. -Impacts parking, powerhouse access, and commercial traffic. -A secondary lift for trapping could be provided to allow some level of pre-sorting of species (similar to Milford).	High -Additional losses due to increased attraction flow.

Draft Alternatives Review – Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
							-A cofferdam in the headpond would be required to facilitate construction of the attraction water intake structure and fishway exit. -Construction could impact access to the powerhouse.			
U4	**New FishHeart System**	-This alternative would include installation of a FishHeart collection system in the tailrace downstream of the powerhouse. The Fishheart system consists of a floating, in-water fish passage solution that uses a barge-mounted pump system to guide and transport fish over the dam. It uses pumped flow to attract fish into one of two 18-inch diameter pipes that are suspended below the barge where fish are captured and moved through the enclosed piping system and above the dam. Guide nets downstream of the structure help to guide fish into the system. -Fish could be pumped from the FishHeart system directly upstream or to the existing trap, sort, and truck facility. -Modify/Improve the existing trap, sort, and truck facility (Discuss with Brookfield).	Experimental -This is still an experimental technology with some support from the agencies, though effectiveness for collecting the target species is still being studied. -The floating nature of the FishHeart system allows it to be repositioned as needed to optimize effectiveness. -Additional satellite entrances can be added as needed. -Could be used to supplement existing fishway.	High Risk -A crane and boat access is needed to lift the Fishheart system into position. -Potential crane operation near overhead powerlines. -A boat and/or drivers may be required to maintain guidance nets. -Safety risk at high flows.	Moderate/High -The Fishheart system is removed after each season and overhauled so that it is in optimal condition before each season. -The existing trap, sort, and truck facility would be reused. -Existing fishway could be abandoned in place or maintained for supplemental passage.	Experimental -Additional testing of this system is needed. -The system uses two submerged pipes for entrances. Some species such as American shad may be hesitant to enter the pipes. -The system uses very little attraction flow which could impact overall effectiveness.	Easy -The Fishheart system would minimize in-water construction. -This option would allow the existing upstream fish passage to operate if needed during construction.	Low -Purchase of Fishheart System. -Installation of anchor points. -Modifications to trap, sort, and truck facility.	Moderate -Integrated cameras with artificial intelligence allow for real time data collection and sorting. Sorting effectiveness is unknown. -Guidance nets could be a maintenance challenge during portions of the upstream passage season. -Requires annual installation and removal. -The Fishheart system is typically removed during high flow events. -No impact on parking, powerhouse access, or commercial traffic.	Low -No attraction water from upstream of the dam is required.
ALTERNATIVES RULED OUT										
-	**No Action (Maintain Existing Conditions)**	This was eliminated due to the low effectiveness of the existing fishway.	–	–	–	–	–	–	–	–
-	**New Vertical Slot Fishway on North Side of Powerhouse**	This was eliminated due to the limited real estate available between the powerhouse and Shad Island.	–	–	–	–	–	–	–	–
	New Fish Lift on North Side of Powerhouse	This was eliminated due to the limited real estate available between the powerhouse and Shad Island and the operations and maintenance challenges.	–	–	–	–	–	–	–	–
-	**New Traditional Pool and Weir Ladder**	This was ruled out due to the agency's preference for vertical slot fishways in recent years.	–	–	–	–	–	–	–	–
-	**New Denil Ladder**	This was eliminated due to the anticipated design population at Brunswick (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).	–	–	–	–	–	–	–	–

Draft Alternatives Review – Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
-	**New Alaskan Steeppass**	This was eliminated due to the anticipated design population at Brunswick (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).	–	–	–	–	–	–	–	–
-	**New Whoosh System**	This was eliminated due to the experimental nature of the technology and the limited success for American shad at prior on-site demonstrations.	–	–	–	–	–	–	–	–
-	**New Nature-Like-Fishway**	This was eliminated due to the required footprint and the limited amount of real estate available at Brunswick. The fishway entrance would also need to be located several hundred feet downstream of the powerhouse, which could adversely affect overall effectiveness.	–	–	–	–	–	–	–	–
-	**New Fishway on Topsham Side of the Dam**	This was eliminated as it would likely be less effective under non-spill conditions, the presence of the fish barrier dam, and the rock ledges that prevent fish from easily passing upstream to the spillway area.	–	–	–	–	–	–	–	–



PROJECT PLAN
SCALE: 1"=80'

Potential Modifications

-Extend the Fishway Entrance Downstream and Install an Overshot Style Entrance Gate
-Modify Fishway to a Pool and Chute Style Fishway and add 10 Additional Pools
-Increase the Size of the Downstream Turning Pool
-Modify Existing Floor Diffuser to Reduce Upwelling and Improve Internal Fishway Hydraulics (CFD Modeling Needed to Determine Extents of Modifications)
-Replace Chamfered Plywood Corners with Radiused Concrete or Steel
-Provide Additional/Supplemental Attraction Flow Near Entrance Using a Ramped Entrance Diffuser (Need to Review Bathymetry DS of Entrance to Determine Feasibility)
-Provide Flow Induction Pumps Near Fishway Entrance.
-Modify/Improve Existing Trapping Facility

Alternative U1 - Modifications to Existing Fishway

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD
SUMMER ST
MAIN ST
WATER ST
ANDROSCOGGIN RIVER
SHAD ISLAND
COMMERCIAL BUILDING

57'–0" NON–OVERFLOW DAM
48'–0" EMERGENCY SPILLWAY
80'–0" TAINTER GATE
322'–0" CONC. UNCONTROLLED SPILLWAY
170'–0" CONC. LONG FISH BARRIER WALL
188'–0" CONC. SPILLWAY WITH FLASHBOARDS
APPROX. EDGE OF WATER (TYP.)
PROJECT POWERHOUSE (SEE F–2)
PROJECT UNDERGROUND ELECTRIC LINE
18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER
INTERCONNECTION POINT (NON–PROJECT)
OVERHEAD ELECTRIC
OE
BOAT BARRIER
FISHWAY

7 F–3
6 F–3
5 F–3
4 F–3
3 F–3
2 F–3
F–3

Overshot Entrance Gate
Entrance Dewatering Gage
Existing Fishway to be Demolished
Vertical Slot Fishway
Grizzly Rack
Dewatering Gate
AWS Intake Screen
AWS Intake Structure
Attraction Water Pipe
Wall Diffuser
Crowder (Below)
Viewing Room (Below)
Trap and Transport Hopper
New Sorting Facility
Pool Size (12'wx15'Long)
Slot Width = 18"
New Bridge

PROJECT PLAN
SCALE: 1"=80'

Alternative U2 - New Vertical Slot Fishway

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD

SUMMER ST

MAIN ST

57'–0" NON–OVERFLOW DAM

48'–0" EMERGENCY SPILLWAY

80'–0" TAINTER GATE

7 F–3

6 F–3

5 F–3

OVERHEAD ELECTRIC

OE

322'–0" CONC. UNCONTROLLED SPILLWAY

4 F–3

170'–0" CONC. LONG FISH BARRIER WALL

SHAD ISLAND

3 F–3

188'–0" CONC. SPILLWAY WITH FLASHBOARDS

APPROX. EDGE OF WATER (TYP.)

2 F–3

ANDROSCOGGIN RIVER

Overshot Entrance Gate

Entrance Dewatering Gage

Portion of Existing Fishway to be Demolished

BOAT BARRIER

New Training Wall

Portion of Existing Fishway to be Abandoned in Place

Trap and Transport Hopper

PROJECT POWERHOUSE (SEE F–2)

Wall Diffuser

DS Migrant Pipe

Exit Flume

V-Trap

Grizzly Rack

Main Hopper

New Bridge

Exit Flume Dewatering Gate

Blocking Screen

PROJECT UNDERGROUND ELECTRIC LINE

Attraction Water Pipe

Exit Flume Conveyance Flow Screen

AWS Intake Screen

F–3

Crowder

18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER

Viewing Room (Below)

New Sorting Facility

AWS Intake Structure

INTERCONNECTION POINT (NON–PROJECT)

COMMERCIAL BUILDING

MAIN ST

ANDROSCOGGIN RIVER

WATER ST

PROJECT PLAN
SCALE: 1"=80'

Alternative U3 - New Fish Lift

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD

SUMMER ST

MAIN ST

57'–0" NON–OVERFLOW DAM

48'–0" EMERGENCY SPILLWAY

80'–0" TAINTER GATE

7 F–3

6 F–3

5 F–3

OVERHEAD ELECTRIC

OE

322'–0" CONC. UNCONTROLLED SPILLWAY

4 F–3

170'–0" CONC. LONG FISH BARRIER WALL

SHAD ISLAND

3 F–3

188'–0" CONC. SPILLWAY WITH FLASHBOARDS

APPROX. EDGE OF WATER (TYP.)

2 F–3

Gap in Net for DS Migrants

BOAT BARRIER

Anchor Cables

Guidance Nets

New Fishheart System

PROJECT POWERHOUSE (SEE F–2)

ANDROSCOGGIN RIVER

Transport Pipe To Sorting Facility

Existing Fishway to Remain

New Bridge

Transport Pipe To Exit Flume

PROJECT UNDERGROUND ELECTRIC LINE

Fishheart Control Building

1 F–3

Existing Sorting Facility

18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER

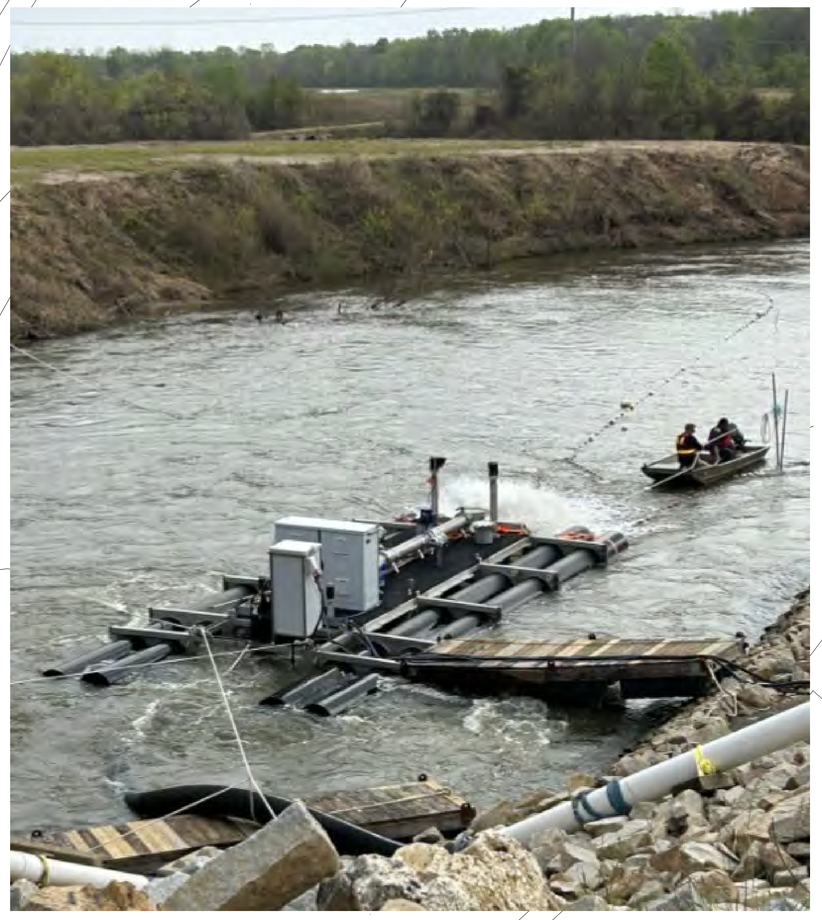
Existing Exit Flume

INTERCONNECTION POINT (NON–PROJECT)

COMMERCIAL BUILDING

MAIN ST

WATER ST



PROJECT PLAN
SCALE: 1"=80'

Alternative U4 - New Fishheart System

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

NLF Option

Legend
- Goat Island
- Powerline

POWERLINE

SHAD ISLAND

Brunswick

Androscoggin River Reser

EVALUATE INTERFERENCE WITH BRIDGE AND PROPERTIES.

Brunswick Falls

NLF CONCEPT
- 100- FT WIDE
- 375 CFS, MIN FLOW
- 1830 FEET LONG
- 2.2% SLOPE

FLOW

RIVER FLOWS, FISH PASSAGE SEASON
95% FLOWS=1,750 CFS
5% FLOWS = 16,800 CFS

NLF WALL TO PROTECT AND CONTAIN CHANNEL DURING LOW AND HIGH FLOWS.

DEMO DAM ABUTMENT AND CONSTRUCT NEW ACCESS BRIDGE ACROSS NLF

Google Earth

300 ft

"Free the Andro" NLF Option

Legend
- Goat Island
- Powerline

NLF CHANNEL MODIFICATION FOR SLOPE AND LOW FLOW CHANNEL

BEDROCK EXCAVATION

BEDROCK EXCAVATION

NEW SPILLWAY GATES

DEBRIS BOOM

Androscoggin River

NEW 20-FT TALL SPILLWAY WALL 685 ft

Goat Island

NEW 5FT TO 20-FT TALL SPILLWAY WALL, 580 ft

131 ft

OVERHEAD POWERLINE

Brunswick

Androscoggin River Reservoir

1,789 ft

nswick Falls

45 ft

316 ft

286 ft

NLF CONTROL WEIRS OR ROCK ARCH RAMPS TO PROVIDE HEADPOND ELEVATION

NLF CHANNEL IN RIVER BOTTOM. FILL AND EXCAVATION GRADING AS REQUIRED FOR SLOPE. ADDITIONAL WEIRS NOT SHOWN

DEMO EXISTING ABUTMENT, GATES, SPILLWAY

FTA NLF CONCEPT
- **WIDTH VARIES**
- **375 CFS, MIN FLOW**
- **2560 FEET LONG**
- **1.6% SLOPE**

RIVER FLOWS, FISH PASSAGE SEASON
95% FLOWS=1,750 CFS
5% FLOWS = 16,800 CFS

N

500 ft

Google Earth

Response to Upstream Passage Alternative Study Meeting (March 5, 2026) Comments for the Brunswick Hydroelectric Project

Stakeholder	Comments	BWPH Response
Maine Department of Marine Resources (MDMR) April 9, 2026		
MDMR-1	Given the location of this site and the resulting effects on diadromous species, the licensee should evaluate alternatives that include multiple measures to provide safe, timely, and effective passage at the project. Examples could include but are not limited to providing two fishways at the project or combining multiple alternatives such as conducting turbine turndowns during the passage season to improve hydraulic conditions in the tailrace and favor attraction to new fishway entrance(s). At FERC-licensed hydropower projects, providing multiple fishway entrances or separate fishways is a common design practice because hydraulic conditions and fish behavior often require passage routes on both banks or at multiple locations to effectively attract and pass diadromous fish. For example, in the Connecticut River basin early, single fishway designs frequently failed to meet passage standards for American shad, leading to: • Addition of multiple fishways (Turners Falls) • Conversion to fish lifts (Holyoke) • Repeated structural and hydraulic modifications (Vernon) • In some cases, abandonment of ineffective ladders (Rainbow Dam).	Comment noted. The purpose of the Upstream and Downstream Fish Passage Alternatives Study is to analyze each alternative individually. If there is an advantage to combine alternatives, that would be done as part of BWPH's fish passage measure proposal in the Final License Application.
MDMR-2	Designs for new fishways or fishway modifications should include facilities to operate and maintain public access to a viewing window (or equivalent viewing facilities) at the project. Please include a comparison of upstream fishway capacities for target species across all of the alternatives identified.	BWPH will include provisions to maintain a viewing window or equivalent when applicable to a given alternative as part of new or modified fishway designs. Fishway capacities for target species will be described in the Upstream and Downstream Fish Passage Alternatives Study report for each upstream passage alternative analyzed.
MDMR-3	During the March 5 meeting, stakeholders discussed observations of a "bubble wall" near the existing fishway entrance that was caused by Unit operations and was thought to prevent American shad from entering the fishway. This observation is supported by telemetry studies conducted by Normandeau Associates Inc., which showed that only 2.4% of tagged American shad entered the attraction flow field and none entered the fishway, and additional observations of fish behavior made by MDMR staff at the site. Given this information, all alternatives should address this interaction between the fishway entrance and the turbine discharges. One approach to address this interaction would be locating the fishway entrance downstream and away from the influence of the turbine discharges. Entrance location decisions should also be informed by the results of the 2026 telemetry study at the project.	While it has been hypothesized the "bubble wall" may be a contributing factor to low American shad passage efficiency, the methodologies used as part of the radio telemetry studies conducted previously were not specifically designed to test this factor. As contemplated in the FERC approved study plan for the Project, both the Project Interactions Telemetry Study and CFD Modeling Study results will be used to inform the location of any upstream fishway entrance, as well as other key design aspects related to each alternative. The Project Interactions Telemetry Study will provide information on fish behavior and movement in the tailrace for American Shad, river herring, and Sea Lamprey, while the CFD Modeling Study will examine flow patterns and velocities in the tailrace.
MDMR-4	**Alternative U1: Fishway Modification -** MDMR agrees with Brookfield's assertion that modifications to the existing vertical slot fishway are likely to have low/moderate effectiveness. While MDMR is okay with Brookfield including this alternative going forward, we reiterate that Brunswick is the first dam on the Androscoggin River, located at the head of tide. Thus, the Brunswick Dam impacts all diadromous fish that return to the watershed on their migration to freshwater habitats upstream. It is therefore critical that upstream and downstream passage measures implemented at the project have strong supporting evidence that they will perform as expected. Evidence available to MDMR does not support that modifications to the existing vertical slot fishway will address current impacts to passage at the project.	Comment noted. Alternative U1 is one of several alternatives that is being included for further analysis in Phase 2 of the feasibility assessment. This analysis will include a ranking of alternatives (e.g., feasible, potentially feasible, not feasible), pros/cons of the alternatives, and order-of-magnitude cost estimates for installation, operation, and maintenance. Once the feasibility analysis is complete, BWPH will develop its proposal for upstream fish passage measures for inclusion in the Final License Application.
MDMR-5	**Alternative U2: New Vertical Slot Fishway -** Like Brookfield's engineering consultants, MDMR is concerned by the length of the fishway and the number of switchbacks in the current conceptual design, which may reduce effectiveness for American shad. Additionally, 18" is the minimum slot width recommended by the USFWS and larger slot widths (e.g., 24" or greater) may be more effective but would require additional fishway length. MDMR notes that there may be alternative vertical slot configurations that could increase slot width and reduce the number of switchbacks.	Comment noted. Phase 2 of the feasibility assessment will include a ranking of alternatives (e.g., feasible, potentially feasible, not feasible) as well as the pros/cons of all alternatives. This information will be used at that time to evaluate the merits of each alternative to provide safe, timely, and effective upstream fish passage.

Stakeholder	Comments	BWPH Response
	During the March 5, 2026 call, Brookfield's consultants mentioned that this alternative would require the existing fishway to be shut down for multiple passage seasons. Please describe the rationale and necessity behind shutting down the upstream fishway for multiple upstream passage seasons. Shutting down the existing fishway and not providing any upstream passage at the project is not a practical or realistic expectation. For any alternatives that will impact the function of the existing fishway, including shutting it down entirely, the Licensee should provide a plan to provide temporary means of passage. For example, technologies such as a Fishheart system could be used to provide interim passage during fishway construction.	The necessity for shutting down the existing fishway was described at the March 5, 2026 meeting. This alternative would require full demolition of the existing fishway before construction of this fishway alternative could be completed. For any alternative that may eventually be instituted that requires shutdown of the existing fishway during construction, BWPH will evaluate other means to provide temporary upstream passage at the Project.
MDMR-6	**Alternative U3: New Fish Lift -** Recent MDMR calculations suggest that the Androscoggin River to Lewiston Falls (including the Little Androscoggin and the Sabattus River) could support 171,125 American shad, 1,008,202 blueback herring, and 7,728,805 alewives. This, along with 600 Atlantic salmon should be the design population used for each alternative. Issues at V-gate structures have been observed at other fish lifts in Maine. Please add this consideration to the effectiveness column. Additionally, lifts are not volitional and can experience shutdowns and be inoperable during portions of the passage season. Please add this consideration to the effectiveness column as well. Please explain the rationale behind abandoning a portion of the existing fishway in place and provide more detailed information related to the structures proposed for abandonment if this alternative is pursued further. Remnant portions of the existing fishway that are below high tide may impact fish passage at a new facility. Portions of the fishway above high tide should not be abandoned as they will continue to decay into the river over time.	BWPH notes the MDMR calculations provided here for alewives (7,728,805) and American shad (171,225) are significantly higher than the production potential identified for alewives (2,706,445) and American shad (127,449) noted in the *2017 Draft Fisheries Management Plan for the Lower Androscoggin River, Little Androscoggin River and Sabattus River.* BWPH is not aware of any updates from resource agencies to this management plan to support the recent MDMR calculations. BWPH will add both considerations to the overall alternatives screening analysis. BWPH will provide details on any structures to be abandoned in place and the rationale for doing so in the Upstream and Downstream Fish Passage Alternatives Study report-Phase 2.
MDMR-7	**Alternative U4: New Fishheart System -** MDMR is not supportive of this alternative at this time. We are not aware of any information to suggest that this system is effective for the target species and numbers of fish (i.e., millions) that could be present annually downstream of the project. The Brunswick project is the gateway to the rest of the watershed and MDMR is not comfortable relying on this experimental technology as a permanent solution for upstream passage at this project. However, we may be supportive of an approach that utilized Fishheart as a temporary solution during construction of a permanent upstream fishway or as a measure to supplement other upstream passage measures.	Comment noted. BWPH intends to examine this alternative further as part of the Phase 2 feasibility assessment. While this technology remains experimental, there are currently prototype installations at the Santee-Cooper and Tunnel Hydroelectric Projects, where data is being collected and analyzed to determine the effectiveness of this method. Data from these studies will be helpful in determining the applicability of this alternative to the Brunswick Project.
MDMR-8	**Alternatives Not Considered -** Please expand on the concern related to limited real estate available between the powerhouse and Shad Island in relation to a new fishway (vertical slot or fish lift) on the North side of the powerhouse. The Nature-Like-Fishway (NLF) and Topsham side fishway alternatives should be analyzed and developed further during Phase 2 of the feasibility assessment. Although limited real estate was referenced as a reason that the NLF alternative was ruled out, two separate NLF concepts were presented during the March 5 meeting. One concept required modification of the river left shoreline along with potential property concerns, while the other could be constructed completely within the river channel. Given that an NLF is technically feasible at the site, there is no reason to remove it from consideration at this stage.	There are many limitations for a potential new fishway (vertical slot or fish lift) on the North side of the powerhouse besides available real estate, these include the following 1) impacts to the spillway discharge capacity, 2) concerns related to the capability of withstanding significant ice and debris loading, 3) would make trapping and trucking fish more difficult, and 4) may result in fall back of fish over the spillway. BWPH intends to examine the in-channel NLF alternative further as part of the Phase 2 feasibility assessment. Due to the constraints posed by the property ownership along the Topsham shoreline, BWPH does not intend to analyze the river-left split channel NLF alternative in the Phase 2 feasibility assessment.
National Marine Fisheries Service (NMFS) April 20, 2026		
NMFS-1	**Alternative U1: Modification of Existing Vertical Slot Ladder** • We believe a vertical slot alternative, if properly modified, could represent a sufficient volitional passage alternative. • We support modifications to bring the Energy Dissipation Factor (EDF) within USFWS recommendations for American shad. • We note that while internal efficiencies may improve under this alternative, the theoretical capacity remains lower than a new facility due to smaller pool sizes. • Although a modified design may result in improvements for American shad passage, we have no evidence that the improvement will be sufficient.	Comment noted. See response to MDMR-4.
NMFS-2	**Alternative U2: New Vertical Slot Ladder (South Side)** - We have significant concerns regarding any design that necessitates a high number of turning pools within a confined area. These configurations can significantly reduce passage effectiveness, particularly for American shad.	Comment noted. See response to MDMR-5.

Stakeholder	Comments	BWPH Response
NMFS-3	**Alternative U3: New Fish Lift (South Side) -** While often effective at other projects, fish lifts do not provide volitional access. In general, our preference remains for volitional passage alternatives, though we do recognize that a fish lift may be the best overall option at the site.	Comment noted. See response to MDMR-6.
NMFS-4	**Alternative U4: New FishHeart System -** We question the logic of eliminating the "Whooshh" system as an alternative due to its experimental nature while simultaneously proposing the similarly experimental FishHeart system for consideration as an alternative. Ultimately, we have reservations about the deployment of any experimental fish passage technology within the GOM DPS for Atlantic salmon without any prior empirical, real-world information with which to assess potential effects to the species.	The "Whooshh" system was eliminated as an alternative as it was tested extensively at the Conowingo Hydroelectric Project in 2022. The results of the testing indicated that the effectiveness of system in conveying American Shad was not ideal, primarily due to issues related to appropriate tube sizing. In addition, the Whooshh system does not have tubes sized to pass river herring. The FishHeart system does not have these limitations. See response to MDMR-7. Testing for the FishHeart system is currently on-going at several sites to determine the effectiveness of this method.
NMFS-5	**Alternatives Ruled Out - NMFS disagrees with the exclusion of several alternatives from the matrix:** • Traditional Pool and Weir: Brookfield incorrectly asserts that our agency does not prefer pool and weir fishways. Full-size Ice Harbor-type fishways (a type of pool and weir fishway) are typically one of our preferred designs. We believe this style of fishway can be effective in many circumstances and could be a potentially viable alternative here. However, as stated above, with proper modifications, believe that a vertical slot ladder is a reasonable volitional alternative to consider in this analysis. • Vertical Slot (North Side): As stated above, we do not believe that "real estate" is a sufficient limiting factor to rule out a vertical slot ladder on the north side of the powerhouse, nor have you provided substantial evidence that is the case. • Fish Lift (North Side): We disagree with the assertion that "real estate" or access difficulties are absolute limiting factors for a fish lift alternative at this location, nor have you provided substantial evidence that this is the case. • Nature-Like Fishways: These alternatives have been eliminated without any detailed explanation or demonstration of the factors cited as reasons for their elimination. We agree that nature-like fishways typically do require a larger footprint, but you have provided no evidence that nature-like fishway designs would be impossible or even impractical at this site due to site-specific constraints. We recommend a more robust evaluation of nature-like fishway alternatives.	Comment noted. The statement will be removed from future versions of the upstream passage alternatives matrix. See response to MDMR-8. See response to MDMR-8. See response to MDMR-8.
Free the Andro (FTA) April 17, 2026		
FTA-1	**Alternative U1: Modification of the Existing Vertical Slot Fishway -** FTA concurs with MDMR's position that modifications to the existing fishway have not been demonstrated to address current passage impacts. U1 should remain in the analysis only as a baseline for comparison, not as a standalone solution capable of meeting any reasonable performance standard for the design populations identified.	See response to MDMR-4.
FTA-2	**Alternative U2: New Vertical Slot Fishway -** FTA supports carrying Alternative U2 forward into Phase 2 feasibility analysis, but has significant concerns about both its design parameters and the process by which it is being developed. FTA further notes that entrance location for U2 must not be finalized before the results of the Project Interaction Study are available.	See response to MDMR-5. See response to MDMR-3.
FTA-3	**Alternative U3: New Fish Lift -** FTA supports carrying Alternative U3 forward into Phase 2 feasibility analysis. NMFS indicated a preference for this option at the March 5, 2026 meeting. However, FTA agrees with MDMR's concern that fish lifts are non-volitional and are subject to operational shutdowns during portions of the passage season, reducing their reliability relative to passive fishways.	See response to MDMR-6.
FTA-4	**Alternative U4: FishHeart System -** FTA agrees with MDMR's April 9, 2026 assessment that the FishHeart system is not appropriate as a permanent standalone solution for upstream passage at the Brunswick Project.	See response to MDMR-7.
FTA-5	**Nature-Like Fishway Alternatives Must Be Carried Forward -** FTA's most significant concern with the upstream alternatives matrix is the apparent effort by BWPH to screen out the Nature-Like Fishway (NLF) alternatives before a	See response to MDMR-8.

Stakeholder	Comments	BWPH Response
	rigorous feasibility analysis has been conducted. The Revised Study Plan, in section 5.2.2, explicitly committed to Phase 1 providing "a comprehensive report of potential measures for upstream and downstream passage at the Project without discussion of costs or implied preferences." MDMR specifically noted that the in-channel option "could be constructed completely within the river channel" and that "there is no reason to remove it from consideration at this stage." NMFS requested at the March 5 meeting that if either NLF option is screened out, the report must document precisely why, with supporting drawings and constraints analysis. FTA echoes this request and asks the Commission to require BWPH to carry both NLF options forward into Phase 2 for a full costed feasibility assessment. FTA notes that BWPH raised the NLF entrance's distance from the powerhouse as an attraction flow concern.	
FTA-6	**Dam Removal As A Baseline Comparator Should Not Be Categorically Excluded -** FTA recognizes that both BWPH and via earlier rulings at the scoping stage, FERC specifically addressed dam removal in both the Scoping Document and the December 30, 2024 Study Plan Determination, finding it unnecessary given that reasonable mitigation measures can be implemented. FTA respectfully but firmly disagrees with this position and is again stating it for the docket record. As FTA reiterated in its February 27, 2026 filing, dam removal should be included in the analysis matrix as a baseline comparator — not because FTA demands that the dam must be removed, but because an alternatives analysis that excludes the no-dam baseline cannot credibly evaluate the relative costs, benefits, and effectiveness of the options that remain.	BWPH will not be analyzing a dam decommissioning alternative as part of the Upstream and Downstream Fish Passage Alternatives Study report. BWPH states again for the record in its December 30, 2024 Study Plan Determination as well as the July 29, 2024 Scoping Document 2, FERC determined that neither a decommissioning study nor the analysis of project decommissioning as a reasonable alternative in the NEPA document was warranted as part of the relicensing proceeding. In the Study Plan Determination FERC stated that "*BWPH does not propose decommissioning, nor does the project record demonstrate that there are serious resource concerns that cannot be mitigated if the project is relicensed with appropriate resource protection measures. Information from other studies (Computational Fluid Dynamics Modeling; Upstream and Downstream Fish Passage Alternatives Study; Visual Surveys of Upstream American Eel Movements; Diadromous Fish Behavior, Movement, and Project Interaction Study; and the Evaluation of Stranding Risk/Bathymetry Study) should provide the information needed to identify potential passage improvements. Therefore, because decommissioning has been eliminated as a reasonable alternative to relicensing, there is no justification for recommending a study of decommissioning the Brunswick Dam.*" Moreover, as stated in the July 29, 2024 Scoping Document 2, the Commission uses existing conditions (i.e., the Project in place under existing operating conditions) "to establish baseline environmental conditions for comparison with other alternatives" when conducting its NEPA analysis. Therefore, adopting a dam removal alternative as a "baseline comparator" as FTA suggests would run counter to the Commission's longstanding policy that is applied to all FERC hydropower relicensings in the United States.
FTA-7	**The Analysis Must Evaluate Combinations of Passage Measures -** MDMR's April 9, 2026 comments specifically urge BWPH to evaluate alternatives that include "multiple measures to provide safe, timely, and effective passage at the project," offering examples such as providing two fishways, or combining a new fishway with turbine turndowns during the passage season. FTA strongly supports this recommendation. FTA asks the Commission to require BWPH's Phase 2 feasibility report to explicitly evaluate combinations of measures, including a new fishway combined with turbine turndowns, a nature-like fishway combined with a powerhouse passage structure, and any permanent fishway combined with interim eel passage measures during construction.	See response to MDMR-1.
FTA-8	**Interim American Eel Passage Cannot Be Deferred -** FTA is deeply concerned by BWPH's statement that it "will not be operating the temporary eel ramps" at the Brunswick Project. MDMR has specifically requested that BWPH voluntarily operate and maintain a temporary eel trap at the project until a new license is issued and permanent upstream eel passage is implemented. FTA supports this request and asks the	BWPH is unaware of any instance in which the Commission has required a licensee to operate temporary eel ramps as mitigation during a relicensing proceeding under an existing FERC license. Such a requirement would be unprecedented. The study phase of relicensing is intended to identify and evaluate environmental issues. For any resource impacts that are

Stakeholder	Comments	BWPH Response
	Commission to require it. FTA also notes MDMR's concern that the process by which eel study ramps were placed was inadequate, occurring without adequate prior discussion with and notice to the agencies, and urges that any future consultation on interim eel passage measures include a dedicated meeting with adequate notice to all parties.	identified, mitigation and protection measures are developed and implemented over the next license term.
FTA-9	**Alternatives Must Not Be Narrowed Before Empirical Data is Available -** As NMFS noted in its February 25, 2026 ISR comments, both the CFD Modeling Study and the Phase 2 Diadromous Fish Behavior Study were either in progress or deferred to 2026 at the time of the ISR. These studies are specifically designed to characterize the hydraulics of the tailrace, the location and behavior of fish congregating below the dam, and the effectiveness of attraction flows — exactly the data needed to make credible decisions about which upstream alternatives to carry forward. Allowing the alternatives to be narrowed now — before any of this data exists — risks locking in design assumptions that are later contradicted by the evidence.	See response to MDMR-3.
FTA-10	**The Commission's April 17, 2026 Study Plan Determination -** FTA concurs fully with the Commission's finding that, because in-water construction at the Frank J. Wood bridge is not expected to occur during the 2026 spring passage season and the existing bridge infrastructure is likely to have a negligible effect on fish behavior, movement, and telemetry receiver locations, there is no basis to delay the study.	BWPH views the Project Interaction Study as a critical component in the analysis of upstream fish passage alternatives at the Project. Due to circumstances related to the on-going bridge construction, in its April 6, 2026, filing to the Commission, BWPH raised concerns that the study, should it be conducted in 2026, could yield biased results and would not be representative of future site conditions. In subsequent docketed filings, the Commission, MDMR, NMFS, and FTA have stated that based on their experience and judgement, the construction activities will not affect the study. Accordingly, they appear willing to accept the eventual study results and outcome, including any modifications to the methodology (i.e., receiver placement) that may be necessary to work around the bridge construction and allow the study to proceed in 2026.
FTA-11	**The Licensee Cannot Unilaterally Constrain The Scope Of The Alternatives Analysis -** FTA asks the Commission to enforce this commitment and to remind BWPH that the scope of the alternatives analysis, and the timing of the studies that inform it, are determined by the Commission — not by the Licensee.	BWPH defines the scope of the alternatives analysis consistent with the FERC-approved study plan. That plan requires BWPH to consult with applicable resource agencies to seek input and feedback on potential alternatives. The plan does not require BWPH to adopt all alternatives identified during the literature search or agency consultation. The purpose of Phase 1 of the alternatives analysis is to refine and focus the Phase 2 feasibility assessment on alternatives that have reasonable application at the Project. It is counterproductive to expend time and resources on the analysis of alternatives that do not meet initial screening criteria and are not viable at the onset. See response to FTA-10.

April 9, 2026

MDMR Comments on Brunswick Upstream Alternatives Matrix

On March 2, 2026, Brookfield (licensee) provided a preliminary upstream passage alternatives matrix and associated sketches to the agencies and stakeholders for review and comment. Brookfield scheduled a meeting to discuss the preliminary alternatives on March 5, 2026, which MDMR attended. MDMR has subsequently reviewed the alternatives and provides the following comments.

General Comments

Brunswick is the first dam on the Androscoggin River and is located at the head of tide. Thus, the Brunswick dam impacts all diadromous fish that return to the watershed on their migration to freshwater habitats upstream. It is critical that upstream and downstream passage measures implemented at the project have strong supporting information that indicates that they will perform as expected. Given the location of this site and the resulting effects on diadromous species, the licensee should evaluate alternatives that include multiple measures to provide safe, timely, and effective passage at the project. Examples could include but are not limited to providing two fishways at the project or combining multiple alternatives such as conducting turbine turndowns during the passage season to improve hydraulic conditions in the tailrace and favor attraction to new fishway entrance(s). At FERC-licensed hydropower projects, providing multiple fishway entrances or separate fishways is a common design practice because hydraulic conditions and fish behavior often require passage routes on both banks or at multiple locations to effectively attract and pass diadromous fish. For example, in the Connecticut River basin early, single fishway designs frequently failed to meet passage standards for American shad, leading to:

- Addition of multiple fishways (Turners Falls)
- Conversion to fish lifts (Holyoke)
- Repeated structural and hydraulic modifications (Vernon)
- In some cases, abandonment of ineffective ladders (Rainbow Dam).

As MDMR expressed in our comments on the Pre Application Document for the Brunswick Project, the fishway viewing area is an important public resource at the project. Designs for new fishways or fishway modifications should include facilities to operate and maintain public access to a viewing window (or equivalent viewing facilities) at the project.

Please include a comparison of upstream fishway capacities for target species across all of the alternatives identified.

During the March 5 meeting, stakeholders discussed observations of a "bubble wall" near the existing fishway entrance that was caused by Unit operations and was thought to prevent American shad from entering the fishway. This observation is supported by telemetry studies conducted by Normandeau Associated Inc., which showed that only 2.4% of tagged American shad entered the attraction flow field and none entered the fishway, and additional observations of fish behavior made by MDMR staff at the site. Given this information, all alternatives should address this interaction between the fishway entrance and the turbine discharges. One approach to address this interaction would be locating the fishway entrance downstream and away from the influence of the turbine discharges. Entrance location decisions should also be informed by the results of the 2026 telemetry study at the project.

Alternative U1: Fishway Modifications

MDMR agrees with Brookfield's assertion that modifications to the existing vertical slot fishway are likely to have low/moderate effectiveness. While MDMR is okay with Brookfield including this alternative going forward, we reiterate that Brunswick is the first dam on the Androscoggin River, located at the head of tide. Thus, the Brunswick Dam impacts all diadromous fish that return to the watershed on their migration to freshwater habitats upstream. It is therefore critical that upstream and downstream passage measures implemented at the project have strong supporting evidence that they will perform as expected. Evidence available to MDMR does not support that modifications to the existing vertical slot fishway will address current impacts to passage at the project.

Alternative U2: New Vertical Slot Fishway

Like Brookfield's engineering consultants, MDMR is concerned by the length of the fishway and the number of switchbacks in the current conceptual design, which may reduce effectiveness for American shad. Additionally, 18" is the **minimum** slot width recommended by the USFWS and larger slot widths (e.g., 24" or greater) may be more effective but would require additional fishway length. MDMR notes that there may be alternative vertical slot configurations that could increase slot width and reduce the number of switchbacks

During the March 5, 2026 call, Brookfield's consultants mentioned that this alternative would require the existing fishway to be shut down for multiple passage seasons. Please describe the rationale and necessity behind shutting down the upstream fishway for multiple upstream passage seasons. Shutting down the existing fishway and not providing any upstream passage at the project is not a practical or realistic expectation. For any alternatives that will impact the function of the existing fishway, including shutting it down entirely, the Licensee should provide a plan to provide temporary means of passage. For example, technologies such as a Fishheart system could be used to provide interim passage during fishway construction.

Alternative U3: New Fish Lift

Recent MDMR calculations suggest that the Androscoggin River to Lewiston Falls (including the Little Androscoggin and the Sabattus River) could support 171,125 American shad, 1,008,202 blueback herring, and 7,728,805 alewives. This, along with 600 Atlantic salmon should be the design population used for each alternative.

Issues at V-gate structures have been observed at other fish lifts in Maine[1]. Please add this consideration to the effectiveness column. Additionally, lifts are not volitional and can experience shutdowns and be inoperable during portions of the passage season[2]. Please add this consideration to the effectiveness column as well.

Please explain the rationale behind abandoning a portion of the existing fishway in place and provide more detailed information related to the structures proposed for abandonment if this alternative is pursued further. Remnant portions of the existing fishway that are below high tide may impact fish passage at a new facility. Portions of the fishway above high tide should not be abandoned as they will continue to decay into the river over time.

Alternative U4: New Fishheart System

MDMR is not supportive of this alternative at this time. We are not aware of any information to suggest that this system is effective for the target species and numbers of fish (i.e., millions) that could be present annually downstream of the project. The Brunswick project is the gateway to the rest of the watershed and MDMR is not comfortable relying on this experimental technology as a permanent solution for upstream passage at this project.

[1] Accession No. 20240116-5009
[2] Kearnan K, and J Waldman. 2024. Causes of Fish Lift Shutdowns on U.S. East Coast Hydroelectric Dams. Fisheries 49:9 403-411.

However, we may be supportive of an approach that utilized Fishheart as a temporary solution during construction of a permanent upstream fishway or as a measure to supplement other upstream passage measures.

Alternatives Not Considered

Please expand on the concern related to limited real estate available between the powerhouse and Shad Island in relation to a new fishway (vertical slot or fish lift) on the North side of the powerhouse.

The Nature-Like-Fishway (NLF) and Topsham side fishway alternatives should be analyzed and developed further during Phase 2 of the feasibility assessment. Although limited real estate was referenced as a reason that the NLF alternative was ruled out, two separate NLF concepts were presented during the March 5 meeting. One concept required modification of the river left shoreline along with potential property concerns, while the other could be constructed completely within the river channel. Given that an NLF is technically feasible at the site, there is no reason to remove it from consideration at this stage.

During the March 5, 2026 call, Brookfield criticized the NLF and Topsham side fishway because of the limited attraction flow compared to the project turbines. It is important to note that this issue could be addressed by providing sufficient attraction flow to the Topsham side of the river.

Similarly, Brookfield noted that the presence of the fish barrier dam and rock ledges would prevent fish from reaching a fishway in the spillway area. However, flows and ledge have been intentionally manipulated to prevent fish from being attracted to and accessing this area. Thus, assessing a fishway on river left would include the assumption that any fishway on river left would undo, or otherwise address, these modifications.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

RE: NMFS Comments on Brookfield White Pine Hydro's Upstream Fish Passage Alternatives Meeting Summary for the Brunswick Project (P-2284)

NMFS has reviewed the Draft Alternatives Review for upstream fish passage at the Brunswick Project. While we appreciate the preliminary analysis, we emphasize that the upstream project interaction and behavior study has not yet been completed. This study is necessary to adequately evaluate *any* upstream passage alternatives and their potential success in the context of site-specific hydraulics and fish behavior. In particular, the results from the study will be necessary to inform the design location of the fish passage entrance. The entrance location will dictate much of the subsequent design configurations regardless of the type of fish passage. As such, the comments we provide below should be considered preliminary, until such time that we are able to review and integrate the information from the upstream interaction and behavior study.

Comments on Proposed Alternatives

Alternative U1: Modification of Existing Vertical Slot Ladder

- We believe a vertical slot alternative, if properly modified, could represent a sufficient volitional passage alternative.
- We support modifications to bring the Energy Dissipation Factor (EDF) within USFWS recommendations for American shad.
- We note that while internal efficiencies may improve under this alternative, the theoretical capacity remains lower than a new facility due to smaller pool sizes.
- Although a modified design may result in improvements for American shad passage, we have no evidence that the improvement will be sufficient.

Alternative U2: New Vertical Slot Ladder (South Side)

- We have significant concerns regarding any design that necessitates a high number of turning pools within a confined area. These configurations can significantly reduce passage effectiveness, particularly for American shad.

Alternative U3: New Fish Lift (South Side)

- While often effective at other projects, fish lifts do not provide volitional access. In general, our preference remains for volitional passage alternatives, though we do recognize that a fish lift may be the best overall option at the site.

Alternative U4: New FishHeart System

- We question the logic of eliminating the "Whooshh" system as an alternative due to its experimental nature while simultaneously proposing the similarly experimental FishHeart system for consideration as an alternative. Ultimately, we have reservations about the deployment of any experimental fish passage technology within the GOM DPS for Atlantic salmon without any prior empirical, real-world information with which to assess potential effects to the species.

Alternatives Ruled Out

NMFS disagrees with the exclusion of several alternatives from the matrix:

- **Traditional Pool and Weir:** Brookfield incorrectly asserts that our agency does not prefer pool and weir fishways. Full-size Ice Harbor-type fishways (a type of pool and weir fishway) are typically one of our preferred designs. We believe this style of fishway can be effective in many circumstances and could be a potentially viable alternative here. However, as stated above, with proper modifications, believe that a vertical slot ladder is a reasonable volitional alternative to consider in this analysis.
- **Vertical Slot (North Side):** As stated above, we do not believe that "real estate" is a sufficient limiting factor to rule out a vertical slot ladder on the north side of the powerhouse, nor have you provided substantial evidence that is the case.
- **Fish Lift (North Side):** We disagree with the assertion that "real estate" or access difficulties are absolute limiting factors for a fish lift alternative at this location, nor have you provided substantial evidence that this is the case.
- **Nature-Like Fishways:** These alternatives have been eliminated without any detailed explanation or demonstration of the factors cited as reasons for their elimination. We agree that nature-like fishways typically do require a larger footprint, but you have provided no evidence that nature-like fishway designs would be impossible or even impractical at this site due to site-specific constraints. We recommend a more robust evaluation of nature-like fishway alternatives.

April 17, 2026

VIA E-FILING

Debbie-Anne A. Reese, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

RE: Brunswick Hydroelectric Project (FERC No. 2284). Free the Andro Coalition Comments on Brookfield White Pine Hydro's Upstream Fish Passage Alternatives Meeting Summary (March 5, 2026 Meeting, filed March 31, 2026); and Response to Comments on the Initial Study Report (filed April 2, 2026).

Dear Secretary Reese:

I. INTRODUCTION

Free the Andro Coalition (FTA) respectfully submits these comments on the Upstream Fish Passage Alternatives Meeting Summary for the March 5, 2026 meeting, filed by Brookfield White Pine Hydro LLC (BWPH or Licensee) on March 31, 2026; and on BWPH's Response to Comments on the Initial Study Report, filed April 2, 2026. These comments are submitted in conformance with 18 C.F.R. § 5.15(d). FTA also supports and incorporates by reference the comments filed on April 9, 2026 by the Maine Department of Marine Resources (MDMR) on the upstream fish passage alternatives, and NMFS's April 10, 2026 response opposing BWPH's April 6, 2026 request to postpone Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study. FTA also notes and concurs with the Commission's April 17, 2026 Study Plan Determination denying that postponement request.

FTA was formed from a coalition of organizations including the Merrymeeting Bay Chapter of Trout Unlimited, Maine Rivers, American Rivers, RESTORE: The North Woods, and Friends of Merrymeeting Bay, along with their individual members. FTA builds upon comments filed by Merrymeeting Bay Trout Unlimited (MMBTU) at prior stages of this proceeding, including on the Notice of Intent/Pre-application Document (February 19, 2024) and on the Revised Study Plan (December 14, 2024). FTA's mission is to seek removal of obstacles to the upstream and downstream passage of diadromous fish in the Androscoggin River at the Brunswick Dam site.

The Brunswick Dam is the first dam inland from the Atlantic Ocean on the Androscoggin River, Maine's third largest river, draining a watershed of 3,450 square miles. Its location at the head of tide makes it the single most consequential barrier to the restoration of sea-run fish throughout the entire watershed. This relicensing — the first in 47 years — is a rare and critical opportunity. As codified in Section 10(a)(1) of the Federal Power Act, a hydropower project must serve the public interest, not merely the Licensee's interest in power generation. As the *Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes* published by NOAA Fisheries in 2020 states: "The development of the Androscoggin River does not meet a comprehensive development standard."[1] The use of this publicly held river by a privately held, for-profit multinational

corporation is a privilege and not a sole controlling right, and that privilege must be earned through genuine and effective fish passage.

II. DESIGN POPULATIONS MUST BE ESTABLISHED BEFORE ALTERNATIVES ARE SCREENED

A foundational requirement for any credible alternatives analysis is the use of properly established design populations for each target species. Without this baseline, effectiveness ratings, capacity calculations, and comparative analyses are meaningless. MDMR has provided specific, science-based population targets in its April 9, 2026 comments on the upstream alternatives:[3]

- American Shad: 171,125 fish
- Blueback Herring: 1,008,202 fish
- Alewife: 7,728,805 fish
- Atlantic Salmon (ESA-listed): 600 fish*

> * In freshwater, the primary threat to Atlantic salmon recovery is dams. The population level effects of dams are acute and well documented:
>
> - Dams directly limit or block access to otherwise essential habitats, and diminish the capacity of habitat to produce smolts.
> - Dams directly kill or injure a significant number of migrating salmon.
> - Dams compound the effects of climate change by limiting Atlantic salmon's access to cool water habitats that are most prevalent in higher elevation areas in northern and western Maine.
> - Dams have reduced both the amount and diversity of available habitat, resulting in the loss of life history and genetic diversity essential to providing population resilience to the challenges above and marine survival.
> - Dams limit the amount of marine-derived nutrients adult salmon and other species return to the system, which provide critical resources to feed the next generation of fish.
>
> (NOAA Fisheries, *Species in the Spotlight – Priority Actions 2021–2025*, at 3.) The Androscoggin River is a significant part of the Merrymeeting Bay Salmon Habitat Rearing Unit (SHRU) and the entire project area is designated critical habitat for Atlantic salmon.

FTA strongly urges the Commission to require BWPH to incorporate these MDMR-calculated design populations as the standard that any credible analysis should aspire to for all upstream fish passage alternatives analyses. The 2020 NOAA Comprehensive Plan specifically identifies the Androscoggin River as capable of supporting substantial runs of all of these species, and these are the populations that the new license conditions must be designed to serve.[1] Scaling passage alternatives to meet these populations is a prerequisite to a valid Phase 2 feasibility analysis.

The existing vertical slot fishway has a documented passage efficiency that is wholly inadequate relative to even a fraction of these populations. A 2022 river herring telemetry study showed an entrance efficiency of only 37.5% and an overall internal effectiveness of 33.3%.[4] No documented American Shad have passed the existing fishway in any reliable numbers, with the single best year on record — approximately 1,000 shad in 2016 — occurring only when Unit 1 was taken offline

for maintenance.[4] This anecdote is not merely illustrative; it is diagnostic. It reveals that the existing powerhouse operations are themselves a primary source of passage failure.

III. COMMENTS ON SPECIFIC UPSTREAM FISH PASSAGE ALTERNATIVES

A. Alternative U1: Modification of the Existing Vertical Slot Fishway

BWPH rates Alternative U1 as having "Low/Moderate" effectiveness,[4] and FTA agrees that this rating likely overstates the potential improvements achievable through modification of the existing facility. However, FTA is concerned that U1 is being preserved in the analysis matrix in a way that may allow BWPH, at a later phase, to argue that modest improvements to the existing fishway satisfy the Commission's fish passage mandate. That outcome would be inconsistent with the Federal Power Act and with the 2020 NOAA Comprehensive Plan.[1]

The existing fishway suffers from at least three interrelated and largely structural deficiencies that modification cannot meaningfully address:

- Inadequate slot width. The existing fishway uses 11-inch slots, significantly below the USFWS minimum recommendation of 18 inches for American Shad;[5] NMFS has stated it would prefer 24-inch slots at a first-dam-on-the-river site, which the available footprint cannot accommodate.[4]
- Insufficient attraction flow. The existing system delivers 100 cfs total, against a USFWS guideline of approximately 375 cfs (5% of station capacity).[5] The geometry of the existing facility makes it physically infeasible to achieve this level through modifications alone.[4]
- Turbine interference at the entrance. Camera observations documented by researchers at Bowdoin College show a "curtain" of bubbles and turbulence generated by Unit 1's discharge that disrupts fish orientation and prevents entry to the fishway.[4] The dramatic increase in American Shad passage when Unit 1 was offline in 2016 is compelling empirical evidence that the powerhouse itself is a very significant barrier — not the fishway design alone.[4]

FTA concurs with MDMR's position that modifications to the existing fishway have not been demonstrated to address current passage impacts.[3] U1 should remain in the analysis only as a baseline for comparison, not as a standalone solution capable of meeting any reasonable performance standard for the design populations identified above.

B. Alternative U2: New Vertical Slot Fishway

FTA supports carrying Alternative U2 forward into Phase 2 feasibility analysis, but has significant concerns about both its design parameters and the process by which it is being developed. NMFS has stated a preference for 24-inch vertical slots at a first-dam-on-the-river site,[4] while the current conceptual design uses 18-inch slots per USFWS guidance,[5] which the available footprint constrains to an excessive number of switchbacks. MDMR has specifically flagged the number of switchbacks as a concern for American Shad passage effectiveness.[3]

The most operationally consequential problem with U2 as currently conceived is that it requires full demolition of the existing fishway before construction can begin, taking the existing passage facility offline for multiple passage seasons.[4] MDMR has specifically requested that BWPH

provide a plan for temporary upstream passage during any construction period.[3] FTA strongly supports this request. No new license should permit the elimination of existing upstream passage capacity — however inadequate — without a contemporaneous plan to restore or replace it.

FTA further notes that entrance location for U2 must not be finalized before the results of the Project Interaction Study are available. As noted in Section IX below, the Commission's April 17, 2026 Study Plan Determination confirmed that Phase 2 of the Project Interaction Study will proceed during the spring 2026 passage season as originally approved, ensuring that critical behavioral data will be available before the Final License Application is filed. MDMR has reported observational evidence suggesting that American Shad approach the powerhouse area and then travel counterclockwise past the current fishway entrance without entering[3] — exactly the behavioral pattern that Phase 2 tagging data is designed to confirm and quantify.

C. Alternative U3: New Fish Lift

FTA supports carrying Alternative U3 forward into Phase 2 feasibility analysis. NMFS indicated a preference for this option at the March 5, 2026 meeting.[4] However, FTA agrees with MDMR's concern that fish lifts are non-volitional and are subject to operational shutdowns during portions of the passage season, reducing their reliability relative to passive fishways.[3] As with U2, entrance siting for U3 must await the Project Interaction Study results. MDMR has suggested investigating "over-unit entrances" if behavioral data supports that approach,[4] and that determination cannot be made without Phase 2 empirical data.

D. Alternative U4: FishHeart System

FTA agrees with MDMR's April 9, 2026 assessment that the FishHeart system is not appropriate as a permanent standalone solution for upstream passage at the Brunswick Project. MDMR has stated it is "not aware of any information to suggest that this system is effective for the target species and numbers of fish (i.e., millions) that could be present annually downstream of the project."[3] If U4 is retained in the matrix at all, it should be evaluated only as a potential interim measure during construction of a permanent facility, not as a substitute for one, and any such evaluation must be accompanied by clearly stated performance standards, monitoring requirements, and contingency measures.

IV. NATURE-LIKE FISHWAY ALTERNATIVES MUST BE CARRIED FORWARD

FTA's most significant concern with the upstream alternatives matrix is the apparent effort by BWPH to screen out the Nature-Like Fishway (NLF) alternatives before a rigorous feasibility analysis has been conducted. The Revised Study Plan, in section 5.2.2, explicitly committed to Phase 1 providing "a comprehensive report of potential measures for upstream and downstream passage at the Project without discussion of costs or implied preferences."[2] BWPH must be held to that commitment.

At the March 5 meeting, BWPH presented two NLF concepts:

- A right-bank bypass channel (100 feet wide, approximately 1,800 feet long, 2.2% slope), requiring placement on private parcels and partial demolition of the left dam abutment; and[4]

- An in-channel, river-left NLF via Shad/Goat Islands (approximately 2,560 feet long, 1.6% slope), remaining primarily within the existing river channel without private land acquisition.[4]

MDMR specifically noted that the in-channel option "could be constructed completely within the river channel" and that "there is no reason to remove it from consideration at this stage."[3] NMFS requested at the March 5 meeting that if either NLF option is screened out, the report must document precisely why, with supporting drawings and constraints analysis.[4] FTA echoes this request and asks the Commission to require BWPH to carry both NLF options forward into Phase 2 for a full costed feasibility assessment.

An NLF at this site would represent the most ecologically effective passage solution — providing truly volitional passage for all species, including those difficult to attract to mechanical fishways. FTA notes that BWPH raised the NLF entrance's distance from the powerhouse as an attraction flow concern. That concern is precisely the kind of site-specific hydraulic and behavioral question that the Project Interaction Study and CFD Modeling Study are designed to answer. As confirmed in Section IX below, Phase 2 of the Project Interaction Study will proceed in spring 2026 as approved, making the critical behavioral data available to inform the NLF feasibility analysis before the Final License Application is filed. Vladimir Douhovnikoff of FTA specifically proposed the river-left in-channel NLF option during the March 5 meeting, and NMFS expressed support for advancing it to feasibility assessment.[4]

V. DAM REMOVAL AS A BASELINE COMPARATOR SHOULD NOT BE CATEGORICALLY EXCLUDED

At the March 5, 2026 meeting, BWPH's representative stated unequivocally that "Brookfield is not going to be removing the dam" and declined to include dam removal in the upstream alternatives matrix.[4] FTA recognizes that both BWPH and via earlier rulings at the scoping stage, FERC specifically addressed dam removal in both the Scoping Document and the December 30, 2024 Study Plan Determination, finding it unnecessary given that reasonable mitigation measures can be implemented. FTA respectfully but firmly disagrees with this position and is again stating it for the docket record.

As NMFS requested at the January 27, 2026 downstream alternatives meeting, and as FTA reiterated in its February 27, 2026 filing, dam removal should be included in the analysis matrix as a baseline comparator — not because FTA demands that the dam must be removed, but because an alternatives analysis that excludes the no-dam baseline cannot credibly evaluate the relative costs, benefits, and effectiveness of the options that remain.[6] This is basic comparative analysis methodology, and it is the approach employed in the Worumbo Dam relicensing (FERC Docket P-3428).

VI. THE ANALYSIS MUST EVALUATE COMBINATIONS OF PASSAGE MEASURES

MDMR's April 9, 2026 comments specifically urge BWPH to evaluate alternatives that include "multiple measures to provide safe, timely, and effective passage at the project," offering examples such as providing two fishways, or combining a new fishway with turbine turndowns during the passage season.[3]

FTA strongly supports this recommendation. The Brunswick Dam is the head-of-tide facility on a 3,450 square-mile watershed that the 2020 NOAA Comprehensive Plan identifies as capable of supporting millions of river herring and tens of thousands of American Shad.[1] The existing fishway's documented 33% internal effectiveness rate for river herring[4] — even setting aside its inadequate attraction flow and entrance performance — illustrates why a single-alternative approach will be insufficient. FTA asks the Commission to require BWPH's Phase 2 feasibility report to explicitly evaluate combinations of measures, including a new fishway combined with turbine turndowns, a nature-like fishway combined with a powerhouse passage structure, and any permanent fishway combined with interim eel passage measures during construction.

VII. INTERIM AMERICAN EEL PASSAGE CANNOT BE DEFERRED

FTA is deeply concerned by BWPH's statement that it "will not be operating the temporary eel ramps" at the Brunswick Project — despite the project's own visual survey data documenting 58,272 American eels at the Brunswick Dam across 12 survey dates during the expected upstream passage period.[7] BWPH's stated rationale — that eel ramps would cause "disruptions to the Project's normal operations" — is precisely backwards. It is the Project's operations that are disrupting tens of thousands of eels from completing their natural life cycle.

MDMR has specifically requested that BWPH voluntarily operate and maintain a temporary eel trap at the project until a new license is issued and permanent upstream eel passage is implemented.[8] FTA supports this request and asks the Commission to require it. FTA also notes MDMR's concern that the process by which eel study ramps were placed was inadequate, occurring without adequate prior discussion with and notice to the agencies,[8] and urges that any future consultation on interim eel passage measures include a dedicated meeting with adequate notice to all parties.

VIII. ALTERNATIVES MUST NOT BE NARROWED BEFORE EMPIRICAL DATA IS AVAILABLE

The upstream alternatives matrix presented at the March 5 meeting was developed before the results of the most critical site-specific studies are available. As NMFS noted in its February 25, 2026 ISR comments, both the CFD Modeling Study and the Phase 2 Diadromous Fish Behavior Study were either in progress or deferred to 2026 at the time of the ISR.[9] These studies are specifically designed to characterize the hydraulics of the tailrace, the location and behavior of fish congregating below the dam, and the effectiveness of attraction flows — exactly the data needed to make credible decisions about which upstream alternatives to carry forward.

Every alternative in the upstream matrix depends on empirical behavioral data for its key design parameters. Alternatives U2 and U3 both reference the Project Interaction Study and CFD Modeling Study to determine entrance locations. The NLF options depend on data about fish congregation areas below Shad Island and the left channel to evaluate whether attraction to an entrance 1,100 feet from the powerhouse is feasible. Even U1's modification assumptions depend on CFD results to determine whether tailrace hydraulics can be improved to reduce the interference effect identified at the existing entrance. Allowing the alternatives to be narrowed now — before any of this data exists — risks locking in design assumptions that are later contradicted by the evidence.

IX. THE COMMISSION'S APRIL 17, 2026 STUDY PLAN DETERMINATION

FTA commends the Commission for its April 17, 2026 Study Plan Determination denying BWPH's April 6, 2026 request to postpone Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study from the spring 2026 passage season to spring 2027. FTA concurs fully with the Commission's finding that, because in-water construction at the Frank J. Wood bridge is not expected to occur during the 2026 spring passage season and the existing bridge infrastructure is likely to have a negligible effect on fish behavior, movement, and telemetry receiver locations, there is no basis to delay the study. The Commission's determination that Phase 2 must proceed in the spring 2026 passage season as originally approved is precisely the outcome that NMFS and FTA each urged in their respective filings.

FTA also acknowledges the important contribution of NMFS in responding swiftly and substantively to oppose BWPH's postponement request. NMFS's April 10, 2026 filing directly rebutted the factual basis for BWPH's request, demonstrated that in-water construction had effectively concluded before the filing was made, and identified the postponement's fundamental inconsistency with the ILP framework. The Commission's determination rested on that record, and FTA is gratified that NMFS's timely engagement was reflected in the outcome. Phase 2 of the Project Interaction Study is the empirical foundation for virtually every critical decision in the upstream alternatives analysis, and its timely completion in spring 2026 is essential to the integrity of this relicensing proceeding.

X. THE LICENSEE CANNOT UNILATERALLY CONSTRAIN THE SCOPE OF THE ALTERNATIVES ANALYSIS

The Commission's April 17, 2026 Study Plan Determination also reflects a broader pattern in BWPH's conduct of this proceeding: on April 6, 2026, BWPH requested postponement of the study most critical to upstream passage design, on the basis of factual claims that NMFS rebutted directly and that the Commission found did not constitute good cause for modification.

The ILP process exists precisely to ensure that the alternatives analysis is comprehensive, objective, and informed by the best available science. The Revised Study Plan explicitly committed to Phase 1 providing a comprehensive alternatives report "without discussion of costs or implied preferences."[2] FTA asks the Commission to enforce this commitment and to remind BWPH that the scope of the alternatives analysis, and the timing of the studies that inform it, are determined by the Commission — not by the Licensee.

XI. CONCLUSION AND REQUESTED RELIEF

For the reasons set forth above, FTA respectfully requests that the Commission:

- FTA notes with approval the Commission's April 17, 2026 denial of BWPH's request to postpone Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study, and requests that the Commission confirm that Phase 2 will proceed during the spring 2026 passage season as approved by the Study Plan Determination;
- Require BWPH to incorporate the MDMR-calculated design populations (171,125 American Shad; 1,008,202 Blueback Herring; 7,728,805 Alewife; 600 Atlantic Salmon) as the standard to be sought for all upstream fish passage alternatives analyses;[3]

- Require BWPH to carry both Nature-Like Fishway alternatives (right-bank bypass and in-channel river-left) forward into Phase 2 feasibility analysis, with a documented explanation including drawings and engineering constraints if either is subsequently screened out;
- Require BWPH to include dam removal as a baseline comparator in the alternatives analysis matrix, consistent with NMFS's request and standard environmental review methodology;
- Require BWPH to evaluate combinations of multiple passage measures in Phase 2, including new fishways combined with operational measures such as turbine turndowns;
- Require BWPH to immediately implement interim upstream eel passage measures (temporary eel ramps) consistent with MDMR's request, with proper consultation on placement and operation;[38]
- Require BWPH to provide adequate time (minimum 30 days) for stakeholder review and comment on future alternatives matrices, feasibility reports, and meeting summaries;
- Require BWPH to provide a plan for interim upstream fish passage during any construction period that would require taking the existing fishway offline;
- Ensure that no alternatives are narrowed or screened out before the results of the Project Interaction Study and CFD Modeling Study are available and shared with resource agencies and stakeholders;[9]
- Require BWPH to deliver complete, not merely preliminary, results in the January 2027 Updated Study Report, with sufficient time for agency and stakeholder review before the Draft License Application is prepared.[911]

FTA remains committed to working constructively with the Licensee, FERC, resource agencies, and other stakeholders to achieve a new license for the Brunswick Project that genuinely serves the public interest and the ecological and cultural legacy of the Androscoggin River. This will require bold thinking and honest analysis — not a predetermined outcome, and not a process where empirical studies are deferred until after the key decisions have already been made. The diadromous fish of the Androscoggin have waited 47 years for this relicensing. The record must reflect all options, all data, and all voices.

Respectfully submitted,

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SOURCES

1. NOAA Fisheries, Greater Atlantic Regional Fisheries Office. *Androscoggin River Watershed Comprehensive Plan for Diadromous Fishes*. National Oceanic and Atmospheric Administration (2020). [Cited at p. 71.]

2. Brookfield White Pine Hydro LLC. *Brunswick Hydroelectric Project (FERC No. P-2284) Revised Study Plan*. Filed December 2, 2024.

3. Maine Department of Marine Resources. *Comments on Brunswick Hydroelectric Project (FERC No. P-2284) Upstream Fish Passage Alternatives*. Filed April 9, 2026.

4. Brookfield White Pine Hydro LLC. *Brunswick Hydroelectric Project (FERC No. P-2284) – Upstream Fish Passage Alternatives Meeting Summary (Meeting of March 5, 2026),* including Attachment 1: Alternatives Matrix and Conceptual Sketches. Filed March 31, 2026. [The Alternatives Matrix reports results of a 2022 river herring telemetry study conducted by Normandeau Associates, Inc. (NAI).]

5. U.S. Fish and Wildlife Service. *Fish Passage Engineering Design Criteria*. Northeast Regional Office, Hadley, Massachusetts (2019).

6. Brookfield White Pine Hydro LLC. *Brunswick Hydroelectric Project (FERC No. P-2284) – Downstream Fish Passage Alternatives Meeting Summary (Meeting of January 27, 2026)*. Filed February 9, 2026.

7. Brookfield White Pine Hydro LLC. *Brunswick Hydroelectric Project (FERC No. P-2284) – Response to Comments on Initial Study Report*. Filed April 2, 2026.

8. Maine Department of Marine Resources. *Comments on Brunswick Hydroelectric Project (FERC No. P-2284) Initial Study Report*. Filed March 2, 2026.

9. National Marine Fisheries Service. *Comments on Brunswick Hydroelectric Project (FERC No. P-2284) Initial Study Report*. Filed February 25, 2026.

10. Brookfield White Pine Hydro LLC. *Brunswick Hydroelectric Project (FERC No. P-2284) – Request to Postpone Phase 2 of the Diadromous Fish Behavior, Movement, and Project Interaction Study*. Filed April 6, 2026.

11. National Marine Fisheries Service (Julia E. Crocker, Chief, ESA Fish, Ecosystems, and Energy Branch, Protected Resources Division). *Brunswick Hydroelectric Project (FERC No. 2284) – Diadromous Fish Behavior, Movement, and Project Interaction Study Schedule*. Filed April 10, 2026.

APPENDIX C–EVALUATION MATRIX

Appendix C - Alternatives Review Matrix– Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
U1	**Modification of Existing Vertical Slot Ladder**	This alternative would include modifying the existing vertical slot fishway to improve overall effectiveness. The existing fishway has (42) 8.5-foot-wide by 10-foot-long pools with 11-inch slots. The fishway was designed for a maximum drop per pool of 12 inches. The ladder has a conveyance flow of 30 cfs and a supplemental attraction flow of 70 cfs for a total attraction flow of 100 cfs. The supplemental attraction flow is provided via a floor diffuser near the entrance. The extent and feasibility of the modifications will be determined based on additional analysis and CFD modeling. Some potential modifications include: • Decreasing conveyance flow. The EDF (Energy Dissipation Factor) for the existing pools ranges from ~2.8 to 4.9 and is 4.0 at normal conditions. This is above USFWS's recommendation of 3.15 for American Shad. Reducing conveyance flow to ~ 20 cfs would bring the EDF down to acceptable levels. • Increasing supplemental attraction flow. Due to the geometry of the existing facility, it's not feasible to increase the supplemental attraction flow through the existing fishway. To supplement the attraction flow, a ramped entrance diffuser similar to the one at the Scotland fishway may be able to be installed in front of the entrance. Review of the bathymetry in this area is required to assess the feasibility and determine amount of flow that could be provided. Total attraction flow will still likely be less than 5% of station discharge which is what's recommended by USFWS. • Modifying the fishway type. USFWS recommends a minimum slot width of 18 inches for American Shad. Increasing the slot width also requires that the pool size increases to maintain the hydraulic performance of the fishway. Increasing the pool sizes is not feasible due to the site constraints. Modifying the fishway to a pool and chute style fishway may improve passage for shad. Additionally reducing the length of the pool from 10 feet to 8 feet	Low/Moderate -A telemetry study of river herring conducted by NAI in 2022 showed an entrance efficiency of 37.5% and an overall internal effectiveness of 33.3%. A similar study for American shad in 2022 showed that only 2.4% of the tagged fish entered the attraction flow field and no fish entered the fishway. -Reducing conveyance flow would improve internal fishway hydraulics and improve internal efficiencies. -Increased supplemental attraction flow would improve entrance efficiency. -Smaller pool sizes mean a lower theoretical capacity than a new vertical slot fishway. -Overshot entrance gate should improve entrance efficacy. -Provides volitional passage (not currently operated due to invasive species).	Low Risk -Minimal changes to operating conditions.	Low -The bulk of the existing facility which was built in 1983 would remain in place.	High -Use of ramped entrance diffuser is limited. -The existing upstream fishway may need to be shut down for a portion of the season to facilitate construction. -Its unlikely that these modifications would improve effectiveness enough to meet the standards that the agencies will likely require. -Extension of the turning pool may be limited by property boundary or bridge easements.	Moderate -A small cofferdam near the fishway entrance would be required to facilitate potential modifications. -A cofferdam in the headpond would be required to facilitate construction of the attraction water intake structure. -Routing of new attraction water pipe may be difficult.	Moderate - Construction of ramped entrance diffuser. -Construction of entrance channel extension. -Installation of overshot entrance gate. -Installation of new dewatering gate. -Installation of flow induction pumps. -Modifications to internal fishway baffles. -Modifications to existing floor diffuser. -Replacement of wooden chamfers. -Installation of new attraction water pipe. -Construction of new attraction water intake. -Modifications to trap, sort, and truck facility.	Low/Moderate -Additional raking/cleaning of new attraction water intake. -No impact on parking, powerhouse access, or commercial traffic. -Vertical slot fishways are typically less complicated to maintain and operate. Pool and weir systems require more frequent operational adjustments for varying headwater and tailwater levels	Moderate -Additional losses due to increased attraction flow (likely to be less than a new vertical slot or fish lift).

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
		would allow you to add 10 additional pools, reducing the drop per pool to 9 inches. • Increasing the size of the turning pool. It's unclear from the effectiveness testing that has been completed if the 180-degree turning pool at the downstream end of the fishway is problematic, but these have been an issue at other projects. Increasing the size of the tuning pool to further reduce the EDF and providing additional room for fish to rest could improve internal efficiencies. • Modifying the existing floor diffuser. Some recent studies have indicated that floor diffusers can be an area of concern in fishways. Due to the geometry of the existing facility, it is not feasible to replace the existing floor diffuser with a wall diffuser, but it may be possible to improve the hydraulics at the floor diffuser by adding baffles, porosity plates, or turning vanes. • Replacing the existing chamfered wooden corners with radiused steel plate or concrete. • Extending the existing entrance downstream to allow for an overshot style entrance gate to be installed. • Installation of flow induction pumps near the fishway entrance. • Modify/Improve the existing trap, sort, and truck facility (Discuss with Brookfield).								
U2	**New Vertical Slot Ladder on South Side of the Powerhouse**	-This alternative would include constructing a new larger vertical slot fishway with a 9-inch drop per pool. Based on the maximum fishway operating head at the site (~ 40-feet), a vertical slot fishway with a 9-inch drop per pool would require approximately 52 pools. -The required pool size is based on the slot width. The minimum required slot width for American shad is 18 inches which results in a 12-foot-wide by 15-foot-long pool. -This alternative would require the construction of a new trap, sort, and truck facility.	Moderate/High • Increased attraction flow would improve entrance efficiency. • Elimination of floor diffusers would improve internal fishway efficiency. • Reduced drop per pool would improve internal fishway efficiency. • Larger pool sizes would increase the capacity of the fishway.	Low Risk -Similar operating procedures as the existing facility.	High -New fishway. -New trap, sort, and truck facility.	Moderate -Would likely require the existing upstream fishway to be shut down for multiple passage seasons to facilitate construction. -Footprint may be limited by property boundary or bridge easements. -Feasibility of installing a larger cofferdam in the tailrace needs further investigation and contractor input. -The cofferdam in the tailrace may impact project generation.	Difficult -A large cofferdam in the tailrace would be required to facilitate construction of the fishway. -Complete demolition of the existing fishway would be required. -Large impact area. -An SOE (support of excavation) structure to support the existing access road while the new facility is built would be required. -A cofferdam in the headpond would be required to facilitate	High -Construction of new vertical slot fishway. -Installation of new attraction water pipe. -Construction of new attraction water intake. -Construction of new trap, sort, and truck facility.	Moderate -Similar operating conditions to existing facility. -More pools to maintain. -Additional raking/cleaning of new attraction water intake. -Impacts parking, powerhouse access, and commercial traffic.	High -Additional generation losses due to increased attraction flow. -Potential for additional generation losses due to the cofferdam in the tailrace.

Appendix C - Alternatives Review Matrix– Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
			• Length of the fishway may result in some fallback which would impact internal fishway efficiency. • Multiple switchbacks required could reduce effectiveness particularly for shad. • Would provide volitional passage.				construction of the attraction water intake structure and fishway exit. -Construction could impact access to the powerhouse.			
U3	**New Fish Lift on South Side of Powerhouse**	-This alternative would include constructing a new fish lift to the south of the existing vertical slot fishway. -The hopper would be sized to accommodate the anticipated design population size (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring). -This alternative would require the construction of a new trap, sort, and truck facility.	<u>High</u> -Increased attraction flow would improve entrance efficiency. -Elimination of floor diffusers would improve internal fishway efficiency. -Length of fishway is reduced which should improve internal efficiency. -Would not provide volitional passage.	<u>Moderate Risk</u> -Additional safety requirements associated with hopper lifting and fish lift operation.	<u>High</u> -New fish lift. -New trap, sort, and truck facility. -Remaining portion of existing fishway to be abandoned in place.	<u>Low to Moderate</u> -Would likely require the existing upstream fishway be shut down for at least one passage season to facilitate construction. -Feasibility of installing a cofferdam in the tailrace needs further investigation and contractor input, even though it would be smaller than the one needed for the new vertical slot fishway. -The cofferdam in the tailrace may impact project generation. -Mechanical failures can result in the fishway being down for portions of the passage season.	<u>Moderate</u> -A cofferdam in the tailrace would be required to facilitate construction of the fishway. The cofferdam would be smaller than the one needed for the new vertical slot fishway since most of the new fish lift would be on the land side of the existing fishway. -Portions of the existing fishway need to be demolished to facilitate construction. The remaining portion of the structure would be abandoned in place. -An SOE (support of excavation) structure to support the existing access road while the new facility is built would be required. -A cofferdam in the headpond would be required to facilitate construction of the attraction water intake structure and fishway exit.	<u>High</u> -Construction of new fish lift. -Installation of new attraction water pipe. -Construction of new attraction water intake. -Construction of new trap, sort, and truck facility.	<u>High</u> -Fish lifts are more complex and have more mechanical components that need to be maintained. -Additional raking/cleaning of new attraction water intake. -Impacts parking, powerhouse access, and commercial traffic. -A secondary lift for trapping could be provided to allow some level of pre-sorting of species (similar to Milford).	<u>High</u> -Additional generation losses due to increased attraction flow. <u>-Potential for additional generation losses due to the cofferdam in the tailrace.</u>

Appendix C - Alternatives Review Matrix– Upstream Fish Passage at the Brunswick Project

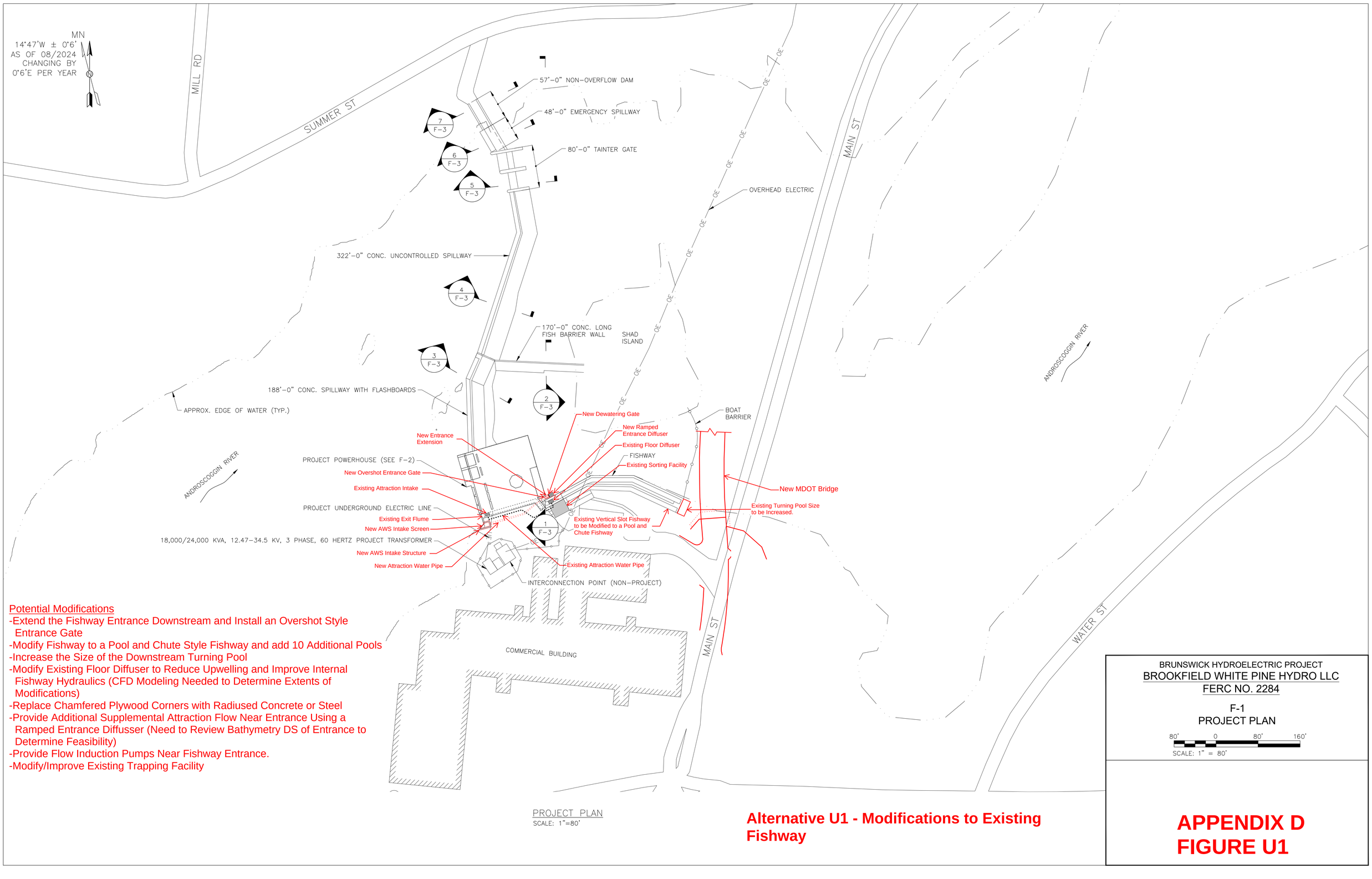
ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
							-Construction could impact access to the powerhouse.			
U4	**New FishHeart System**	-This alternative would include installation of a FishHeart collection system in the tailrace downstream of the powerhouse. The Fishheart system consists of a floating, in-water fish passage solution that uses a barge-mounted pump system to guide and transport fish over the dam. It uses pumped flow to attract fish into one of two 18-inch diameter pipes that are suspended below the barge where fish are captured and moved through the enclosed piping system and above the dam. Guide nets downstream of the structure help to guide fish into the system. -Fish could be pumped from the FishHeart system directly upstream or to the existing trap, sort, and truck facility. -Modify/Improve the existing trap, sort, and truck facility (Discuss with Brookfield).	Experimental -This is still an experimental technology with some support from the agencies, though effectiveness for collecting the target species is still being studied. -The floating nature of the FishHeart system allows it to be repositioned as needed to optimize effectiveness. -Additional satellite entrances can be added as needed. -Could be used to supplement existing fishway.	High Risk -A crane and boat access is needed to lift the Fishheart system into position. -Potential crane operation near overhead powerlines. -A boat and/or drivers may be required to maintain guidance nets. -Safety risk at high flows.	Moderate/High -The Fishheart system is removed after each season and overhauled so that it is in optimal condition before each season. -The existing trap, sort, and truck facility would be reused. -Existing fishway could be abandoned in place or maintained for supplemental passage.	Experimental -Additional testing of this system is needed. -The system uses two submerged pipes for entrances. Some species such as American shad may be hesitant to enter the pipes. -The system uses very little attraction flow which could impact overall effectiveness.	Easy -The Fishheart system would minimize in-water construction. -This option would allow the existing upstream fish passage to operate if needed during construction.	Low -Purchase of Fishheart System. -Installation of anchor points. -Modifications to trap, sort, and truck facility.	Moderate -Integrated cameras with artificial intelligence allow for real time data collection and sorting. Sorting effectiveness is unknown. -Guidance nets could be a maintenance challenge during portions of the upstream passage season. -Requires annual installation and removal. -The Fishheart system is typically removed during high flow events. -No impact on parking, powerhouse access, or commercial traffic.	Low -No attraction water from upstream of the dam is required.
U5	**New NLF proposed by NGO, "Free the Andro" (FTA)**	The NLF concept presented in the NGO concept shows the river divided by a new 1600 foot long spillway wall, creating (1) a canal feeding water to the powerhouse, and (2) a NLF channel on river-left with the dam and radial gates removed or bypassed. Excavation and grading of the NLF channel would be required to provide a 2% slope or less. A series of weirs would be required at the upstream location to create a controlled headpond elevation and be hardened against ice and debris. Excavation would be required at the NLF entrance around Shad Island, through the 10-12 ft tall Shad Falls. Bedrock excavation in the new powerhouse canal will likely be required to control velocities and headloss. New gates adjacent to the powerhouse will be required to manage ice and debris.	Moderate to High - Entrance not located near attraction flow is likely to reduce fish attraction effectiveness. Entrance is appx 1100 feet downstream and on the opposite bank. - Once fish are in the NLF, highly effective. - Modification of the pools and ledges downstream of the dam along Shad Island will be required to form a minimum flow channel for efficient alosines passage.	Low to Moderate -The new spillway wall will be a primary spillway retaining wall under FERC criteria - New gate(s) will be required adjacent to the powerhouse for flow, debris and ice management. -The new spillway will need to provide spillway capacity to pass the IDF without upstream flooding. The spillway may require additional gates or pneumatic crest control, combined with the discharge capacity of the NLF.	Moderate/High -The NLF will be constructed from concrete, gravel, cobble and large rock and will be needed to be durable. -Floods and high flows may cause damage to NLF. - Spillway wall likely reinforced concrete designed for longevity. - new spillway gates designed for ~50-yr service life.	Moderate to High - The spillway canal wall will require significant in-water work, which will require significant construction staging and complexity, and will require extensive permitting. -NLF entrance area is large and will require more concentrated flow to meet USFWS attraction criteria; likely requiring in-channel construction in the tailrace and significant excavation through Shad Falls to form a minimum flow channel. -The footprint of the NLF channel is	Difficult - The spillway canal wall will require in-water foundation and construction work, which will be susceptible to high flows. - 1600 feet of spillway wall construction in the wet will require phased construction. - Large amounts of excavation and fills required to grade NLF.	High -Demo of existing dam and gates. -1600 feet of new concrete spillway wall designed as a FERC water retaining structure and primary spillway. - Excavation along the new canal required. - New spillway gates likely to be required to manage ice and debris. -Bedrock excavation within the NLF channel entrance around Shad Island. - NLF grading to form effective passage.	Low to Moderate -Debris impacts will be less with the wider NLF channel and debris management should be minimal. -Annual placement and removal of a debris boom. - periodic inspection and documentation of conditions. - NLF concept is more susceptible to flood impacts and will carry a portion of flood flows. Inspections and maintenance required following high flow events.	High - Additional generation losses due to increased attraction flow. - Increase in headloss along new canal may reduce operating headpond elevations at the dam. - New spillway gate discharge will impact tailwater levels and reduce generation.

Appendix C - Alternatives Review Matrix– Upstream Fish Passage at the Brunswick Project

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
						extensive and will likely require multiple construction seasons.				
ALTERNATIVES RULED OUT										
-	**No Action (Maintain Existing Conditions)**	This was eliminated due to the low effectiveness of the existing fishway.	–	–	–	–	–	–	–	–
-	**New Vertical Slot Fishway on North Side of Powerhouse**	This was eliminated due to the limited real estate available between the powerhouse and Shad Island.	–	–	–	–	–	–	–	–
	New Fish Lift on North Side of Powerhouse	This was eliminated due to the limited real estate available between the powerhouse and Shad Island and the operations and maintenance challenges.	–	–	–	–	–	–	–	–
-	**New Traditional Pool and Weir Ladder**	This was ruled out due to the agency's preference for vertical slot fishways in recent years.	–	–	–	–	–	–	–	–
-	**New Denil Ladder**	This was eliminated due to the anticipated design population at Brunswick (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).	–	–	–	–	–	–	–	–
-	**New Alaskan Steeppass**	This was eliminated due to the anticipated design population at Brunswick (130,000 American shad, 600 Atlantic salmon, and 4.6M river herring).	–	–	–	–	–	–	–	–
-	**New Whoosh System**	This was eliminated due to the experimental nature of the technology and the limited success for American shad at prior on-site demonstrations.	–	–	–	–	–	–	–	–
-	**New Fishway on Topsham Side of the Dam**	This was eliminated as it would likely be less effective under non-spill conditions, the presence of the fish barrier dam, and the rock ledges that prevent fish from easily passing upstream to the spillway area.	–	–	–	–	–	–	–	–
-	**New Nature-Like-Fishway, Left Abutment, Topsham Shoreline**	This was eliminated due to the required footprint and the limited amount of real estate available along the Topsham shoreline, the demolition of portions of the left abutment, bridge access requirements across the NLF for spillway gate O&M. The fishway entrance would need to be located 1100 feet downstream of the powerhouse, which could adversely affect overall effectiveness. The NLF flow, sized for 5% of powerhouse hydraulic capacity, is 374 cfs. For 374 cfs, the NLF would need to be approximately 95 to 110 feet wide to provide flow depths and velocities suitable to pass alosines and other species. Narrower widths may produce deeper/faster flow velocities too high for fish passage. The falls at Shad Island would require a large amount of excavation to provide NLF bed grades suitable for weaker swimming species. The NLF will need a riverside wall to isolate the NLF flows from the river flows and gate discharges. The upper section of the NLF riverside wall will act as a primary water retaining structure and will be subject to FERC design criteria. A	Moderate - Entrance not located near attraction flow is likely to reduce effectiveness of the entrance. Entrance is appx 1100 feet downstream and on the opposite bank. - Once fish are in the NLF, passage would be highly effective. - NLF average grade is 2.2%, where agencies have expressed preference for slopes of 1.5%.	Low to Moderate - Low safety risk. -NLF will require construction of flood walls and retaining walls along the NLF to protect the passage channel. - Requires demolition and modification of a portion of the left abutment for the NLF penetration through the abutment. - Riverside upstream NLF wall becomes part of the primary water retaining structure, subject to FERC criteria. - Will need to demonstrate that the construction of the NLF does not reduce spillway capacity through raising of tailwater, or affecting	Moderate/High -The NLF will be constructed from concrete, gravel, cobble and large rock and will be durable. -Floods and high flows may cause damage to NLF, and will either be a design condition, or an acknowledged repair risk.	Low to Moderate -Risk is that fish will not be attracted to the entrance efficiently due to competing attraction flows and distance from powerhouse. - Public acceptance of the NLF may be difficult, considering visuals and impact to private land frontage. -The footprint of the NLF channel is extensive and will likely require multiple construction seasons.	Difficult - Access will be difficult considering the impacts from the new bridge, abutment, powerlines and real estate issues. - Excavation of the NLF entrance will be complicated considering impacts to adjacent structures and bridge piers. - Significant excavation required to pass Shad Island falls. - Construction beneath the new bridge will impact means and methods of construction and access. - NLF channel walls required to protect NLF from high flows and control NLF bed grade and substrates.	High - Limited season for construction below and above the dam. - Risks for flooding of the construction site are high. - Long riverside NLF concrete walls will be needed to protect the NLF from high flows and gate discharges, as well as retain earth fill. The NLF walls will require construction in a dewatered condition. - Requires removal / modification of a portion of the dam abutment. -Will require a 100-ft access bridge across the NLF for O&M access to the radial gates and stoplog gates.	Low -Annual debris removal of large debris. - Maintenance of hydraulic inlet to the NLF to prevent excessive debris accumulation. -annual placement and removal of a debris boom. - periodic inspection and documentation of NLF conditions.	Moderate -NLF flow of 374 cfs is 5% of station capacity.

ID	Alternative	Description	Effectiveness	Safety	Equipment Longevity	Risk/Uncertainty	Constructability	Construction Costs	Operation and Maintenance Costs	Impacts to Generation
		land-side wall may be required to minimize the NLF footprint, and act as a retaining wall where slopes can not be cut back. An access bridge across the NLF will be required to access gates. Excavation at the entrance of the fishway, along the NLF, and near the dam will be subject to vibration limits to prevent damage to adjacent structures and bridge foundations. Use of explosives may be limited, increasing the costs of excavation.		approach flows to the gates.				- Bedrock excavation along the NLF and at the NLF entrance. (10-15')		

APPENDIX D–CONCEPTUAL FIGURES OF UPSTREAM PASSAGE ALTERNATIVES



PROJECT PLAN
SCALE: 1"=80'

Potential Modifications

- -Extend the Fishway Entrance Downstream and Install an Overshot Style Entrance Gate
- -Modify Fishway to a Pool and Chute Style Fishway and add 10 Additional Pools
- -Increase the Size of the Downstream Turning Pool
- -Modify Existing Floor Diffuser to Reduce Upwelling and Improve Internal Fishway Hydraulics (CFD Modeling Needed to Determine Extents of Modifications)
- -Replace Chamfered Plywood Corners with Radiused Concrete or Steel
- -Provide Additional Supplemental Attraction Flow Near Entrance Using a Ramped Entrance Diffusser (Need to Review Bathymetry DS of Entrance to Determine Feasibility)
- -Provide Flow Induction Pumps Near Fishway Entrance.
- -Modify/Improve Existing Trapping Facility

Alternative U1 - Modifications to Existing Fishway

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

APPENDIX D
FIGURE U1

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD

SUMMER ST

MAIN ST

57'–0" NON–OVERFLOW DAM

48'–0" EMERGENCY SPILLWAY

80'–0" TAINTER GATE

7 F–3

6 F–3

5 F–3

OVERHEAD ELECTRIC

OE

322'–0" CONC. UNCONTROLLED SPILLWAY

4 F–3

170'–0" CONC. LONG FISH BARRIER WALL

SHAD ISLAND

3 F–3

188'–0" CONC. SPILLWAY WITH FLASHBOARDS

APPROX. EDGE OF WATER (TYP.)

2 F–3

New Overshot Entrance Gate

New Entrance Dewatering Gate

Existing Fishway to be Demolished

BOAT BARRIER

ANDROSCOGGIN RIVER

New Vertical Slot Fishway

PROJECT POWERHOUSE (SEE F–2)

FISHWAY

New Viewing Room (Below)

New Pool Size (12' Wide x 15' Long)

Slot Width = 18"

New Bridge

New Grizzly Rack

New Wall Diffuser

New Dewatering Gate

PROJECT UNDERGROUND ELECTRIC LINE

New AWS Intake Screen

F–3

18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER

New Crowder (Below)

Trap and Transport Hopper

New Sorting Facility

New AWS Intake Structure

New Attraction Water Pipe

INTERCONNECTION POINT (NON–PROJECT)

COMMERCIAL BUILDING

ANDROSCOGGIN RIVER

WATER ST

PROJECT PLAN
SCALE: 1"=80'

Alternative U2 - New Vertical Slot Fishway

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

APPENDIX D
FIGURE U2

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD

SUMMER ST

MAIN ST

57'–0" NON–OVERFLOW DAM

48'–0" EMERGENCY SPILLWAY

80'–0" TAINTER GATE

7 F–3

6 F–3

5 F–3

4 F–3

3 F–3

2 F–3

F–3

OVERHEAD ELECTRIC

OE

322'–0" CONC. UNCONTROLLED SPILLWAY

170'–0" CONC. LONG FISH BARRIER WALL

SHAD ISLAND

188'–0" CONC. SPILLWAY WITH FLASHBOARDS

APPROX. EDGE OF WATER (TYP.)

ANDROSCOGGIN RIVER

New Overshot Entrance Gate

New Entrance Dewatering Gate

Portion of Existing Fishway to be Demolished

New Training Wall

Portion of Existing Fishway to be Abandoned in Place

New Wall Diffuser

New DS Migrant Pipe

New V-Trap

New Main Hopper

New Blocking Screen

New Attraction Water Pipe

New Exit Flume Conveyance Flow Screen

New Crowder

New Sorting Facility

BOAT BARRIER

New MDOT Bridge

New Trap and Transport Hopper

PROJECT POWERHOUSE (SEE F–2)

New Exit Flume

New Grizzly Rack

New Exit Flume Dewatering Gate

PROJECT UNDERGROUND ELECTRIC LINE

New AWS Intake Screen

18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER

New AWS Intake Structure

New Viewing Room (Below)

INTERCONNECTION POINT (NON–PROJECT)

COMMERCIAL BUILDING

WATER ST

PROJECT PLAN
SCALE: 1"=80'

Alternative U3 - New Fish Lift (South Side of Powerhouse)

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

APPENDIX D
FIGURE U3

MN
14°47'W ± 0°6'
AS OF 08/2024
CHANGING BY
0°6'E PER YEAR

MILL RD

SUMMER ST

MAIN ST

57'–0" NON–OVERFLOW DAM

48'–0" EMERGENCY SPILLWAY

80'–0" TAINTER GATE

OVERHEAD ELECTRIC

322'–0" CONC. UNCONTROLLED SPILLWAY

170'–0" CONC. LONG FISH BARRIER WALL

SHAD ISLAND

188'–0" CONC. SPILLWAY WITH FLASHBOARDS

APPROX. EDGE OF WATER (TYP.)

Gap in Net for DS Migrants

BOAT BARRIER

Anchor Cables

Guidance Nets

New Fishheart System

Existing Fishway to Remain

PROJECT POWERHOUSE (SEE F–2)

Transport Pipe To Sorting Facility

New DOT Bridge

Transport Pipe To Exit Flume

PROJECT UNDERGROUND ELECTRIC LINE

Fishheart Control Building

Existing Sorting Facility

18,000/24,000 KVA, 12.47–34.5 KV, 3 PHASE, 60 HERTZ PROJECT TRANSFORMER

Existing Exit Flume

INTERCONNECTION POINT (NON–PROJECT)

ANDROSCOGGIN RIVER

COMMERCIAL BUILDING

WATER ST

PROJECT PLAN
SCALE: 1"=80'

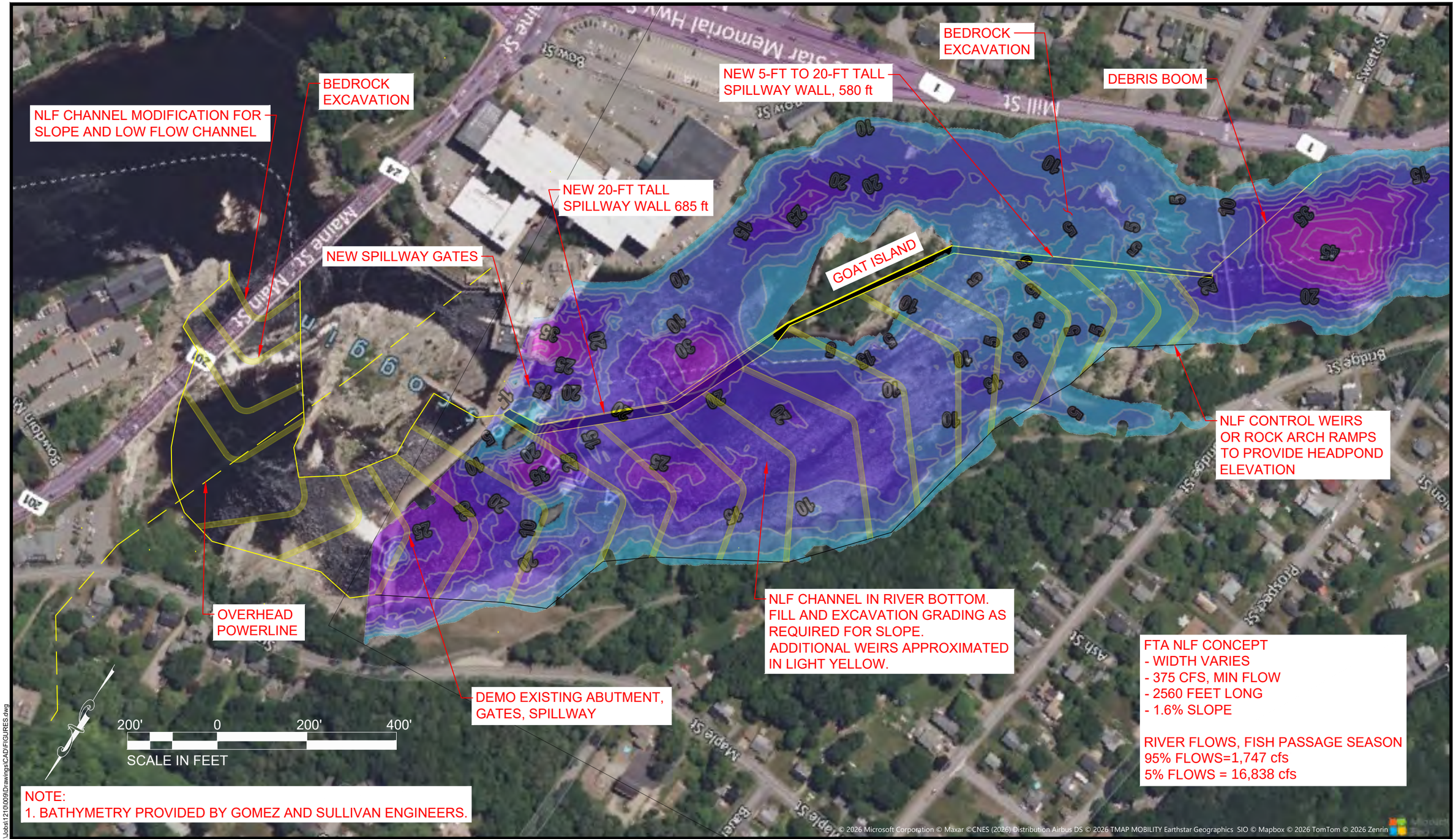
Alternative U4 - New FishHeart System

BRUNSWICK HYDROELECTRIC PROJECT
BROOKFIELD WHITE PINE HYDRO LLC
FERC NO. 2284

F-1
PROJECT PLAN

80' 0 80' 160'
SCALE: 1" = 80'

APPENDIX D
FIGURE U4



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BROOKFIELD WHITE PINE HYDRO, LLC

BRUNSWICK HYDROELECTRIC PLANT
PROJECT PLAN ALTERNATIVE U5, NATURE-LIKE FISHWAY

APPENDIX D
FIGURE U5

DATE: 07-13-26

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