SCIENTIFIC REVIEW OF THE ENVIRONMENTAL REGISTRATION DOCUMENT FOR THE PROPOSED ALTON NATURAL GAS STORAGE PROJECT

Context

DFO Maritimes Science Branch was asked by the Habitat Protection and Sustainable Development (HPSD) Division to review the Province of Nova Scotia's Environmental Assessment Registration Document for the Alton Natural Gas Storage Proposal on May 24, 2007. It is expected that this Science Response will be used to assist HPSD in developing its own comments for the Province, as well as in making any Fisheries Act determinations related to this project. DFO Science was asked to address the following questions:

1) Could operation of the water intake result in the death of fish in the area of the intake? Has adequate information been provided to make a conclusion?

2) Could operation of the brine mixing pond result in the death of fish? Could the release of the diluted brine impact on the health or behaviour of fish? Has adequate information been provided to make a conclusion?

3) Is additional information required in order to predict effects on Atlantic salmon, related to the operation of the water intake and brine mixing pond? Could Atlantic salmon be harmed by the operation of the water intake and brine mixing pond?

4) Is the recommended mitigation and monitoring associated with the water intake and brine mixing pond appropriate? Are there any further recommendations for mitigation and monitoring?

5) Are there any other issues that should be flagged at this time?

This is the first project of this nature to be reviewed by DFO Science in the Maritimes Region, and no framework currently exists to support review of such a project. A preliminary response has been provided through the Special Science Response process; however, more detailed scientific peer review and assessment of the potential impacts of this project is recommended to fully address the questions that have been posed.

Background

Alton Natural Gas Storage Limited Partnership has submitted a proposal to the province of Nova Scotia to develop an underground hydrocarbon storage facility in a series of engineered salt caverns near Alton, Nova Scotia. The potential environmental effects of this proposal are being assessed through the province's Environmental Assessment (EA) process. DFO Habitat Management will provide comments to the province to support this EA process, and DFO will also be required to make its own determination of potential project impacts under the Fisheries Act.

Water is proposed to be withdrawn from the Shubenacadie River Estuary (approximately 25 km from the mouth of the estuary) for use in the development of the salt caverns, as well as to dilute the wastewater being returned to the Shubenacadie River after use. Wastewater produced during the construction of this project would be discharged to the Shubenacadie River after dilution in a mixing pond. Construction along the banks of the Shubenacadie River would be required to install water intakes and outflows. If activities proceed as planned, the brining process may last 8-10 years. The storage facility is being designed to provide service for a minimum of 50 years.

Response

The Shubenacadie River is a regionally unique tidal river with the longest tidal bore in Nova Scotia. A number of regionally rare species are dependant on this river to carry out their life-history processes, these include inner Bay of Fundy Atlantic salmon (currently listed as endangered under Schedule 1 of the Species at Risk Act), striped bass (currently being assessed by the Committee on the Status of Endangered Wildlife in Canada) and Atlantic sturgeon (red listed by the province of Nova Scotia). Additional species that are either resident or seasonal inhabitants of the tidal Shubenacadie River include: brook trout, brown trout, alewife, blueback herring, American shad, rainbow trout, American eel, rainbow smelt, stickleback, winter flounder, smooth founder, mummichog, Atlantic silverside, Atlantic tomcod, Atlantic herring, northern pipefish, sea lamprey, yellow perch, white perch, smallmouth bass, chain pickerel, and cyprinids.

The Shubenacadie River Estuary is an extremely dynamic environment, with a tidal bore that travels 30 km up from the river mouth. The site currently proposed for water withdrawal and discharge for the Alton Salt Dome project is a location of large extremes in the relative proportions of seawater and freshwater, total flow, suspended sediment, and water temperature and salinity. These extremes can be expected twice daily and monthly in response to the diurnal- and spring-neap tidal cycles respectively, and both seasonally and daily with weather conditions. In the estuarine portion of the Shubenacadie River Estuary high sediment concentrations can be expected to significantly influence the hydrodynamics in the river at certain times of the year. Deposition of highly mobile sediment concentrations will influence channel morphology, and therefore the presence of fluid mud could significantly reduce mixing of fresh, marine and introduced brine waters in the estuary. This high degree of natural variability introduces a high level of uncertainty into predictions of potential impacts to fish and fish habitat and may complicate the management regime needed to ensure that water withdrawal and discharge are conducted in a manner that do not result in harm to fish and fish habitat. The Environmental Registration Document does include a reference to the relative amount of water that would be withdrawn from the Shubenacadie River Estuary as compared to the amount of water potentially present. However, this calculation is based on the maximum ebb flows and does not reflect potential flow reductions at any one point in time. On average, the proposed water withdrawals are likely to be low relative to total water flows.

The proponent conducted preliminary characterization of the proposed site for water withdrawal and discharge between October and December 2006. Results while indicative of natural variability, did not adequately resolve the variability that can be anticipated to occur at this site on daily, monthly, seasonal, and interannual time scales. The tidal range at the proposed outflow site was approximately 2 to 4 m in November. Salinities at the discharge site ranged from 0 to 18 ppt between November and December. Lowest salinities appeared to occur in December when tidal range was low and freshwater inputs (i.e., rain, snow) were high. One sample collected by the proponent in October had a Total Suspended Solids (TSS) level of 340 mg/L (Jacques Whitford, 2007, p. 45). It is not known what the location, depth, tidal or weather

conditions were at the time this sample was taken. Water samples collected in October on the ebb and flood tides near the proposed discharge site had turbidities of 93 NTU (ebb) and 180 NTU (flood). These levels were measured during a period of high freshwater runoff and low salinity (<1 ppt) and were not calibrated to provide estimates of TSS. High levels of fine sediment may be difficult to remove from intake water with the proposed centrifugal separator system.

A striped bass baseline monitoring proposal was provided to DFO Science on May 16, 2007. A review of this proposal is included in Appendix A.

There are a number of information gaps within the Environmental Registration document that, if filled, would be helpful in the determination of potential impacts to fish and fish habitat. These include the expected chemical composition of the discharge brine relative to the natural range in the chemical composition of the estuarial water at the proposed project discharge location. Also, a better understanding of water circulation throughout the year, in addition to the studies that focused only on the Oct-Dec period. Estimates of the range of temperature and dissolved oxygen concentrations of the discharge water entering the Shubenacadie River will be required to determine potential effects on fish species – particularly during the winter months when some species of fish may be especially responsive or sensitive to temperature gradients or transient cells of warmer or cooler water.

The Environmental Registration document has not addressed potential cumulative effects of this project in relation to other proposed development projects in the Bay of Fundy, such as the proposed tidal power projects in the Bay of Fundy. Potential interactions between these projects may exist. For example, changes to the tidal regime or distribution/consumption of sediments within the Bay of Fundy, would likely influence tidal incursion and flow rates at the proposed location of the Alton Salt Dome water withdrawal and discharge. A Strategic Environmental Assessment of ocean renewable energy is currently being conducted for the Bay of Fundy to provide information on the potential impacts of tidal energy.

Information on mitigation options presented within the Environmental Registration document were not considered to be adequate to determine their potential effectiveness at minimizing impacts to fish and fish habitat. For example, the effectiveness of fish screens and the proposed two-week operational shutdown during peak spawning of striped bass at minimizing entrainment of eggs, larvae and juveniles of a variety of fish species is unknown at this time.

The uncertainties of potential impacts on fish and fish habitat as well as more general ecological considerations associated with the proposed locations suggest further project alternatives and/or mitigation options need to be explored.

Alternative locations for water withdrawal have not been assessed in the Registration document. There may be several advantages of withdrawing water from a less saline environment, such as a lake. For example, suspended sediments may be reduced, water flow rates may be easier to predict, sensitivities of fish and fish habitat may be reduced. Additional work would be required to develop sound science advice on this issue. While several options for brine discharge appear to have been explored by the proponent, details related to the assessment of discharge into the Cobequid Bay have not been provided within the Environmental Registration document. Discharge into the marine environment may have several advantages. For example, the ratio of water discharges to water present would be much lower, water flow rates would be more predictable and discharge timing may be less dependant on timing and environmental conditions. It would be informative to discuss the impacts of best case locations for water

withdrawal and discharge independent of constraints, relative to any proposed location. Additional work will be required to provide science advice on this issue.

This is considered to be only a preliminary evaluation of the potential impacts of the proposed Alton Salt Dome project on fish and fish habitat (including species at risk) and of mitigation and monitoring options. A more comprehensive and inclusive peer review of the available information is recommended to provide a sound scientific basis for decision-making. Such a review could potentially be conducted within the next few months. However, such a review could potentially identify additional information or studies that may be required to resolve the question posed by DFO Habitat Management, which may require additional time and resources.

Conclusions

The Shubenacadie River Estuary at the proposed location of water withdrawal and discharge for the Alton Salt Dome project is a dynamic receiving environment possessing a high level of natural variability, which has not been fully characterized within the Environmental Registration document. Existing uncertainties associated with natural variability in the underlying physical and climatological dynamics of, and their interaction within, the receiving environment complicate the task of prediction of potential environmental effects on aquatic ecosystem components. Both the design and implementation of measures to mitigate the impacts to aquatic ecosystem components, such as the timing of brine discharge, may be therefore equally complicated.

Given the presence of a species listed as endangered species under the Species at Risk Act (inner Bay of Fundy salmon) and other regionally rare and sensitive species (striped bass and Atlantic sturgeon), it is expected that a lower than average level of risk tolerance may be applied to projects proposed for this environment. At present, the Environmental Registration document contains insufficient information to enable full evaluation and risk assessment of the potential impacts to aquatic ecosystem components, including species at risk.

Given that advice has not been provided by DFO Maritimes Science on this type of project in the past, and given that this is only a preliminary evaluation of the information contained within the Environmental Registration, it is recommended that a DFO-led scientific peer review meeting be conducted to more fully evaluate the scientific and technical information available for this project, to discuss additional mitigation and monitoring options, to determine what information may be required (if any) to address outstanding knowledge gaps.

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Sources of information

Jacques Whitford. 2007. Environmental Registration for the Proposed Alton Natural Gas Storage Project. Final Report.

Appendix A

Scientific Review of the May 16, 2007 "Striped Bass Egg and Larvae Monitoring Proposal"

Based on the information that is known about the Shubenacadie-Stewiacke striped bass population, DFO Science has suggested an alternative monitoring and evaluation approach. These suggestions are intended to improve the basis for assessing the feasibility of mitigating the effects of the brine discharge process, for age 0+ year diadromous fishes, including striped bass.

Some things which are known about the Shubenacadie-Stewiacke striped bass population include:

- striped bass eggs will occur in abundance within the vicinity of the proposed area of activity,
- there is substantive inter-annual variability in timing and duration of the spawning season,
- spawning is triggered when water temperatures rise to approximately 16°C,
- spawning events can be of very short duration (e.g., measured in hours and possibly minutes on some days), and
- spawning events are largely independent of the spring-neap cycle, as was hypothesized by Rulifson and Tull (1999).

These features (i.e., listed above) indicate that while a predictive basis (e.g., real time water temperature data) to scheduling water extraction and/or brine release around striped bass spawning activity is feasible,

1) a high degree of active management would be required, and
2) it would probably not satisfactorily minimize risk of entrainment and/or exposure to brine to not only the eggs but to larvae and young juveniles.

It is suggested that the simplest and safest recourse is not to allow activities associated with the dilution and discharge of brine to take place during the striped bass spawning season. Late April to early July is a sensitive period for most of the other local populations of diadromous fish species, for spawning (e.g., alewife, blueback herring, American shad, Atlantic silversides, rainbow smelt), for outmigration (e.g., inner Bay of Fundy Atlantic salmon smolts), or recruitment to the river (e.g., American eel elvers). Collectively, these processes represent a level of biological complexity that could not easily be accommodated within a mitigation framework.

Therefore, it is suggested that the proponent focus on monitoring and evaluation activities that can be linked to specific actions that would be taken to mitigate the effects on very young fish. As stated in the proposal, these actions are entrainment into the water intake and the brine dilution facility, and exposure to effluent from the facility.

<u>Entrainment</u>

Fish screening specifications would need to accommodate both a target flux of estuarial water while effectively preventing fish from entering the intake (i.e., fish size relative to screen mesh size, and risk of impingement at a given velocity of water through the screening). A reasonable approach, therefore, would be to define the seasonal growth trajectory of the smallest age

classes (i.e., those most susceptible to entrainment) and thereby identify the date that the brine dilution and release phase could begin for a given screening configuration.

A robust growth model for Age 0+ striped bass has been developed. It has been shown previously that application of the growth model to size at age information and water temperatures can satisfactorily capture the seasonal growth trajectory of wild, age 0+, Shubenacadie-Stewiacke striped bass. The striped bass monitoring component could therefore be oriented around sampling of juvenile striped bass (July onward) to define the seasonal growth profile, and thereby determine the approximate date that entrainment through the screens could be discounted. The growth model, and summer water temperature information, could be made available to assist with an assessment of inter-annual variability in the date that dilution/discharge of brine could begin.

There are no comparable growth models for the other local populations of diadromous fishes. Temporally stratified (minimally bi-weekly) sampling of the juvenile fish assemblage within the inner portions of the Shubenacadie River Estuary would yield information on the screening requirements to eliminate entrainment, and whether screening is feasible. (Size at age will vary substantively among species. Juvenile alosine fish will be much smaller than striped bass juveniles of the same age (i.e., days) for example).

Exposure

It is doubtful that any information concerning the effects of exposure to brine (at varying concentrations) is available for any or most of the diadromous species present within the Shubenacadie River Estuary. However, the infrastructure and expertise to assess the effects of exposure to brine on juvenile diadromous fish is available at a local university. The need to look at exposure effects would be contingent upon the relative difference between the chemical composition of the brine and seawater occurring naturally in the river. If the proponent cannot produce information that shows the chemical properties of the brine at the point of discharge:

a) does not differ from that of seawater, and
b) would not harm fish at the proposed dilution, upon release into the river,

then it is recommended that studies be scheduled to assess both the lethal and sub-lethal effects of exposure, minimally on juvenile striped bass.

None of the above is intended to imply that fulfillment of the activities recommended in this document will address all fish conservation issues. Rather the suggestions should be regarded as advice on where the proponent might more effectively direct their monitoring activities in 2007.

Reference:

Rulifson, R.A. and K.A. Tull. 1999. Striped bass spawning in a tidal bore river: the Shubenacadie Estuary, Nova Scotia. Transactions of the American Fisheries Society 128:613-624.

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