Decision Criteria

All the criteria mentioned in the following list are defined specifically in relation to hydropower dams. This list is non-exhaustive; it does not include all decision criteria that may be important to all people. For example, in some situations, it may be important to include additional animal species, community economic impact, demand for whitewater *and/or* flatwater recreation, jobs, water quality (could use existing state water quality standards), etc. For decision criteria that are included, many criteria could be unpacked into different sub-criteria (e.g., species-specific habitat area (e.g., Atlantic salmon only, or Alewife only), different uses for reservoir storage such as drinking water or fire suppression). The criteria identified in this list are representative of current issues important to dam decision making as expressed by stakeholders in interview.

1. **Sea-run fish habitat area** (hundreds of square meters): proxy criteria estimated as possible upstream sea-run fish (Atlantic salmon, Alewife, Blueback herring, American eel) functional habitat (Roy et al., 2018).
2. **River recreation area** (square kilometers): estimated downstream area of river that may increase or decrease with a dam decision alternative, represents functional area for whitewater recreation defined by Roy et al. (2018).
3. **Reservoir storage** (100,000 acre-feet): estimated storage potential of the reservoir, based on its volume (Roy et al., 2018).
4. **Annuitized project costs*** ($2019 thousands USD/yr): estimated total project costs (capital and operation & maintenance) on an annual basis using a 6.2% discount rate and a 20-year financial lifetime.
5. **Number of properties impacted**: estimated number of properties impacted by the decision alternative, based on potential changes in viewshed or property value (Roy et al., 2018).
6. **Breach damage potential** (unitless): a proxy for safety based on the State hazard rating, which indicates the potential for downstream property damage, injury, and death in the case of dam breach (Roy et al., 2018).
7. **Annual electricity generation**** (GWh/yr): 4-year average estimate, based on licensee-reported site-specific electricity generation values reported to FERC annually. Estimates for Penobscot Mills project developments are based on site-specific average annual electricity generation values reported in the FERC license for the project).
8. **Annual carbon dioxide (CO2) emissions reduction***** (metric kilotonnes per year): estimate of avoided carbon dioxide emissions from annual hydropower-generated electricity production (reservoir or diversion-design dams); based on decreasing generation from the State's electricity generation mix; includes life cycle emissions impacts.
9. **Indigenous cultural traditions and lifeways****** (unitless): rating to convey the importance of preserving or restoring the culture and practices of indigenous people.
10. **Town/city identity** (unitless): rating to convey the importance of the dam for preserving the existing town/city identity for residents living along the river.
11. **Industrial historical importance** (unitless): rating to convey the importance of the dam for preserving/restoring the industrial history of the site.
12. **Aesthetic value** (unitless): rating to convey the importance of improving or preserving aesthetics (e.g., appearance, scenic value, smell, sound) at a dam site.

*Annuitized costs for all decision alternatives with fish passage include fish mitigation costs, because the Penobscot River is home to Atlantic salmon, a species covered under the Endangered Species Act. The Penobscot River is a historic migration route for Atlantic salmon and federal agencies have authority to prescribe fish passage there. The higher cost associated with endangered species fish projects (estimated as 30-year total costs by Hall et al., 2003) reflect more realistic (higher) annuitized costs. Future work could include more accurate fish passage project cost modeling.

**Current annual electricity generation data (for West Enfield, Medway, Ripogenus) is a 4-year average, calculated using 2015 - 2018 values reported to FERC. Where no annual electricity generation data could be parsed for individual dam developments (i.e., at the Penobscot Mills Project), FERC license information on average annual electricity generation was used. Additional annual electricity generation estimates were based on annual capacity factors calculated from the annual electricity generation data (again using 4-year average values), or in the case of the Penobscot Mills Project, based on the project-level 4-year average annual capacity factor (i.e., same % value for each of the 5 dam developments) from 2015 – 2018 values reported to FERC. Future studies could update these values to 2019 or use a larger dataset.

***Note: carbon emissions values (CO_2 emissions avoided from municipal solid waste and fossil fuel generation sources) are based on Maine's current electricity mix. Users should be aware that while carbon emissions reductions are a hallmark of renewable electricity generation, they are not the only indicator of a hydropower project's sustainability. While hydropower has long played a role in Maine's electricity mix, as additional renewable generators (e.g., solar and wind) are deployed, the role of hydropower in the grid mix may begin to decline. Future studies could look at different renewable energy deployment scenarios and what this means for the state under new Renewable Portfolio Standards introduced by Gov. Janet Mills in 2019.

**** Indigenous cultural traditions and lifeways data come from a survey of Penobscot Nation citizens (N=2), supported by researcher observations of informal conversations with Penobscot Nation citizens and representatives. Future studies could improve on these data by surveying a greater number of tribal citizens.