APPENDIX C

Dispersion Modeling of Discharged Brine

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Numerical Brine Dispersion Modeling in the Shubenacadie River

Martec Technical Report # TR-07-12

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Management System
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I SO 9001:200

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Science & Computing

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1.0 Numerical Brine Dispersion Modeling in the Shubenacadie River

The numerical modeling of brine dispersion in receiving waters of the Shubenacadie River is based on the USEPA supported Cormix Modeling System (Jirka et. al., 1996) for near-field mixing predictions, and a detailed RMA 10/11 finite element hydrodynamic/water quality river model (United States Waterways Experimental Station Coastal and Hydraulics Laboratory) to quantify far-field dispersion.

Various outfall configurations were considered as potential designs for brine discharge in the Shubenacadie River. These included the following:

Option # 1 *Submerged Outfall at mid-channel and shore-attached.*

Option # 2 *Submerged Diffuser positioned across the river width (perpendicular diffuser) and along the riverbank (parallel diffuser). In addition, multi-staged diffuser configurations were considered where ports operate only under specific ambient and discharge conditions.*

Option # 3 *Shore-attached discharge from pre-mixing pond.*

A mid-channel single outfall as well as the perpendicular diffuser were not considered feasible options due to the potential problems associated with sedimentation covering the outfall or ports, erosion, potential damage to the pipe from ice flows, difficulties associated with laying or directional drilling of the pipe or diffuser across the river and the required annual maintenance. For these reasons, only shore-attached outfalls were considered feasible layouts for the three options described above.

The Cormix Modeling System provides detailed mixing analysis of dense (negatively buoyant) discharges in steady and unsteady receiving waters and can account for bottom density current mixing with sloping bathymetry. Until recently, very little guidance has been documented in the literature concerning the dispersion of negatively buoyant jets in receiving water environments. However, Jirka (2007) has developed guidelines for the optimal discharge configuration for brine effluents in the marine environment for single and multiple port (diffuser) configurations. These guidelines can be incorporated directly into Cormix with results assessed in terms of efficiency of mixing and the ability of the receiving water environment to assimilate the brine discharge.

For submerged outfalls, better mixing efficiencies can be attained with high-velocity discharges in relatively deep water. Previous researchers (Zeitoum et al., 1970 and Roberts et al., 1997) have found that an optimal outfall or port angle with a 60^o inclination provides the highest dilution of negatively buoyant jets. However, Cipollina at al. (2005) and Jirka (2007) have found that the negatively buoyant jet inclination should be in the range of 30^o to 45^o above horizontal in order to provide good trajectory of the effluent as well as a high degree of mixing at the point of impingement on the bottom slope. The lower angle of inclination also provides considerably flatter trajectories, thus allowing the discharge to be located in much smaller ambient depth conditions.

Detailed studies by Zhang and Baddour (1998) for negatively buoyant jets have also shown that a high Froude Number (non-dimensional parameter for jet densimetric characteristics) greater than 10, with a recommended range between 20 to 25, produces an efficient jet with improved dilution in the near-field. Similar to a high Froude Number, the US Energy Department has recently recommended that submerged brine discharges be designed with a minimum jet velocity of 9 m/sec to encourage jet mixing and higher dilution in the near field.

In addition to these recommendations, Jirka (2007) recommends that the outfall be designed such that the upper jet boundary Z_{max} be no higher than 75% of the local water depth (Figure 1.0). This prevents surface interaction effects with the plume which can actually cause a visible "boil" and a lower dilution than if interaction does not occur.

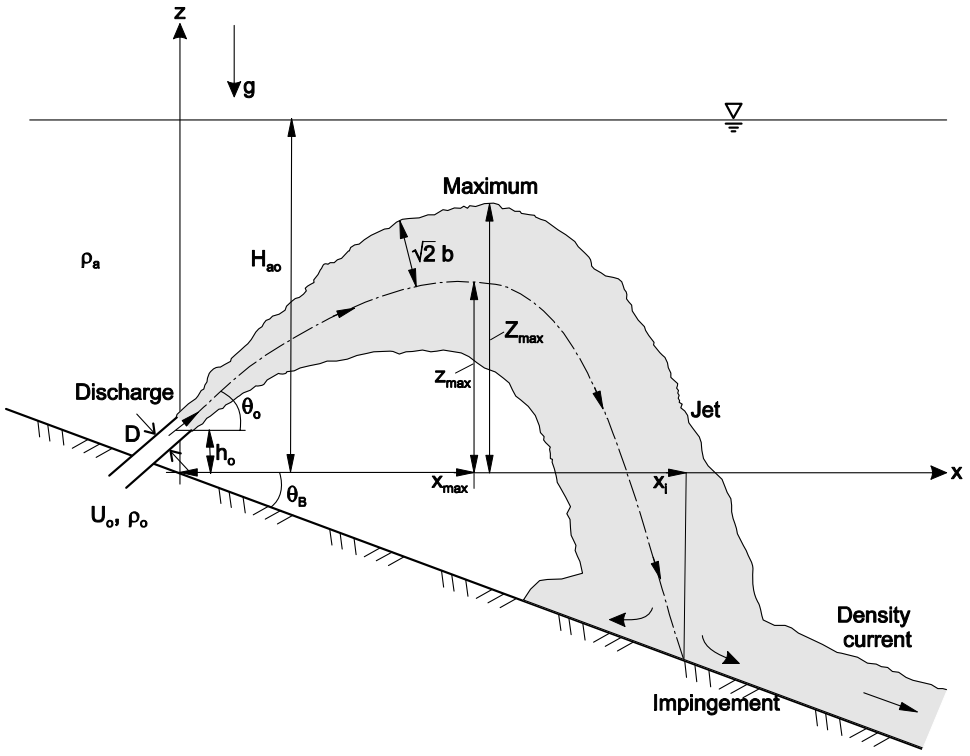


Figure 1.0 Schematic of Negatively Buoyant Brine Discharges (after Jirka, 2007)

Outfall Option # 3 considers a shore-attached surface discharge of brine from a pre-mixing pond where the saturated brine (260 ppt) is diluted to 25 ppt before being released into the river. Numerically, this type of configuration was previously difficult to model in the older versions of Cormix due to limitations in the theory. However, a recent March 2007 release of the model allows negatively buoyant surface discharges to be modeled and includes for the effects of sloping seafloor and bottom density currents. Sensitivity analysis of this model for various surface discharge and ambient conditions are currently underway.

1.1 Shore-Attached Submerged Single Outfall (Option # 1)

Numerical modeling of brine discharge was carried out for a series of discharge end-of-pipe conditions to establish salinity concentrations above ambient at different downstream locations. The brine was considered saturated with a corresponding salinity of 260 ppt and density of 1200 kg/m^3. The general configuration of the shore-attached submerged outfall is presented in Figure 2.0. In order to reduce interaction of the plume with the riverbank, the submerged outfall modeled is located approximately 20 meters from the top of the East Bank with an outfall height of 0.5 meters above the river bottom (geodetic elevation of 3.22 m)

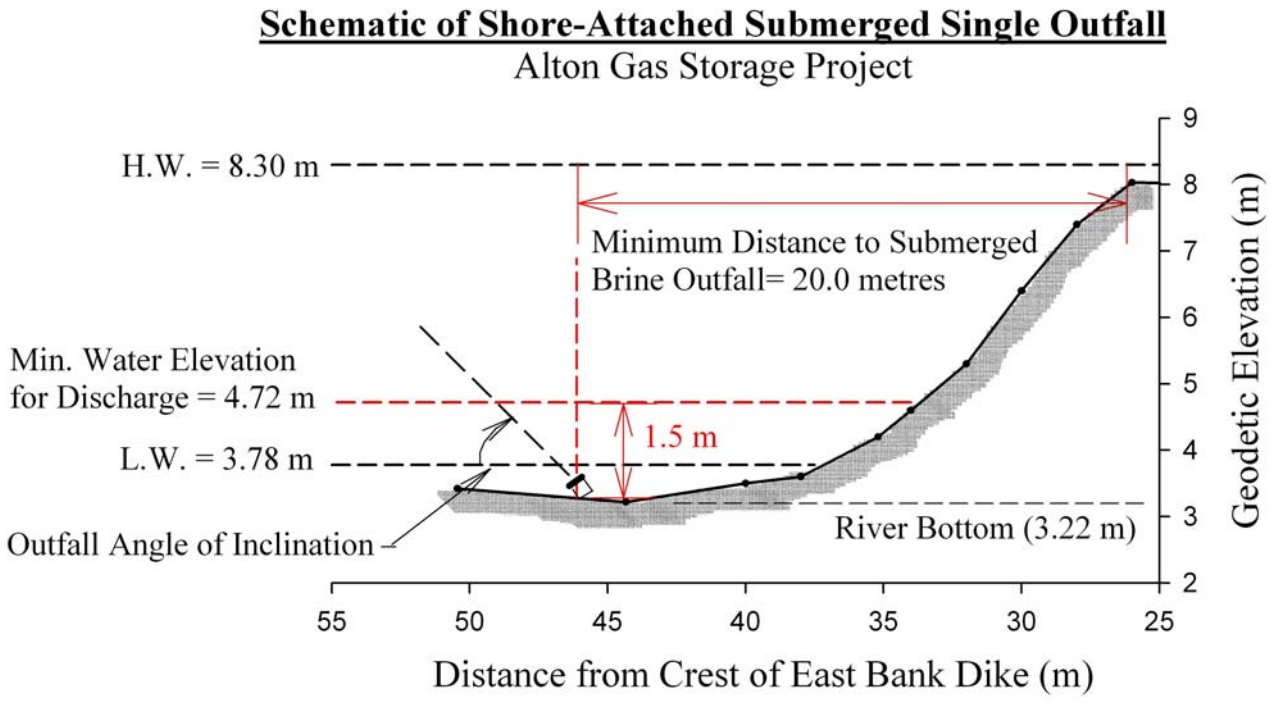


Figure 2.0 Schematic of Shore-Attached Submerged Single Outfall

The end-of-pipe conditions considered are shown in Table 1.0 with saturated brine volume rates of 6,000 m^3/day and 9000 m^3/day mixed with various brackish feedwater dilutions (a total of 6 discharge cases). Three receiving water conditions were considered for each discharge case giving a total of 18 overall discharge cases considered. The receiving water conditions were obtained from the flow and water elevation measurements carried out at the site on November 6 and 30, 2006.

Figure 3.0 depicts the dispersion results for Case 1.0 showing the salinity above ambient as a function of distance downstream for discharge case #1 for the three river conditions A, B, and C identified in Figure 3.0. Similar plots were generated for Cases 2.0 to 6.0. A summary of the results of the analysis for all 18 discharge cases is given in Table 2.0. The bottom three rows in the table give the salinity values (above ambient, S_a = 10 ppt) expected for each case at 10 m, 100 m and 1000 m downstream of the outfall.

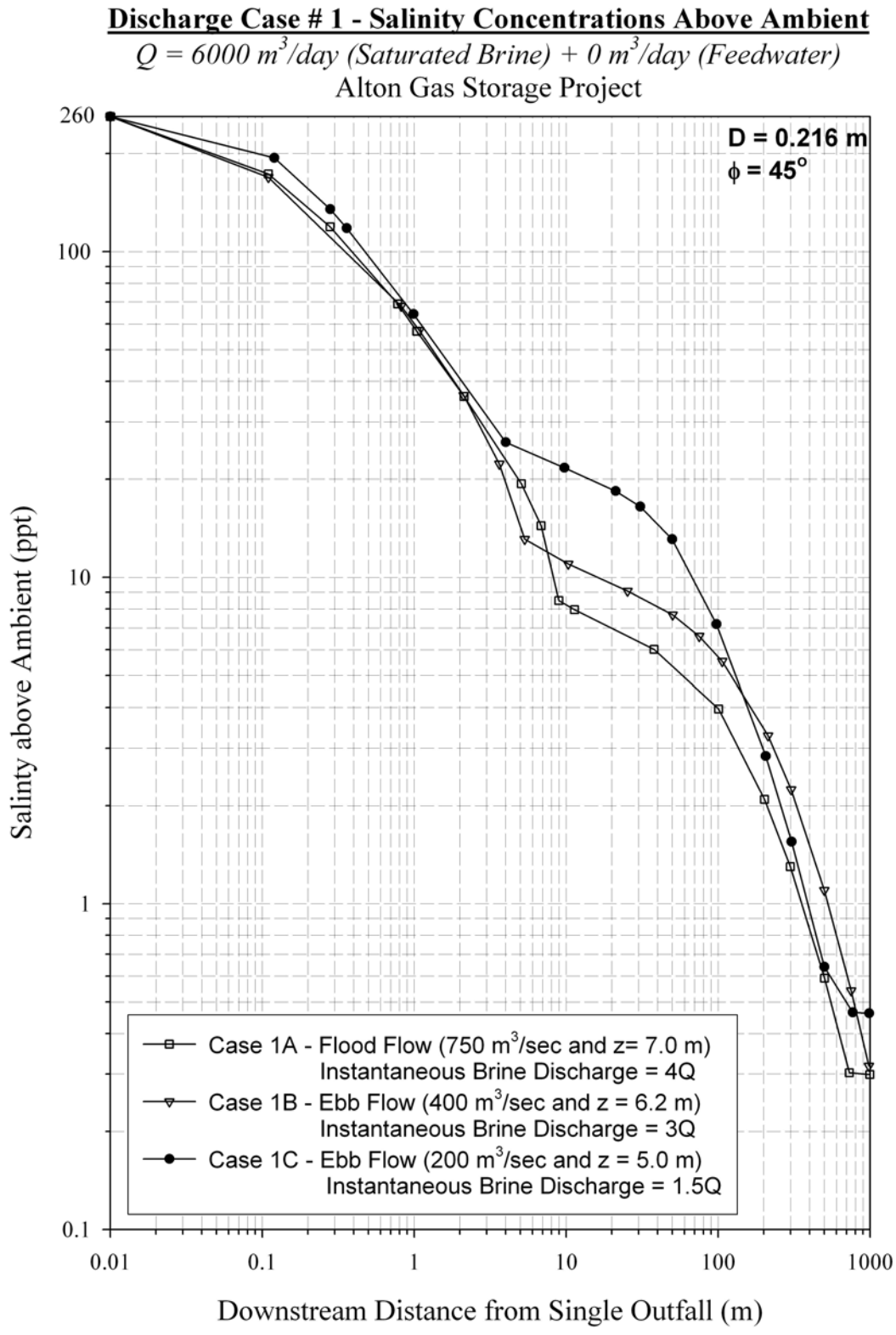


Figure 3.0 Discharge Case #1 – Salinity Above Ambient

Table 1.0 Numerical Water Quality Simulation Cases

End-of-Pipe Discharge Conditions for Various Cases of Saturated Brine Solution Diluted with Brackish River Water (Feedwater)

Discharge Case	1	2	3	4	5	6
Saturated Brine Volume Rate (m^3/day) @260 ppt	6,000	6,000	6,000	9,000	9,000	9,000
Brackish River Water Volume Rate (m^3/day) @10 ppt	0	3,000	6,000	0	4,500	9,000
Total Volumetric Discharge (m^3/day)	6,000	9,000	12,000	9,000	13,500	18,000
Total Volumetric Discharge (litres/sec)	69.4	104.2	138.8	104.2	156.3	208.4
Total Brine Concentration (ppt)	260.0	176.7	135.0	260.0	176.7	135.0
Discharge Density (kg/m^3)	1,200	1,133	1,101	1,200	1,133	1,101

Receiving Water Conditions for each Discharge Case

River Condition A – Flood Flow (750 m^3/sec) and Water Elevation (7.0 m)

River Condition B – Ebb Flow (400 m^3/sec) and Water Elevation (6.2 m)

River Condition C – Ebb Flow (200 m^3/sec) and Water Elevation (5.0 m)

Total Number of Discharge Cases Simulated = 18

A variable brine discharge rate was modeled for each receiving water condition such that during high river flows and elevations greater volumes of brine were released into the receiving waters. Due to the limited water depth at the outfall site, jet velocities exiting the outfall are relatively low, particularly during low water conditions when the brine discharge is throttled back to lower rates. Although the reduced jet velocity prevents interaction with the river surface, it also creates inefficient mixing conditions in close proximity to the outfall. Predicted Froude Numbers for the 18-discharge cases range from 1.5 to 12, well below the recommended range of 20 to 25.

Table 2.0 Summary of Near-field 3-Dimensional Dispersion Modeling Results (Option # 1)

Discharge Case No.	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	6C
Saturated Brine Rate (m3/day)	6000	6000	6000	6000	6000	6000	6000	6000	6000	9000	9000	9000	9000	9000	9000	9000	9000	9000
Feedwater Rate (m3/day)	0	0	0	3000	3000	3000	6000	6000	6000	0	0	0	4500	4500	4500	9000	9000	9000
Total Discharge (m3/day)	6000	6000	6000	9000	9000	9000	12000	12000	12000	9000	9000	9000	13500	13500	13500	18000	18000	18000
Discharge Salinity (ppt)	260	260	260	177	177	177	135	135	135	260	260	260	177	177	177	135	135	135
Outfall Diameter (m)	0.22	0.22	0.22	0.30	0.30	0.30	0.40	0.40	0.40	0.30	0.30	0.30	0.45	0.45	0.45	0.60	0.60	0.60
Discharge Angle (^{o})	45	45	45	40	40	40	35	35	35	40	40	40	35	35	35	30	30	30
River Flow (m3/sec)	+750	-400	-200	+750	-400	-200	+750	-400	-200	+750	-400	-200	+750	-400	-200	+750	-400	-200
Froude Number (dim)	12.0	9.0	4.5	9.9	7.4	3.7	7.4	5.6	2.8	7.9	5.9	3.0	5.4	4.0	2.0	4.1	3.0	1.5
Salinity (ppt) @ 10 m	8.20	11.25	21.41	7.72	9.99	20.31	8.71	11.40	25.81	13.73	18.92	38.70	16.02	21.94	47.41	21.32	26.94	44.12
Salinity (ppt) @ 100m	3.99	5.59	7.10	3.77	5.10	6.80	4.28	5.69	8.17	6.81	10.63	13.75	7.90	11.89	14.74	9.81	14.21	14.33
Salinity (ppt) @ 1000 m	0.30	0.32	0.46	0.30	0.32	0.48	0.32	0.33	0.48	0.38	0.63	0.60	0.39	0.64	0.61	0.40	0.68	0.61

For most discharge cases, diluting the saturated brine with feedwater has a negative effect and tends to increase downstream salinity. The addition of feedwater increases the discharge volume and prevents proper mixing or entrainment with river flows. The relatively large jet is thicker and requires the outfall angle of inclination to be lowered to prevent surface interaction. In addition, jet velocities need to be decreased (by increasing the pipe diameter) to ensure that the plume does not produce a near-surface boil and decreased dilution. This demonstrates that the relatively high rate of brine discharge from a single outfall is not operating efficiently and it is necessary to distribute the flow over several ports (i.e., multiport diffuser) to effectively mix the brine in this shallow water marine environment.

1.2 Shore-Attached Parallel Diffuser (Option # 2**)**

This outfall configuration effectively divides the discharge over several smaller ports that are typically spaced an equal distance along the riverbank. This allows the individual jets to exit the ports at a higher velocity and entrain greater volumes of river water during the turbulent mixing phase. The main disadvantage of a parallel diffuser is that a relatively large separation distance between ports is usually required in order to allow sufficient dilution of the individual plumes before merging into the adjacent port. Because rivers have relatively parallel streamlines of flow, concentrations from the individual plumes are usually additive at a particular downstream location, such that the plume associated with the furthest downstream port has contributions from each of the upstream ports.

An optimized single port with a reduced saturated brine rate of 2,250 m^3/day (with no discharge multiplier) can be jetted without surface interference and have a corresponding Froude number within the recommended range. A discharge multiplier cannot be applied to the single port flows because jet velocities will be too large and cause near-field flow instabilities. Jet velocities greater than 9-10 m/sec should not be exceeded in this marine environment.

Mixing zone variables for the single port analysis are as follows:

- 30 meter Downstream Mixing Zone with a minimum 1:100 dilution at the boundary
  Optimum Configuration: Port Diameter = 60.0 mm
  Port Angle = 35 degrees
  Maximum Allowable Discharge = 2,250 m^3/day (0.02604 m^3/sec)
  Downstream salinities above ambient: See Figure 4.0
  Subsurface negatively buoyant plume with jet velocity of 9.2 m/sec
  Discharge Restrictions: Water Elevations less than 4.8 m Geodetic and near HW slack water

Results show a significant improvement in dilution when compared to option # 1 with salinities less than approximately 2.5 ppt at a downstream distance of 30 meters. This is equivalent to a 1:100 dilution at the boundary of the 30-m mixing zone. For comparative purposes, Figure 4.0 presents the downstream salinity (above ambient) for similar receiving water conditions as Option # 1.

The figure demonstrates the effectiveness of achieving turbulent mixing with a high Froude Number, particularly within the 30-m mixing zone, where regardless of ambient condition, similar salinities are predicted downstream for the three cases. Salinities only begin to diverge at a distance

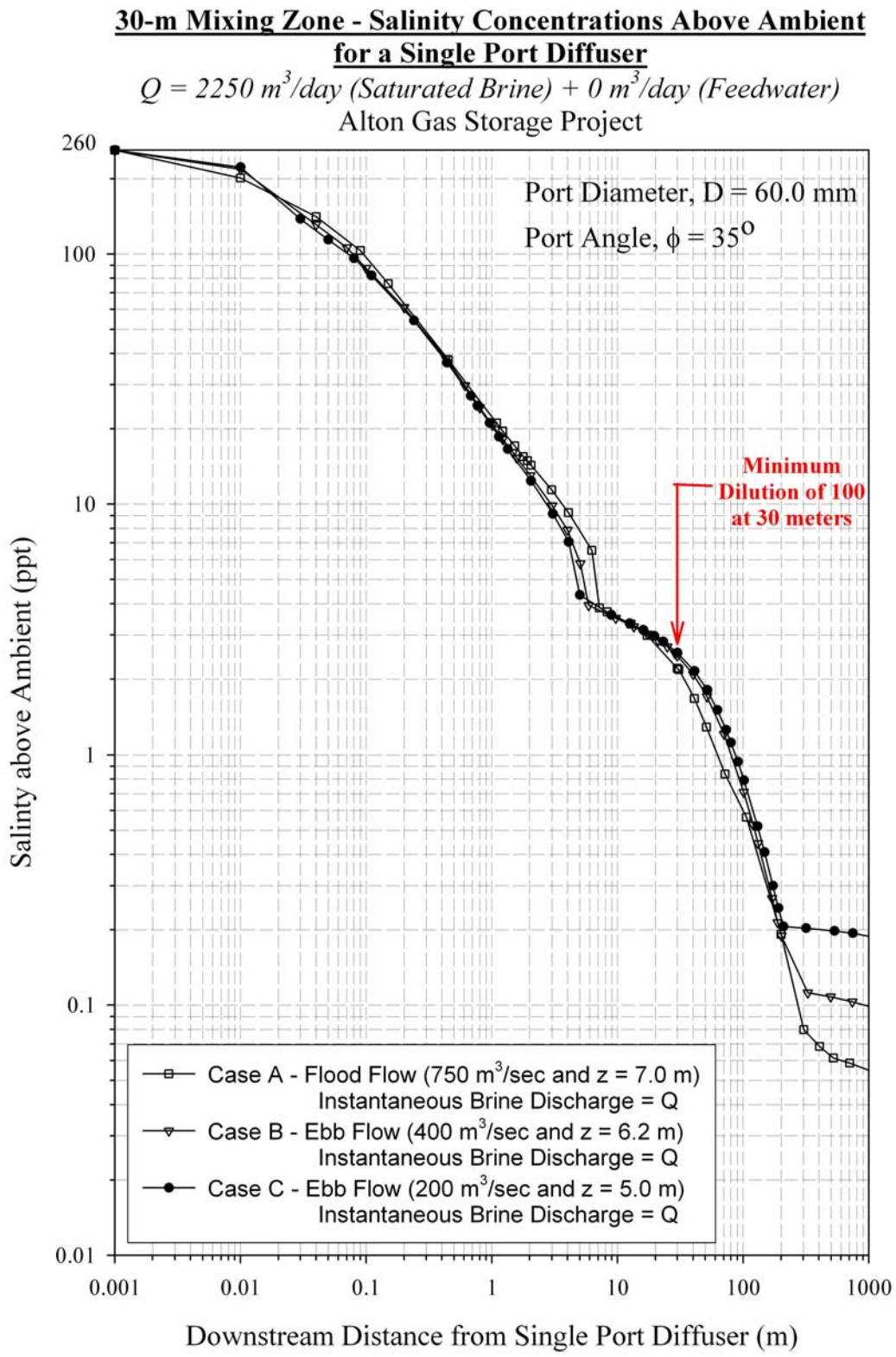


Figure 4.0 Downstream Salinity for Single Port Diffuser

200-m downstream, a location where the buoyant spreading and diffusion processes end and passive ambient diffusion becomes dominant.

Although the single port diffuser results presented in Figure 4.0 is optimized to account for relatively large variations in ambient conditions, further optimization can be carried out by considering dual-staged ports at single locations along the diffuser line. This allows the port to operate more efficiently during particular stages of the tidal cycle (i.e., river flow and water elevation conditions) than a single port. The operation of the dual-stage ports is dependent on the following receiving water conditions:

Stage 1 Port Operates when river elevation exceeds 5.0 m Geodetic (MWL) and current speeds are in excess of 45 cm/sec.

- Optimum Configuration: Port Diameter = 56 mm
  Port Angle = 35 degrees
- Maximum Allowable Discharge = Q = 0.02315 m^3/sec (2000 m^3/day)
- Saturated Brine = 260 ppt

Stage 2 Port Operates when river elevation exceeds 6.2 m Geodetic and current speeds are in excess of 65 cm/sec.

- Optimum Configuration: Port Diameter = 90 mm
  Port Angle = 47.5 degrees
- Maximum Allowable Discharge = 3Q = 0.06944 m^3/sec
- Saturated Brine = 260 ppt

Only one of the dual-stage ports operates at any given time. The increased water elevation and flow in the river during stage 2 conditions allows the port to be designed with a higher brine discharge and angle of inclination than the stage 1 port. The threshold receiving water conditions for the stage 1 and 2 ports are likely the period of time that maximum salinity concentrations will occur downstream of the ports. Greater dilution will occur for the other periods of operation due to increased river flow and water depth. Figure 5.0 presents the maximum salinity concentrations downstream (above ambient, Sa = 10 ppt) for dual-staged port operation from a single location. The ports were optimized for a minimum dilution of 1:100 at the downstream boundary of a 30-m mixing zone.

The associated brine concentrations downstream from a parallel diffuser located along the east bank of the river, with dual-staged ports separated a distance of 100 meters apart, is presented in Figure 6.0. Results from the diffuser analysis show the following:

(1) For a 5-port dual-staged diffuser, maximum salinity concentrations 500 meters downstream of the first dual-staged port (P1) are 1.0 ppt (above ambient) for stage 1 and 1.9 ppt (above ambient) for stage 2 conditions.
(2) Salinities greater than 28 ppt occur within 1-meter of ports for both stages.
(3) Salinities greater than 5.5 ppt occur within 10-meters of ports for both stages.
(4) Maximum salinities 1000-meters downstream of P1 are less than 1 ppt for both stages.
(5) Maximum plume width 1000 meters downstream of P1 is less than 45-meters (from east bank) for both stages.

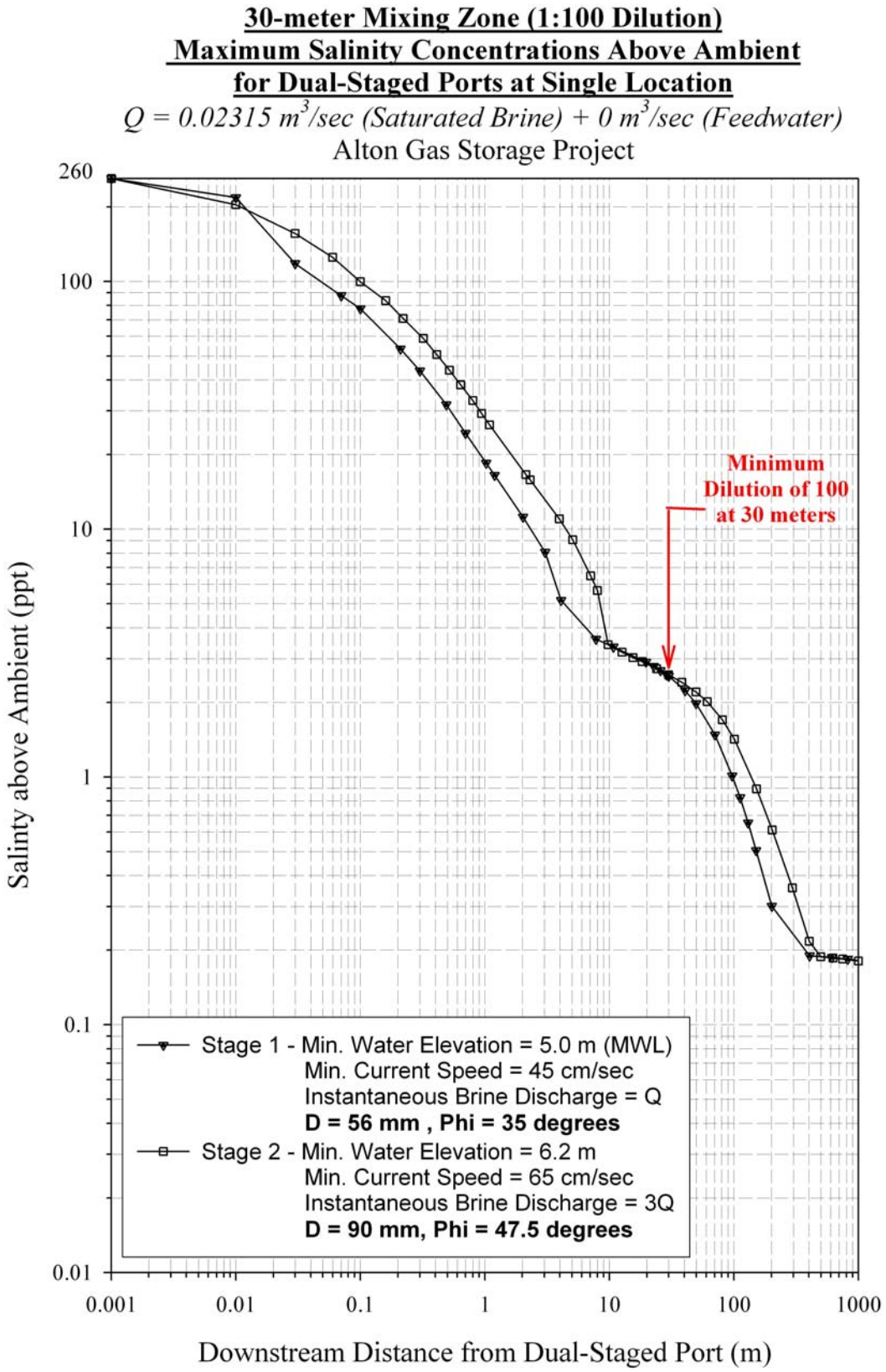


Figure 5.0 Maximum Salinity Downstream of Dual-Staged Ports at a Single Location

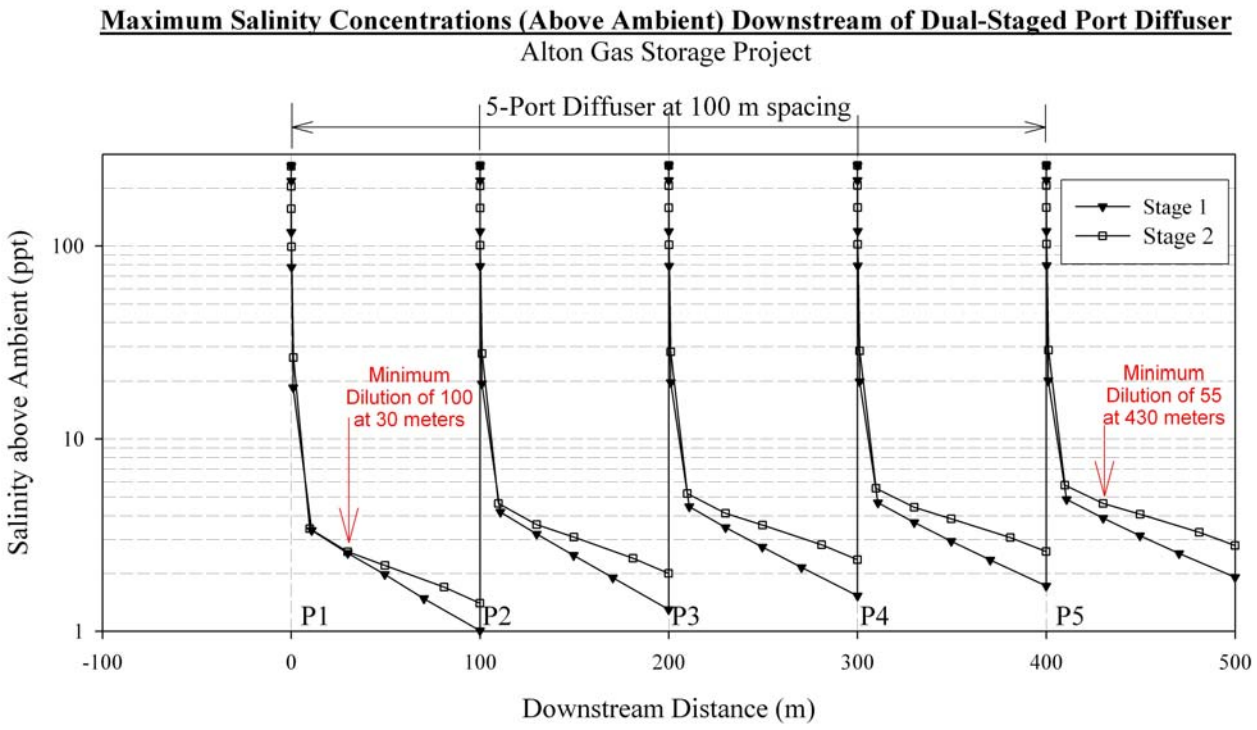


Figure 6.0 Maximum Salinity Downstream of a 5-Port Parallel Diffuser

It is estimated that a cumulative daily discharge of approximately 6,000 m^3/day of saturated brine can be released into the river during flood and ebb flow conditions, given the restrictions for stage 1 and 2 operations. In addition, in order to discharge 6,000 m^3/day of saturated brine during ebb flows only, a total of 9 dual-staged ports are required along the riverbank (800 meter long parallel diffuser).

1.3 Shore-Attached Discharge from Pre-Mixing Pond (Option # 3)

Diluting the saturated brine (260 ppt) in a pre-mixing pond before releasing the brine solution (25 ppt) into the Shubenacadie River reduces the elevated levels of salinity in the near field. In order to pre-mix the saturated brine, a mixing pond will be required of sufficient size to dilute the design discharge of 9000 m^3/day (approximately 4500 m^3 of saturated brine per tidal cycle) to 25 ppt. To estimate the required volume of the mixing pond, simple mass continuity equations must be satisfied, such that

$$(V_{discharge})(S_{discharge}) = (V_{saturated\ brine})(S_{saturated\ brine}) + (V_{mixing\ water})(S_{mixing\ water}) \qquad (1)$$

and,

$$V_{discharge} = V_{saturated\ brine} + V_{mixing\ water} \qquad (2)$$

where, the average salinity of the mixing water ($S_{\text{mixing water}}$) is assumed to be 10 ppt , saturated brine salinity ($S_{\text{saturated brine}}$) of 260 ppt, discharge salinity ($S_{\text{discharge}}$) into the river of 25 ppt, and a saturated brine volume ($V_{\text{saturated brine}}$) of 4500 m^3 pumped into the mixing pond per tidal cycle. Substituting these known variables in equations (1) and (2) above, and solving simultaneously gives a mixing water volume ($V_{\text{mixing water}}$) of 70,500 m^3 at 10 ppt and a total discharge volume ($V_{\text{discharge}}$) of 75,000 m^3 at 25 ppt.

Because the water level in the mixing pond will be designed to mimic the water elevation in the river (as described in the pond operations section by Matrix Solutions Inc.), the volume of brine solution discharged into the river will vary depending on the stage of the tide (small or large tidal range). The salinity of the pond will vary with the tidal range, and will be designed to achieve a salinity of 25 ppt for a small tidal cycle resulting in a salinity of less than 25 ppt for mean and large tidal cycles. If the pond is designed to discharge approximately 75,000 m^3 of brine solution for the small tide, then it is estimated that approximately 100,000 m^3 of brine solution will be discharged during the medium tide and 125,000 m^3 for the large tide. Operational controls that continually monitor these variables are essential to ensure that a salinity of 25 ppt or less is discharged into the river.

Due to the rapid rise and fall of the tide at the proposed outfall site, the majority of the volume of water contained in the mixing pond will be released during ebb flow over a fairly short period of time. This will allow the brine solution to be released into the river during the early stages of ebb flow when river flows are the largest. This not only provides greater volumes of river water for initial dilution but also allows a portion of the remaining ebb flow period to effectively flush the brine out of the Shubenacadie River and into Cobequid Bay. Modelling of the river would determine the residence time of brine in the river.

Preliminary near field dispersion modeling of brine discharged from the mixing pond has been carried out for the following conditions:

Small Tide

River Conditions	Small Tide (High Water Elevation of 6.0 m Geodetic)
	River Flow = 170 m^3/sec
	Depth = 1.8 m
	Salinity = 15 ppt (at time of discharge)
Discharge Conditions	Total Brine Volume = 75,000 m3
	Discharge Rate = 5.95 m^3/sec for 3.5 hours
	Salinity = 25.0 ppt (Excess Salinity = 10 ppt)
	Rectangular Outfall = 10-m wide by 1.8-m deep

Mean Tide

River Conditions Mean Tide (High Water Elevation of 7.0 m Geodetic)
River Flow = 300 m^3/sec
Depth = 2.4 m
Salinity = 15 ppt (at time of discharge)

Discharge Conditions Total Brine Volume = 101,787 m3

Discharge Rate = 8.08 m^3/sec for 3.5 hours
Salinity = 21.1 ppt (Excess Salinity = 6.1 ppt)
Rectangular Outfall = 10-m wide by 2.4-m deep

Large Tide

River Conditions Large Tide (High Water Elevation of 8.0 m Geodetic)
River Flow = 500 m^3/sec
Depth = 3.0 m
Salinity = 15 ppt (at time of discharge)

Discharge Conditions Total Brine Volume = 128,573 m3
Discharge Rate = 10.20 m^3/sec for 3.5 hours
Salinity = 18.8 ppt (Excess Salinity = 3.8 ppt)
Rectangular Outfall = 10-m wide by 3-m deep

Figure 7.0 presents the preliminary brine dispersion results for the small, mean and large tidal conditions in terms of salinity above ambient at various downstream locations. For the three tidal ranges considered, the total volume of saturated brine (260 ppt) pumped into the mixing pond was 4500 m^3 per tidal cycle. The dispersion analysis represents a "snapshot" of salinity above ambient (S_a = 15 ppt) downstream of the rectangular outfall during ebb flow at a period in time of approximately 1.5 hours after the high tide flow reversal.

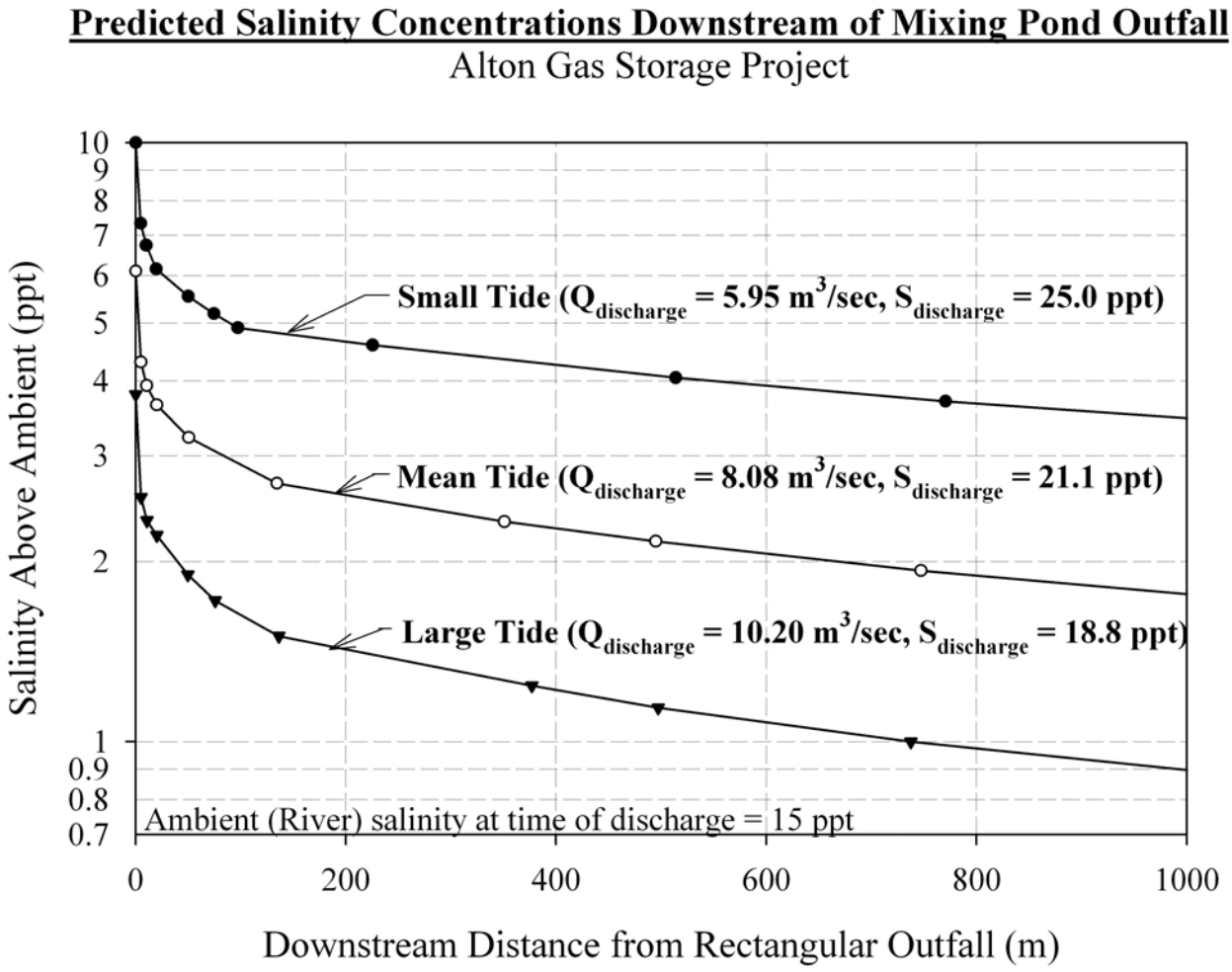


Figure 7.0 Preliminary Brine Dispersion Results

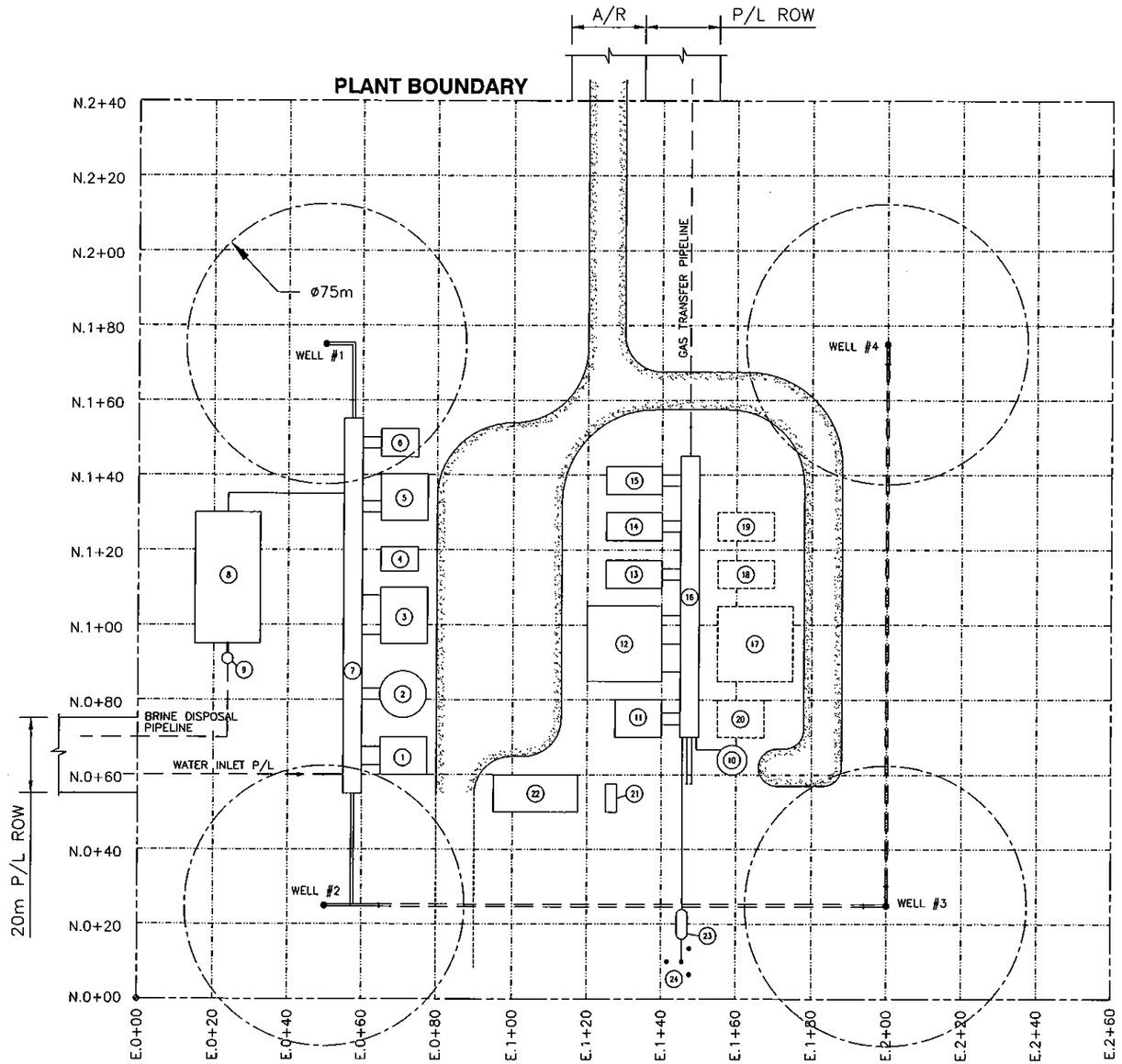
Results from the preliminary near field dispersion analysis show the following:

1) The decay of brine in the near field is most rapid within 100-meters of the outfall (dilution of approximately 2 for the three tidal conditions), beyond this point the decay is more gradual. Predicted salinities above ambient at a downstream distance of 1000-m from the outfall is 3.4 ppt, 1.74 ppt and 0.89 ppt for the small, mean, and large tidal conditions, respectively.
2) For the three tidal conditions, the plume becomes attached to the east bank a short distance downstream of the outfall. Due to the momentum of the brine discharge, the plume initially extends into the river a distance of approximately 20 –m and then decreases to a width of 10-m approximately 150 meters downstream. From this location, the plume gradually begins to increase in width (from the east bank) to approximately 20 meters at a distance 1000-m downstream.
3) Preliminary modeling results show the plume becomes vertically mixed within 250-m of the outfall. Worst-case scenarios associated with low river flows and higher discharge salinities will be investigated.

The model scenario presented above assumes a constant discharge from the mixing pond for a period of 3.5 hours after flow reversal, whereas the actual discharge will likely last for a longer time period. In reviewing the water elevation and flow measurements at the proposed outfall site, ebb flowing water begins not at high tide but usually 20 to 30-minutes after high tide. During this period, river water can drop up to 1.0-m in elevation depending on tidal flow condition. This means that when the water elevation begins to fall in the mixing pond, river water is still flooding upriver and could cause the brine to be dispersed with the flood flows until reversal occurs. Careful modeling of the pond hydraulics and river flows would define the details of the interactions occurring at the outlet during the release period and allow any required modifications to the pond/river interface to be carried out.

APPENDIX D

Preliminary Designs of the Surface Facility



PLANT NORTH
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EQUIPMENT LIST

ITEM	DESCRIPTION
1	DE-AERATOR PACKAGE
2	INLET WATER SURGE TANK
3	WATER INJECTION BUILDING
4	LEACHING FACILITIES MCC & ELECTRICAL BUILDING
5	INJECTION HEADER & METERING BUILDING
6	NITROGEN GENERATOR
7	LEACHING PLANT PIPE RACK
8	BRINE RETENTION POND
9	BRINE DISPOSAL PUMP & SUMP
10	WASTE WATER TANK
11	WELL METER / SEPARATOR BUILDING
12	GAS HANDLING COMPRESSOR BUILDING
13	DEHYDRATOR #1
14	DEHYDRATOR #2
15	GAS TRANSFER METER BUILDING
16	GAS HANDLING FACILITIES PIPE RACK
17	FUTURE GAS HANDLING COMPRESSOR BUILDING #2
18	FUTURE DEHYDRATOR #3
19	FUTURE DEHYDRATOR #4
20	FUTURE WELL METER / SEPARATOR BUILDING
21	GAS HANDLING FACILITIES MCC & ELECTRICAL BUILDING
22	OFFICE & CONTROL ROOM
23	FLARE KNOCK-OUT
24	EMERGENCY FLARE STACK

REFERENCE DRAWINGS	DRAWING NO.

NOTES:

NO.	REVISION	BY	DATE	CHKD.
A	ISSUED FOR APPROVAL	BL	06-11-09	

SEAL: PERMIT:

SOLTECH ENGINEERING INC.
#280, 5920 1A STREET S.W.
CALGARY, ALBERTA
T2H 0G3
(403) 263-6773

CLIENT
ALTON NATURAL GAS STORAGE LP

TITLE
SALT CAVERN STORAGE FACILITY
PLOT PLAN

SCALE	PROJECT NO.	DRAWING NO.	REV.
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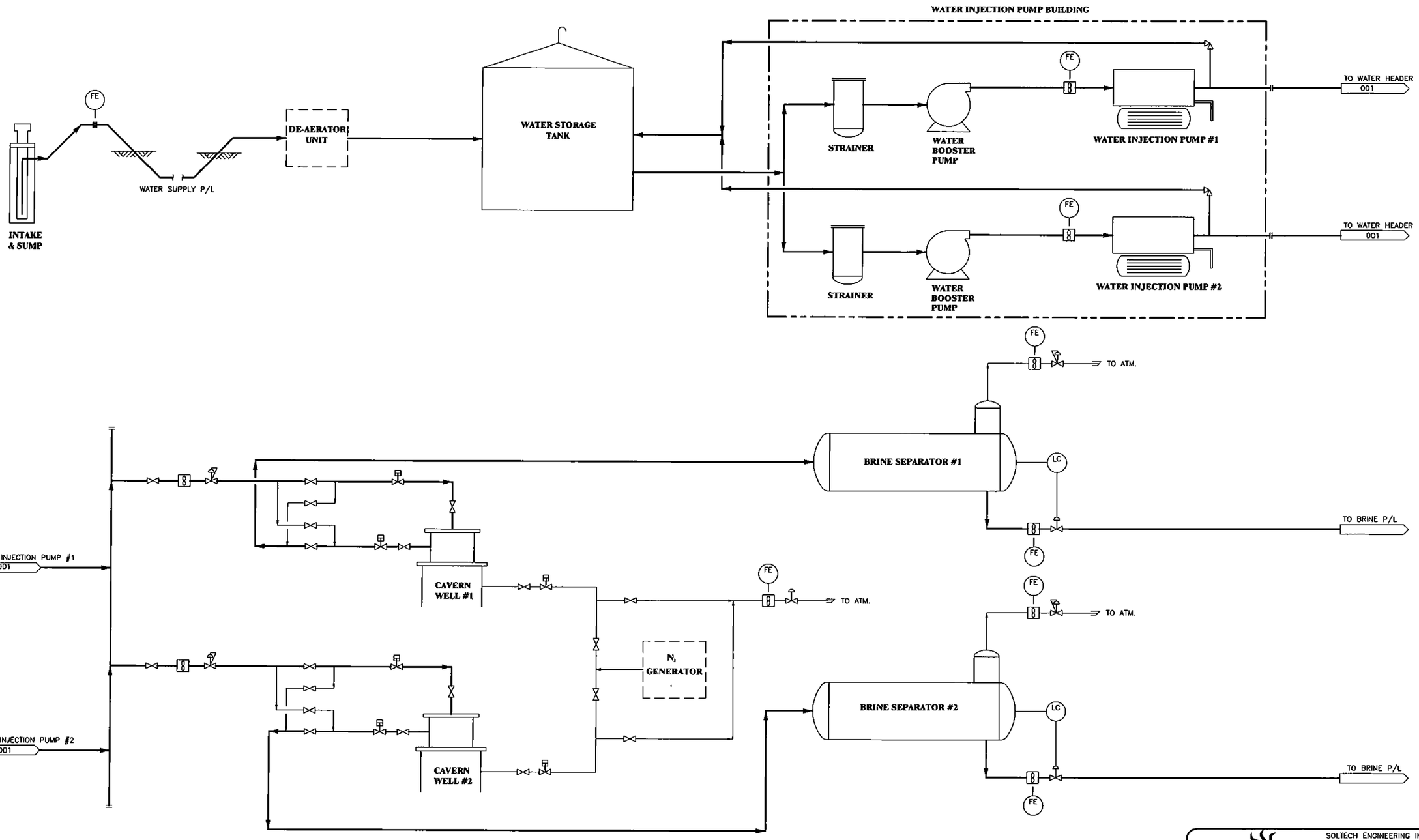

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CLIENT: ALTON NATURAL GAS STORAGE LP

TITLE: CAVERN DEVELOPMENT FACILITIES

PROCESS FLOW DIAGRAM

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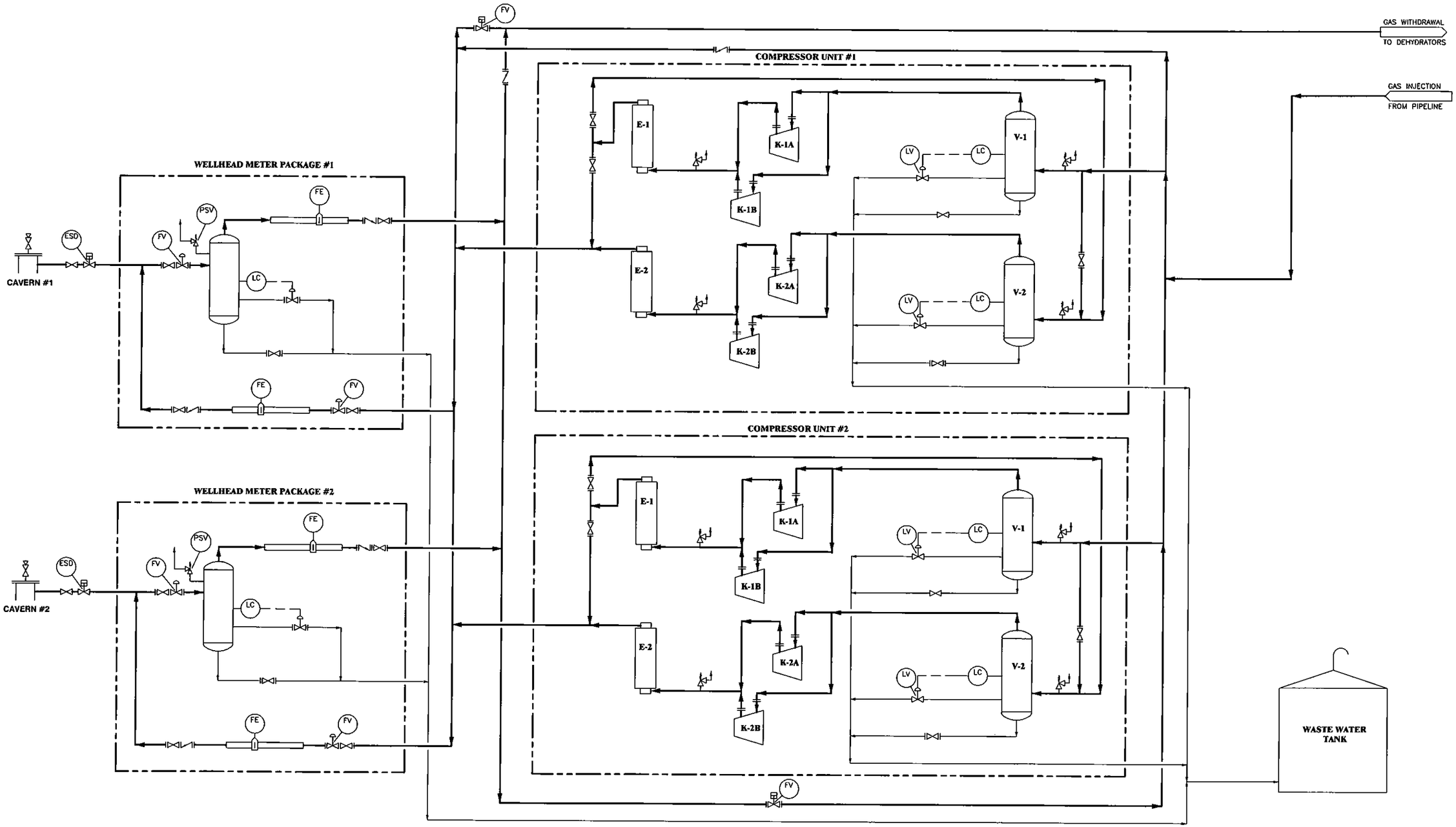

REFERENCE DRAWINGS	DRAWING NO.

NOTES:

NO.	REVISION	BY	DATE	CHKD.
A	ISSUED FOR APPROVAL	VK	06-07-14	QS

SEAL: PERMIT.

SOLTECH ENGINEERING INC.
#280, 5920 1A STREET S.W.
CALGARY, ALBERTA
T2H 0G3
(403) 263-6773

CLIENT: ALTON NATURAL GAS STORAGE LP

TITLE: GAS HANDLING FACILITIES

PROCESS FLOW DIAGRAM

SCALE	PROJECT NO.	DRAWING NO.	REV.
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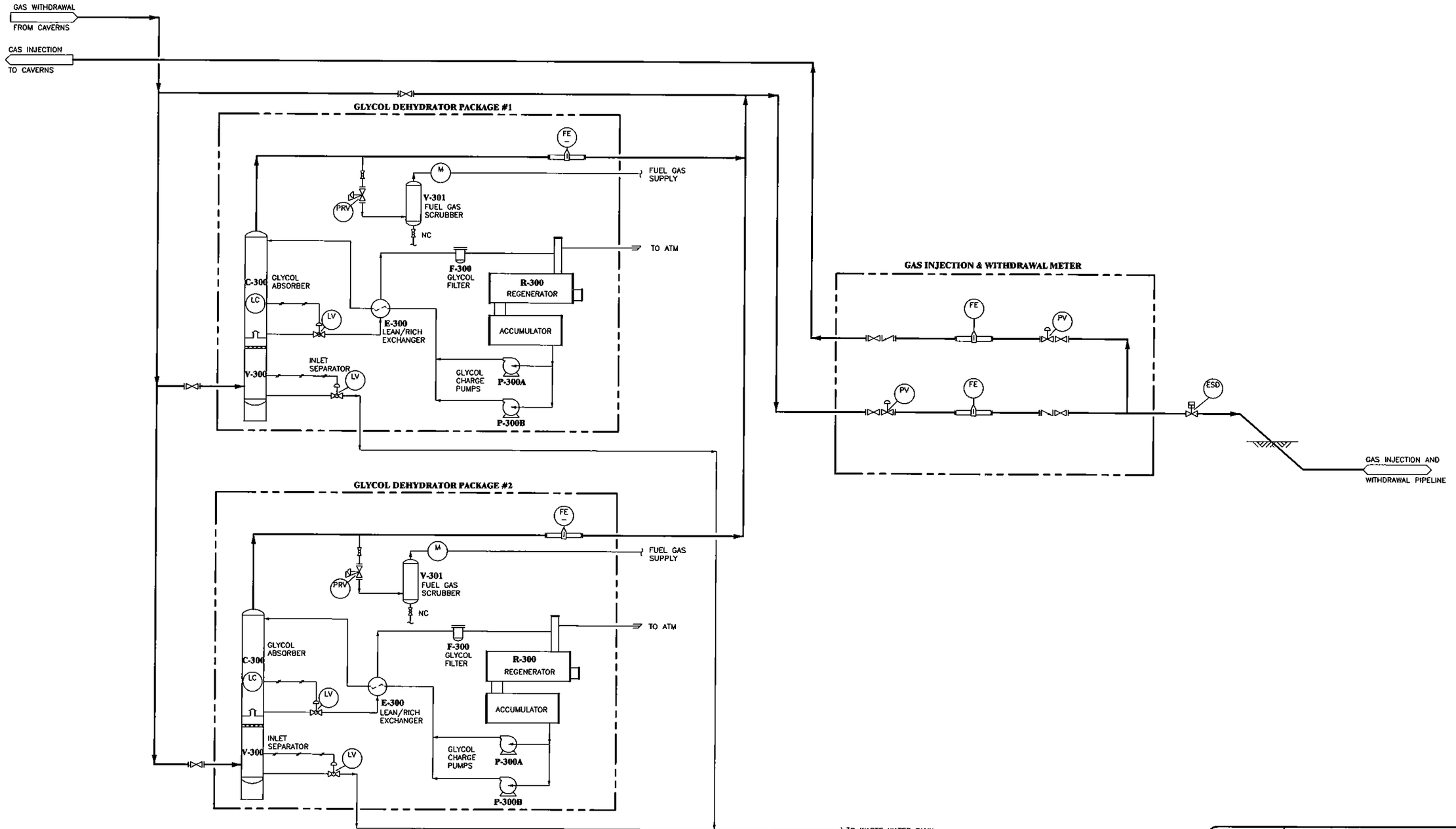

REFERENCE DRAWINGS	DRAWING NO.

NOTES:

NO.	REVISION	BY	DATE	CHKD
A	ISSUED FOR APPROVAL	VK	06-07-14	QS

SEAL:

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PROCESS FLOW DIAGRAM

SCALE	PROJECT NO.	DRAWING NO.	REV.
NTS	102-01-00	003	A

APPENDIX E

Injection Zones Discussion

Alton Natural Gas Storage

Injection Zones Discussion

For

Landis Energy Corporation

by

Hitchner Exploration Services Ltd.

Calgary, Alberta
January 2007

Alton Gas Storage - Injection Zones

The well log data from three wells, Alton-06-01, Alton 99-01 and Cloverdale #1 were analyzed to find appropriate zones for potential use as brine injection zones. The well log information was incomplete. Based on well log quality and availability of information, as well as concern for potential potable ground water contamination, all zones in the three wells shallower than the main salt zone were not considered.

The Alton 99-01 well had reasonable well log data below the salt where there appeared to be some presence of zones with porosity. The attached Figure 1 is a well analysis summary plot for Alton 99-01. The second column from the right hand side of the plot shows the analysis porosity scaled from 0.2 to 0.0 in fractional porosity units.

The zone from approximately 1012 to 1050 m. appears to have the best-calculated porosity (maximum 9% porosity) and would be the most likely candidate for fluid injection. The concern with using this zone would be pore capacity as well as zone permeability. The zone is comprised of highly cemented sand and expectations would be that the permeability would be low (less than 10 mD) which means injection pressures would need to be high to over come the permeability. The maximum porosity averaging 9% suggests that the zone just doesn't have the pore capacity to accept large volumes of injected fluid.

For contrast there are wells in the heavy oil belt of the Western Canadian Sedimentary Basin (WCSB) that have Lower Mannville Ellerslie water bearing sandstone zones that average 32% porosity with 1 Darcy permeability and zone thickness exceeding 20 meters. Those are the types of formation zones that are required for meaningful injection schemes.

Another WCSB example would be the Viking sandstone of Southern Alberta. Figure 2 is an analysis example of potential injection zones where the porosity approaches 30% with reasonably high permeability. Even the Viking zones of this well would be superior candidates for brine injection compared to the zones below 1010 m. of Alton 99-01.

Conclusion

Analysis of available well log data from Alton-06-01, Alton-99-01 and Cloverdale #1 and comparison with known injection wells from WSCB suggest that there are no potential zones that are realistically capable of being used for brine injection in any of the three wells.

Figure 1 – Well Analysis Summary Plot for Alton 99-01

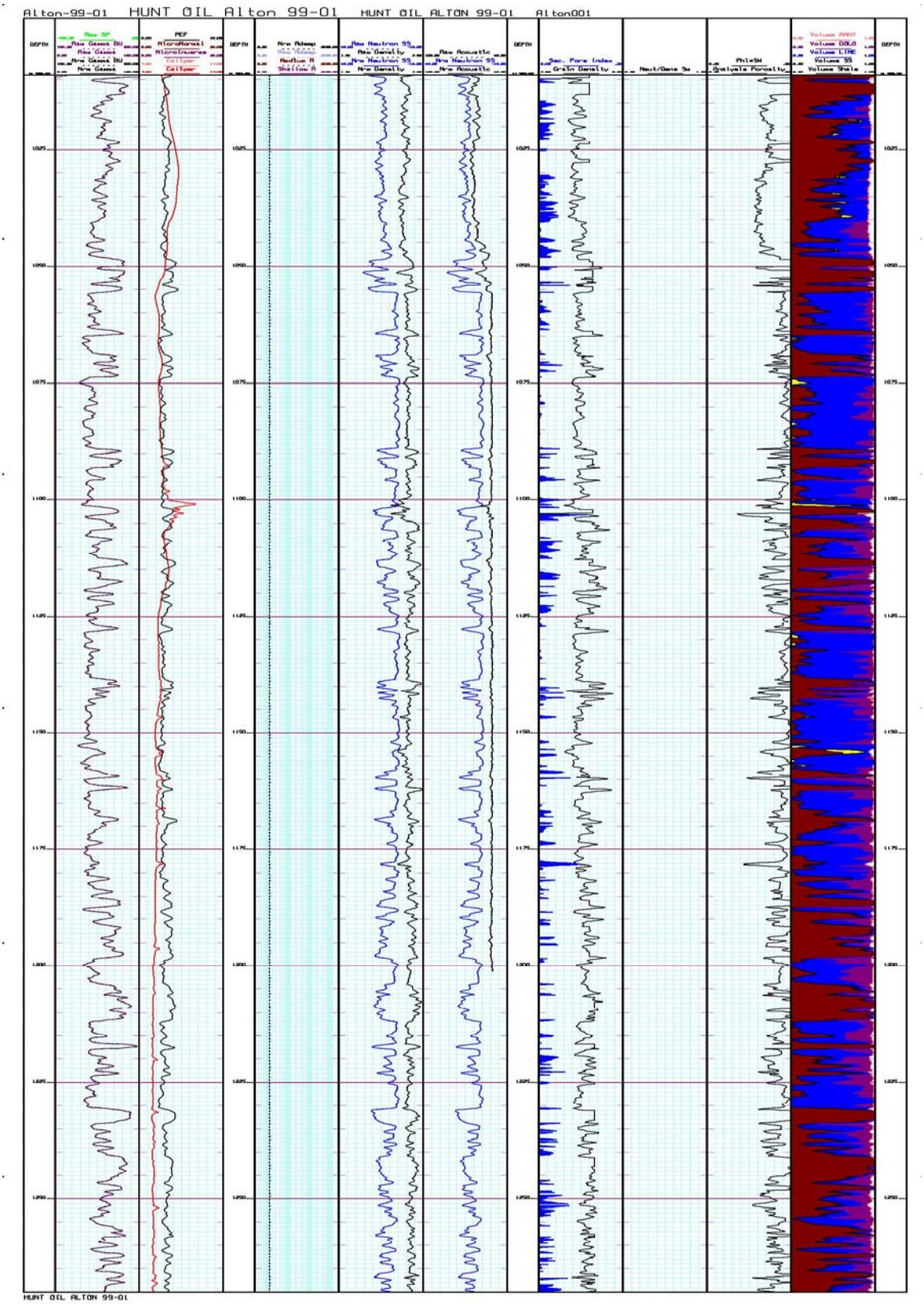
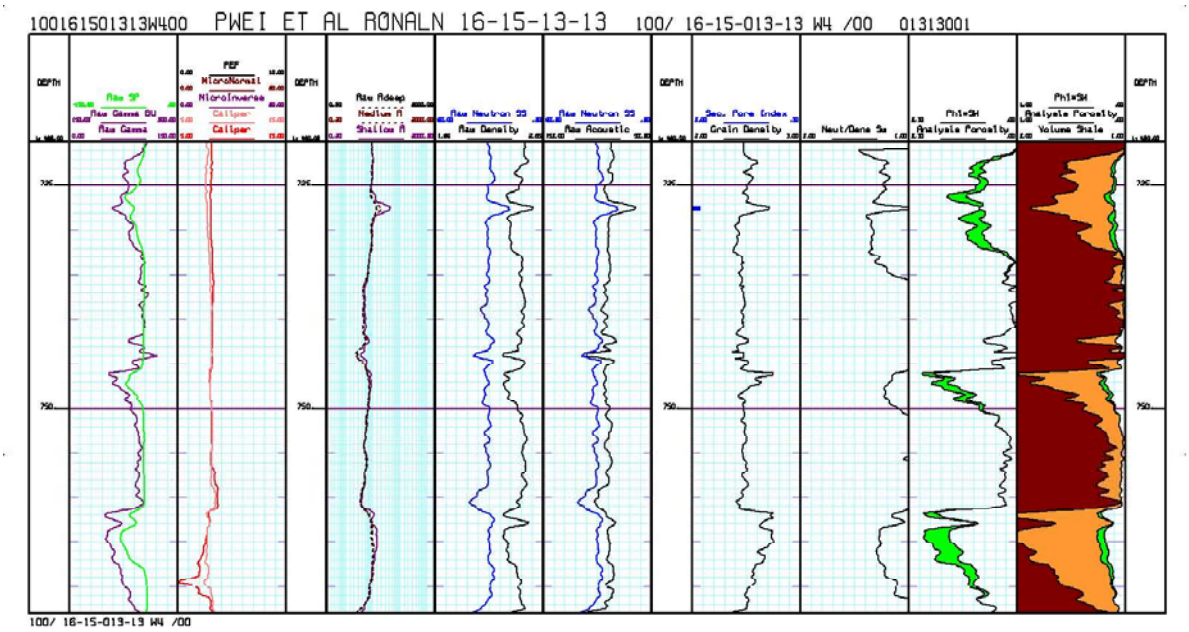


Figure 2 – WSCB - Viking Example



Analysis Summary for Alton 99-01

The analysis summary plots provide a visualization of the parameters derived in the analysis.

The plots are organized as columns of data separated by depth columns for ease of reference. Columns are numbered and described from left to right across the plot

Data Column 1 - Gamma Ray

This column plots the gamma ray data before and after normalization. The gamma ray is scaled from 0 to 150 (150-300 back up) and plotted in black with the solid line representing the data after normalization and the dashed line representing before normalization.

Data Column 2 – Caliper, PEF & Microlog

The X and Y caliper are scaled from 7” to 17" and are plotted in light and dark red. The micro-normal is plotted in brown and the micro-inverse is plotted in purple and are scaled 0 to 20 ohm-m. The micrologs are not present on every well but when they do exist; positive microlog separation indicating permeability is highlighted in red. The PEF curve is plotted in black and scaled from 0 to 10.

Data Column 3 - Resistivity

This column plots the deep reading resistivity data. There was no resistivity data available so an arbitrary value of 1 ohm-m. was assigned to all depth levels and this is shown as a vertically dashed line on a logarithmic column scaled from 0.2 to 2000. ohm-m.

Data Column 4 - Neutron and Density

This column plots the bulk density and sandstone neutron before and after normalization. The bulk density is scaled from 1.91 to 2.90 g/cc. (45% to -15% sandstone porosity) and is plotted in black with the solid line representing the data after normalization and the dashed line representing before normalization. The neutron is scaled from 45% to -15% in sandstone porosity units and is plotted in blue with the solid line representing the data after normalization and the dashed line representing before normalization.

Data Column 5 - Neutron and Acoustic

This column plots the acoustic before and after normalization and the normalized sandstone neutron. The acoustic is scaled from 100 to 40 microseconds/ft. and is plotted in black with the solid line representing the data after normalization and the dashed line representing before normalization. The normalized neutron is scaled from 45% to -15% in sandstone porosity units and is plotted in blue.

Data Column 6 – Grain Density & Secondary Porosity Index using Neutron/Density

Column 6 plots the apparent grain density calculated from a neutron vs. density cross plot analysis. This curve is plotted in black and scaled from 2.5 to 3.0 g/cc. Normal sandstone will read between 2.65 and 2.68 g/cc. Limestone will read 2.71 g/cc. and dolomite will read 2.87 g/cc. A mixture of sand and dolomite to the logs might calculate as an apparent grain density of limestone.

The Secondary Porosity Index is also plotted in this column in blue with blue shading. The curve is scaled from 0 to 0.20 fractional porosity units and is used to indicate apparent vugs, fractures and/or dual porosity systems. It is a measure of the contrast of the neutron-density porosities to that of the acoustic log. .

Certain zones have definable secondary porosity indexes, which suggest the presence of fracturing. How extensive the fracture systems are and how useful these systems would be for brine injection is indeterminate

Data Column 7 – Conventional Water Saturation using Neutron/Density

This column plots the water saturations derived from conventional methods. The water saturation is plotted in black and is scaled from 0 to 1.00 in fractional units. Since there was no resistivity data available, water saturations were not determined.

Data Column 8 – Conventional Porosity Analysis using Neutron/Density

This column plots the porosity scaled from 0.2 to 0.0 fractional units along with the bulk volume water or phi*Sw product. The porosity was developed using shale corrected neutron and density values. The shale corrections were based on the gamma ray log.

The porosity analysis was ‘free run’ in that no attempt was made to exclude extremely enlarged borehole.

Data Column 9 – Bulk Volume Analysis

This column plots a representation of the bulk volume analysis of the rocks. The scaling is from 0 to 1.0 in fractional units. The dark brown shading represents the apparent volume of shale as determined from the gamma ray. The yellow shading represents the apparent sandstone rock matrix volume. The dark blue shading represents the apparent limestone rock matrix volume. The dark purple shading represents the apparent dolostone rock matrix volume. The light red shading represents the apparent anhydrite rock matrix volume. The remainder of the plot shows the apparent porosity.

APPENDIX F

Brine Consumption Study

BRINE CONSUMPTION STUDY

PREPARED FOR

ALTON NATURAL GAS STORAGE L.P.

ALTON, NOVA SCOTIA SITE

Prepared by:

Don Dickie & Associates

Sackville, New Brunswick

February 8, 2007

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FIGURES, TABLES & CHARTS

INTRODUCTION:

Alton Natural Gas Storage L.P. is preparing to develop salt cavern storage for natural gas at its property near Alton, Nova Scotia. After acquiring necessary approvals, the project contemplates moving forward with the drilling of an initial four wells, installation of a fresh (leaching) water delivery pipeline, leaching plant and brine disposal system. Depending on the level of demand for gas storage, additional drilling and leaching may continue over a ten year time frame, resulting in up to twenty caverns with an individual storage capacity of one bcf/cavern or 20 bcf in total.

To create these storage caverns, bedded salt formations will be leached with the resultant production of salt brine over the entire ten year period. Alton has contracted Don Dickie & Associates (Appendix) to evaluate alternatives to disposal of this brine into the local marine environment. This evaluation is restricted to those practices currently utilized within the province and it's regions in general, and which are conventional, practical and reasonable.

Three options are presented accompanied by the relative costs, timing, volumes, benefits and downsides. They are as follows:

OPTION 1:

Supply Alton brine to the two major Nova Scotia-based commercial producers.

a) Sifto Canada Corp. located at Nappan produces high grade salt products from its salt solution mining and evaporation facility. Bedded salt formations are dissolved through fresh water injection to generate concentrated brine through a process very similar to that contemplated for Alton.
b) The Canadian Salt Company Limited located at Pugwash produces both rock salt and evaporated salt. Dry mining is conducted within

underground salt formations. Primary crushed material is hoisted to the surface and further upgraded for highway de-icing and chemical production end uses. A portion of this material is further converted to brine and refined through the facility's evaporation plant.

OPTION 2:

Supply Alton brine to municipal and provincial public works departments.

Those groups responsible for maintaining the winter roads and highways are increasingly using salt brine in anti-icing and pre-wetting applications. These brines are currently being produced for the most part at the maintenance yards by dissolving rock salt in specially designed agitator and dissolving systems and storing the brine on-site for on-demand use.

OPTION 3:

Produce evaporated salt for commercial sale.

Construct a salt brine receiving facility, evaporation plant with compaction, crushing & screening systems and a shipping terminal (similar to Sifto Canada and The Canadian Salt Company Limited) for the purpose of producing salt for commercial use and sale. Several volume capacities will be evaluated.

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to the many companies and individuals who made themselves available for discussion and consultation (Appendix).

The material contained herein was derived through the following sources:

- Landis Energy Corporation and its Alton project consultants.
- Personal communication with several individuals from: (Appendix).
    - Sifto Canada Corp., Compass Minerals International.
    - The Canadian Salt Company Limited.
    - Town of Amherst.
    - Halifax Regional Municipality.
    - Nova Scotia Department of Transportation and Public Works.
    - Whiting Equipment Canada Limited
- Internet and literature review. (Appendix).
- The writer's direct experience and background from working within the industry.

DISCLAIMER

The intent of this study is to provide general information as a platform for more detailed analysis if warranted. It is not intended as a detailed reference, guide or suggestion to be used in trading or investment. The author makes no warranty of any kind with respect to the content and accepts no liability, either incidental, consequential, financial or otherwise, arising from the use of this information.

EXECUTIVE SUMMARY

- The Alton project is expected to generate up to 10,000 m^3 of brine/day. Initially brine production rates will be much lower, and the brine will be undersaturated with salt.

- Evaporation facilities at Nappan and Pugwash consume saturated brine at an average combined rate of 1,560 m^3/day. Cost of brine generation is low while brine quality and supply are well established and secure.
  Freight cost for delivering brine from Alton to the Nappan and Pugwash producers is estimated at up to 13 times the cost of those experienced by these producers on-site. In addition, interruption of supply, brine saturation and quality are concerns.

- Use of brine within Nova Scotia for pre-wetting of highways during the winter season is gaining momentum. According to sources polled, total consumption in the province will likely top out at 2,200 to 2,800 m^3/year.
  The potential market for Alton brine as a pre-wetting supply is very small and represents less than one day of Alton production per year. It may be attractive to local users or larger users who can make a case for the freight cost versus in-house production.

- A scenario of building an evaporator plant complete with downstream equipment and storage was considered. On a capital and operating cost basis alone, such a facility cannot compete with the established producers. In addition the current markets are saturated and volumes such as those contemplated from Alton are excessive when compared to even national volumes for evaporated salt. If converted to a rock salt equivalent a number of factors continue to overwhelm an Alton production scenario.

In conclusion, this study illustrates that use of Alton brine in any commercial application is restricted to very small volumes only. The various scenarios presented do not offer a viable means for usage of the project brine other than in very limited amounts. It is the writer's opinion that marine disposal of brine represents the only practical means of addressing cavern development and the related brine generation from this activity. It is recommended that the project developer focus its studies in that area of environmental assessment.

PROJECT ASSUMPTIONS TIMETABLE

- Begin with development of four caverns; time frame 28 months to completion.
- Day 1 – Commence drilling well #1.
- Day 30 – Brining well/cavern #1 @ 1500m^3 /day.
- Day 50 – Four wells drilled.
- Day 60 – Brining all four caverns @ 6,000m^3/day.
- Day 150 – Peak brine generation @ 10,000 m^3/day.
- 28 months – Four caverns at target volume. 500,000 tonnes of salt removed from each, storage capacity 1 bcf gas/cavern.
- 28 months to 10 years – Next four wells drilled and leaching @ 10,000 m^3/day. To continue with similar development for up to 10 years resulting in 20 storage caverns.

* Unless designated otherwise, all units of measure in this report employ the metric system.

ALTON TYPICAL SALT CAVERN SATURATION PROFILE

(REPRODUCED FROM SOLTECH DOCUMENT)

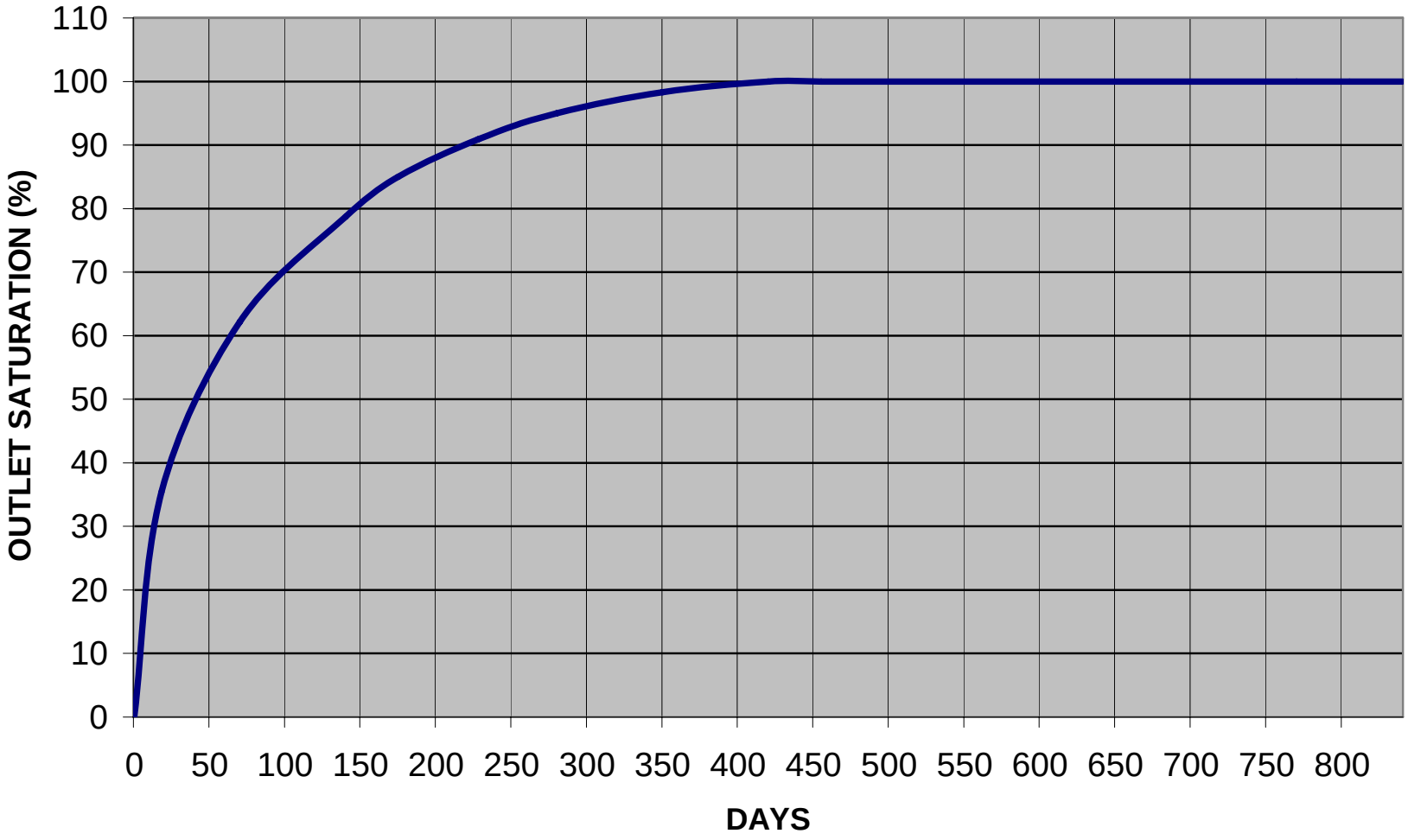

Figure 1

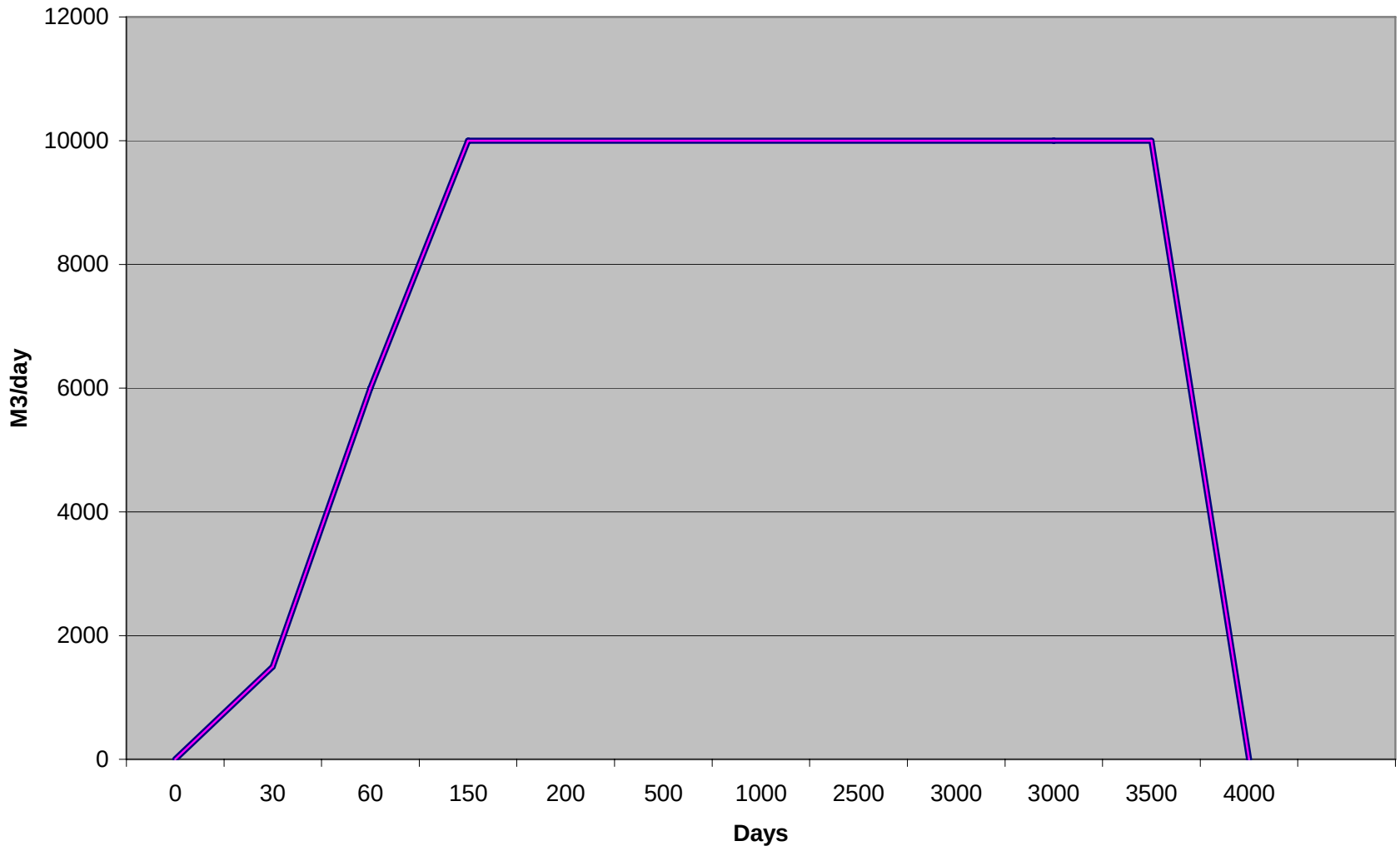
Alton Brine Production Volumes
12000
10000
8000
6000
4000
2000
0
M3/day
0
30
60
150
200
500
1000
2500
3000
3000
3500
4000
Days

Figure 2

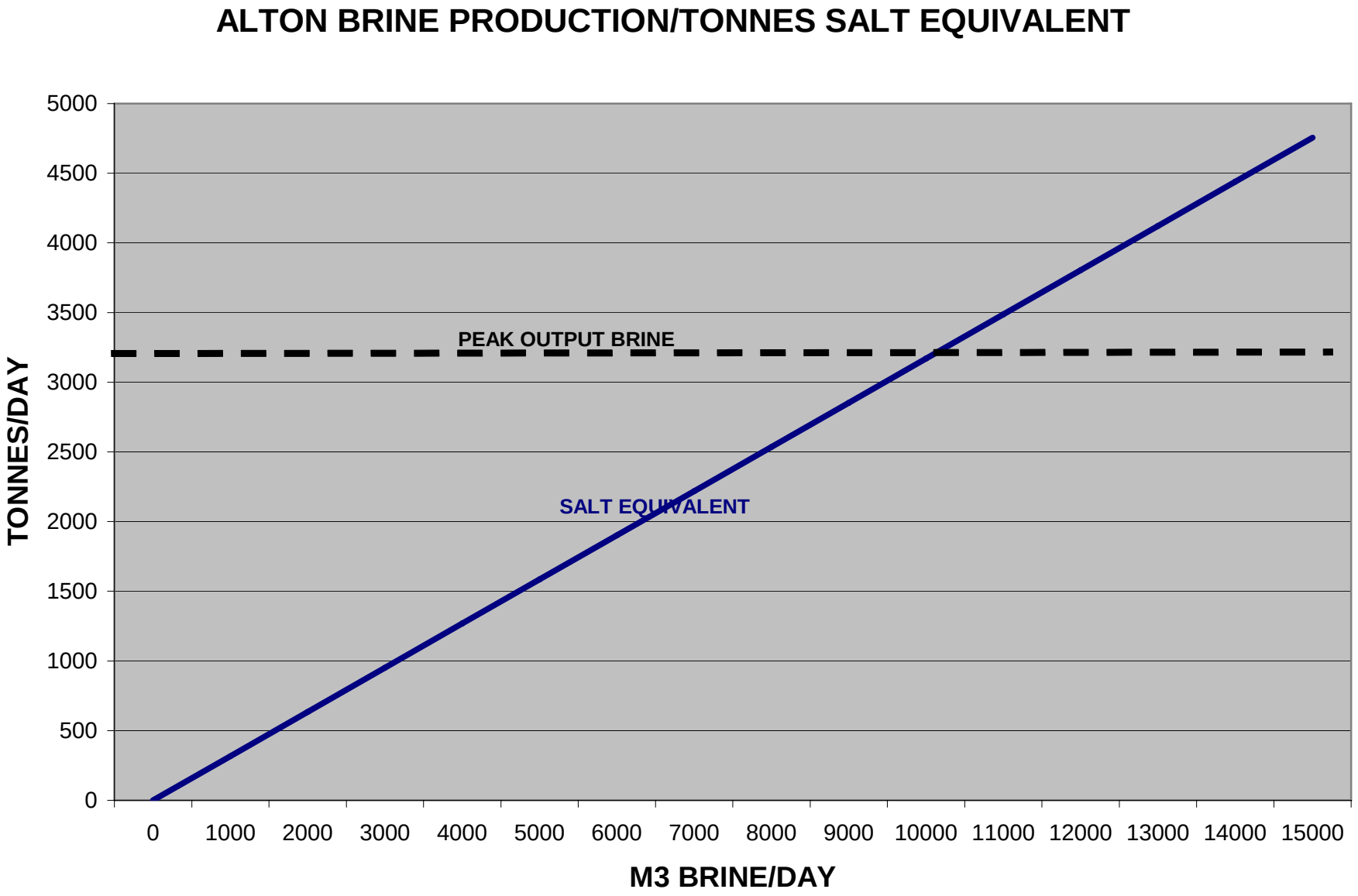
ALTON BRINE PRODUCTION/TONNES SALT EQUIVALENT
TONNES/DAY
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
PEAK OUTPUT BRINE
SALT EQUIVALENT
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
M3 BRINE/DAY

Figure 3

Sodium Chloride Salometer Chart (US GALLONS)

Salometer % of Sat	Spec G.	Conc. %	Weight #/gal Brine	Gallons Per Tonne	NaCl #/gal	Water #/gal	NaCl g/l	Water g/l	Freeze Pt (F)	Freeze Pt (C)	Pounds NaCl to 1000 Gallons Water	Total Gallons Brine	
0	1.000	0.000	8.32	240.3	0.000	8.324	0.0	997.8	32.0	0.0	0	1000	
1	1.002	0.264	8.34	239.8	0.022	8.318	2.6	997.1	31.8	-0.1	22	1001	
2	1.004	0.528	8.36	239.4	0.044	8.311	5.3	996.3	31.5	-0.3	44	1001	
3	1.006	0.792	8.37	238.9	0.066	8.307	7.9	995.8	31.3	-0.4	66	1002	
4	1.008	1.056	8.39	238.4	0.089	8.302	10.6	995.1	31.1	-0.5	89	1003	
5	1.010	1.320	8.41	237.9	0.111	8.296	13.3	994.4	30.8	-0.7	111	1003	
6	1.011	1.584	8.42	237.7	0.133	8.282	16.0	992.8	30.5	-0.8	134	1005	
7	1.013	1.848	8.43	237.2	0.156	8.276	18.7	992.1	30.2	-1.0	157	1006	
8	1.015	2.112	8.45	236.8	0.178	8.268	21.4	991.1	30.0	-1.1	180	1007	
9	1.017	2.376	8.46	236.3	0.201	8.264	24.1	990.6	29.6	-1.3	203	1007	
10	1.019	2.640	8.48	235.9	0.224	8.256	26.8	989.6	29.3	-1.5	226	1008	
11	1.021	2.904	8.50	235.3	0.247	8.252	29.6	989.1	29.1	-1.6	249	1009	
12	1.023	3.169	8.51	234.9	0.270	8.244	32.3	988.2	28.9	-1.7	272	1010	
13	1.025	3.431	8.53	234.4	0.293	8.239	35.1	987.6	28.5	-1.9	296	1010	
14	1.027	3.696	8.55	234.0	0.316	8.232	37.9	986.8	28.2	-2.1	319	1011	
15	1.029	3.959	8.56	233.5	0.339	8.226	40.7	986.1	27.9	-2.3	343	1012	
16	1.031	4.220	8.58	233.1	0.362	8.219	43.4	985.3	27.6	-2.4	367	1013	
17	1.032	4.487	8.59	232.8	0.385	8.204	46.2	983.5	27.3	-2.6	391	1015	
18	1.034	4.751	8.60	232.4	0.409	8.195	49.0	982.4	27.0	-2.8	415	1016	
19	1.036	5.015	8.62	231.9	0.432	8.191	51.8	981.8	26.7	-2.9	439	1016	
20	1.038	5.275	8.64	231.6	0.456	8.182	54.6	980.8	26.4	-3.1	464	1017	
21	1.040	5.543	8.66	231.0	0.480	8.177	57.5	980.2	26.1	-3.3	488	1018	
22	1.042	5.807	8.67	230.6	0.504	8.168	60.4	979.1	25.7	-3.5	513	1019	
23	1.044	6.071	8.69	230.2	0.528	8.162	63.2	978.4	25.4	-3.7	538	1020	
24	1.047	6.335	8.71	229.5	0.552	8.162	66.2	978.4	25.1	-3.8	563	1020	
25	1.048	6.599	8.72	229.3	0.576	8.147	69.0	976.7	24.7	-4.1	588	1022	
26	1.050	6.862	8.74	228.9	0.600	8.138	71.9	975.5	24.4	-4.2	613	1023	
27	1.052	7.121	8.76	228.4	0.624	8.133	74.7	974.9	24.0	-4.4	638	1023	
28	1.054	7.391	8.77	228.0	0.648	8.123	77.7	973.7	23.7	-4.6	664	1025	
29	1.056	7.655	8.79	227.5	0.673	8.117	80.7	973.0	23.3	-4.8	690	1025	
30	1.058	7.919	8.80	227.2	0.697	8.107	83.6	971.8	23.0	-5.0	716	1027	
31	1.060	8.183	8.82	226.7	0.722	8.101	86.5	971.1	22.6	-5.2	742	1027	
32	1.062	8.440	8.84	226.3	0.746	8.091	89.4	969.9	22.3	-5.4	767	1029	
33	1.064	8.710	8.86	225.8	0.771	8.085	92.5	969.2	22.0	-5.6	794	1030	
34	1.066	8.974	8.87	225.5	0.796	8.075	95.4	968.0	21.6	-5.8	821	1031	
35	1.068	9.239	8.89	225.0	0.821	8.068	98.4	967.2	21.3	-5.9	847	1032	
36	1.070	9.502	8.90	224.6	0.846	8.058	101.4	965.9	20.9	-6.2	874	1033	
37	1.072	9.662	8.92	224.1	0.862	8.061	103.3	966.3	20.5	-6.4	890	1033	
38	1.074	10.030	8.94	223.8	0.896	8.041	107.5	963.9	20.2	-6.6	928	1035	
39	1.076	10.294	8.96	223.3	0.922	8.034	110.5	963.1	19.8	-6.8	955	1036	
40	1.078	10.558	8.97	222.9	0.947	8.024	113.5	961.8	19.4	-7.0	983	1037	
41	1.080	10.322	8.99	222.5	0.928	8.061	111.2	966.4	19.1	-7.2	958	1033	
42	1.082	11.086	9.00	222.1	0.998	8.006	119.7	959.7	18.7	-7.4	1038	1040	
43	1.084	11.350	9.02	221.7	1.024	7.999	122.8	958.8	18.3	-7.6	1066	1041	
44	1.086	11.614	9.04	221.3	1.050	7.987	125.8	957.5	17.9	-7.8	1094	1042	
45	1.088	11.878	9.06	220.8	1.076	7.980	128.9	956.6	17.5	-8.1	1122	1043	
46	1.090	12.142	9.07	220.5	1.101	7.970	132.0	955.4	17.1	-8.3	1150	1044	
47	1.092	12.406	9.09	220.0	1.128	7.962	135.2	954.4	16.7	-8.5	1179	1045	
48	1.094	12.670	9.10	219.7	1.153	7.950	138.3	953.0	16.2	-8.8	1208	1047	
49	1.096	12.934	9.12	219.2	1.180	7.943	141.4	952.1	15.8	-9.0	1236	1048	
50	1.098	13.198	9.14	218.9	1.206	7.931	144.5	950.7	15.4	-9.2	1266	1049	
51	1.100	13.462	9.16	218.4	1.233	7.923	147.7	949.8	15.0	-9.4	1295	1051	
52	1.102	13.725	9.17	218.1	1.259	7.912	150.9	948.5	14.5	-9.7	1324	1052	
53	1.104	13.989	9.19	217.6	1.286	7.904	154.1	947.4	14.1	-9.9	1354	1053	
54	1.106	14.253	9.20	217.3	1.312	7.892	157.3	946.0	13.7	-10.2	1384	1055	
55	1.108	14.517	9.22	216.9	1.339	7.884	160.5	945.0	13.3	-10.4	1414	1056	
56	1.110	14.781	9.24	216.5	1.365	7.871	163.7	943.6	12.8	-10.7	1444	1057	
57	1.112	15.045	9.26	216.1	1.393	7.863	166.9	942.6	12.3	-10.9	1474	1059	
58	1.114	15.309	9.27	215.7	1.419	7.851	170.1	941.2	11.8	-11.2	1505	1060	
59	1.116	15.573	9.29	215.3	1.447	7.842	173.4	940.1	11.4	-11.4	1535	1061	
60	1.118	15.837	9.30	215.0	1.473	7.830	176.6	938.6	10.9	-11.7	1566	1063	
61	1.120	16.101	9.32	214.5	1.501	7.821	179.9	937.6	10.4	-12.0	1597	1064	
62	1.122	16.365	9.34	214.2	1.528	7.809	183.2	936.1	9.9	-12.3	1629	1066	
63	1.124	16.629	9.36	213.8	1.556	7.800	186.5	935.0	9.4	-12.6	1660	1067	
64	1.126	16.893	9.37	213.4	1.583	7.788	189.8	933.5	8.9	-12.8	1692	1069	
65	1.128	17.157	9.39	213.0	1.611	7.778	193.1	932.4	8.4	-13.1	1724	1070	
66	1.130	17.421	9.40	212.7	1.638	7.765	196.4	930.9	7.9	-13.4	1756	1072	
67	1.132	17.685	9.42	212.3	1.666	7.756	199.7	929.7	7.3	-13.7	1788	1073	
68	1.134	17.949	9.44	211.9	1.694	7.745	203.1	928.4	6.8	-14.0	1821	1075	
69	1.137	18.213	9.46	211.3	1.724	7.740	206.6	927.8	6.3	-14.3	1853	1075	
70	1.139	18.477	9.48	211.0	1.751	7.727	209.9	926.3	5.7	-14.6	1886	1077	
71	1.141	18.741	9.50	210.6	1.780	7.717	213.4	925.1	5.2	-14.9	1920	1079	
72	1.143	19.004	9.51	210.3	1.808	7.704	216.7	923.5	4.6	-15.2	1953	1080	
73	1.145	19.208	9.53	209.9	1.831	7.700	219.4	923.0	4.0	-15.6	1979	1081	
74	1.147	19.533	9.55	209.5	1.865	7.682	223.5	920.9	3.4	-15.9	2020	1083	
75	1.149	19.797	9.56	209.1	1.893	7.670	227.0	919.5	2.8	-16.2	2055	1085	
76	1.151	20.060	9.58	208.8	1.922	7.659	230.4	918.1	2.2	-16.6	2089	1087	
77	1.154	20.324	9.61	208.2	1.952	7.653	234.0	917.4	1.6	-16.9	2123	1088	
78	1.156	20.588	9.62	207.9	1.980	7.639	237.4	915.7	1.0	-17.2	2158	1090	
79	1.158	20.852	9.64	207.5	2.010	7.629	240.9	914.5	0.4	-17.6	2193	1091	
80	1.160	21.110	9.65	207.2	2.038	7.615	244.3	912.8	-0.4	-18.0	2227	1093	
91	1.162	21.380	9.67	206.8	2.068	7.604	247.9	911.5	-1.0	-18.3	2264	1095	
82	1.164	21.649	9.69	206.5	2.097	7.589	251.4	909.8	-1.6	-18.7	2300	1097	
83	1.167	21.908	9.71	205.9	2.128	7.585	255.1	909.3	-2.3	-19.1	2335	1097	
84	1.169	22.172	9.73	205.6	2.157	7.571	258.5	907.5	-3.0	-19.4	2371	1099	
85	1.171	22.486	9.75	205.2	2.192	7.555	262.7	905.7	-3.7	-19.8	2415	1102	
86	1.173	22.700	9.76	204.9	2.216	7.546	265.6	904.5	-4.4	-20.2	2444	1103	
87	1.175	22.964	9.78	204.5	2.246	7.534	269.2	903.2	-5.2	-20.7	2481	1105	
88	1.177	23.228	9.80	204.1	2.276	7.521	272.8	901.6	-5.8	-21.0	2518	1107	
88.3	1.178	22.310	9.81	203.9	2.188	7.620	262.3	913.4	-6.0	-21.1	2390	1092	EUTECTIC TEMP
89	1.180	23.492	9.82	203.6	2.307	7.514	276.6	900.8	-4.2	-20.1	2556	1108	
90	1.182	23.751	9.84	203.3	2.336	7.500	280.0	899.1	-1.1	-18.4	2593	1110	
91	1.184	24.920	9.86	202.9	2.456	7.399	294.4	887.0	1.8	-16.8	2763	1125	
92	1.186	24.288	9.87	202.6	2.397	7.472	287.3	895.7	4.8	-15.1	2670	1114	
93	1.186	24.547	9.89	202.3	2.427	7.461	291.0	894.4	7.9	-13.4	2708	1116	
94	1.191	24.812	9.91	201.8	2.459	7.452	294.8	893.3	11.1	-11.6	2747	1117	
95	1.193	25.073	9.93	201.5	2.489	7.438	298.4	891.6	14.4	-9.8	2785	1119	
96	1.195	25.339	9.94	201.1	2.520	7.424	302.1	890.0	18.0	-7.8	2825	1121	
97	1.197	25.602	9.96	200.8	2.550	7.411	305.7	888.4	21.6	-5.8	2864	1123	
98	1.199	25.867	9.98	200.4	2.582	7.398	309.5	886.9	25.5	-3.6	2904	1125	
99	1.202	26.131	10.00	200.0	2.614	7.389	313.3	885.7	29.8	-1.2	2944	1127	
99.6	1.203	26.285	10.01	199.8	2.632	7.380	315.5	884.7	32.3	0.2	2968	1128	
100	1.204	26.395	10.02	199.6	2.645	7.375	317.0	884.0	60.0	15.6	2985	1129	

Table A

SALE OF BRINE TO PRODUCERS

Both Sifto Canada Corp. in Nappan and The Canadian Salt Company Limited in Pugwash operate salt brine evaporation and upgrade facilities. Best estimates for production put each facility at approximately 90,000 tonnes/year (Reference #5). Products are high purity and range from bulk evaporated to those further processed and packaged for such uses as table salt, agricultural feeds, fish processing and packing, water conditioning and food processing.

Sifto generates evaporator feed brine from solution mining and creation of underground caverns. The Canadian Salt Company Limited operates a surface brining facility which combines water with rock salt from its surface milling operations. Combined daily brine usage is approximately 1,560 m^3 (Figure 4). Alton brine production will quickly increase to 10,000 m^3/day (Figure 2) and is expected to remain there for up to ten years.

Discussions were held with senior management at both facilities in order to assess the practicality of Alton brine being shipped to either or both producers versus utilizing their own on-site production. While it is obvious that price for delivery and sale is of major importance, other criteria also factor into the decision such as:

a) Brine saturation %.
b) Interruption/continuity of supply.
c) Brine chemistry, critical for both evaporator performance and end product quality.
d) Brine color concerns.
e) Evaporator bleeds ($CaCO_3$ and $CaSo_4$.) are still a consideration.

With respect to cost, it is estimated that these facilities incur brine production costs ranging from $3.00 to $10.00 per tonne of salt equivalent. Delivered prices for Alton brine must be competitive with in-house brine costs. Freight rate inquiries were

made which put the delivered brine price on freight alone at $35-40/tonne of salt equivalent. Specifically, a 49,000 litre B-train from Alton would cost approximately $600/load delivered with a salt equivalent of 15.53 tonnes. The conclusion is that Alton brine, even if given away, is at a 3.5 to 13 times cost disadvantage (Figure 5).

In addition to the above, other considerations noted come into play as follows:

a) Brine Saturation %

It will take in excess of one year (Figure 1) for a new cavity to reach 100% saturation. Since the Alton project will be developing up to twenty cavities over a ten year time frame, it is an obvious conclusion that periods of undersaturated brine production are inevitable. For the salt producers, undersaturated brine results in lower production output and higher energy costs as a minimum. These outcomes are undoubtedly unacceptable.

b) Interruption of Supply

One or both facilities would decommission their own brining operations if converting to an outside supplier. On-site brine storage capacities constitute at most a one day supply. Daily receiving would require up to 24 loads per customer or one load every hour. Delays due to production interruption at Alton or from inclement weather as examples could not be tolerated.

c) Brine Chemistry

Evaporators and systems materials of construction do not react well to acidic or caustic ph. Content of elements such as Mn and Fe will destroy mild and low grade stainless steels. Additionally some elemental chemistry will negatively affect product compaction quality rendering the end product offspec. As such producers will require certificates of analysis on a frequent basis and only after having first confirmed initial production brine qualities.

d) Color

This item speaks for itself as elevated Fe content for example will discolour product to a degree that customers will not accept.

e) Evaporator Bleeds

Evaporators are designed to recrystallize minerals which the brine holds in solution. During the process, not only does salt recrystallize, but also carbonates and sulphates. In the case of Sifto, these precipitates are returned to the brine wells with the leaching injection waters. Usage of Alton brine would still require handling these other “by products”, most likely through the existing equipment and caverns. As a result, the facility will be required to maintain these systems and unable to realize the savings from their decommissioning.

The use of a third party to supply brine does provide advantages to the producers. Some examples of cost savings are:

- Possible decommissioning of brine production equipment.
- Reduced maintenance costs.
- Reduced capital costs.
- Extra product (rock salt) available for resale.

Unfortunately when the brine freight costs are considered they greatly outweigh all other advantages. This negative cost differential when combined with the other criteria in a) – e) make this option unattractive to the potential end users.

WORKSHEET FOR BRINE SALES

- 4 caverns generating brine @ 2,500 m^3/ day = 10,000/m^3/day.
- Sifto and C.S.C. each ~ 90,000 tonnes/yr evaporated salt.
- 1 tonne salt requires 3.155 m^3 brine.
- 90,000 tonnes salt requires 283,950 m^3 or 778 m^3/ day.
- The two operations consume ~ 1,560 m^3 / day.

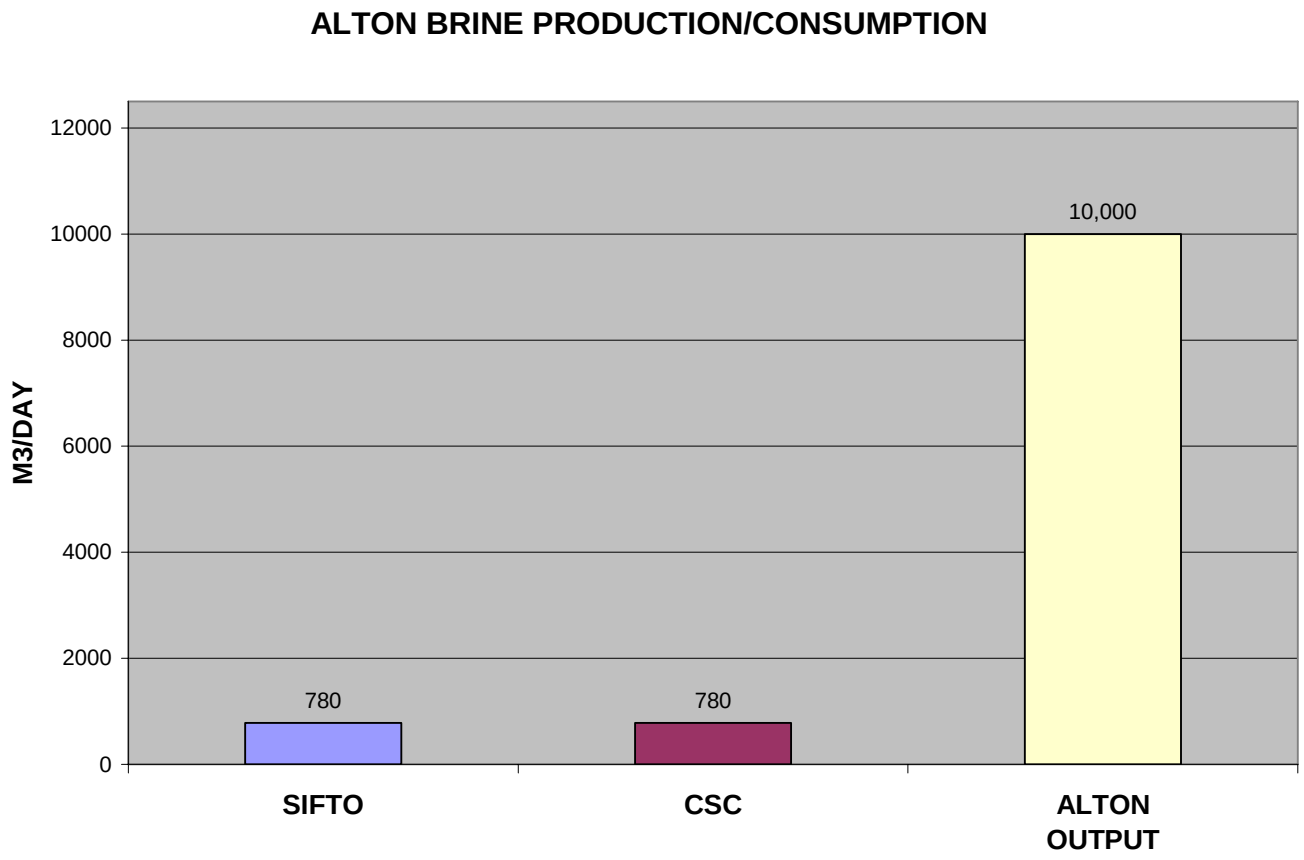

Figure 4

BRINE COSTS COMPARISON (SALES TO COMMERCIAL COMPANIES) - SIFTO, CSC, ALTON

- 1 tonne evaporated salt requires 3.15 m^3 of brine.
- Approximate freight cost from Alton to Nappan or Pugwash (based on 49,000 litre B – train traveling 300 kms round trip) ~ $600 or 1.2 cpl (cents/litre) *

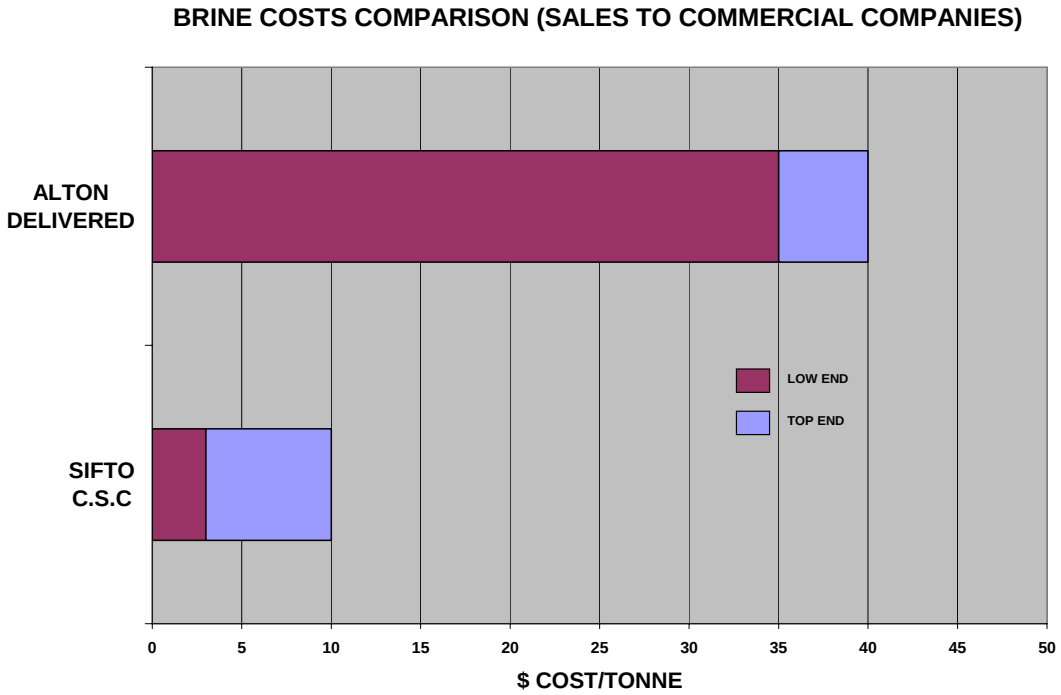

Figure 5

SUPPLY BRINE TO PROVINCIAL AND MUNICIPAL USERS

Nova Scotia is reported to be the third largest user of road salt in Canada (Reference #2). The Nova Scotia Department of Transportation and Public Works and many municipalities and regions are utilizing pre-wetting and some anti-icing techniques using salt brine. Salt brine application in highway maintenance is a somewhat recent practice and as such statistics are not yet well documented or readily available for Nova Scotia.

As part of this study, managers with groups such as the Nova Scotia Department of Transportation and Public Works, Halifax Regional Municipality, etc. were consulted. Also utilized were relevant websites, and technical resources (Appendix).

As is evidenced in Table "B" and Figure 6, the volume of brine currently consumed for ice control is small. Those groups utilizing brine, report combining forty litres of brine with each tonne of rock salt spread onto the roads and highways. This technique with the Nova Scotia Department of Transportation and Public Works for example is only used approximately 20% of the time since once a storm is well underway the practice is ineffective due to the condition of the highways.

If all roadway maintenance groups, province-wide were pre-wetting, only 20 m^3/day of brine would be required over a 150 day period annually based on the 20% estimate from Nova Scotia Department of Transportation and Public Works.

There are logistics issues to utilizing Alton brine for the above purposes. Most user groups make brine from rock salt or acquire it locally. As such many only have storage capabilities ranging from a few hundred litres to 10 m^3. To bring in brine from Alton, the end users would need to greatly increase their holding volume capabilities or face punitive freight costs for small loads.

Brine levels proven most effective lie at 88% saturation or 23% concentration (Reference #2). Levels below this will cause freezing and the associated safety concerns; higher concentrations lead to ineffective de-icing and plugging off of equipment due to salt crystallization. As such, saturation levels of incoming brine require monitoring and adjustment as warranted.

Those jurisdictions with experience in using pre-wetting have generally invested $10-12,000/mixing system and additional capital into tanks, piping, etc.

For Alton brine to find it's way to Nova Scotia highway maintenance users, individual user assessments will be required. In any case, volumes will be very low when compared to Alton output. It will most likely be attractive to end users close to the project. Larger groups such as Halifax Regional Municipality and most of the provincial districts will as a minimum find the freight distances a major financial hurdle.

BRINE PRE-WETTING INFORMATION SHEET

- 1 tonne salt = 3,700 L brine @ 23% concentration.
- Users apply @ 40 L / tonne rock salt.
- Halifax Regional Municipality cost delivered ~ $54.00 / tonne of rock salt. Yield = 3,700 L @ 1.46 cents / L (cpl).
- At 100,000 L / year usage, Halifax Regional Municipality requires mixing 27 tonnes of salt. Storage tanks < 10,000 L or 10 m^3.
- Cost to haul brine (HRM) estimated ~ $260.00 for a 49,000 L (49m^3) B – train or .53 cpl. Smaller quantities elevate cpl factor.
- Mixing system – capital cost $10 – 12,000.

BRINE PRE-WETTING STATISTICS

ICE SALT ANNUAL USAGE RATES IN NOVA SCOTIA

AREA	LANE KM'S	SALT USAGE (tonnes annual)	BRINE USAGE (m^3 annual)
Town of Amherst	70 – 75	1000 – 1500	10 – 20 (40 L/t)
H.R.M.	3,100	25,000	100
Provincial Highways (Depart. Of Trans. & P.W.)	23,000	220,000 to 280,000	apply with 20% of Total salt (-40 L/t)
All Municipalities	6,000 (est.)	55,000 – 70,000 (est.)	Unknown
All N.S.	29,000	275,000 to 350,000	@ -40L/ton 2,200 – 2,800 m^3

Table B

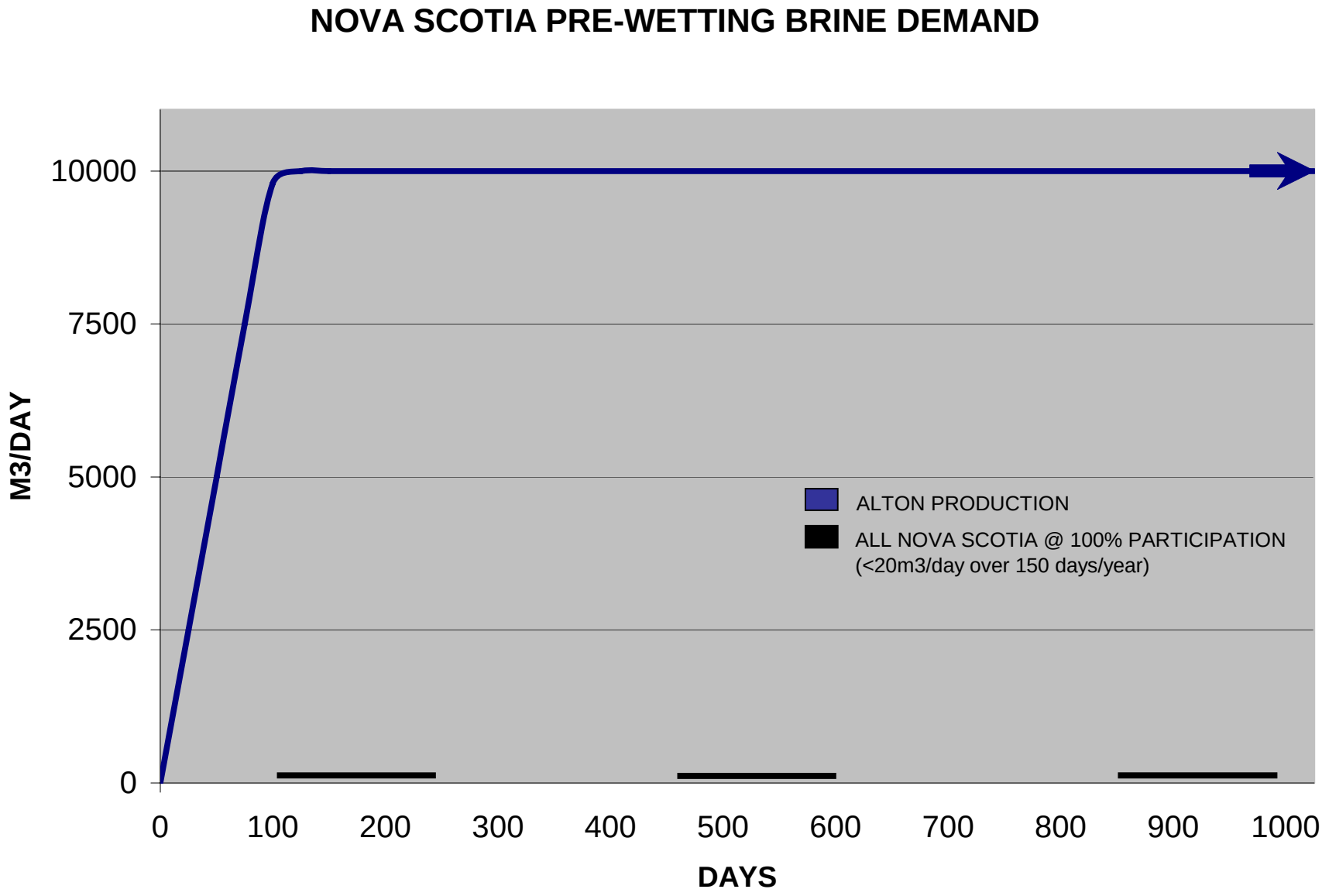
NOVA SCOTIA PRE-WETTING BRINE DEMAND
M3/DAY
10000
7500
5000
2500
0
0
100
200
300
400
500
600
700
800
900
1000
DAYS
ALTON PRODUCTION
ALL NOVA SCOTIA @ 100% PARTICIPATION
(<20m3/day over 150 days/year)

Figure 6

ESTABLISH EVAPORATION PRODUCTION FACILITY

There are seven facilities across Canada producing evaporated salt from brine. According to Natural Resources Canada (Reference #1), total annual capacity is 945,000 tonnes, while total production in 2005 stood at 912,000 tonnes. Individual plant capacities range from the smallest at 100 tonnes/day, (36,500/year) to the largest at 680 tonnes/day, (248,200/year). Only one Canadian plant has an annual capacity greater than 200,000 tonnes.

Atlantic Canadian evaporated salt production takes place at two sites (Nappan and Pugwash) and average output is estimated at 500 tonnes/day or 180,000 tonnes/year (Table “C”) with a large percentage of that volume being shipped to markets outside the region. It is presumed that both facilities have unused production capacity.

There are three rock salt production facilities in N.S., N.B. and Quebec, with a total annual capacity of approximately 4.4 million tonnes. Actual production volumes fluctuate somewhat from year to year due to weather variability and it is suspected that most years there is excess capacity available. Rock salt production in the Atlantic region, is estimated at 3,000 tonnes/day or approximately 3.1 million tonnes/year (Table “C”).

The established salt producers in Canada are Canadian Salt, Cargill and Sifto Canada Corp., a subsidiary of Compass Minerals International. These are mature organizations with strategically placed production facilities and well established markets, sales and distribution networks, port terminals and related infrastructure. From their production facilities in Nova Scotia, New Brunswick and Quebec, markets are serviced in Eastern Canada and along the United States eastern seaboard.

COMMERCIAL SALT PRODUCTION

MARITIME CANADA

(Tonnes/day x 1000)

COMPANY	CAPACITY ROCK	ESTIMATED PRODUCTION	CAPACITY EVAP	ESTIMATED PRODUCTION
Sifto	0	0	280	250
Canadian Salt Company.	7,800	2,500	310	250
Cargill/ PCS Sussex	700	500	0	0
TOTALS	8,500	3,000	590	500
Alton Potential	0	0	3,170 *	0

Table C

* At 10,000 m^3/ day

The Alton project is scheduled to produce 10,000 m^3 of brine per day for up to ten years. This volume of brine contains approximately ten million tonnes of salt. For a production facility to consume all Alton brine it must be sized to evaporate 10,000 m^3 of brine and process, store, ship and sell 3,170 tonnes/day or approximately one million tonnes/year. As noted above, this volume exceeds the total combined capacity of all the evaporated salt producers in Canada. For this reason, the various capacity scenarios include equipment which will compact, crush & screen, and store the product for use as an alternative to conventional rock salt.

Several scenarios are evaluated within this produce and sell option. Note chart 1 and figures 7,8,9. Chart 1 illustrates the timeline for engineering, construction and

commissioning of a new production facility. Even the most aggressive schedule will require 3.5 years to production. At this rate the project life for salt production is reduced to less than seven years.

Capital cost projections do not include the cost of debt servicing. Operating costs do not include sg&a, or charges other than the operating costs on-site. It is further assumed that a partnership with one of the majors will be required for sales, marketing, logistics, infrastructure, etc.

Upon review of the chart and tables it is fully apparent that this option is financially impractical.

- The cost of capital and operating exceeds product sale price points in all scenarios; even the one million ton facility with its economies of scale. Therefore, the Internal Rate of Return for the project is negative; an unlikely scenario for attracting investors.

- It is very unlikely that the market serviced from Nova Scotia can absorb additional volume when established facilities have unused capacity and expansion capability for less capital requirement than Alton. Also to consider is the damage that could occur within the industry long-term for any short-term production at Alton. Should there be an aggressive marketing and price assault on the U.S. markets, implications under NAFTA require consideration.

- The life of the project is less that seven years and would require accelerated depreciation and incur early costs for decommissioning and closure.

- The facility is landlocked and would require expensive on-site storage and truck/rail freight to a port, creating a significant distribution cost disadvantage.

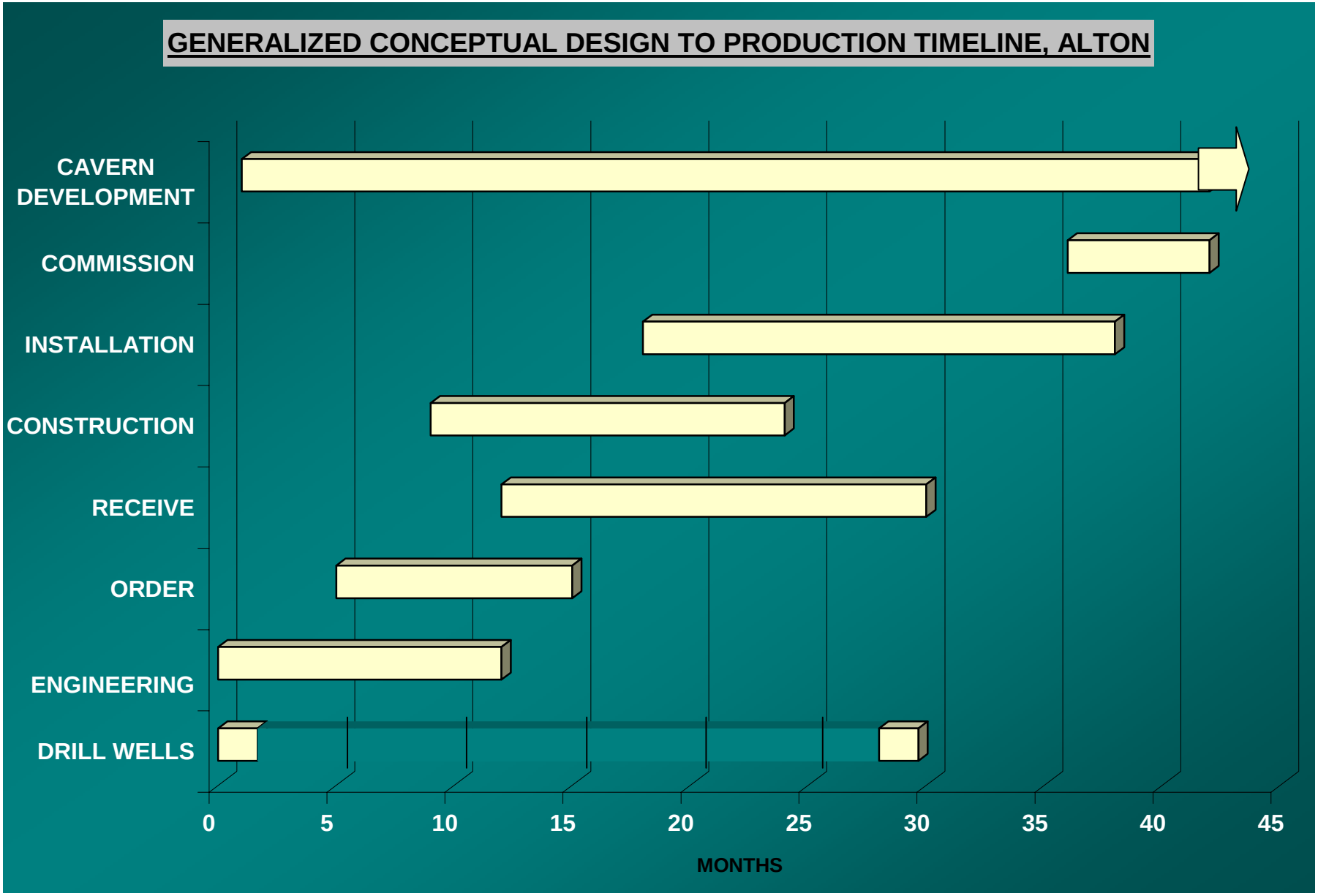
GENERALIZED CONCEPTUAL DESIGN TO PRODUCTION TIMELINE, ALTON
CAVERN DEVELOPMENT
COMMISSION
INSTALLATION
CONSTRUCTION
RECEIVE
ORDER
ENGINEERING
DRILL WELLS
0
5
10
15
20
25
30
35
40
45
MONTHS

Chart 1

CAPITAL COST ASSESSMENT (GENERALIZED)
ALTON EVAPORATED SALT PRODUCTION FACILITY

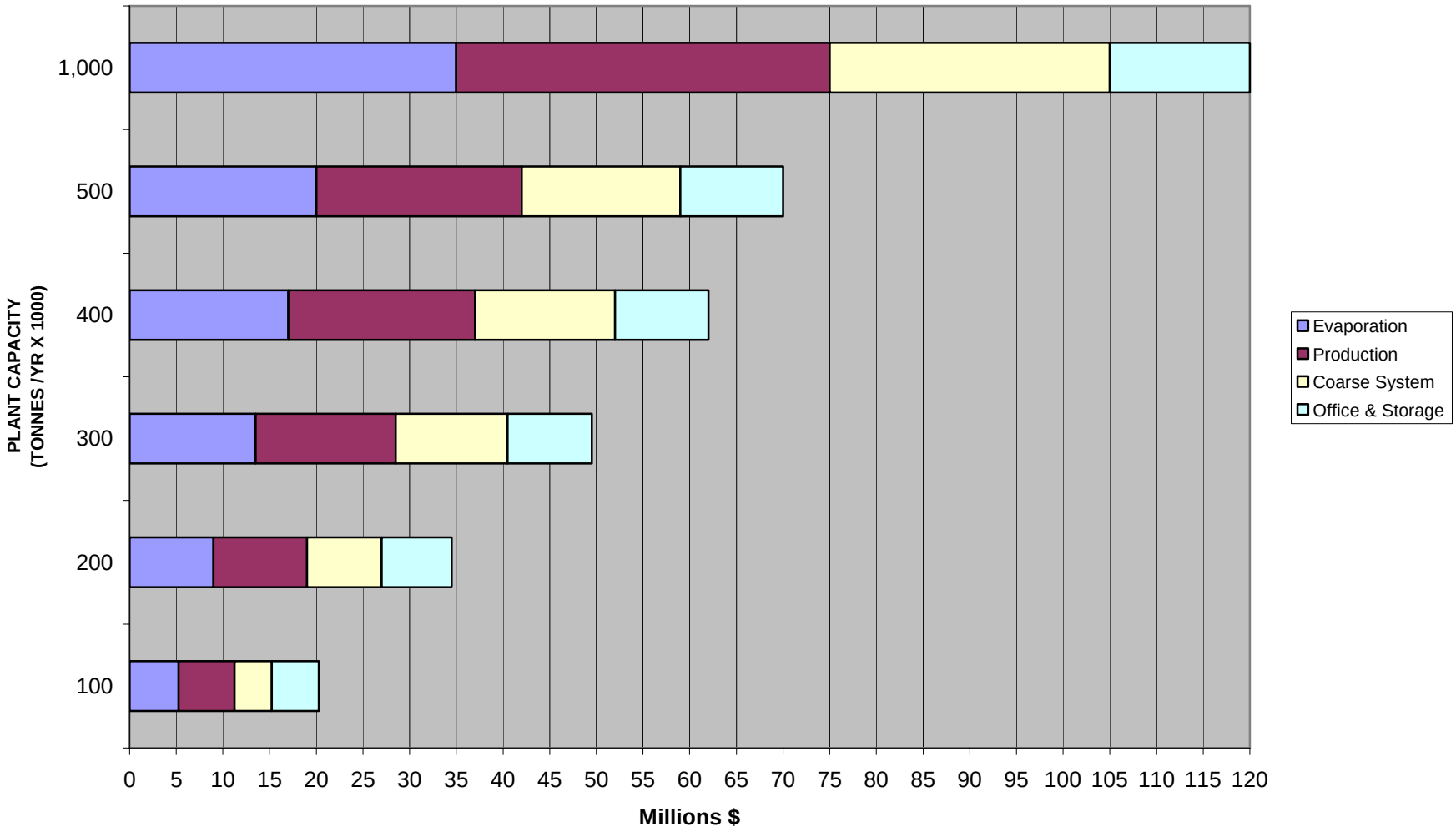

Figure 7

SIMPLIFIED COST OF CAPITAL/TONNE

ASSUMPTION

- Project life 7,000,000 tonnes production over 7 years
- Follow capital cost outline from Whiting Equipment
- Does not include cost of debt servicing

PLANT COST ($ x 1000)	PLANT CAPACITY (x 1000/Tonne/Yr)	LIFE (Yrs)	COST/TONNE $
20,250	100	7	28.93
34,500	200	7	24.64
49,500	300	7	23.57
62,000	400	7	22.14
70,000	500	7	20.00
120,000	1,000	7	17.14

Table D

SIMPLIFIED COST OF CAPITAL/TONNE

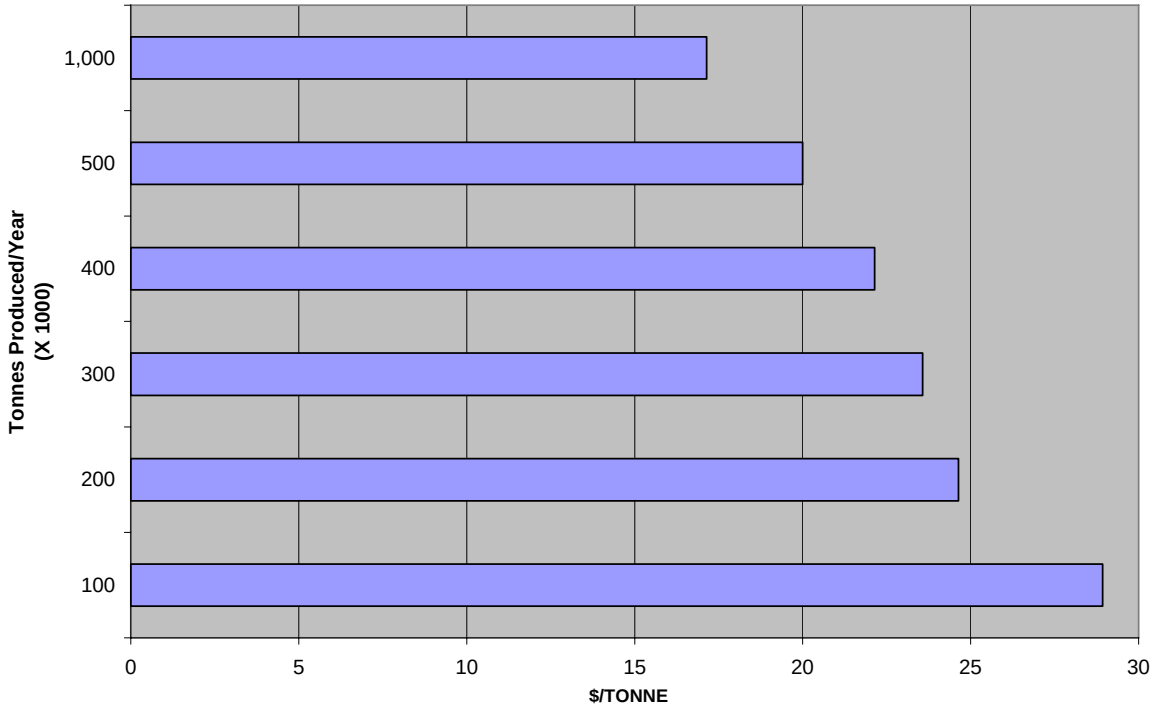

Figure 8

SIMPLIFIED COST/TONNE
EVAPORATED & COMPACTED SALT PRODUCTION

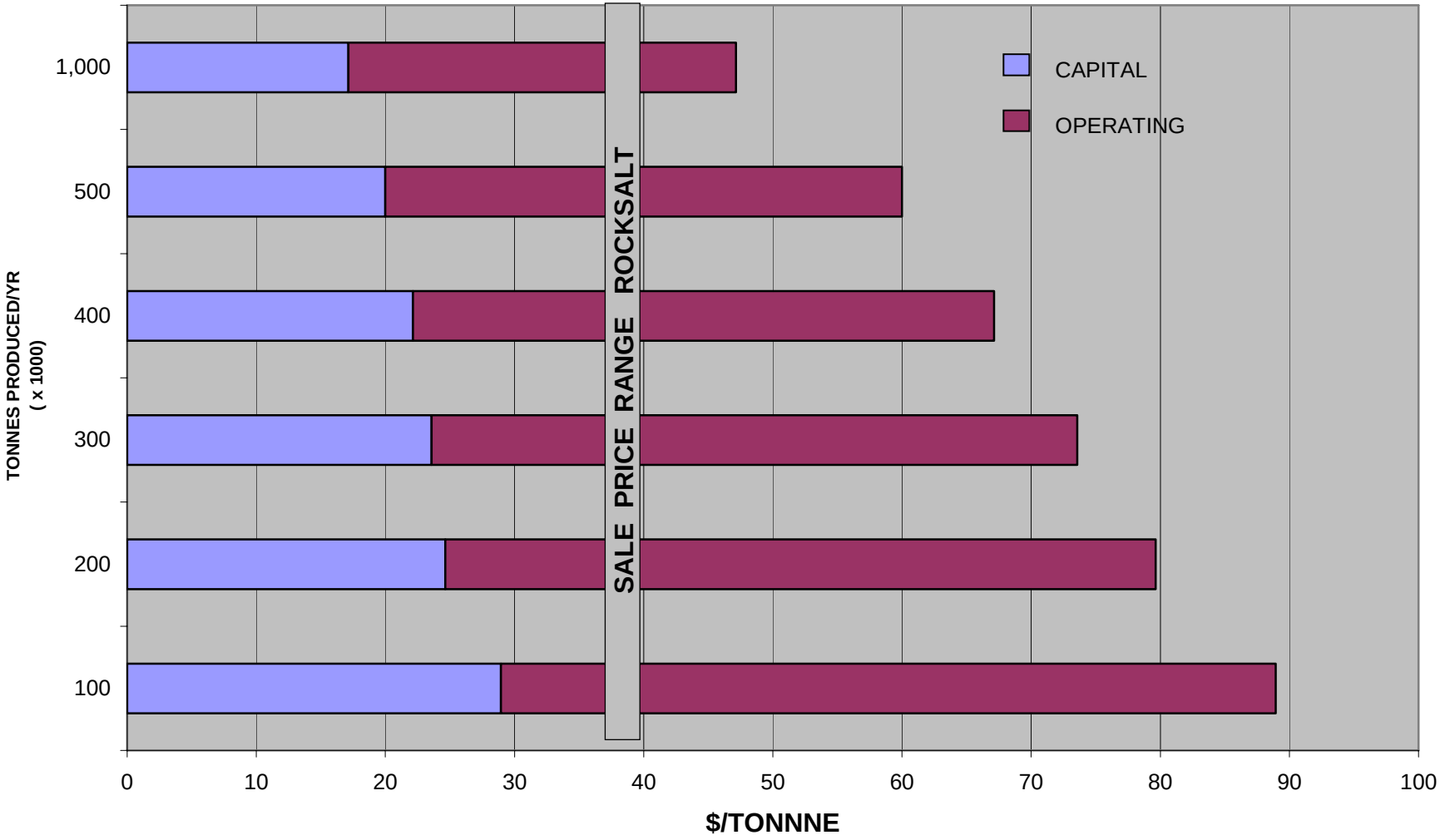

Figure 9

SUMMARY AND CONCLUSIONS

Please refer to the “Executive Summary”.

This report by no means represents an exhaustive study. Volumes have been written on the salt industry. The intent of the material contained herein is to provide the reader with an overview of the industry in a regional context and how the Alton gas storage project may apply to it.
It is concluded that none of the options considered in this report can be justified on either an economic or volume basis.

Respectfully Submitted,
Don Dickie and Associates

Don Dickie
Lead Consultant.

APPENDIX

PARTICIPANTS/CONTRIBUTORS TO STUDY

Mr. Jerry Poe, Technical Director, Compass Minerals International, Overland Park, Kansas.

Mr. Floyd D'Entremont, Plant Manager, Sifto Canada Corp., Nappan, Nova Scotia.

Mr. Art Gilroy, Buyer, Sifto Canada Corp., Nappan, Nova Scotia.

Mr. Grant Sutherland, Facility Manager, The Canadian Salt Company Limited, Pugwash Mine and Refinery.

Mr. Buck Wile, Mine Superintendent, The Canadian Salt Company Limited.

Mr. Ben Pitman, Operations Manager, Operational Services, Town of Amherst.

Mr. Aaron Bourgeois, Transportation Foreman, Operational Services, Town of Amherst.

Mr. Gordon Smith, Water and Sewer Foreman, Operational Services, Town of Amherst.

Mr. Gordon Hayward, Co-ordinator, Ice and Snow Program, Halifax Regional Municipality.

Mr. Peter Hackett, Area Manager Colchester, Nova Scotia Department of Transportation and Public Works, Truro.

Mr. Bob MacLean, Operations Supervisor Londonderry, Nova Scotia Department of Transportation and Public Works.

Mr. Paul Richard, Acting Manager of Operations, Nova Scotia Department of Transportation and Public Works, Halifax, Nova Scotia

Mr. David Neville, Sales Manager, Whiting Equipment Canada Inc., Welland, Ontario.

REFERENCES AND SUGGESTED REFERENCE MATERIAL

1. Natural Resources Canada,
   Mineral and Mining Statistics On-Line,
   Mines, Quarries, Pits, Bogs, Mills and Concentrators in Canada – Salt

2. Environment Canada, Road Salts,
   Case Study #7

3. Health Canada
   Environmental and Workplace Health,
   Priority Substances List Assessment Report for Road Salts

4. Natural Resources Canada,
   Mineral and Metals Sector,
   “Salt”, by Michael Dumont

5. Salt in Nova Scotia,
   Nova Scotia Department of Natural Resources,
   Mineral Resources Branch,
   Information Circulars

6. Government of Nova Scotia,
   Transportation and Public Works,
   Highway Operations

7. “Salt Institute” Website

DDA

DON DICKIE & ASSOCIATES
CONSULTANTS TO MANAGEMENT

Don Dickie, Lead Consultant

Don graduated from Acadia University in Nova Scotia with a BSc, Geology and later completed a Business Administration Certificate from Sheridan College in Oakville, Ontario. A seasoned professional with a diverse technical and progressive management background developed over 30 years; Don has experience in geology, rock mechanics, surface, underground and solution mining. Holding positions with government and primarily private industry in organizations including New Brunswick, Dept. of Natural Resources, Hudson's Bay Mining & Smelting, Domtar Inc., Harris Chemical Group, IMC Global and Compass Minerals International, his working locations have spanned a broad range of unionized facilities throughout Canada, the USA and the UK.

Don's responsibilities have ranged from exploration geologist, in-house geological and geotechnical specialist, to operating management roles as Mine Superintendent, Operations Superintendent, Assistant Mine Manager and Plant General Manager, applying and acquiring the integrated skills and experience commensurate with these positions. Working mostly in industrial minerals industries, including limestone, gypsum and potash, primary involvement has been with salt; specifically underground mining, solution mining and cavern development, mechanical evaporation, upgrading, manufacturing and related responsibilities. More recently activities have included feasibility studies for co-generation, salt cavern storage of natural gas, and cavern disposal of non-hazardous oilfield waste.

Don has performed in house roles as safety trainer and total quality management trainer and facilitator. He has authored and co-authored technical papers in geology and rock mechanics with presentations before the **C**anadian **I**nstitute of **M**ining and **M**etallurgy, World Salt Congress (Kyoto, Japan) and represented the industry as a member of the **CIMM** Rock Mechanics and Strata Control Committee. An active member of his community, Don has held a number of volunteer positions.

Initiatives now involve offering value-added services to industry and government as a consulting resource to management and lead consultant of "Don Dickie & Associates" (DDA). DDA was established in 2006 with the primary objective of redirecting acquired skills and experience to focus on the areas of business development, project management/participation, feasibility studies and productivity/production analysis and enhancement.

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APPENDIX G

Public Consultation Information

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For Immediate Release **February 1, 2006**

News Release

Landis completes seismic and will proceed with drilling

David Birkett, President of Landis Mining Corporation (symbol LIS on the TSX Venture Exchange) is pleased to announce that Landis, on behalf of itself and its partner, has completed the acquisition and interpretation of 28 km of new 2D seismic data over the Alton natural gas storage project area in Nova Scotia. Mr. Birkett commented: "We are encouraged by the results of the seismic and are proceeding with the next phase of development for the Alton natural gas storage project."

The seismic data defined an anomalously thick salt formation within the project area. The next phase of the project will include the drilling of a core hole to evaluate the cap rock above the salt formation and to confirm the correlation of the seismic data with the geology in the project area. It is anticipated that the core hole will take 40 days to complete, with commencement expected in February.

Landis and its partner each own 50% interests in the Alton natural gas storage project. Under the terms of the partnership agreement, the partner will contribute up to $3 million, and Landis will contribute up to $2 million (including previously invested funds) toward the development of the project. Thereafter, the parties will be responsible for costs on an equal basis. Landis is the operator of the project.

Long-term gas supply to the region is viewed as critical to the viability of the project. Landis is closely monitoring LNG projects and other offshore opportunities in the region and is moving forward with securing Letters of Intent from potential customers of the storage project.

Currently there are no underground gas storage facilities north of Boston along the Maritimes and Northeast Pipeline route, which runs from Nova Scotia to the northeastern United States.

Landis is an energy asset and service company and is currently developing energy related infrastructure projects in Nova Scotia.

For more information, contact:

Mr. David Birkett, President
Landis Mining Corporation
Phone: (403) 263-2118

Landis Mining Corporation
Suite 2320, 444 – 5th Avenue SW **TSX Symbol LIS**
Calgary, Alberta **Phone (403) 263-2118**
T2P 2T8 **Fax (403) 264-8365**

For Immediate Release **May 16, 2006**

News Release

Landis recommences drilling

David Birkett, President of Landis Mining Corporation (symbol LIS on the TSX Venture Exchange) is pleased to announce that Alton Natural Gas Storage L.P., in which Landis holds a 50% interest, has recommenced the drilling program announced in February. The delay in the drilling program was due to an early spring break up and associated road weight restrictions in Nova Scotia.

Seismic data has defined an anomalously thick salt formation within the project area. This next phase of work is the drilling of a core hole to evaluate the cap rock, analyze the salt formation and correlate the seismic data with the actual geology.

Long-term gas supply to the region is viewed as critical to the viability of the project. Landis is closely monitoring LNG projects and other offshore opportunities in the region and is moving forward with securing Letters of Intent from potential customers of the storage project.

There are currently no underground gas storage facilities north of Boston along the Maritimes and Northeast Pipeline route, which runs from Nova Scotia to the northeastern United States.

Landis is an energy asset and service company and is presently developing energy related infrastructure projects in Nova Scotia.

For more information, contact:

Mr. David Birkett, President
Landis Mining Corporation
Phone: (403) 263-2118

Brookfield, Nova Scotia
October 12, 2006

Alton Natural Gas Storage Project

Landis Energy Corporation and Fort Chicago Energy Partners, through Alton Natural Gas Storage L.P., are proposing to develop an underground storage facility for natural gas near Alton, Nova Scotia to meet the growing demand for natural gas storage in Nova Scotia, New Brunswick and northeast US. Presently, no storage facilities connect to the Maritimes and Northeast Pipeline system.

The project began in 2002 when Landis Energy commenced an exploration program in Nova Scotia to identify a salt formation suitable for storage. Exploration work to date and preliminary geotechnical analysis indicates a geologically sound salt formation exists between 500 and 1000 meter below the ground in the Alton area.

The site has a number of advantages in addition to its proximity to the Maritimes & Northeast Pipeline. These include its geological properties and other valuable infrastructure such as rail lines, power lines and tidal river as a main water source.

In October 2006, the application for a Hydrocarbon Storage Licence will be submitted to the Nova Scotia Government for approval which is the next step in developing the storage facility.

Alton Ownership

The project is owned equally through a limited partnership between Landis Energy Corporation and Fort Chicago Energy Partners. Landis Energy is the operator of the project.

Both Landis Energy and Fort Chicago are committed to developing energy related infrastructure projects in the province of Nova Scotia.

Landis Energy and Fort Chicago are publicly traded companies, listed on the TSX Venture Exchange (symbol **LIS**) and TSX Exchange respectively (symbol **FCE.un**).

Alton Components

The components of the proposed project include:

- Buried pipelines from the area overlaying the salt formation to the confluence of the Shubenacadie/Stewiacke Rivers, for water withdrawal and brine discharge and;
- An underground storage facility in engineered salt caverns with above ground structures.
- Buried pipelines from the facility to the Maritimes & Northeast Pipelines system.

Community Benefits

To date, through Alton Natural Gas Storage L.P., Landis Energy and Fort Chicago have contributed over $1.6 million to the Nova Scotia economy. This equates to over 60% of total project expenditures.

We plan to continue contributing to the community by:

- Creating jobs through the construction and operation of the facility.
- Bringing gas closer to the communities of Alton, Brookfield, Stewiacke, and Truro through the development of a gas pipeline to the Alton facility.
- Decrease gas price volatility for Heritage Gas customers.
- Long-term facility life – 50+ years.
- Providing the opportunity for other energy related projects to develop in the area as a result of storage.
- Using local organizations whenever possible (i.e. labour, civil engineering, transportation, restaurants, hotels, retail, etc.).
- Contributing to the overall economic growth.

Environment

The Alton Natural Gas Storage Project is currently proceeding with the preparation of an environmental assessment report and will register this Project under the Nova Scotia Environment Act as a Class I Undertaking under the Environmental Assessment Regulations. The environmental assessment (EA) report will evaluate potential environmental effects, mitigation and monitoring.

The following studies have been undertaken in support of the EA:

- Vascular plant survey
- Breeding bird and other wildlife surveys
- Bass fish population survey
- Archaeological and heritage resource survey
- Land use including agricultural and recreational use
- First Nations land and resource use (Mi'Kmaq Ecological Knowledge Study)
- Brine dispersion modeling

As part of the EA process, the Alton Natural Gas Storage Project is implementing a public consultation plan including distribution of project information, meetings with various regulatory and elected officials, key stakeholder groups and a public open house. The objectives are:

- To inform the public and key stakeholders about the project and provide accurate and consistent information and;
- To obtain input from potentially affected parties/individuals to ensure the EA focuses on the issues of concern and that appropriate mitigation measures are identified and implements.

The EA Report will be available for public review and comment.

Forward Looking Statement

This information sheet contains forward-looking information on project start-up and future demand. Actual results could differ materially due to changes in project schedules, operating performance, demand for storage, commercial negotiations or other technical and economic factors or revisions.

Project Description

- Pipeline route will be cleared, grubbed to a width of 20m. A 12" and 14" pipeline will be buried to a depth of four feet.
- Streams and highways will be directionally drilled and wetlands will be avoided during pipeline installation.
- Water will be injected into the salt deposit to dissolve part of the salt formation resulting in salt caverns impermeable to hydrocarbon storage.
- Water intake rates would ideally be 10,000m^3 per day which is comparable to an irrigation system for ¼ section of land.

Risks & Safety Measures

The health and safety of the community is our highest priority. The caverns will be developed in accordance with the latest edition of Canada Standards Association (CSA) Standard Z341, Storage of Hydrocarbons in Underground Formations, to ensure safe development and operation.

Storage facilities are extremely safe. One of the oldest facilities in Canada, located in Saskatchewan, has operated for over 40 years without incident.

Project Schedule

- Initially, four caverns of approximately 70,000m^3 (30m diameter by 100 m in height) will be formed in 2 to 3 years.
- The project may eventually develop as many as 10 to 15 caverns resulting in the brining process lasting approximately 8 to 10 years.
- Brining and gas storage operations will operate concurrently once the gas storage facility is in operation.

Management Team

David Birkett, *President & CEO*
Gordon Hart, *Chairman*
John Hilland, *Vice President Operations*
Jan van Egteren, *Vice President Marketing*
Paul MacLean, *Senior Advisor*

Landis Energy Corporation
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PO Box 36052
Halifax, Nova Scotia B3J 3S9
Phone: 902-422-9718 Fax: 902-422-9421
www.altongas.com

alton

NATURAL GAS STORAGE LP

Alton Gas Storage Project

Key Project Features

Map Features

- Proposed Pipeline Route
- Bridge
- Major Highway
- Collector Highway
- Paved Road
- Unpaved Road
- Rail
- Approximate Drill Location
- Gate
- Silo
- Key Feature/Residence (within 50m)
- Building (1997, NSTS, 10k)
- Contour (5m)
- Utility Line
- Watercourse
- Waterbody
- Property Boundary

Air Photos: Nova Scotia Aerial Photography, 2004

Map Parameters
Projection: UTM, NAD83, Zone 20
Scale: 1 : 30,000
Date: September 2006
Project No.: 1012229

0 200 400 800 1,200 1,600
Meters

Jacques Whitford

FortChicago

alton
NATURAL GAS STORAGE LP

LANDIS
ENERGY CORPORATION

Public Open House

Alton Natural Gas Storage Project

Wednesday, November 22, 2006

5pm to 8pm

Brookfield Firehall

The purpose of this public open house will be to present information on:

- Project design and location
- The environmental assessment process
- The studies that will be undertaken as part of the environmental assessment

Alton Natural Gas Storage Project

Landis Energy Corporation and Fort Chicago Energy Partners, through Alton Natural Gas Storage L.P., are proposing to develop an underground storage facility for natural gas near Alton, Nova Scotia, to meet the growing demand for natural gas storage in Nova Scotia, New Brunswick, and northeast U.S. Presently, no storage facilities connect to the Maritimes & Northeast Pipeline system.

The Project began in 2002 when Landis Energy commenced an exploration program in Nova Scotia to identify a salt formation suitable for storage. Exploration work to date and preliminary geotechnical analysis indicates a geologically sound salt formation exists between 500 m and 1000 m below the ground in the Alton area. An application for a Hydrocarbon Storage Licence is being submitted to the Nova Scotia Government for approval.

The site has a number of advantages in addition to its proximity to the Maritimes & Northeast Pipeline. These include its geological properties and other valuable infrastructure such as power lines, rail lines, and a tidal river as the water source.

The components of the proposed project include:

- Buried water line from the area overlaying the salt formation to the Shubenacadie River for water withdrawal and brine discharge
- An underground storage facility in engineered salt caverns with above ground structures

Project Description

- The water line route will be cleared to a width of 10 m - 20 m and 12” and 14” lines will be buried to a depth of four feet
- Streams and highways will be directionally drilled and wetlands will be avoided during water line installation
- Water will be circulated through the salt deposit to dissolve part of the salt formation resulting in salt caverns impermeable to hydrocarbons
- Water intake rates would ideally be 10,000 m^3 per day, which is comparable to an irrigation system for 200 acres of land
- A future application will be made for a gas pipeline to connect the storage facility to the Maritimes & Northeast Pipeline

Environmental Assessment

The Alton Natural Gas Storage Project is currently proceeding with the preparation of an environmental assessment (EA) report and will register this Project under the *Nova Scotia Environment Act* and Environmental Assessment Regulations as a Class I Undertaking.

The environmental assessment will focus on key environmental and socio-economic aspects that could potentially be affected by the Project. The following studies are underway in support of the EA:

- Vascular plant survey
- Breeding birds and other wildlife surveys
- Archaeological and heritage resource survey
- Land use including agricultural and recreational use
- First Nations land and resource use (Mi’Kmaq Ecological Knowledge Study)
- Brine dispersion modeling

Public Consultation

As part of the EA process, the Alton Natural Gas Storage Project is implementing a public consultation plan including distribution of project information, meetings with various regulatory and elected officials, key stakeholder groups, and a public open house. The objectives are:

- To inform the public and key stakeholders about the project and provide accurate and consistent information
- To obtain input from potentially affected parties/individuals to ensure the EA focuses on the issues of concern and that appropriate mitigation measures are identified and implemented

The EA report will be available for public review and comment. For more information on how to comment on the EA report, please see http://www.gov.ns.ca/enla/ea/.

Risks & Safety Measures

The health and safety of the community is our highest priority. The caverns will be developed in accordance with the latest edition of Canada Standards Association (CSA) Standard Z341, Storage of Hydrocarbons in Underground Formations, to ensure safe development and operation.

Underground natural gas storage facilities are very safe. One of the oldest salt cavern facilities in Canada, located in Saskatchewan, has operated for over 40 years without incident.

Project Schedule

- Initial Phase: four caverns of approximately 100,000 m^3 (40 m diameter by 80 m height) will be formed over 2-3 years starting in 2007. Commercial operation is expected in 2009
- Depending on future market demand, the project may develop an additional 10 to 15 caverns at a later date
- If so, brining and gas storage operations may operate concurrently as additional caverns are developed

Community Benefits

We plan to continue contributing to the community by:

- Creating jobs through the construction and operation of the facility
- Bringing gas closer to the communities of Alton, Brookfield, Stewiacke, and Truro through the development of a gas pipeline to the Alton facility
- Decreasing gas price volatility for Heritage Gas customers
- Increasing regional security of supply levels
- Contributing to the tax base (Income, Property, and Sales)
- Allowing for the potential of developing other energy related projects as a result of storage
- Contributing to the overall economic growth of the community

Projected costs of developing the facility are estimated at $60 million over the next several years. We are committed to using local resources as much as possible, as we have done to date.

Project Team

Please contact Alton Gas with any comments or questions that you may have about the Project.

Management
David Birkett, *President & CEO*
Gordon Hart, *Chairman*
John Hilland, *Vice President Operations*
Jan van Egteren, *Vice President Marketing*
Paul MacLean, *Senior Advisor*

Engineering
SolTech Projects Inc.

Environmental
Jacques Whitford Limited
Martec Limited
Matrix Solutions Inc.

Public Relations
MT&L Public Relations Limited

This information sheet contains forward-looking information on Project start-up and future demand. Actual results could differ materially due to changes in project schedules, operating performance, demand for storage, commercial negotiations or other technical and economic factors or revisions.

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Alton Natural Gas Storage L.P.
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www.altongas.com

Community happenings • Nov. 18 to 25

NOV. 18 – Tea and bake sale. Immaculate Conception Church. 1 to 3 p.m. Crafts, books, baked goods, sucker pull, balloon pop, raffles and more. Adults, $5; children under 10, $2. Sponsored by the Catholic Women's League.

NOV. 18 – Christmas craft bazaar. Stewiacke Community Centre. 9 a.m. to 3 p.m. Admission, $2.

NOV. 18 – Christmas luncheon and sale. Knox United Church, Brookfield. 11 a.m. to 1:30 p.m.

NOV. 18 – Annual craft sale. St. David's Hall, Pictou Road Bible Hill. 10 a.m. to 2 p.m. Refreshments. No admission charge.

NOV. 18 – Turkey supper. St. James United Church, Upper Musquodoboit. 4 to 6 p.m. Fancywork items and Christmas decorations for sale. Adults, $8; children 12 and younger, free. Takeouts and wheelchair accessible. Sponsored by the St. James board of stewards.

NOV. 18 – Colchester Singles bowling. 7 p.m. Call for more information, 893-4794.

NOV. 18 – Christmas sale and luncheon. Brunswick Street United Church. 11 a.m. to 1 p.m. Soup, biscuit, dessert and beverage. $5.

NOV. 18 – Dime auction. Viewing, 1 p.m.; draw, 2 p.m. Mira Young Street, Truro. New and used items, home baking, and more. Proceeds for staff education.

NOV. 18 – Gospel music coffee house. Debert Baptist Church. 7 p.m. Guest: Fred Morash, Hope FM 98.5 county gospel show. Refreshments. Everyone welcome.

NOV. 18 – Christmas market. Upper Stewiacke fire hall. 10 a.m. to 4 p.m. More than 20 vendors. $2 admission. Sponsored by Stewiacke Valley Farmers' Market. Call 671-2148.

NOV. 18 – Variety concert. Middle Stewiacke Recreation Centre. 7 p.m. Admission, $5 per person, $15 per family. Refreshments served.

NOV. 18 – Potluck supper. 4:30 to 6 p.m. Debert fire hall. Adults, $8; children, $4. Sponsored by the Debert United Church stewards and trustees.

NOV. 18 – Heather Bruce in concert. First United Church. 7 p.m. Guests: Truro Youth Singers. Adults, $10; students, $8. Tickets at the door and MacQuarries Pharmasave, Esplanade. Sponsored by Music Under the Steeple.

NOV. 18 – Christmas tea and sale. 2 to 4 p.m. St. Paul's Presbyterian Church, 387 Lower Truro Rd.

NOV. 18 – Morris Clark and The Altonators will host an afternoon of old-time country music. Middle Stewiacke Recreation Centre. 1:30 to 4:30 p.m. Lunch. Everyone welcome. Proceeds for the centre.

NOV. 18 – Breakfast. Truro legion. 8 to 10 a.m. $5. All are welcome.

NOV. 18 – Potluck supper. 4 to 6 p.m. Salem United Church, River John. Adults, $8; children, $4. Takeout available. Pantry table.

NOV. 18 – Card party. 7:30 p.m. Harmony-Camden Church hall. Everyone welcome.

NOV. 18 & 19 – Festive craft market. Langille Athletic Centre. Saturday, 10 a.m. to 7 p.m.; Sunday, 11:30 a.m. to 5 p.m.

NOV. 18 & 19 – Standard first aid, level C CPR. Canadian Red Cross service centre, 798 Prince St., Truro. Call 668-2038.

NOV. 19 – Christmas craft and bake sale. 10 a.m. to 3 p.m. Hilden fire hall. Sponsored by the Hilden Garden Club. Tables, $5. To rent, call 897-9086 or 897-4501.

NOV. 19 – John Fisher Choir. Economy United Church. 7 p.m. Everyone welcome.

NOV. 19 – Christmas bazaar and tea. Tatamagouche legion hall. 10 a.m. to 4 p.m. Tea from noon to 2 p.m. $3. To book tables, call 657-2589 or 657-2140. Sponsored by the legion ladies auxiliary branch #64.

NOV. 19 – Variety concert. 2 p.m. Truro legion. Admission, $5. Presented by the Truro and Area Bluegrass and Oldtime Music Association.

NOV. 20 – Country/gospel coffee house. Noel United Church, 6:30 p.m. Every third Sunday of the month. Free-will donation box. Light lunch. Everyone welcome.

NOV. 20 – Overeaters Anonymous. Truro Boys and Girls Club, 175 Victoria St. Rear entrance for wheelchair ramp. 7:30 p.m. Call 673-2981 or 895-5739.

NOV. 20 – Angels Remembered. Truro Mall during mall hours. Hang an angel on the tree in memory of a loved one. Make a donation. Sponsored by the Colchester East Hants Community Hospice Society. Runs to Nov. 30.

NOV. 20 & 21 – Truro Al-Anon. 10 a.m., Monday; 8 p.m., Tuesday. Halliday building, Willow Lane, Hubtown Room. Call 893-5535.

NOV. 21 – Illusions Art Gallery presents "Changes." Show opening. Main reception Nov. 24, 6 p.m. 515 Prince St., Truro. Call 843-3300.

NOV. 21 – Card party, 45s. Every Tuesday. Onslow United Church hall, 7 p.m. Everyone welcome.

NOV. 22 – Coffee party, 2 p.m. Masstown United Church. Tea and pantry table. Play room for children.

NOV. 22 – Annual general meeting. Northumberland Arts Council, 7 p.m. Fraser Cultural Centre, Tatamagouche.

NOV. 23 – Blood donor clinic. Tatamagouche Farmers' Market, 41 Creamery Rd. 5 to 8 p.m.

NOV. 23 – Overeaters Anonymous. 1 p.m. St. Andrew's United Church parlour, King Street, Truro. Call 899-2980.

NOV. 23 – Elegant Grace fashion show with Marj Hatherly of Where Seconds Count. Central Nova Wesleyan Church, 38 Pleasant St., Truro. 6:30 to 8 p.m. Cost, $6. Call 893-3686. Proceeds for the Girl Talk Youth Program.

NOV. 24 – Annual Christmas tea and sale. Townsview Estates. 1:30 to 3:30 P.M. $4. Everyone welcome.

NOV. 24 – Facilitating youth groups. Tatamagouche Centre. For more information call 1-800-218-2220. Runs until Nov. 26.

NOV. 24 – A Taste of Art. Dessert party. Hosted by St. John's Anglican Church and the Attic Painters. Noon to 4 p.m. at the church's Kaulback Hall. $3 at the door.

NOV. 24 &25 – Ten Thousand Villages's 60th anniversary fair trade gift sale. Friday, 10 a.m. to 9 p.m.; Saturday, 10 a.m. to 5 p.m. Immanuel Baptist Church, Truro. Call 893-4197. No admission charge.

NOV. 25 – Roast beef dinner. St. David's United Church, Pictou Road, Bible Hill. 4 and 6 p.m. For information and tickets, call Pat at 893-4497. Cost, $10 per plate.

NOV. 25 – Christmas talent auction. 6:30 p.m., viewing; auction at 7 p.m. St. James United Church, Great Village. Homebaked goods, decorated wreaths, table top trees, and more. Refreshments.

NOV. 25 – Third Truro Group Committee's Attic to Cellar sale. 10 to 11 a.m. St. Andrew's United Church. Proceeds for Beavers, Cubs and Scouts.

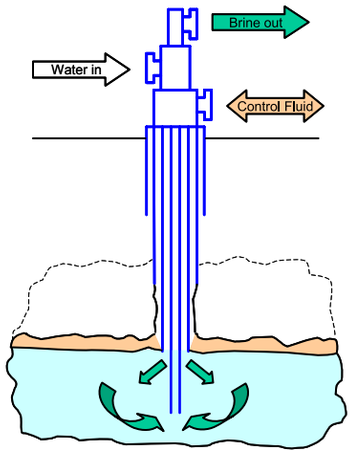
NOV. 25 – Christmas coffee party. St. Andrew's United Church, Corner of King and Duke streets. 10 a.m. to noon. Silent auction, bake table, and more. Coffee party, $5. Sponsored by St. Andrew's United Church women.

NOV. 25 – Christmas salad, tea and pantry table. Onslow United Church. 11:30 a.m. to 1:30 p.m. Bread, rolls, biscuits, pies, squares and more. $5. Chair lift available for people requiring assistance.

Community Happenings listings are free to non-profit organizations. 30 word maximum. Written submissions to Community Happenings Box 220, Truro B2N 5C3. Fax 893-0518. e-mail news@truroddaily.com. Current events only. We recommend submissions be made two weeks prior to date of the event. No dances, please.

PROJECT OVERVIEW

- Alton Natural Gas Storage L.P. proposes to develop an underground storage facility for natural gas.
- The project will consist of a number of engineered caverns developed in a salt deposit located at depths of over 800 m (½ mile).
- The purpose is to deliver gas to markets during high demand periods (i.e. winter).



PROPOSED WELL CONFIGURATION

HISTORY AND CURRENT USE

alton
NATURAL GAS STORAGE LP

- Salt caverns are very safe.
- The first salt caverns used for natural gas storage in Canada were built in Saskatchewan in 1963.
- Over 35 underground salt cavern facilities operating in North America.
- Caverns will be developed in accordance with the latest edition of Canadian Standards Association (CSA) Standard Z341, Storage of Hydrocarbons in Underground Formations, to ensure safe development and operation.

PROJECT COMPONENTS

alton
NATURAL GAS STORAGE LP

- Buried waterlines from the facility to the Shubenacadie River for brackish water withdrawal and brine discharge.
- Buried gas pipeline from the facility to the Maritimes and Northeast Pipeline Halifax lateral.
- Engineered salt caverns with above ground structures.
  - Four caverns approximately 40 m in diameter by 80 m in height.

NATURAL GAS STORAGE FACILITY

alton

NATURAL GAS STORAGE LP

Alton Gas Storage Project

Key Project Features

Map Features

- Building (1997, NSTS, 10k)
- Gate
- Silo
- Water Intake Pipes
- Brine Discharge Pipe
- Proposed Pipeline Route (Rev. Nov. 06)
- Bridge
- Major Highway
- Collector Highway
- Paved Road
- Unpaved Road
- Rail
- Contour (5m)
- Utility Line
- Watercourse
- Waterbody
- Property Boundary

Air Photos: Nova Scotia Aerial Photography, 2004

Map Parameters
Projection: UTM, NAD83, Zone 20
Scale: 1 : 10,000
Date: November 2006
Project No.: 7012229

0 250 500 1,000
Meters

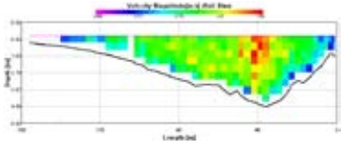
Jacques Whitford

PROJECT DESCRIPTION

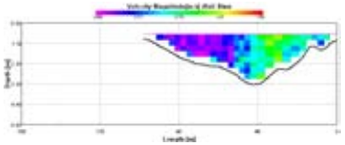
alton
NATURAL GAS STORAGE LP

- A waterline route will be cleared to a width of 10 m – 20 m.
  - 12” and 14” pipelines will be buried to a depth of four feet.
  - Streams and highways directionally drilled and wetlands avoided.
- Brackish water intake rate approx. 10,000 m^3 per day.
  - Comparable to an irrigation system for 200 acres of land.
- Water will be circulated through the salt deposit to dissolve a salt cavern impermeable to hydrocarbons.
- Brine will be discharged into the tidal Shubenacadie River.

RECORDING FLOW

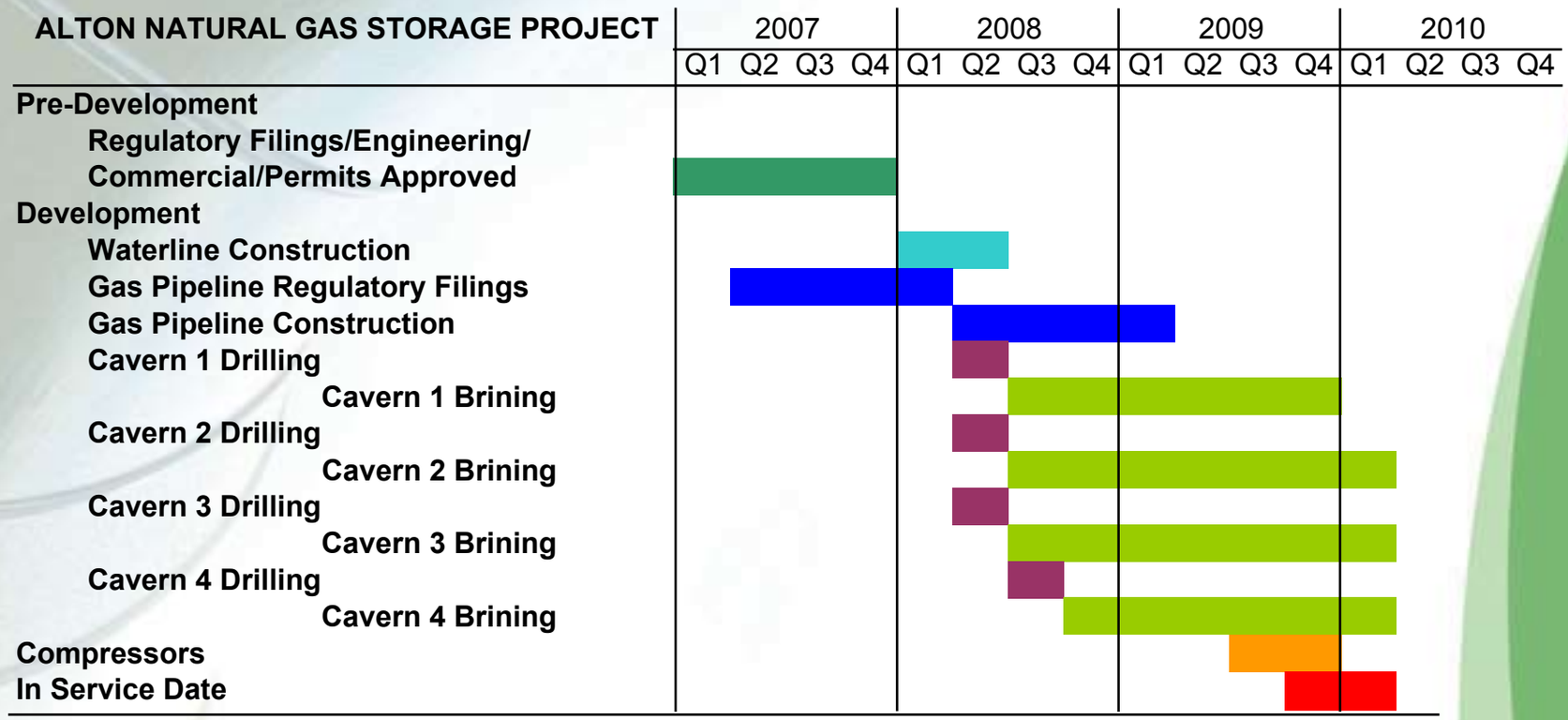


HIGH FLOW RATES



LOW FLOW RATES

PROPOSED PROJECT SCHEDULE



ENVIRONMENTAL ASSESSMENT

alton
NATURAL GAS STORAGE LP

- The Environmental Assessment (EA) report is currently being prepared.
- The project will be registered with the Nova Scotia *Environmental Act* and Environmental Assessment Regulations as a Class I Undertaking.
- The EA will focus on environmental and socio – economic aspects. Studies include:
  - Vascular plant survey;
  - Breeding birds and other wildlife surveys;
  - Archaeological and heritage resource survey;
  - Land use including agricultural and recreational use;
  - First Nations land and resource use (Mi'kmaq Ecological Knowledge Study); and
  - Brine dispersion modeling.

PUBLIC CONSULTATION

alton
NATURAL GAS STORAGE LP

- The public consultation plan includes distribution of project information, meetings with various regulatory and elected officials, key stakeholder groups, and a public open house. The objectives are:
  - To inform the public and key stakeholders about the project and provide accurate and consistent information.
  - To obtain input from potentially affected parties/individuals to ensure the EA focuses on the issues of concern and that appropriate mitigation measures are identified and implemented.
- The EA report will be available for public review and comment.

Alton Natural Gas Storage Project
www.altongas.com

PUBLIC OPEN HOUSE
November 22, 2006
Brookfield, Nova Scotia

FEEDBACK FORM

Thank you for attending the Open House. We encourage you to complete the following feedback form. Your input will help us to identify key issues and concerns related to this Project and will be incorporated in the environmental assessment. For more information, please contact kfraser@jacqueswhitford.com or 902-468-7777, extension 380.

Name: _____

Organization (if any): _____

Mailing Address: _____

_____

Telephone: _____ **E-mail:** _____

How did you hear about the Open House?

❑ Letter ❑ Newspaper
❑ Word of Mouth ❑ Other_____

Comments:

_____

_____

_____

_____

_____

_____

(Additional space provided on back)

alton
NATURAL GAS STORAGE LP

Suite 2320 – 444 5th Avenue S.W.
Calgary, Alberta T2P 2T8

Phone: 403.263.2118
Fax: 403.264.8365
www.altongas.com

November 24, 2006

Millbrook First Nation
PO Box 634
Truro, NS B2N 5E5

Dear Chief Paul and Council:

As you may already know, we are in the early planning stages for development of an underground salt cavern facility for storage of natural gas in the Alton area. We are also preparing an environmental assessment for the project and have enclosed project details and a map outlining the project components.

Membertou Geomatics Consultants are currently undertaking a Mi'kmaq Ecological Knowledge Study in your community to determine traditional and current use of the area and to include this information in the environmental assessment. Please contact Jason Googoo (jasongoogoo@membertou.ca) if you have any questions regarding the Mi'kmaq Ecological Knowledge Study.

We would appreciate any input you can provide for the environmental assessment. We anticipate completing a draft report by January 31, 2007 and require information prior to that time. I would be pleased to meet with you about any other aspects of the project. Please contact either me (david@landis.ca) or Virginia Soehl at Jacques Whitford (vsoehl@jacqueswhitford.com) who is leading the environmental assessment.

Sincerely,

for David Birkett
President
Alton Natural Gas Storage L.P.

cc: Ms. Janice Maloney, Kwilmuk Maw-klusuaqn
Mr. Donald Julien, Confederacy of Mainland Mi'kmaq
Mr. Joe B. Marshall, Union of Nova Scotia Indians

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alton
NATURAL GAS STORAGE LP

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November 24, 2006

Shubenacadie First Nation
522 Church St.
Micmac Post Office
Hants Co., NS B0N 2H0

Dear Chief MacDonald and Council:

As you may already know, we are in the early planning stages for development of an underground salt cavern facility for storage of natural gas in the Alton area. We are also preparing an environmental assessment for the project and have enclosed project details and a map outlining the project components.

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APPENDIX H

Disposition Table with Draft EA Comments

Comments on Proposed Alton Natural Gas Storage Project Draft EA Document May 2007

Comment No.	Originator	Question/Statement [1]	Response
NSEL-AC-01	Andrew D Cameron	The authors of the report appear to understand the issues associated with agriculture and provide a reasonable approach toward a solution.	Comment noted.
NSEL-MT-01	Minh Tan Environmental Chemical Specialist NSEL	Overall, it was very well done with lots of details. Design is not complete so further details are still to come, but request was made for some of that information to ensure it will be there in capacities desired. Specific comments are as follows:	Comment noted.
NSEL-MT-02	Minh Tan Environmental Chemical Specialist NSEL	Please briefly elaborate on some applicable requirements of ASME B31.3. While I expect this is a very technical document, referencing it without giving details of any type leaves it somewhat meaningless.	EA text updated with the following text in Section 2.1.1.2: This American Society of Mechanical Engineers Code contains requirements for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants, and related processing plants and terminals. The requirements cover materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping. Also included is piping which interconnects pieces or stages within a packaged equipment assembly.
NSEL-MT-03	Minh Tan Environmental Chemical Specialist NSEL	Please provide a clear summary statement on Alton's commitment to meeting or exceeding CSA Z341. Alton said it would meet or exceed requirements of CSA Z341 on numerous occasions relating to various aspects of CSA Z341 in talking about related aspects of the project. CSA Z341 is lengthy, and it is not clear how much of CSA Z341 the numerous commitments made by Alton would cover. A Board established under the Pipeline Regulations would determine what of CSA Z341 would be required for adherence, the terms of which would not be known until after an EA. However, Alton seem to already know what it intends to meet or exceed of CSA Z341 so perhaps it could make an overarching summary statement whether it intends to meet or exceed CSA Z341 as required by that Board (minimum required), potentially in more capacities than would be required, or in all aspects of CSA Z341, additional to many similar small statements made in the draft EA.	EA updated with the following text in Section 2.5: The most common cause of incidents is from undetected corrosion in the wellbore, wellhead or surface piping, aggravated by poorly designed control and safety systems and/or poor operating procedures. CSA Z341 recognizes that corrosion may be an important factor in cavern system failures, and therefore addresses this issue in a number of sections. For example, casing inspection logs capable of identifying corrosion are required before placing the system in service, and every 10 years thereafter. Where a cavern well passes through a potentially corrosive zone, a special completion is required with extra tubing creating an annulus that is filled with a corrosion inhibiting fluid. A full section, Section 8.4, is devoted to Corrosion Control requirements, and includes the use of impressed-current cathodic protection systems. CSA Z341 specifies that corrosion control monitoring shall conform to a further standard, NACE RP0186. Surface piping and equipment is more accessible, and therefore easier to monitor for corrosion. In gas plants and facilities such as the Alton project, this is normally done by the use of ultrasonic thickness tests and the evaluation of corrosion coupons; these items will be used in the Alton project. Weekly visual inspection of all components will be used to monitor external corrosion, and special materials or coatings will be employed where they can be effective. Alton intends to install and use a de-aerator to reduce the oxygen level in the intake water to reduce internal corrosion in the piping, vessels and wells. In addition, corrosion allowances will be incorporated into the design of all these components. Regular testing will also be employed to check for a number of potential problems, including corrosion.
NSEL-MT-04	Minh Tan Environmental Chemical Specialist NSEL	Many failures of similar facilities in North America cited in Section 2.5 had to do with corrosion, ultimately. While corrosion is addressed later on in brief discussion of potential hazards and safety features, a brief discussion here on how corrosion will be monitored in the Alton project so as to avoid any similar outcomes would be effective, though not necessary.	EA updated with the following text in Section 2.5: CSA Z341 is the standard specified by the Nova Scotia Code of Practice Respecting the Underground Storage of Hydrocarbons. It is the only such standard worldwide, and is specified and/or copied in many jurisdictions. This standard recognizes that corrosion may be an important factor in cavern system failures, and therefore addresses this issue in a number of sections. For example, casing inspection logs capable of identifying corrosion are required before placing the system in service, and every 10 years thereafter. Where a cavern well passes through a potentially corrosive zone, a special completion is required with extra tubing creating an annulus that is filled with a corrosion inhibiting fluid. A full section, Section 8.4, is devoted to Corrosion Control requirements, and includes the use of impressed-current cathodic protection systems. CSA Z341 specifies that corrosion control monitoring shall conform to a further standard, NACE RP0186. Surface piping and equipment is more accessible, and therefore easier to monitor for corrosion. In gas plants and facilities such as the Alton project, this is normally done by the use of ultrasonic thickness tests and the evaluation of corrosion coupons; these items will be used in the Alton project. Weekly visual inspection of all components will be used to monitor external corrosion, and special materials or coatings will be employed where they can be effective. Alton intends to install and use a de-aerator to reduce the oxygen level in the intake water to reduce internal corrosion in the piping, vessels and wells. In addition, corrosion allowances will be incorporated into the design of all these components. Regular testing will also be employed to check for a number of potential problems, including corrosion.

Comment No.	Originator	Question/Statement [1]	Response
NSEL-MT-05	Minh Tan Environmental Chemical Specialist NSEL	Please provide Emergency Response and Contingency Plans with details. There was very impressively thorough discussion of potential hazards and environmental impacts from them. However, in most cases, Emergency Response Plans and/or Contingency Plans were only roughly outlined as to what they would be intended to do, or approaches were generally given, rather than specific details. Design is not complete so the details are not yet available. However, plans with details are required for the final EA. Please be sure to provide details of such plans, including training of local personnel depended upon like fire fighters, for all situations considered since if they were deemed worthy for consideration based on "reasonable" probability of occurrence, that should justify having details ready for plans to handle these situations. The request for details in these plans should be reasonable given most situations are limited in potential consequences, as stated by Alton.	It is standard practice for NS provincial EAs to provide an outline of the Emergency Response and Contingency Plan in the EA registration document. Additional details will be provided in the Environmental Protection Plan with final design plans provided to regulators when available.
NSEL-MT-06	Minh Tan Environmental Chemical Specialist NSEL	Please provide more thorough test results for some parts of Table 6.1 on Element Levels in Diluted (10:1) Brine [pg 84-85]. The problem is that the Detection Level is sometimes at CCME guidelines or above, rendering the result ineffective. An example would be for Selenium. CCME allows for 0.1 ug/L, but the detection level is at 50 ug/L. A No Detection result could mean some 49 ug/L could be present, which is way beyond the 0.1 ug/L limit. There is no hope of detecting potentially dangerous levels of selenium given the parameters used for measurement so the No Detection conclusion drawn may be dangerously incorrect. As well, please add other sources of recommended limits besides CCME where CCME does not have a value, and identify those sources with an asterisk or some other symbol. CCME may not have a limit, but that does not mean some other reputable source may not have recommended a limit. Having a limit helps give Reported Levels context and meaning. Otherwise, there is no way to determine if the Detection Level might have been sufficient to address required or meaningful testing, nor if Reported Levels might be "safe" pending recommended values and non-CCME source credibility. Of course, there is less or no expectation to comply with non-CCME sources' recommended values, but it does help put results into some sort of context, especially if other sources were fairly credible, like the US Environmental Protection Agency. Only with this context can the true potential damage of brine discharge could be assessed.	The analytical tests conducted on the brine dilution were intended as an indicator of the levels of potentially harmful metals in the salt-core that may be introduced to the Estuary via diluted brine discharge. Maxxam Analytical Laboratories (the laboratory retained by the proponent to conduct analytical testing) endeavoured for detection limits to be at or below the Canadian Council of Ministers of the Environment (CCME) interim Canadian Water Quality Guidelines for the Protection of Aquatic Life, (CCME 1996); however, the presence of high levels of sodium chloride (salt) made it unfeasible to have detection limits at or below the CCME guideline limit for all metals (*i.e.* , cadmium, chromium, copper, iron, selenium, and thallium). The CCME guideline limits that are below the detection limits generally pertain to limits identified for freshwater systems and the aqueous solutions tested were essentially seawater (~26 ppt) and thus Maxxam could not achieve detection limits at or below the CCME freshwater guidelines. Regardless, no exceptionally high levels of metals in the salt core were indicated by results and thus the present analytical results give a proximate indicator of the potential risk that metals in the salt-core pose to aquatic receptors. The EA report has been revised to acknowledge the limitations of inferring the risk of toxic effects due other metals present in the salt-core based on existing analytical results. Other guidelines have been referenced to give context to results for metals for which no CCME guidelines apply, refer to Table 6.1 in the EA document. Given the limitations of the existing analytical results, the risk of other elements present in the salt-core (and thus in diluted brine discharged to the Estuary) will be determined by toxicity testing using diluted brine and representative organisms. In addition, more detailed analytical testing may be required on the brine (at varying dilutions) if tested solutions are deemed to have toxic effects. The specifics of this toxicity testing program will be developed in consultation with regulators, most notably Environment Canada. The test solution used for toxicity testing would consist of saturated brine from the salt-core diluted to mimic the upper-target salinity level of discharge at the outlet of the holding pond (*i.e.* , 25 ppt).
NSEL-MT-07	Minh Tan Environmental Chemical Specialist NSEL	Please include brief, but required, statements on Funding Sources and Other Approvals Required for the EA.	As stated in Section 2.6, this Project will be 100% privately funded. Alton Natural Gas Storage L.P. is committed to using local resources where possible.
NSEL-GC-01	Gordon G. Check Hydrogeologist NSEL	From a geoscience point of view, in my opinion there should be more information provided in the document related to the geology of the actual salt storage. This includes providing a geological cross-section to show the location and stratigraphy of the salt layering (Figure 5.1 is a 2-D geological map view and does not actually confirm salt anywhere in the area). This may include providing a graphical figure of the borehole stratigraphy from the (1) apparent test hole to date as well as any other relevant testing (seismic etc.). This project is completely dependent on the right subsurface geological conditions - but information confirming these has not been provided.	Details of the seismic data are proprietary but can be discussed with government regulators on request. EA updated with the following text in Section 5.1 to provide further clarification: In early 2005, 8 km of seismic data was acquired from Hunt Oil Company. This survey tied into the EOG/Hunt Cloverdale #1 well and the Hunt Alton 99-1 well, which had encountered 420 m of salt. This program allowed Alton to regionally understand the salt formation in the area surrounding the permits held today. In 2005, a gravity survey was conducted in order to correlate the seismic data with gravity in an attempt to gain a better understanding of the formation and to outline potentially deeper and thicker portions of the salt formation. Later that year, Alton conducted a 28 km seismic survey within the present salt and potash licences and mineral exploration licences. The survey defined an area with the desired geological characteristics to allow for the storage of hydrocarbons. In the winter and spring of 2006, Alton drilled a core hole 650 m to the north of the Hunt Alton 99-1 well to confirm the seismic interpretation and candidacy of the salt formation for the use of underground hydrocarbon storage. The drilling program was conducted on the Special Licence No.1-05.
NSEL-GC-02	Gordon G. Check Hydrogeologist NSEL	A second related aspect to this is that, again in my view, the conceptual cavern development diagram (Figure 2.3) should be related more directly to the actual site geology - both in cross-section as well as plan view on a map. The diagram is far too simplified/generalized. Where exactly are these caverns being proposed ? Under the Estuary ? Where are the proposed cavern boundaries relative to the known subsurface geology ? Much better graphic(s) should be prepared to show these things. This is relevant information to ask for.	Figure 2.3 revised and basemapping revised to indicate subsurface footprint.

Comment No.	Originator	Question/Statement [1]	Response
NSEL-PL-01	Peter Labor Field Management & Outreach Coordinator, Protected Areas Branch, NSEL	We are in the final stages of completing a background study of the Shubenacadie Waterway to consider its potential as a nomination candidate for the Canadian Heritage Rivers System (CHRS). There has been strong public and stakeholder support for this process, and we have worked with municipalities, local and regional stakeholders, researchers, landowners, and Mi'kmaq rights holders through the background research project. As we are still in the very early stages of considering nomination for the waterway, I can not say what affect the project might have with respect to heritage river considerations. Since the CHRS process is largely stakeholder driven, I expect that if we proceed towards nomination of the waterway, the natural gas storage project could receive considerable discussion by stakeholders during the CHRS process. In general, I anticipate that some people might see this type of project as being inconsistent with heritage river designation. While CHRS nomination/designation does not provide and regulatory authority, designation of candidate rivers requires the filing of a management plan that articulates how nominated river values will be maintained. Also, any adverse impacts of the project on natural, cultural, or recreational features (values) of the waterway would need to be taken into consideration during the nomination process. Since our department is fully engaged in a public discussion on the merits of the Shubenacadie Waterway for heritage river nomination, I think it would be prudent to ensure that the proponent is aware of the CHRS process, is considering the potential impacts of the project on the heritage values identified in the CHRS background study, and has addressed these considerations and the broader public interest in having the waterway considered for CHRS status.	Comment noted.
NSDNR-HG-01	Hugh Gillis, NS Department of Natural Resources	We are satisfied that short-term effects on terrestrial species posed by the proposed development of the site are relatively minimal. Development will result in the loss of some sites with 3 species (yellow listed General Status) of relatively rare plants that were previously unknown prior to inventories undertaken by the consultants. Other adjacent locations for each of these rare plants are known within the boundaries of the affected lands that may facilitate persistence, and 'rescue effects' such that plants still have potential for expanding populations in post-development time. The proponent should be required, as they indicate in the Draft EA Document, to clean up any brine escapement and salinized areas that may adversely effect plants or other wild species during the development phase, both on or off the site.	Comment noted.
NSDNR-HG-02	Hugh Gillis, NS Department of Natural Resources	Of greater concern is the issue of brine discharge into the Shubenacadie River given the relatively inland positioning of the proposed development. In particular, impacts on invertebrates and the trophic dynamics of the Shubenacadie system, are in our opinion, not adequately assessed in the Document. Of particular note, we suggest impacts of heightened salinity in the event of a system dysfunction and brine discharge on "key stone" food species like *Corophium volutator* need more detailed data and discussion in light of potential impacts. Such impacts could affect endangered Inner Bay of Fundy Salmon, Striped Bass, migratory birds, fishes and species of commercial interest. We wish to bring the above noted issues to the attention of NSDEL, as they pertain in particular, to species-at-risk listed under *SARA* , but defer comment to potential levels of impacts to other Provincial and Federal Departments with relevant expertise.	Section 6.1.5.1 under Fish and Fish Habitat (Section 6.1) discusses potential impacts of diluted brine discharge on *Corophium volutator* in addition to other benthic invertebrates and primary producers found in the Estuary and mudflats. In regards to the potential impacts on *C. volutator* , experimental results from McLusky (1970), who examined the salinity tolerances and behavioural responses to variable salinities of *C. volutator* , are summarized and used to infer the risk that diluted brine discharge poses to this 'keystone' species and higher trophic level organisms that depend directly or indirectly on the *C. volutator* population in the Estuary.
NSDNR-HG-03	Hugh Gillis, NS Department of Natural Resources	These comments are provided to assist the proponent in the preparation and improvement of the document, and not as criticism of it, or comment on the undertaking itself.	Comment noted.
EC-SZ-01	Stephen Zwicker Environmental Assessment Section Environment Canada	There are no specific Fisheries Act regulations governing effluent discharges that would be associated with the Project. It is however, the responsibility of the Proponent to ensure that activities are managed so as to prevent the release of substances deleterious to fish. Section 36(3) of the Fisheries Act prohibits the deposit of deleterious substances into waters frequented by fish.	Comment noted.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-02	Stephen Zwicker Environmental Assessment Section Environment Canada	It is understood based on the discharge point identified and the discussion in Section 2.1 of the draft Report, that the Proponent is considering the outlet from the proposed pre-mixing pond as the control point and is suggesting how compliance with Section 36 of the *Fisheries Act* will be achieved at that location. In Environment Canada's view, while it appears that the proposed pre-mixing pond concept could work; potential issues related to the need to use large quantities of river water to achieve compliance will likely need to be further evaluated in consultation with DFO and/or the NSEL. The proposal to test the effluent and hydrostatic testing waters for toxicity and to develop the specifics of the testing program in consultation with regulators (Section 6.1.5.2, p. 91, Section 6.1.6, p. 92) is encouraged by Environment Canada.	Comment noted.
EC-SZ-03	Stephen Zwicker Environmental Assessment Section Environment Canada	As part of any consultation, the Proponent should be prepared to consider the following factors: • How it will be determined that brine levels in the Estuary are not straying beyond the currently naturally occurring levels due to project-related activities; • Who will be conducting the monitoring; • Protocols for reporting results; • Measures that would be taken should it be determined that salinity levels were straying beyond the current naturally occurring levels.	The Proponent will be conducting the monitoring of salinity levels in diluted brine discharged to the Estuary during the brining stage of the Project and results will be made available to regulators for review. Discharge will be continuously monitored to ensure that salinity of the diluted brine does not exceed 25 ppt. Altering volumes of brine pumped into the mixing pond or temporary shut-down of brining will occur if salinity of diluted brine discharged to the Estuary exceeds 25 ppt. The details of the monitoring program of the diluted brine discharge, including protocols for reporting results and measures that will be taken if salinity exceeds 25 ppt, will be determined as part of the Industrial Approval Application.
EC-SZ-04	Stephen Zwicker Environmental Assessment Section Environment Canada	It is indicated in Section 6.6.5.1 of the draft Report that pipeline crossings will be done using Horizontal Directional Drilling (HDD) methods if technically feasible based on geotechnical studies yet to be conducted (p.114). Even in the absence of this confirmation, more information on HDD could be presented in the Report including: • Techniques to be considered as part of the feasibility analysis; • The use of and characteristics of drilling muds; • Risk of 'frac-outs' and response measures if they occur	Surface and subsurface conditions are evaluated and considered in the selection of technically feasible sites to undertake HDD operations. Surface conditions primarily include topography and watercourse approach slopes and proximity to existing structures/buildings and other infrastructure. Subsurface conditions primarily considered include an evaluation of the material along the drill path (*i.e.* , soil and/or bedrock); depth to bedrock; type of soil (particularly the amount and size of rocks/boulders); the type of bedrock (including hardness, degree of fractures, acid generating potential, *etc.*). Drilling fluids or muds are critical for pipeline installation via HDD. Drilling muds are used and appropriately selected to lubricate and maintain pressure in the hole to enable the drilling process. Drilling fluids consist of inert bentonite clay mud mixed with water and additives such as cellulosic polymers (to enhance viscosity), thickeners, Loss Control Material (LCM), and other products intended to modify the qualities of the fluid and control conditions in the borehole. Any additives to the drilling mud will be non toxic. A frac-out is the inadvertent loss of drilling mud to the surface through fissures in the bedrock or interstitial spaces through the soils. These releases are typically caused by over pressurization of the borehole beyond the containment capability of the soil overburden. Providing adequate depth of cover is designed to mitigate this potential. Existing geological conditions such as fractures that provide a hydraulic connection to the surface may cause frac-outs even when downhole fluid pressures are low. Best industry practices regarding the monitoring and control of drilling fluid will be included in the EPP which will ensure the speedy detection and response to inadvertent mud loss. In the unlikely event of a mud loss, this information will be immediately communicated to the appropriate personnel to ensure immediate action is taken. Throughout drilling, a detailed log of all drilling activities and mud volumes will be maintained on a continuous basis by the drilling personnel in order to correlate drilling status with potential fluid migration events. Annular pressure will be monitored continuously throughout the drill and the ream. If this pressure is outside the range specified, operations will be immediately adjusted to react to the situation. Monitoring of all aspects of drilling will be conducted to detect signs of a fluid release during all drilling, reaming, and pipe installation procedures. Adequate trained personnel will be on site at all times during drilling, reaming, and pipe installation procedures to ensure preventative and emergency response measures will be implemented immediately and effectively. Emergency Response and Contingency Plan will be prepared that will outline the appropriate procedure to respond to an inadvertent fluid release occurrence. Inadvertent fluid releases are unlikely to cause a significant effect on the environment. Frequent monitoring and inspection of the drill progress will ensure fluid releases are quickly identified, contained and cleaned-up, should they occur. In the case of such an unlikely event, the effects are expected to be localized, of short duration and reversible.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-05	Stephen Zwicker Environmental Assessment Section Environment Canada	In several sections of the draft Report, HDD is identified as a primary mitigation measure for protection of sensitive environmental resources (*e.g.,* pp. 96, 102, 104). Given that the feasibility of HDD at each of these locations has not been determined, alternative crossing methods and their potential environmental impacts should be discussed.	As discussed in Section 6.1.4 under Fish and Fish Habitat (Section 6.1), if HDD is not practical given the underlying geology, alternative stream crossing methods will be developed in consultation with DFO and NSEL. Supporting work will include detailed fish habitat assessments, permit application and habitat compensation (if required), stream specific mitigation, sediment control plans and follow-up monitoring.
EC-SZ-06	Stephen Zwicker Environmental Assessment Section Environment Canada	It is not clear from the draft Report how unplanned fluid releases which could occur during directional drilling would be managed. A release of drilling fluids or cuttings into water frequented by fish could constitute a violation of the *Fisheries Act* (s. 36[3]). Where applicable, it is recommended that the directional drilling path selection process and corresponding efforts establish due diligence in preventing frac-out or any other spill, and to ensure compliance with Section 36(3) of the Fisheries Act be documented.	Comment noted. See response to EC-SZ-04.
EC-SZ-07	Stephen Zwicker Environmental Assessment Section Environment Canada	More information on the use of glycol for dehydration purposes during the operation of the facility is needed. The draft Report indicates that the dehydration process is not connected to the brine disposal stream but some waste water will be generated from this process. In one of the diagrams in Appendix D, there is a reference to a wastewater tank, however important details related to this tank are lacking including: • the amount of water that will be generated from the dehydration process; • the predicted quality of the water; and, • where the water will be directed after leaving the wastewater tank	EA updated with the following text in Section 2.1.2.6: Tri-ethlyene glycol dehydration is a standard method of removing any water vapour from a natural gas stream. Water in the gas may condense, and at high pressures may cause the formation of a hydrate, much like ice, that can plug piping systems even at room temperatures. Pipeline specifications therefore require the removal of excess water to a level below which hydrates can occur. In a glycol dehydrator, the gas passes through a trayed or packed vessel where it contacts very pure glycol, which absorbs the moisture. The glycol then flows to a regenerator, where it is heated to distil the absorbed water from it. This water usually comes off as steam and is vented as vapour. If the gas stream to be dehydrated contains substances such as benzene, toluene or xylene, these will be condensed and drained to a special waste tank, from which it will be transported to a refinery for processing, or to a suitable waste facility. The amount of water that will be generated from the dehydrator is a function of the amount remaining on the walls of the cavern and the residence time for evaporation of this water. When first placed in service, there will be more water than will be available after a few injection/withdrawal cycles. As the cavern pressure declines with removal of stored gas, the amount of water that the gas can hold increases. At maximum, and for design purposes, the gas may contain about 0.034 m3 of water per mmscf, and this would be reduced to 0.002 m3/mmscf. At a flow rate of 135 mmscf per day, this would amount to about 4.59 m3 per day. Typically this rate would occur for very little of the total production.
EC-SZ-08	Stephen Zwicker Environmental Assessment Section Environment Canada	As part of planning and construction of any Project, a number of measures need to be considered implemented as applicable to minimize and control erosion and sedimentation including the following: · coordinate construction activities with seasonal constraints (*e.g.,* time clearing, grubbing, and excavation activities to avoid heavy precipitation; avoid sensitive periods for fish and wildlife; shut down and stabilize the work site in accordance with pre-established criteria in advance of the winter season) {before revegetation is no longer possible and before freeze-up}; · implement measures in advance of grubbing and excavation activities, that will allow surface drainage to be diverted around the work area; · implement further mitigative actions as necessary based on monitoring results. · monitor any nearby receiving waters for total suspended solids or contaminants of concern to ensure maintenance of the Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines for the protection of aquatic life (http://www.ccme.ca/publications/ceqg_rcqe.html) when considered in conjunction with existing ambient water quality and site-specific factors; · maintain sediment control structures (by inspecting and repairing structural problems during and after storm events, removing accumulated sediment at regular intervals or at designated capacities, and by disposing of it at an approved site, given its unsuitability as structural fill material); · stabilize exposed soil as soon as possible (*e.g.,* stabilize interim exposed soil with mulch, erosion control blankets or final exposed soil with fast-growing, non-invasive, native vegetation); · minimize the exposed soil area (by limiting the area that is exposed at any one time and by limiting the amount of time that any area is exposed); · maintain vegetated buffer zones as appropriate to protect environmental values; · install all perimeter control structures (*e.g.,* silt fencing, sediment traps, settling ponds) prior to any land disturbance.	Comment noted. Measures to minimize and control erosion and sedimentation will be built into the Project specific Environmental Protection Plan (EPP), where applicable. In addition, the EA report (Section 6.1.5.1, Habitat Effects) has been updated to include these measures and other more specific mitigative strategies to avoid or minimize the introduction of sediment to the Estuary.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-09	Stephen Zwicker Environmental Assessment Section Environment Canada	The Project has the potential to impact migratory birds. The conservation of migratory birds is the joint responsibility of the countries these birds visit during the breeding, migration, and non-breeding seasons. Environment Canada is responsible for fulfilling Canada's obligations for the conservation of migratory birds through administration of the *Migratory Birds Convention Act* (*MBCA*) and the associated regulations. Migratory birds protected by the Act generally include all seabirds except cormorants and pelicans, all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). Most of these birds are specifically named in the Environment Canada publication, *Birds Protected in Canada under the Migratory Birds Convention Act*, Canadian Wildlife Service Occasional Paper No. 1.	Comment noted.
EC-SZ-10	Stephen Zwicker Environmental Assessment Section Environment Canada	At this point, it is unclear how the Proponent proposes to comply with the MBCA. The draft Report does not include a clear commitment to avoid the destruction of active nests of migratory birds and comply with the *MBCA*. The Report states that "Clearing should be conducted during the fall and winter" (p. 101) but then later states that "If clearing is necessary prior to August 15, the Project area will be monitored for breeding activities no more than one week prior to beginning of Project activities. Activities which may impact the young will not occur within a 50 m buffer zone surrounding the nest." The proposal to have an ornithologist conduct a nest survey in advance of clearing in order to identify the presence of nests and to implement a 50 m buffer zone around active nests is not very realistic. First of all, as adult birds generally avoid approaching their nests in a manner that would attract predators to their eggs or chicks, the locations of nests in vegetation are generally very difficult to find. Secondly, considering the amount of habitat that would be impacted by the proposed project and would therefore need to be searched, this measure seems unlikely to be successful.	Comment noted. It is our expectation that clearing in the fall and winter generally allows for compliance with the *MBCA*. If clearing during the fall and winter is not feasible, the proponent will work with CWS to develop a practical mitigation plan to avoid contravening the *MCBA*. Such a plan would include provisions for indentifying nests and establishing buffers to avoid disturbing adults and young.
EC-SZ-11	Stephen Zwicker Environmental Assessment Section Environment Canada	It is stated that other hydrocarbons may be stored in caverns in the future, and that test waters from hydrostatic testing would be stored in lined ponds in cases where there is potential for hydrocarbon residues on cavern walls. Birds may be attracted to constructed ponds. It is not clear whether these would be enclosed structures or whether birds would have access to the liquids being treated. Further clarification on these structures is required, as well as methods proposed, for all project components and phases, to avoid deposit of substances harmful to migratory birds in areas frequented by these species.	Other hydrocarbons may be stored in the caverns in the future. In cases where there is the potential for hydrocarbon residues on cavern walls, hydrostatic test waters will not be discharged into the Estuary. Test waters will be stored in secure facilities (*e.g.*, lined and enclosed pond) and re-used for further testing.
EC-SZ-12	Stephen Zwicker Environmental Assessment Section Environment Canada	Under Section 6 of the Migratory Birds Regulations (MBR), it is forbidden to disturb, destroy or take a nest or egg of a migratory bird; or to be in possession of a live migratory bird, or its carcass, skin, nest or egg, except under authority of a permit. It is important to note that under the current MBR, no permits can be issued for the incidental take of migratory birds caused by development projects or other economic activities. Furthermore, under Section 5.1 of the *MBCA* describes prohibitions related to deposit of substances harmful to migratory birds: "5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area. (2) No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance — in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area — that is harmful to migratory birds."	Comment noted.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-13	Stephen Zwicker Environmental Assessment Section Environment Canada	It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the *MBCA* and regulations. In fulfilling its responsibility for *MBCA* compliance, the proponent should take the following points into consideration: • The breeding season for most birds within the Project area occurs between May 1st and August 31st; however some species protected under the *MBCA* nest outside this timeframe. • While most bird species construct nests in trees and shrubs, a number of species of birds nest at ground level (*e.g.* Common Nighthawk, Killdeer), and some species may nest in burrows in stockpiles of soil or the banks of pits (*e.g.* Bank Swallows).	Comment noted.
EC-SZ-14	Stephen Zwicker Environmental Assessment Section Environment Canada	One method frequently used to minimize the risk of destroying bird nests consists of avoiding certain activities, such as clearing, during the nesting period for migratory birds in the region. Risk of impacting active nests or birds caring for pre-fledged chicks, discovered during project activities outside the May 1st to August 31st window, can be minimized by measures such as the establishment of vegetated buffer zones around nests, and minimization of activities in the immediate area until nesting is complete and chicks have naturally migrated from the area. It is incumbent on the proponent to identify the best approach, based on the circumstances, to complying with the *MBCA*.	Comment noted.
EC-SZ-15	Stephen Zwicker Environmental Assessment Section Environment Canada	The Project has the potential to impact species at risk and/or of conservation concern. The proponent must ensure its activities are managed so as to comply with the *Species at Risk Act* (*SARA*). *SARA* is one of three elements of Canada's Strategy for the Protection of Species at Risk. The other two are the federal-provincial/territorial *Accord for the Protection of Species at Risk* and the Habitat Stewardship Program for Species at Risk.	Comment noted.
EC-SZ-16	Stephen Zwicker Environmental Assessment Section Environment Canada	The 1996 *Accord for the Protection of Species at Risk* commits the federal government, provinces and territories to establish complementary legislation and programs to protect Canada's species at risk. The Act complements the work being done by provincial and territorial governments while ensuring federal responsibilities and standards are met.	Comment noted.
EC-SZ-17	Stephen Zwicker Environmental Assessment Section Environment Canada	The goal of *SARA* is to prevent endangered or threatened wildlife from becoming extinct or lost from the wild, and to provide for the recovery of these species. The Act is also intended to manage species of special concern and to prevent them from becoming endangered or threatened. The Act recognizes that the protection of wildlife species is a joint responsibility and that all Canadians have a role to play in the protection of wildlife.	Comment noted.
EC-SZ-18	Stephen Zwicker Environmental Assessment Section Environment Canada	The Minister of Environment's responsibilities under the Act include the protection and recovery of migratory birds and species at risk on federal lands, other than those under the responsibility of the Minister of Fisheries and Oceans or those individuals under the responsibility of the Parks Canada Agency. The Minister of Fisheries and Oceans is responsible for aquatic species at risk.	Comment noted.
EC-SZ-19	Stephen Zwicker Environmental Assessment Section Environment Canada	Under the *Accord for the Protection of Species at Risk*, it is understood that the provinces and territories will undertake actions and enforce prohibitions for the conservation of species at risk that come under their management authority. *SARA* allows the federal government to enact protective prohibitions in cases where a province or territory fails to provide effective protection for a species or its critical habitat.	Comment noted.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-20	Stephen Zwicker Environmental Assessment Section Environment Canada	If the project or elements of the project are subject of an environmental assessment under the *Canadian Environmental Assessment Act (CEAA*), *SARA* amends the definition of "environmental effect" in *CEAA* to include "any change [a project] may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act". In addition, Section 79 of *SARA* confers specific duties to persons required by an Act of Parliament to ensure that an environmental assessment (EA) is conducted. "Persons" are defined to include Responsible Authorities of projects undergoing a federal EA. Responsible Authorities must identify adverse effects of a project on listed species and their critical habitat or residences. If the project is ultimately carried out, Responsible Authorities must ensure that measures are taken to avoid or lessen adverse effects and that effects are monitored. It should also be noted that while *SARA* prohibitions do not apply to species listed as Special Concern, section 79 of *SARA* does apply to these species.	Comment noted.
EC-SZ-21	Stephen Zwicker Environmental Assessment Section Environment Canada	In addition to *SARA* requirements, application of the precautionary principle and the consideration of potential impacts on all rare or imperilled species in Canada (*e.g.,* species of conservation concern) are considered by Environment Canada to be a best practice approach to fulfilling EA responsibilities.	Comment noted.
EC-SZ-22	Stephen Zwicker Environmental Assessment Section Environment Canada	Although alluded to, the importance of the mudflats of the upper Bay of Fundy and its estuaries, including Cobequid Bay and the Shubenacadie River, to migrant shorebirds is not adequately described in the draft Report. Furthermore, the link and potential effects to these birds if their prey species, including *Corophium volutator*, are impacted are not adequately described in the report. The potential effects of accidental concentrated brine discharge or changes in salinity affecting shorebird prey species must be assessed not only with regard to impacts to the invertebrates themselves, but also in terms of potential effects to shorebirds. The EA report should be revised accordingly.	A discussion on the potential impacts of diluted brine discharge on *Corophium volutator* is provided in Section 6.1.5.1 under Fish and Fish Habitat. As summarized in Section 6.1.5.1, McLusky (1970) conducted a series of trials whereby *C. volutator* were placed in tanks where a variety of different salinity zones were available. At salinities between 10-30 ppt, *C. volutator* showed no significant patterns of choice. However, at salinities below 10 ppt, *C. volutator* significantly chose the highest available salinity, and in the range of 30-40 ppt, they chose the lowest available salinity. *C. volutator* have been shown to tolerate salinities up to 50 ppt for long periods (over 500 hours). Discharged diluted brine will not exceed a salinity of 25 ppt, which is well below the lethal salinity level for *C. volutator* and will not occur during the last four hours of the ebb tide when salinities are lowest. Furthermore, according to McLusky (1970), the maximum salinity of discharged water will not alter the distribution patterns of *C. volutator*. As such, no adverse effects are predicted on *C. volutator* populations in the Estuary due to the effects of diluted brine. As no effects are predicted on *C. volutator* populations in the Estuary there is not predicted to be any effects on migratory shorebirds which depend on *C. volutator*; the EA document has been revised to reiterate this important conclusion.
			The potential effects of an accidental release of brine on fish and fish habitat are discussed in Section 7.2.1. The word 'fish' as used in the EA (see Section 6.1.1), as defined by the Fisheries Act, means all fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals. Therefore, all aquatic organisms in habitats defined as fish habitat are considered as fish in the assessment, including C. volutator. As discussed in the EA document, the proponent has committed to incorporating safety features into the design to reduce the risk of an accidental release of concentrated brine. For instance, the brine pipeline will be designed with automatic shutdowns, thus reducing the risk of concentrated brine being released to the Estuary in case of equipment failure. However, because of the possibility, albeit very low, of a release of concentrated brine to the Estuary, the environmental effects of an accidental hazardous spill on fish and fish habitat are considered significant, but not likely. Consequently, the potential for negative effects on migratory shorebirds which depend on components of fish and fish habitat (i.e., C. volutator populations) due to an accidental event are considered unlikely; the EA document has been revised to clarify this.
EC-SZ-23	Stephen Zwicker Environmental Assessment Section Environment Canada	The draft Report states that "because of the possibility, albeit very low, of a release of concentrated brine to the Estuary, the environmental effects of an accidental spill on fish and fish habitat are considered significant, but not likely." However, there is no similar analysis of effects of a release of concentrated brine on migrant shorebirds, due to impacts on their prey, including *C. volutator*. This section of the Report should be revised to include this discussion.	See response to Comment EC-SZ-22

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-24	Stephen Zwicker Environmental Assessment Section Environment Canada	A local resident identified a Great Blue Heron colony approximately 500 m south of the proposed Right-of-Way (ROW) however, the exact location and size of the colony has not yet been verified (p. 66). The draft Report recommends that a field survey be conducted prior to commencement of construction to ensure that there is adequate space for the 400 m buffer recommended by NSDNR. It is unfortunate that this data was not obtained in late 2006 or very early 2007, as it is important that this information be provided for review. However, it is now too late in the year to go out and conduct surveys (either on foot or helicopter) due to the extreme sensitivity of this species to disturbance.	Comment noted.
EC-SZ-25	Stephen Zwicker Environmental Assessment Section Environment Canada	Colonial nesters such as Great Blue Herons are known to be very sensitive to human disturbance during the breeding season, and will fly away if humans approach their colonies. The result is nests or chicks left unattended and vulnerable to predators or the elements. When disturbed by humans, older chicks may fall out of nests while trying to fledge prematurely. Birds are also known to desert nests and entire colonies if disturbance occurs during the periods of pair-formation, nest construction, or early egg-laying. Environment Canada therefore recommends the following: • In late summer (no sooner than late August), a field survey should be conducted to determine the exact location and size of the colony. The following information should be sent to the Canadian Wildlife Service (CWS): a map showing the delineated colony, GPS coordinates, number of nests observed, and number of nests that appear to have been used. In order to avoid attracting people to this sensitive site, it would be preferable to not make the specific location data generally available, but only to provide this data to regulatory authorities. • If the pipeline RoW is located less than 400 m from the edge of the colony, then the RoW should be adjusted so that such a buffer is possible. • In addition to the general buffer (i.e. NSDNR 400 m) from the edge of a heron colony from April through mid-August, CWS recommends no activities with a high disturbance factor (e.g. blasting, drilling) within a 1 kilometer buffer during this period. • No activities that would require the removal of trees should take place within the 400 m buffer regardless of the time of year.	Section 6.3.5.1 updated with comments from EC.
EC-SZ-26	Stephen Zwicker Environmental Assessment Section Environment Canada	The possibility of shifting the route to avoid rare plants is mentioned (pages 96-98). While we encourage the avoidance of rare plants, it would be preferable to not bring the pipeline RoW closer to the colony of Great Blue Herons.	Comment noted.
EC-SZ-27	Stephen Zwicker Environmental Assessment Section Environment Canada	Although none were identified during the June 2006 field survey, the Common Nighthawk is listed in Table 5.6 as one of the "Sensitive, Rare or Uncommon Bird Species Most Likely to be Found Along the RoW" due to the fact that clear-cuts are a common habitat type along the proposed route. At its Spring 2007 meeting, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed this species as Threatened. While this migratory bird has not yet been added to Schedule 1 of *SARA* , the application of the precautionary principle, as recognized in the *SARA* preamble, is advocated.	Comment noted.
EC-SZ-28	Stephen Zwicker Environmental Assessment Section Environment Canada	Even though none were identified in 2006, there is no reason to believe that this species may not choose to nest in appropriate habitats in the study area in future years, including the proposed new pipeline RoW. As such, the revised EA Report should provide a description of potential effects of project-related activities and increased access to the pipeline RoW by the public (*e.g.* ATV use), as well as potential accidental events, on this species. Proposed mitigation measures and monitoring should also be discussed.	Mitigation identified in Section 6.3.5 will protect Common Nighthawks, and other bird species not specifically addressed in the EA, that may nest and/or forage along the proposed RoW. Mitigation includes no clearing activities during the nesting season (April 1 to August 15), no blasting, and no use of pesticides by the proponent along the RoW. The Common Nighthawk is not particularly sensitive to human disturbance, indicated by its nesting in habitats altered by human activities, such as cut-overs and even urban areas. The edge habitat created by the RoW may actually encourage nesting of Common Nighthawks. Strategies to stop or minimize unauthorized access to the RoW (i.e., ATVs) are discussed in Section 6.3.5.2.
EC-SZ-29	Stephen Zwicker Environmental Assessment Section Environment Canada	Although none were identified during the June 2006 field survey, the Chimney Swift is listed in Table 5.6 as one of the "Sensitive, Rare or Uncommon Bird Species Most Likely to be Found Along the RoW." At its Spring 2007 meeting, COSEWIC listed this species as Threatened. While this migratory bird has not yet been added to Schedule 1 of *SARA* , the application of the precautionary principle, as recognized in the *SARA* preamble, is advocated.	Comment noted.

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EC-SZ-30	Stephen Zwicker Environmental Assessment Section Environment Canada	While this species is listed in Table 5.6, there is no further discussion of it in subsequent paragraphs. The revised EA Report should include a description of the nesting habitat (if any) for this species in the study area.	The Chimney Swift nests principally in chimneys, but also on the interior walls of a variety of other anthropogenic structures, such as abandoned buildings and wells. Natural nesting habitat for this species includes the inside walls of large, hollow trees. There is little suitable nesting habitat for the Chimney Swift in the Project area. Open chimneys and abandoned buildings, which are the preferred nesting habitat of this species, do not exist along the RoW or in close proximity to it. Furthermore, suitable natural besting habitats (*i.e.,* large hollow trees) are uncommon along the RoW, due to clear-cut foreestry operations. No nests or adults were encountered during the field surveys.
EC-SZ-31	Stephen Zwicker Environmental Assessment Section Environment Canada	The Olive-sided Flycatcher is ranked Yellow by the NSDNR and is a Partners in Flight priority species. It is stated on p. 102 that Olive-sided Flycatchers were heard in 2 wetlands during 2006 field surveys, and neither of these wetlands is expected to be disturbed during project-related activities. However, it appears the small stream that connects the two wetlands will need to be crossed by horizontal directional drilling (HDD). The draft Report recommends that "HDD at this site be conducted outside the nesting period of this species (June to August)." It should be noted that during field work for the first *Atlas of Breeding Birds of the Maritime Provinces*, chicks of this species were reported into mid-August. We therefore recommend a precautionary approach, and that the time period for not conducting HDD at this site is extended until the end of August.	Comment noted. HDD under the small stream that connects the two wetlands will not be conducted during the period from April 1 to August 31. Section 6.3.5.1 of EA updated.
EC-SZ-32	Stephen Zwicker Environmental Assessment Section Environment	Based on the information provided, it is not possible to gain a clear understanding of the impact of the Project on various forest habitats, and the migratory birds that use these habitats.	See response to comment EC-SZ-33.
EC-SZ-42	Stephen Zwicker Environmental Assessment Section Environment Canada	Several types of migratory bird habitat are in decline in Nova Scotia, including mature coniferous forest, mature deciduous forest and mature mixed forest. This is of concern because certain bird species prefer mature forest habitat. Furthermore, some bird species, generally known as interior species, only prosper when the tracts of mature forest are relatively large and unfragmented (i.e. interior forest). Examples of bird species of conservation concern, or Partners in Flight priority species, that are primarily mature forest habitat dwellers include the Boreal Chickadee, Brown Creeper, Canada Warbler, and Eastern Wood-Pewee.	Comment noted.
EC-SZ-33	Stephen Zwicker Environmental Assessment Section Environment Canada	It is desirable for projects to avoid causing further loss and fragmentation of these habitat types, and to avoid further fragmentation of the landscape. To help demonstrate how the Project is being planned with these objectives in mind, the next version of the EA document should include the following information and clarifications: • mapping that identifies mature and interior forest habitat for migratory birds in the project area, along with a rationale as to why this habitat cannot be avoided through routing and siting of facilities; • the total area (hectares) mature coniferous, mature hardwood, mature mixed forest, and interior forest habitat for migratory birds that would be lost as a result of the project (e.g. clearing of ROW, temporary and permanent access roads and work areas), a description of the specific steps taken to minimize those losses; • an analysis of project impacts on mature and interior forest habitat for migratory birds on a regional scale taking into account cumulative losses; • proposed mitigation for the predicted loss of mature and interior forest habitat for migratory birds and the related effects on species using these habitats.	As discussed in Section 6.3.4, linear developments have the potential to fragment interior forest habitat, bringing wildlife populations, such as forest birds, into contact with humans which can lead to direct mortality and disturbance. However, in the case of pipeline corridors where there is no ongoing human presence and noise, the likelihood of anthropogenic mortality and/or disturbance on wildlife, including forest birds, is reduced. The RoW will be kept as narrow as possible and the route has been chosen to avoid sensitive habitats such as wetlands, riparian zones and streams. In addition, clearing will be scheduled to avoid interaction with the breeding season of most bird species, there will be no blasting and vegetation control will be carried out using mechanical means. Strategies to stop or minimize unauthorized access to the RoW (i.e., ATVs) are discussed in Section 6.3.5.2. Furthermore, terrestrial habitat within the RoW will not be permanently lost; rather it will be converted to open shrub and forest edge habitat, which will be used by a variety of bird species and will likely not pose a long-term barrier to wildlife movement. As discussed in section 5.7.2, based on aerial photography, it is estimated that the proposed RoW crosses 27 parcels of forested land. One parcel is crown land and four parcels are owned by Neenah Paper Company of Canada (spun off from Kimberly-Clark Corporation in 2004). In Nova Scotia, Neenah Paper operates a Kraft pulp mill in Pictou along with several hectares of timberlands. Figure 5.3 in the EA report delineates whether land crossed by the proposed RoW is forested, agricultural, clear cut, *etc*. In total, the following areas (in hectares) will be altered (*i.e.*, converted to open, shrub habitat) as a result of the Project RoW: • Agriculture: 6.69 ha • Alder Stand: 0.19 ha • Natural Tree Stand: 13.32 ha • Treated Tree Stand: 0.74 ha • Plantation: 0.51 ha • Clear Cut: 2.88 ha

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			The terrestrial environment of Nova Scotia has been significantly altered by past anthropogenic influences. Large scale human activities such as forestry and industrial, infrastructure and residential development as well as smaller scale activities such as fishing, hunting and other recreational activities (i.e., ATV use) have altered the distribution and abundance of plant and animal species and the structure, diversity and productivity of onshore ecosystems in Nova Scotia. There has been a cumulative loss of terrestrial habitat within the onshore study area due to forestry, road-development, agriculture and residential development. The pipeline RoW will result in a habitat change to a small area of terrestrial habitat; however, the area altered due to the Project is insignificant as compared to the amount of forested land cleared during un-mitigated clear-cut forestry operations in the vicinity of the Project. In general, the Project will contribute to a cumulative loss of habitat and dependent plant and animal species; however, any effects will be minor (i.e., not significant) and will be further reduced through Project mitigation.
EC-SZ-34	Stephen Zwicker Environmental Assessment Section Environment Canada	The draft Report mentions vent stacks that would be supported by guy wires (p. 16) however, it is not clear whether these structures would be lit? In order to minimize the risk to nocturnal migrants, Environment Canada recommends that the minimum amount of pilot warning and obstruction avoidance lighting should be used. The use of only strobe lights on tall structures at night, at the minimum intensity and minimum number of flashes per minute (longest duration between flashes) allowable by Transport Canada, is recommended. The use of solid-burning or slow pulsing red warning lights at night should be avoided.	Comment noted.
EC-SZ-35	Stephen Zwicker Environmental Assessment Section Environment Canada	It is also recommended that the proponent avoid or restrict the time of operation of exterior decorative lights such as spotlights and floodlights whose function is to highlight features of buildings, or to illuminate an entire building. Especially on humid, foggy or rainy nights, their glow can draw birds from far away. It would be best for the birds if these lights were turned off, at least during the migratory season, when the risk to birds is greatest. Other considerations include: • Lighting for the safety of the employees should be shielded to shine down and only to where it is needed, without compromising safety. • Street and parking lot lighting should also be shielded so that little escapes into the sky and it falls where it is required. • If vent stacks are to be lit, then a detailed avian collision monitoring protocol should be prepared and submitted for review.	Section 2.1.1.5 of EA updated with the following text: All outdoor lighting will be directed and shielded so as to illuminate only the areas that must have adequate lighting for safety of operations personnel. As most equipment will be housed in buildings, the amount of outdoor lighting will be minimal, and will generally be limited to lights mounted on the buildings for illumination of entrances and adjacent equipment. Some of this may be actuated by motion sensors, and can then be turned off except when needed. There will likely be some yard lighting that cannot be avoided; where this occurs, it will be shielded and directed so that little escapes to the sky. There will be a flare stack to burn gas that must be released in an emergency. However, as this is for emergency use only, it will not normally be lit. Typically, it will be tested annually, and will be used when a well work-over is required or on an equipment failure. Well work-overs are specified by standard to occur every ten years for each cavern; they would be staggered so they do not all occur at once. Equipment failures are rare and do not usually result in a gas leak. When a gas leak does occur, gas is usually released over a very short time period.
EC-SZ-36	Stephen Zwicker Environmental Assessment Section Environment Canada	Further details regarding on this topic can be found in the attached pamphlet titled Bird Friendly Structures which, though still in draft form, discusses best management considerations for tall structures.	Comment noted.
EC-SZ-37	Stephen Zwicker Environmental Assessment Section Environment Canada	The significance criteria proposed for effects on birds in Section 6.3.3 only considers effects to species at risk or species of conservation concern. There is no consideration for birds that do not have rarity ranks. It should be recognized that large numbers of birds may congregate in certain areas during certain life-stages (e.g. nesting colonies, shorebirds in migration), and that harm to important habitat components or disturbance to these birds could potentially result in significant effects. The significance criteria should be revised to include consideration of colonial nesters and migrating shorebirds and their habitat (including *C. volutator*). The proposed significance criteria should also be revised to consider species listed as Endangered, Threatened, or Special Concern by COSEWIC but not yet listed on SARA Schedules.	The residual environmental effects evaluation criteria for wildlife and wildlife habitat has been revised to include provisions for COSEWIC listed, sensitive, and secure bird and other wildlife species. Sensitive bird species (i.e., colonial nesters) present in the Project area are discussed in Section 5.6 and potential interactions, issues and concerns as well as analysis, mitigation and environmental effects prediction pertinent to sensitive species are described in Sections 6.3.4 and 6.3.5, respectively. The focus on rare or at-risk species is twofold. First, species that are low in abundance and threatened with extirpation and/or extinction require special protection from anthropogenic impacts to assure their future security and maintain biodiversity. Second, mitigation for rare species serves to protect common species and/or species of unknown status. Overall, the focus on at-risk wildlife species makes for a more concise EA based on a precautionary principle of protecting the species most susceptible to anthropogenic impacts. The feeding habitats of migratory shorebirds on mudflats of the Estuary are discussed in Section 6.1.5.1, under Fish and Fish Habitat; also refer to responses to comments EC-SZ-22 and NSDNR-HG-02.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-38	Stephen Zwicker Environmental Assessment Section Environment Canada	The Federal Policy on Wetland Conservation (FPWC) was introduced "to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." The policy recognizes the importance of wetlands to the environment, the economy and human health, and promotes a goal of no-net-loss of wetland functions. In support of this goal, the FPWC and related implementation guidance identify the importance of planning, siting and designing a project in a manner that accommodates a consideration of mitigation options in a hierarchical sequence - avoidance, minimization, and as a last resort, compensation. Environment Canada advocates application of the FPWC to the Project as a best practice. Environment Canada also supports the provincial government in its protection of wetlands on provincial lands and provides expertise as requested.	Comment noted.
EC-SZ-39	Stephen Zwicker Environmental Assessment Section Environment Canada	It is not clear whether freshwater wetlands would be directly impacted, although it appears that coastal wetland habitat will be impacted. It is stated in draft report that wetlands will be avoided "where feasible" (pages 8 and 34) and based on this it appears that wetlands are not included in the scope of the EA, although this appears to refer to freshwater wetlands only. This is despite the fact that there is no certainty that wetlands will be avoided, and this statement appears to apply to only to freshwater wetlands. For example, no details are provided regarding what factors would be considered when making the determination of whether or not it is "feasible" to avoid wetlands and their 30 m buffers. It is proposed that if wetlands are determined to be unavoidable upon final design routing of the pipeline and location of project facilities, then full wetland evaluations would be conducted according to provincial policy and guidelines, and that permit applications would be submitted with habitat compensation guidelines.	The proponent is planning to avoid all wetlands, where feasible. Factors that would make wetland avoidance not feasible relate to land-use and geological constraints. Should wetlands be determined to be unavoidable, full wetland evaluations will be conducted according to provincial policy and guidelines, and permit applications submitted with habitat compensation proposals. Interaction between the Project and the intertidal zone of the Estuary is possible due to the discharge of diluted brine. This habitat consists of mudflats and salt-tolerant grasses. Potential interactions between the discharge of diluted brine and aquatic-related mammals and migratory shorebirds that forage in the Estuary and associated intertidal zone are discussed in Section 6.1 (Fish and Fish Habitat) as well as Section 6.3 (Wildlife and Wildlife Habitat). In addition, potential interactions between the discharge of diluted brine and rare and sensitive flora that may be present in the intertidal zone are discussed in Section 6.2 (Rare and Sensitive Flora).
EC-SZ-40	Stephen Zwicker Environmental Assessment Section Environment Canada	Since at this time, the proponent cannot guarantee that freshwater wetlands will be avoided, and it appears that coastal wetland habitat will be impacted, Environment Canada recommends that wetlands in the project area be considered a Valued Ecosystem Component (VEC) for the EIA review, and that the document be revised accordingly. This revision should also include consideration of impacts to wetlands due to ATV use of the pipeline RoW.	The proponent recognizes the ecological, economic and hydrological importance of wetlands. Project activities will not occur in wetland areas without full wetland evaluations that would be conducted in accordance with provincial policy and guidelines. In addition, permit applications will be submitted with habitat compensation proposals. See response to comment EC-SZ-39.
EC-SZ-41	Stephen Zwicker Environmental Assessment Section Environment Canada	It is not clear whether wetlands would be directly impacted by the proposed project. It is stated that wetlands will be avoided "where feasible" (pages 8 and 34). The proponents have therefore chosen to scope wetlands out of the EIA. However, no details are provided regarding what factors would considered when making the determination of whether or not it is "feasible" to avoid wetlands and their 30 m buffers. It is proposed that if wetlands are determined to be unavoidable upon final design routing of the pipeline and location of project facilities, then full wetland evaluations would be conducted according to provincial policy and guidelines, and that permit applications would be submitted with habitat compensation guidelines. It is not clear whether coastal wetlands will be affected by the proposed project. Since the proponent cannot guarantee that wetlands will be avoided, Environment Canada recommends that wetlands in the project area be considered a Valued Ecosystem Component (VEC) for the EA review, and that the document be revised accordingly. The revision should also include consideration of impacts to wetlands due to ATV use of the pipeline RoW.	See responses to comments EC-SZ-39 and 40.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-42	Stephen Zwicker Environmental Assessment Section Environment Canada	Environment Canada also recommends that detailed wetland functional analysis be conducted for wetlands potentially affected by project-related activities. Examples of functional assessment methodologies include the United States federal- and state protocols (*e.g*. Brinson 1993) and others (*e.g*. Smith *et al.* 1995). For synoptic functional assessments, many states have developed rapid assessment techniques (*e.g*. California at www.cramwetlands.org). Brinson, M.M. 1993. A Hydrogeomorphic Classification for Wetlands. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, USA. Technical Report WRP-DE-4 Smith, R.D., A. Ammann, C. Bartoldus and M. Brinson. 1995. An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices. U.S. Army Corps of Engineers, Waterways Experiment Station,Vicksburg, MS, USA. Technical Report WRP-DE-9 This analysis will provide a better understanding of the important wetland functions of the wetlands potentially affected by the project, and allow for a more useful evaluation of impacts of the project.	As noted in Section 3.1.1, if wetland avoidance is deemed not feasible (i.e., due to land-use and geological constraints) evaluations of wetlands predicted to interact with the Project will be provided to regulators according to provincial policy and guidelines along with permit applications and habitat compensation proposals. Wetland evaluations will include detailed wetland functional analysis. The proponent is striving to avoid freshwater wetlands and accordingly it is unnecessary to conduct wetland evaluations at this stage of project development.
EC-SZ-43	Stephen Zwicker Environmental Assessment Section Environment Canada	For those wetlands where avoidance is not possible, a detailed description of the reasons why avoidance and minimization of impacts were determined to not be possible should be provided. This information should be provided during the EIA project review process. The mitigation measures and monitoring plan, as well as a proposed compensation plan, should be consistent with those proposed for other projects in Atlantic Canada.	The wetland evaluations will be provided during the permit application process (e.g., industrial approval, water approval) when detailed design information is available. The approach will be consistent with other projects in Atlantic Canada.
EC-SZ-44	Stephen Zwicker Environmental Assessment Section Environment Canada	It is recommended that a variety of species of plants native to the general project area be used in revegetation efforts. Should seed mixes for herbaceous native species for the area not be available, it should be ensured that plants used in revegetation efforts are not known to be invasive. Environment Canada also recommends that measures to diminish the risk of introducing invasive species be developed and implemented. These measures could include: • cleaning and inspecting construction equipment prior to transport from elsewhere to ensure that no matter is attached to the machinery (*e.g.* use of pressure water hose to clean vehicles prior to transport); and • regularly inspecting equipment prior to, during and immediately following construction in wetland areas and in areas found to support Purple Loosestrife to ensure that vegetative matter is not transported from one construction area to another.	EA text updated with EC's suggested mitigation (Section 6.2.5.1).
EC-SZ-45	Stephen Zwicker Environmental Assessment Section Environment Canada	It is not clear, what measures would be taken to protect birds (including avian species at risk) or sensitive habitats in the event of a spill of a substance harmful to birds. Even a small spill could be significant if it were to impact avian species at risk, sensitive habitats, or large numbers of birds. For any size spill, what measures would be taken to contain a spill and to clean up an area should there be a spill during any phase of the project? Who would be responsible for cleanup? What equipment would be available to contain spills? Would measures be taken to keep birds away from the substance? If so, what types of measures would be proposed? What strategy would be in place to deal with accidents where birds were oiled and/or sensitive habitat(s) was (were) contaminated? If birds were oiled, would the proponents do nothing, or capture and kill the birds, or capture and clean the birds?	A Spill Management Plan will be developed and implemented to minimize the effects of spills on the terrestrial and aquatic environment (see Section 2.4.3). A Spill Management Plan will be developed during the permitting process (*e.g*., EPP). It is not anticipated that large volumes of hydrocarbons will be released.
EC-SZ-46	Stephen Zwicker Environmental Assessment Section Environment Canada	Would there be trenches still open at the end of the day? If so, what measures would be taken by project staff or contractors if wildlife (*e.g.* turtle) got trapped in a trench?	Trench inspections for trapped fauna will be conducted at the beginning of each working day. If an animal is trapped in the trench, NSDNR will be contacted. EA updated in Section 6.3.5.1.
EC-SZ-47	Stephen Zwicker Environmental Assessment Section Environment Canada	It should be confirmed that DFO aquatic species at risk biologists have also had the chance to review this project.	DFO scientists have had the opportunity to review the EA. In addition, the proponent engaged DFO scientists and other stakeholders during the EA process to ensure that their concerns and knowledge were incorporated into the document and they were aware of the Project well in advance of the submission of the EA for their review.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-48	Stephen Zwicker Environmental Assessment Section Environment Canada	Please provide a description of temporary work areas, including marshalling yards, access roads and storage areas, that will be required for the project (*e.g.,* approximate number, general locations, total area), and confirmation of whether temporary work areas will be rehabilitated.	Existing roads will be used where possible to access the RoW. Work areas will not be known until the final design is completed, but mitigative measures that apply throughout the EA will also be applied to new access roads and work areas. Further project details will be provided in the permitting process (*e.g.* , industrial approval, EPP).
EC-SZ-49	Stephen Zwicker Environmental Assessment Section Environment Canada	Environment Canada does not agree that a mechanical failure of wellheads, pipeline, or compressors leading to uncontrolled release of natural gas, fire and explosion would have no interaction with the terrestrial environment. Terrestrial environment should therefore be considered a VEC for the assessment of this type of malfunction or accidental event.	Because the stored product, natural gas, is lighter than air, it will rise and will not accumulate in low areas surrounding the site. An explosion or fire would be limited to the location of the release. Therefore, the impact of a critical failure will be limited to the vicinity of the release, and would not likely extend beyond the project site.
EC-SZ-50	Stephen Zwicker Environmental Assessment Section Environment Canada	It is stated on p. 124 that "Should there be a 1% change in flow volume on the discharge line from the underground storage facility to the brine holding and mixing ponds, an alarm will be raised. A small change will initiate an automatic system shutdown." Would failure of brine pond or diluting pond containment dyke initiate a similar automatic system shutdown? If not, how would a containment dyke failure be detected?	Sections 2.5.2, updated with the following text: The brine pond will be equipped with a level sensing device that will provide an indication of the volume of brine in the pond. This will provide a signal that will be integrated with the in-flow and out-flow of brine, so that the volume in storage based on flow can be compared with the volume based on level, and an alarm raised if there is a discrepancy. There will be no alarm system on the mixing pond; this pond is below river level, and is influenced by tidal activity. It is anticipated that this pond will be open to the river, so the water level will in the pond be the same as the river level.
EC-SZ-51	Stephen Zwicker Environmental Assessment Section Environment Canada	What is the proposed height of the holding dykes for the brine holding and mixing ponds? What is the risk of the brine holding and mixing ponds being inundated at extreme high tides, storm events, or overflowing during periods of extreme precipitation and/or snow melt?	According to the river monitoring that was conducted from August to December 2006, the highest tide that was recorded was 8.3 m Geodetic Elevation in November 2006. River monitoring has begun and will run from May 2007 until December 2007. Using this additional data, Alton will establish an appropriate dyke height which will be approximately 10 m and will include a suitable safety factor, as the current dyke is 9.73 m. There is very limited risk that the holding or mixing ponds will be inundated at extreme high tides, storm events and extreme precipitation as the system will be shut down when required. However, the brine pond will be equipped with a level sensing device that will provide an indication of the volume of brine in the pond. See response to comment EC-SZ-50 for further details.
EC-SZ-52	Stephen Zwicker Environmental Assessment Section Environment Canada	The draft Report provides a brief outline of a proposed Environmental Management Plan (Section 2.5.3.1) and a project-specific Emergency Response and Contingency Plan (Section 2.5.3.3). In the context of the EA, it is also recommended that environmental emergency prevention, preparedness, response and recovery plans for the Project include the following specific elements: • a description of biological and human-use resources that could be impacted; • an inventory of oil and chemical products and associated storage locations for both Project construction and operational phases; • the identification of spill response equipment that will be on-site or available in case of emergency events; • staff training; • procedures for responding to operational spills and releases; • an incident reporting system, including notification and alerting procedures; • a list of response organizations and clarification of the roles of each organization; and, • clean-up and disposal procedures.	Text updated in the EA (Section 2.5.3.3).
EC-SZ-53	Stephen Zwicker Environmental Assessment Section Environment Canada	The Proponent is advised to report all spills, releases and deposits into the environment to the Canadian Coast Guard Regional Operations Centre (1-800-565-1633) as soon as possible. The Operations Centre will notify appropriate federal and provincial agencies. The Proponent should also be aware of and discuss any reporting obligations under federal legislation and regulations.	Comment noted.

Comment No.	Originator	Question/Statement [1]	Response
EC-SZ-54	Stephen Zwicker Environmental Assessment Section Environment Canada	As there is little detail on environmental emergency planning and response in the draft Report, the Proponent should commit to submitting the Emergency Response and Contingency Plan to appropriate regulatory agencies for review.	Text updated in the EA (Section 2.5.3.3).
EC-SZ-55	Stephen Zwicker Environmental Assessment Section Environment Canada	As part of project planning and good EA practice, Environment Canada recommends the Proponent discuss sensitivities of infrastructure and operations to elements of climate and weather. Such a discussion should demonstrate that the project will be designed and operated in consideration of the vulnerability of various components to extremes and variability on climatic and meteorological conditions.	See response to comment EC-SZ-51. Also, Section 7.0 Malfunctions and Accidental Events assesses abnormal events, such as extreme climatic conditions, which may lead to failure of the system.
DFO-01	Sciences Division, DFO	Page 7 – 2.1.1.1 Site Preparation and 2.1.1.2 Water Intake and Brine Discharge Facilities Once more design details are known, a decision can be made on whether the work below the ordinary high water mark would be considered a harmful alteration, disruption or destruction of fish habitat in relation to the *Fisheries Act (FA)* , section 35.	Comment noted.
DFO-02	Sciences Division, DFO	Page 9 – Table 2.1 Brining Water Intake It must be demonstrated that complying with the DFO fish screen guidelines for freshwater is adequate to ensure compliance with the *FA* and the *Species at Risk Act (SARA)* , in this particular situation. Details on the design for all of the fish screens should be provided to DFO.	As described in Section 6.1.5, the design of fish screens on water intake infrastructure will be developed in consultation with DFO scientists to meet the requirements stipulated in the department's Freshwater Intake End-of-Pipe Guidelines (1995). Final plans will be submitted to DFO for approval.
DFO-03	Sciences Division, DFO	Page 33 – Table 3.1 Fish and Fish Habitat Should read that "Species at risk are protected under the *SARA"* rather than "Species of special concern".	Comment noted. The text in Table 3.1 has been changed accordingly.
DFO-04	Sciences Division, DFO	Page 47 – 5.4.2 Fish Community - second paragraph The Atlantic salmon is the only "species at risk" under federal legislation, in this location, at this time.	Comment noted. Section 5.4.2 has been changed to reflect that the Atlantic salmon, striped bass and Atlantic sturgeon are all "species of concern" that occur in the Estuary, but only the Atlantic salmon is considered to be at risk species under *SARA*.
DFO-05	Sciences Division, DFO	Page 53 – 5.4.5 Species of Concern This section may be more appropriately entitled "Species at Risk".	The Section includes descriptions of the life history of fish species that are not listed under *SARA* but are considered species of concern by other organizations; *i.e.* , the striped bass is listed as threatened by COSEWIC and Atlantic sturgeon is "red" listed by NSDNR. Furthermore, the striped bass and Atlantic sturgeon have a higher likelihood of being protected by *SARA* during the operational life of the Project than fish species present in the Estuary that are considered secure. The focus on species of concern (and not necessarily only those protected by *SARA)* is twofold: first, species that are low or sensitive require special protection from anthropogenic impacts to assure their future security and maintain biodiversity. Second, mitigation for species of concern serves to protect common species, species of unknown status and/or species with less public appeal. Overall, the focus on fish species of concern makes for a more concise EA based on a precautionary principle of protecting the species most susceptible to anthropogenic impacts.
DFO-06	Sciences Division, DFO	Page 82 – 6.1.2 Boundaries – third paragraph The "Policy for the Management of Fish Habitat" actually relates to the *FA* , section 20, 30, 32, 35 and 36 among others. Those parts of section 36 dealing with control of deleterious substances affecting fish, are administered by Environment Canada, in cooperation with Fisheries and Oceans Canada.	Comment noted. Section 6.1.2 has been changed accordingly.
DFO-07	Sciences Division, DFO	Page 82 - 6.1.3 Residual Environmental Effects Evaluation Criteria In relation to fish and fish habitat, the effects assessment does not appear to evaluate the effects related to construction of the brine intake and discharge system. It deals only with brine discharge, water withdrawal, and the footprint of the structures once construction has been completed. Perhaps this relates back to the definition of "significant adverse environmental effect", which doesn't at present include direct effects, such as mortality. It only appears to include indirect effects that may result from changes to hydrology and water quality. These are appropriate to include but direct mortality would also be a concern.	As described in Section 6.1.5, the final design of the water intake and outflow structures is not available; however, the footprint of these structures may intrude into the intertidal zone and below the low-tide mark and alter a small area of fish habitat. Potential additional permitting requirements (if any) including habitat compensation will be evaluated in consultation with relevant regulators when final design plans are available. The effects of construction of the water intake and outflow structures will be assessed during the additional permitting process if deemed necessary by DFO. Section 6.1.4 has been revised to include potential effects of water intake and outflow structures on fish and fish habitat in the Estuary. In addition, Section 6.1.5.1 (under Habitat Effects) has been updated to reflect the requirement of the proponent to consider effects associated with construction of water intake and outflow structures on fish habitat in the Estuary.

Comment No.	Originator	Question/Statement [1]	Response
DFO-08	Sciences Division, DFO	It is suggested that the definition of "significant adverse environmental effect" be changed From: "A signifcant adverse environmental effect on fish habitat, and ultimately fish, is one that changes hydrology and surface water quality sufficiently to cause:" followed by list. To: "A significant adverse environmental effect on fish and fish habitat is one that would result (either directly or indirectly) in" followed by list.	The residual environmental effects evaluation criteria for fish and fish habitat (Section 6.1.3) has been changed accordingly to include provisions for both direct and indirect effects.
DFO-09	Sciences Division, DFO	Page 83 - 6.1.4 Potential Interactions, Issues and Concerns Further to the comments on section 6.1.3, the list of potential interactions doesn't appear to include effects related to the construction of the brine intake and discharge system. The list focuses on water withdrawal, brine discharge and spills.	See response to comment DFO-08. Section 6.1.4 has been changed to mention potential effects of water intake and outflow structures on fish and fish habitat in the Estuary. In addition, Section 6.1.5.1 (under Habitat Effects) has been updated to reflect the requirement of the proponent to consider effects associated with construction of water intake and outflow structures on fish habitat in the Estuary.
DFO-10	Sciences Division, DFO	Page 83 - 6.1.4 Potential Interactions, Issues and Concerns In regards to the statement about horizontal directional drilling (HDD) and the pipeline watercrossings, it is apparent that options other than HDD are not assessed as part of this environmental assessment. If HDD is not possible for any of the watercrossings, it is important that the information needed by DFO for a *FA* review be provided in a timely manner to DFO in order to ensure that the there are no delays in the review. Depending on the particular watercrossing method selected, there could also be a requirement for a federal environmental assessment. Transport Canada should also be consulted to ensure they do not have any regulatory requirements associated with the watercrossings should HDD not be possible.	Comment noted.
DFO-11	Sciences Division, DFO	Page 84 – 6.1.5.1 Construction This section is confusing. "Construction" appears to refer to construction of the salt caverns as opposed to construction of the brine intake and discharge system. I would suggest that this section be named "Construction of the Project" or better yet, "Construction of the Underground Hydrocarbon Storage Facility".	Section 6.1.5.1 has been updated to include a discussion on the effects of construction of the water intake and outflow structures thus better reflecting the current title.
DFO-12	Sciences Division, DFO	Page 91 – 6.1.5.1 Construction – Second Paragraph It is stated that sedimentation of the Estuary is not considered a threat to fish and fish habitat. According to the information provided earlier in this document (*e.g.* , 6.1.3 and 6.1.4), it doesn't appear that sedimentation effects would be considered within this environmental assessment. Also, there is no information provided as to why sedimentation is not considered a threat.	As stated in the updated EA report in Section 6.1.5, sedimentation of the Estuary due to Project construction (including solution mining and construction of water intake and outflow structures) is not considered a threat to fish habitat due to the baseline conditions in the Estuary and mitigation that will be employed during construction and operation of the Project. Biological communities in the Estuary are not particularly sensitive to suspended solids given the high natural levels of suspended matter in the water column and the shifting, fine-grained substrates. Diluted brine will be held in settling ponds prior to discharge which will facilitate settling of suspended solids. Removal of sediment from ponds may be required; however, in such cases, intakes and outlets will be closed off to avoid introduction of large amounts of sediment to the Estuary. The Project-specific EPP will include further mitigative strategies for reducing the risk of sedimentation and erosion during construction activities in proximity to the Estuary. See Section 6.1.5.1 for examples.

Comment No.	Originator	Question/Statement [1]	Response
DFO-13	Sciences Division, DFO	The following information is also required in order to assess effects that could result from the project: • material assay • pumping rates • physical configuration of the dilution facility and separation facilities • particulate discharge assay and plan • plume analysis for the specific site • detailed site survey including the plume area • expected sectional salinity concentration profiles for the plume at specified distances and tide cycle from the discharge site	The risk of other elements present in the salt-core (and thus in diluted brine discharged to the Estuary) will be determined by toxicity assays using diluted brine and representative organisms. In addition, more detailed analytical testing may be required on the brine (at varying dilutions) if tested solutions are deemed to have toxic effects. The specifics of this toxicity testing program will be developed in consultation with regulators, most notably Environment Canada. The test solution used for toxicity testing would consist of saturated brine from the salt-core diluted to mimic the upper-target salinity level of discharge at the outlet of the holding pond (*i.e.* , 25 ppt). In regards to pumping rates and as described in Section 2.1.1.5, the Project will use relatively small amounts of water, compared to overall flow at the intake site, to minimize any potential impact on the aquatic environment. Preliminary physical configuration of the dilution facility and separation facilities are provided in Appendix B of the EA report (Water Intake and Discharge Facilities). Final design plans will be made available to regulators prior to construction. Dispersion modeling of the discharge for the specific site is provided in Appendix C (Dispersion Modeling of Discharged Brine). The Project design is such that concentrations of salinity of the brine discharge will mimic natural variation of salinity in the system and will not exceed 25 ppt. Detailed surveys pertaining to the physical conditions in the Estuary in the vicinity of the Project have been conducted by Martec. Results of surveys are described in detail in Appendix A (Physical Description of the Shubenacadie River). In addition, further physical and biological monitoring proposed in support of the Project will add to baseline data of conditions in the Estuary near the Project.
TC-CR-01	Environmental Affairs, Transport Canada	Specifically, the Navigable Waters Protection Program (NWPP) will require authorization applications for the specific watercourses that will be involved in the development of the proposed project. Application packages can be obtained from the NWPP office: Navigable Waters Protection Program, Marine Safety, Transport Canada Queens Square Building 1, 11th Floor Box 1013 45 Alderney Drive Dartmouth, Nova Scotia B2Y 4K2 (902) 426-2726 (902) 426-7585 nwpdar@tc.gc.ca If the proponent has further questions or concerns regarding the information required by NWPP they can contact the office at the coordinates above.	Comment noted.

[1] Please note that page numbers refer to the Draft Registration Document and may not correspond with this document. Section numbers are used in the following column to provide guidance.

APPENDIX I

Terrestrial Data

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Adiantum pedatum	Northern Maidenhair-Fern	In fertile or alkaline soils, under oak-birch-sugar maple-elm trees, on intervales	Summer	Unlikely but possible	S1	RED
Alisma gramineum	Narrow-Leaf Water-Plantain	Marshy areas and along shorelines; occasionally completely submerged	June to September	Unlikely	S1SE	NONE
Allium tricoccum	Small White Leek or Wild Leek	Rich, deciduous forests, and intervales	Late July - no leaves remaining at time of flowering	Unlikely but possible	S1	RED
Alopecurus aequalis	Short-Awn Foxtail	Muddy margins of rivers and shallow ponds, and gravel margins where competitor species are few	Summer	Possible	S2S3	YELLOW
Amelanchier nantucketensis	Nantucket Shadbush	Pine barrens, pond margins, fields, edges, non-tidal rivershore, old field /roadside	May	Unlikely	S1	NONE
Anemone canadensis	Canada Anemone	Damp thickets, meadows, and gravelly shores on calcareous or alluvial soils.	May to July.	Unlikely but possible	S2	YELLOW
Anemone quinquefolia var. quinquefolia	Wood Anemone	Wooded riverbanks and shaded intervales.	Late May to early June.	Possible	S2	YELLOW
Anemone virginiana	Virginia Anemone	Rocky or dry, open woods.	June to July	Unlikely but possible	S1S2	YELLOW
Anemone virginiana var. alba	River Anemone	Intervales and streamsides. Calcareous and slaty ledges, shores and thickets.	Early July.	Unlikely but possible	S1S2	YELLOW
Arabis drummondii	Drummond Rockcress	Usually on dry slopes and talus, but occasionally in more fertile locations at lower elevations.	May to July. Identifiable later into at least late summer.	Unlikely	S2	YELLOW
Arabis hirsuta var. pycnocarpa	Hairy Rock-Cress	Moist to dry, usually calcareous, open situations: open woods, stream banks, ledges, cliffs, bluffs, and floodplains	flowering May, June; fruiting June, July	Unlikely	S1S2	RED
Asplenium trichomanes-ramosum	Green Spleenwort	Shaded cliffs along streams, on limestone or other basic rocks.	Can be identified without sprangia.	Unlikely	S2	YELLOW
Atriplex franktonii	Frankton's Saltbush	Coastal strands and salt marsh edges	Summer, best identified in late summer and early autumn	Unlikely but possible, along tidal river	S2	NONE
Bidens connata	Purple-Stem Swamp Beggar-Ticks	Boggy swales, and the borders of ponds, thickets and in ditches behind brackish shores	August and September, can be identified when not in flower.	Possible	S3?	YELLOW
Bidens hyperborea	Estuary Beggar-Ticks	Estuarine, on tidal mudflats	August, can be identified outside of flowering time	Unlikely	S1	YELLOW
Botrychium lanceolatum	Triangle Grape-Fern	Shaded woods with acid soils	June to July	Possible	S2	YELLOW
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	Moist, cool, rich woods, swamp margins, meadows, peaty slopes, clearings	July and August. Can be identified until early October if sporophore is present.	Possible	S2	YELLOW
Botrychium lunaria	Moonwort Grape-Fern	Open, turfy or gravelly slopes, shores, and meadows, usually on basic soils	June to August	Unlikely	S1	RED
Botrychium simplex	Least Grape-Fern	Usually on lakeshores or the mossy edges of streams or waterfalls although it has been reported in a wide variety of habitats.	Late May and June. Can be identified until early October if sporophore is present.	Unlikely	S2S3	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Calamagrostis stricta ssp. stricta	Northern Reedgrass OR Bentgrass	Around lakes and bogs, wet cliff faces, and landward edges of saltmarshes	Flowering time not given, summer	Unlikely but possible	S1S2	YELLOW
Caltha palustris	Marsh Marigold	Relatively rich swamps wet meadows and wet woods. In damp seepage areas and along creeks	Flowers in early June but can be identified fro early May to late October	Unlikely, and if found likely an escape	S2	YELLOW
Campanula aparinoides	Marsh Bellflower	Meadows, ditches and river banks.	August	Likely	S3?	YELLOW
Cardamine parviflora	Small-Flower Bitter-Cress	Dry woods, shaded or exposed ledges, sandy soils	May to June	Unlikely but possible	S2	YELLOW
Carex capillaris	Hair-Like Sedge	cushion form found on seepy, exposed slopes of a cliff-top, culms almost hidden	Summer	Unlikely	S2	RED
Carex castanea	Chestnut-Colored Sedge	Swamps and wet meadows, cliff crevices and ledges	N/A	Unlikely but possible	S2	RED
Carex eburnea	Ebony Sedge	Cliffs and talus slopes, under conifers , particularly on Calcareous substrates	Flowering time not given, summer	Unlikely	S3	YELLOW
Carex garberi	Elk Sedge	Calcareous river shores ledges and seeps , with winter flood and ice scour effects	June to August, mature plants separable from similar *C. aurea*	Unlikely	S1	RED
Carex hirtifolia	Pubescent Sedge	Calcareous regions, in meadows and thickets, forest slopes.	Seeds (perigynia) required for identification. Can be identified from May through September.	Possible	S1S2	RED
Carex houghtoniana	A Sedge	Sandy soils and roadside banks	Seeds (perigynia) required for identification. Can be identified from May through September.	Likely	S2?	UNDETERMINED
Carex livida var. radicaulis	Livid Sedge	Calcareous bogs and meadows.	Seeds (perigynia) required for identification. Can be identified from June through September.	Unlikely	S1	RED
Carex prairea	Prairie Sedge	*Typha* swamp	Late May to July	Unlikely but possible	S1	RED
Carex tuckermanii	Tuckerman Sedge	Swales	June to August	Unlikely but possible	S1	RED
Caulophyllum thalictroides	Blue Cohosh	Deciduous and intervale forest	April to early June, can be identified when not in flower into October.	Possible	S2	RED
Chenopodium berlandieri var. macrocalycium	a Pit-Seed Goosefoot	Coastal sand beaches and strands	Best identified in late summer into autumn	Unlikely	S1?	NONE
Clethra alnifolia	Coast Pepper-Bush	in moist woodlands, near water	July and August	Unlikely	S1S2	RED
Coeloglossum viride var. virescens	Long-Bract Green Orchis	moist, rich deciduous woods, frequently on steep slopes	May - July	Unlikely	S2	YELLOW
Conioselinum chinense	Hemlock Parsley	Swamps, mossy coniferous woods or swales, and seepy slopes near the coast.	Flowers August to October. Identifiable from spring to autumn.	Unlikely	S2S3	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Cryptogramma stelleri	Fragile Rockbrake	Shaded limestone cliffs, and shaded crevices in conglomerate cliff-face.	Late May to September. Can be identified when sporangia are not present.	Unlikely	S1S2	YELLOW
Cynoglossum virginianum var. boreale	Northern Wild Comfrey	Rich woods and thickets, often associated with hemlocks	Flowering May, June; fruiting June, July, identifiable throughout spring to fall	Unlikely but possible	S1	RED
Cypripedium arietinum	Ram's-Head Lady's-Slipper	On calcareous soils, often near outcrops of gypsum, or limestone, occasionally in deciduous forests	Late May	Unlikely	S1	RED
Cypripedium parviflorum or Cypripedium calceolus var parviflorum	Small Yellow Lady's-Slipper	Most often associated with gypsum or open calcarious soils	Flowers in June. Plant identifiable from late May to October	Unlikely but possible	S3	YELLOW
Cypripedium parviflorum var. pubescens or Cypripedium calceolus var pubescens	Large Yellow Lady's-Slipper	Rich calcareous woodlands, also in drier sections of seepage fed wetlands or old beaver pond woodland	Flowers in June. Plant identifiable from late May to October	Possible	S2	YELLOW
Cypripedium reginae	Showy Lady's-Slipper	Alkaline swamps and bogs.	Flowers June through August. Can be identified some weeks prior to bloom and at least to early October.	Possible	S2	RED
Desmodium canadense	Showy Tick-Trefoil	Open woods and river banks	Late July to early September, can be identified when not in flower.	Unlikely but possible	S1	RED
Desmodium glutinosum	Large Tick-Trefoil	Thickets, streambanks, low woods, roadsides, railroads	June to August, can be identified when not in flower	Unlikely but possible	S2	RED
Dichanthelium linearifolium OR Panicum linarifolium	Slim-Leaf Witchgrass	Dry sandy soils.	July to October.	Unlikely	S2?	YELLOW
Dirca palustris	Eastern Leatherwood	Low wet woods, streambanks, rich wooded slopes	March to April	Possible	S1	RED
Draba arabisans	Rock Whitlow-Grass	Muddy soils or on calcareous rocks, in cliff crevices and ledges.	May to July	Unlikely	S2	YELLOW
Dryopteris fragrans var. remotiuscula	Fragrant Fern	Dry, overhanging cliffs, and in cliff crevices along streams or near waterfalls.	June to September. Can be identified without sporangia.	Unlikely	S2	YELLOW
Elymus hystrix	Bottle-Brush Grass	Bottoms, mesic to dry upland forests, glade margins, upland prairies, bluff ledges, streambanks, disturbed sites. In Maritimes in rich open calcareous hardwoods or clearings or similar river intervales	June to August, best identified at or subsequent to bloom into early autumn when most detectable	Unlikely but possible	S1	RED
Elymus wiegandii SYN Elymus wiegandii var wiegandii	Wiegand's Wild Rye	Rich streambanks and meadows	Flowers July and August, not readily noticeable until bloom	Possible	S1	RED
Empetrum eamesii	Rock Crowberry	Exposed sands and siliceous gravels and rocks	identifiable year round	Unlikely	S2S3	YELLOW
Empetrum eamesii ssp. atropurpureum	Purple Crowberry	Granitic or acidic gravel and sands on mountains	identifiable year round	Unlikely	S2S3	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Epilobium coloratum	Purple-Leaf Willow-Herb	Low-lying ground, springy slopes and similar locations.	July and October. Seeds required for identification.	Likely	S2?	YELLOW
Epilobium strictum	Downy Willow-Herb	Boggy areas and wet meadows	Flowers July to September. Likely identifiable from late May to October	Possible	S3	YELLOW
Equisetum pratense	Meadow Horsetail	Grassy stream banks, up to 900m	Coning in May and June, identifiable through growing season	Likely	S2	YELLOW
Erigeron hyssopifolius	Daisy Fleabane	Exposed gypsum outcrops, damp stream banks between flood levels, banks ledges and cliffs. Calcareous and low competition	Flowers July and August but identifiable though less noticeable from May to October	Unlikely but possible	S2S3	YELLOW
Eriophorum gracile	Slender Cotton-Grass	Wet peat and inundated shores	Flowers and fruits early summer, distinguishable on to	Possible	S2	YELLOW
Euthamia caroliniana	Grass-Leaved Goldenrod	Outwash plain pondshores, in moist sand, usually below seasonal high-water level	August to October	Unlikely	S3	YELLOW
Euthamia galetorum	Narrow-Leaf Fragrant Golden-Rod	Old fields, poorly drained soils, ditches, swamps, and lakeshores	August and September	Unlikely	S3S4	GREEN
Festuca subverticillata	Nodding Fescue	Rich, deciduous forested slopes and alluvial woods	June and early July	Unlikely but possible	S1S2	RED
Floerkea proserpinacoides	False Mermaid-Weed	Deciduous ravine slopes, river margins, and intervale forests.	Late May to late June. Can be identified when not in flower.	Unlikely but possible	S2S3	YELLOW
Fraxinus nigra	Black Ash	Low ground, damp woods and swamps.	May and June. Can be identified without flowers.	Likely	S3	YELLOW
Geocaulon lividum	Northern Comandra	Sterile soils and damp sands, in acid or peaty locations. Typically on mesic lichen barrens and drier lichen set areas of ombrotrophic bog.	Late May to early August	Unlikely	S2S3	YELLOW
Goodyera pubescens	Downy Rattlesnake-Plantain	Coniferous woods, often growing on moss	July to August	Likely	S1	RED
Gratiola neglecta	Clammy Hedge-Hyssop	Muddy places, wet ground	June to September	Likely	S1	YELLOW
Helianthemum canadense	Canada Frostweed	Sandy or rocky dry soil in open woods and clearings	May to June	Unlikely	S1	RED
Hepatica nobilis	Round-Lobe Hepatica	Dry, usually mixed deciduous forests	Early May	Unlikely	S1	NONE
Hepatica nobilis var. obtusa or Hepatica americana	Round-Leaved Liverleaf	Rich or rocky wooded slopes, ravines, mossy banks, ledges. Usually on circumneutral soils.	March to April. Can be identified when not in flower	Possible	S1	RED
Hudsonia ericoides	Golden-Heather	Dunes, rocks, pine barrens	May to July. Can be identified when not in flower	Unlikely	S2	YELLOW
Hudsonia tomentosa	Sand-Heather	Sandy dunes and shores	Flowers May to June. Identifiable year round	Unlikely	S1	RED
Hypericum dissimulatum	Disguised St. John's-Wort	Moist, gravelly sand roadsides and in fresh marshes	N/A	Unlikely but possible	S2S3	NONE
Impatiens pallida	Pale Jewel-Weed	Rich alluvial soils, damp thickets, and along intervales	July and August.	Unlikely but possible	S2	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Isoetes acadiensis	Acadian Quillwort	Water up to 1 m deep, bordering lakes or ponds, and occasionally along rivers.	Megaspores required for identification.	Unlikely	S3?	YELLOW
Isoetes lacustris	Lake Quillwort	Cobbly bottoms and gravel bottoms of water bodies, usually in deep water of nutrient poor lakes in the Pre-Cambrian Shield	Megaspores required for identification.	Unlikely	S3?	YELLOW
Isoetes prototypus	Prototype Quillwort	Deep water in nutrient-poor, acidic lakes	Summer	Unlikely	S2	RED
Juncus greenei	Greene's Rush	Coastal sandy soils and dune hollows	June to September. .	Unlikely	S1S2	YELLOW
Laportea canadensis	Wood Nettle	Alluvial woods of mixed or deciduous trees. Floodplains on the Cape Breton plateau. Only in the most fertile locations.	July to September. Can be identified without flowers.	Likely	S3	YELLOW
Lilium canadense	Canada Lily	Rich river or stream intervale meadows and forest	Flowers in July but identifiable from May to October	Likely	S2S3	YELLOW
Limosella australis	Mudwort	Low areas by ponds, gravel lakeshores, the muddy edges of ponds behind barrier beaches and muddy river margins.	Late June to October.	Unlikely	S2S3	YELLOW
Lindernia dubia	Yellow-Seed False-Pimpernel	Wet areas and the muddy edges of streams. Drained Millponds and gravel pits	Flowers late June to October	Possible	S3S4	YELLOW
Listera australis	Southern Twayblade	Among the shaded sphagnum moss of bogs or damp woods.	June. Quickly senesces after flowering.	Possible	S1	RED
Malaxis brachypoda	White Adder's-Mouth	Moss cushions and wet, mossy cliff-edges, where there is little competition from other plant species.	Late May and June.	Unlikely	S1	RED
Megalodonta beckii OR Bidens beckii	Beck Water-Marigold	Shallow, quiet waters, slow-moving streams, and ponds	August and September, identifiable but less noticed when not in flower	Unlikely but possible	S3	YELLOW
Minuartia groenlandica OR Arenaria groenlandica	Mountain Sandwort	Granitic ledges and gravel, on coasts at higher elevations	June to August	Unlikely	S2	YELLOW
Montia fontana	Fountain Miner's-Lettuce	Springy or seepy slopes, wet shores and brackish spots, coastal	Flowers June to September when most noticeable	Unlikely	S1	YELLOW
Oenothera fruticosa	Narrow-Leaved Sundrops	Meadows, open woods, often in disturbed sites	June to August	Unlikely and if present introduced	S2S3SE?	UNDETERMINED
Ophioglossum pusillum	Adder's Tongue	Sterile meadows, grassy swamps, and damp, sandy, or cobbly beaches of lakes.	Late may to August. Can be identified until early October if stipe and sporangia are present.	Unlikely but possible	S2S3	YELLOW
Osmorhiza depauperata	Blunt-Fruited Sweet-Cicely	Moist woods	Flowers May to June. Identifiable into late summer until fruit falls	Unlikely but possible	S1	UNDETERMINED
Packera paupercula or Senecio pauperculus	Balsam Groundsel or Balsam Ragweed	Open Gypsum outcrops, dry cliffs and talus slopes	Flowers in July but identifiable from May to October	Unlikely	S3	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Panicum philadelphicum	Philadelphia Panic Grass	Diversity of situations from dry soil of open woods, fields, rocky sandy ground, to moist soil on shores of lakes and streams.	June to October	Unlikely but possible	S2S3SE	YELLOW
Pilea pumila	Canada Clearweed	Moist rich deciduous or mixed woods along streams to often intermittent water courses, seepage slopes, rich calcareous basin marsh/swamps with summer draw down	Flowers July to October. Identifiable from June onward to October	Possible	S1	YELLOW
Piptatherum canadense , Syn.*Oryzopsis canadensis*	Canada Mountain-Ricegrass	Dry sandy soils.	April to early June	Possible	S2	YELLOW
Platanthera macrophylla	Large Round-Leaved Orchid	Damp woods in deep shade	August	Unlikely but possible	S2	YELLOW
Platanthera orbiculata or Platanthera orbiculata var macrophylla	Large Roundleaf Orchid	Damp woods in deep shade, the Var. *Macrophylla* or *P. macrophylla* is usually in rich old deciduous or mixed woods	Blooms in August	Possible	S3	YELLOW
Poa glauca	White Bluegrass	Cliff crevices, on shelves, and talus slopes.	July and August. Can be identified post flowering until early October.	Unlikely	S2S3	YELLOW
Polygala sanguinea	Field Milkwort	Poor or acidic fields, damp slopes, and open woods or bush.	Late June to October.	Possible	S2S3	YELLOW
Polygonum arifolium	Halberd-Leaf Tearthumb	Thickets, marshy borders, under alders, rich alluvial soil	July to October.	Unlikely but possible	S2	YELLOW
Polygonum raii OR Polygonum oxyspermum	Pondshore Knotweed	Coastal damp sands and gravels	Not given, likely July to September	Unlikely	S2S3SE	YELLOW
Polygonum scandens	Climbing False-Buckwheat	Low alluvial thickets along river intervales	Flowers late August to October. Lacks ocrea without ring of bristles like *P. convolvulus*, fruit best for ID	Possible	S2	YELLOW
Potamogeton zosteriformis	Flatstem Pondweed	Lakes and deep rivers in less acid regions.	July to September. Can be identified when not in flower.	Unlikely	S2S3	YELLOW
Proserpinaca pectinata	Comb-Leaved Mermaid-Weed	Wet savannas, sphagnous swales, and the sandy, gravelly, or muddy borders of lakes or ponds.	June to October. Can be identified when not in flower.	Possible	S3	YELLOW
Ranunculus flammula var. flammula	Greater Creeping Spearwort	Semi-aquatic, in bogs and cold streams.	July to September.	Possible	S2	YELLOW
Ranunculus pensylvanicus	Bristly Crowfoot	Marshes and other habitats with wet soils	July to September	Unlikely but possible	S1	NONE
Rhamnus alnifolia	Alderleaf Buckthorn	Calcareous bogs , swamps, swampy woods and meadows, marl bogs in rich aluvial soils	Flowers mid -May to June. Identifiable from May to October and potentially year round.	Possible	S3	YELLOW
Rubus pensilvanicus	Pennsylvania Blackberry	Thickets , clearings and forest edges	Flowers in June, distinguishable into autumn	Possible	S3?	YELLOW
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	Swales, the edges of swamps, or in gullies - in small colonies	August, can be identified when not in flower.	Possible	S2S3	YELLOW
Rumex salicifolius	Willow Dock	Beaches or along rivers	Not Given, Summer	Unlikely	S2	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Salix pedicellaris	Bog Willow	Acid bogs and sphagnous lake shores.	May to July.	Unlikely but possible	S2	YELLOW
Salix sericea	Silky Willow	Low thickets and streambanks	Late March to early May	Possible	S2	YELLOW
Samolus valerandi ssp. parviflorus	Water Pimpernel	Brackish meadows, tidal banks and the edge of salt marshes.	July to September.	Unlikely	S2	YELLOW
Sanicula odorata	Black Snake-Root	Rich , alluvial woods and along intervales.	July to August	Possible	S1	RED
Saxifraga paniculata ssp. neogaea	a White Mountain Saxifrage	calcareous; rocks (on cliff ledges, in dry sunny situations).	Flowers sparingly, late July	Unlikely	S2	YELLOW
Senecio pseudoarnica	Seabeach Groundsel	Gravelly seashores	Late July to August. Identifiable likely from June to October	Unlikely	S2	YELLOW
Shepherdia canadensis	Canada Buffalo-Berry	Gypsum or talus slopes and along the coast within reach of salt spray.	April to June. Can be identified when not in flower.	Unlikely	S2	YELLOW
Sphenopholis intermedia, syn.Sphenopholis obtusata	Slender Wedge Grass	Cliff faces, in contact with limestone, basalt, or gypsum	June to August	Unlikely	S3S4	YELLOW
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	Driest sand barrens in southwestern counties, also near rivers, roadsides, and fields	Autumn, from September to October	Unlikely but possible	S2	YELLOW
Stellaria longifolia	Longleaf Stitchwort or longleaved chickweed	Damp or wet grassy places, in sandy to mucky soils	May to July	Possible	S3	YELLOW
Symphyotrichum boreale, Syn. Aster borealis	Boreal American-Aster	Gravelly soil of lake beaches, along streams, and the edges of bogs	August and September	Possible	S2?	UNDETERMINED
Symphyotrichum ciliolatum , Syn. Aster ciliolatus	Lindley's Aster	Open fields, lawns, and the edges of woods	August and September	Possible	S2S3	UNDETERMINED
Symphyotrichum undulatum, Syn. Aster undulatus	Wavy-leaf American-Aster	Old fields and the edges of thickets	August and September	Unlikely but possible	S2	YELLOW
Teucrium canadense	American Germander	Gravelly seashores, generally at crest of beach, above direct tidal influence	Flowers July to September when easiest to identify but identifiable from June to October	Unlikely	S2S3	YELLOW
Thuja occidentalis	Northern White Cedar	Lakesides and swamps, or old pastures	Evergreen	Unlikely. If present, a possible escape	S1S2	RED
Tiarella cordifolia	Heart-Leaved Foam-Flower	Rich deciduous and mixed woods	Flowers mid -May to mid-June. Identifiable year round	Possible	S2	YELLOW
Triosteum aurantiacum	Coffee Tinker's-Weed	Rich soils of river intervales, or rich forest on limestone	Flowers in July but identifiable from at least June to October	Unlikely but possible	S2	RED
Utricularia gibba	Humped Bladderwort	Shallow lake margins, small pools and small ponds in quagmires or peaty situations.	Late June to September. Can be identified without flowers, but is very cryptic.	Possible	S2	YELLOW

TABLE I1 Rare or Uncommon Plant Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Season	Likelihood on Site	ACCDC RANK	NSDNR RANK
Vaccinium caespitosum	Dwarf Blueberry	Rocky cliffs and rock crevices. Dry or wet acidic sites	Not given for NS. Likely identifiable in early summer on to October	Unlikely	S2	YELLOW
Vaccinium uliginosum	Alpine Blueberry	Dry or wet organic and inorganic soils, tolerant of high copper concentrations.	Not given for NS. Likely identifiable from early summer to October	Unlikely	S2	YELLOW
Viola nephrophylla	Northern Bog Violet	Cool mossy bogs, the borders of streams, and damp woods.	May to July. Best identified in flower	Likely	S2	YELLOW
Viola sagittata	Arrow-Leaved Violet	Dry sterile woods, clearings, and fields	April and May, identifiable into early autumn	Unlikely but possible	S3S4	YELLOW
Woodsia glabella	Smooth Woodsia	Shaded vertical cliffs, and along streams in northern Cape Breton.	Spores form June to August. Can be identified without sporangia.	Unlikely	S2	YELLOW
Zizia aurea	Common Alexanders	Meadows, shores, damp thickets and wet woods. Generally in relatively rich sites	Flowers May and June but is identifiable until October	Unlikely but possible	S1S2	YELLOW

Likelihood on Site	
Unlikely	Very low probability due to likely absence of suitable habitat, or dispersability limitations combined with lack of nearby known populations.
Unlikely but possible	Low probability due to likely absence of suitable habitat or dispersability limitations combined with lack of nearby known populations, but with more potential than above.
Possible	Medium probability due to more proximal known populations, better dispersability and greater chance apparent existing habitats could hold these species.
Likely	High probability of encountering these species in habitats possibly present in the study area.
Atlantic Canada Conservation Data Centre (ACCDC) General Status Ranks	
S1	Very Rare
S2	Rare
S3	Uncommon
S4	Fairly Common
SE	Exotic
Note: A combination of S ranks (eg. S3S4) or the presence of a question mark denotes uncertainty regarding the population status of species	
Nova Scotia Department of Natural Resources (NSDNR) General Status Ranks	
Blue	Extinct
Red	Known to be or thought to be at risk
Yellow	Sensitive to human activities or natural events
Undetermined	Insufficient data exists to assess status
Green	Secure

Source: ACCDC 2005; NSDNR 2002; Roland and Zinck 1998

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TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Abies balsamea	Balsam Fir	S5	Green
Acer pensylvanicum	Striped Maple	S5	Green
Acer rubrum	Red Maple	S5	Green
Acer saccharum	Sugar Maple	S5	Green
Achillea millefolium	Common Yarrow	S5	Green
Agalinus pururea var. neoscotica	Nova Scotia False-Foxglove	S4	Green
Agrimonia striata	Woodland Agrimony	S5	Green
Agropyron cristatum	Crested Wheatgrass	SE	Exotic
Agrostis capillaris	Colonial Bentgrass	SE	Exotic
Agrostis hyemalis	Rough Bentgrass	S5	Green
Agrostis perennans	Perennial Bentgrass	S4S5	Green
Agrostis stolonifera	Spreading Bentgrass	S5SE	Green
Alnus incana	Speckled Alder	S5	Green
Amaranthus retroflexus	Red-Root Amaranth	SE	Exotic
Amelanchier bartramiana	Bartram Shadbush	S5	Green
Amelanchier sp.	Shadbush	Not Applicable	Not Applicable
Amelanchier sp.	Shadbush	Not Applicable	Not Applicable
Amelanchier x intermedia	Running Serviceberry	HYB	Not Applicable
Anaphalis margaritacea	Pearly Everlasting	S5	Green
Aralia hispida	Bristly Sarsaparilla	S5	Green
Aralia nudicaulis	Wild Sarsaparilla	S5	Green
Arisaema triphyllum	Swamp Jack-In-The-Pulpit	S4S5	Green
Aster acuminatus	Whorled Aster	S5	Green
Aster cordifolius	Heart-Leaf Aster	S4S5	Green
Aster lateriflorus	Farewell-Summer	S5	Green
Aster macrophyllus	Large-Leaf Wood-Aster	S5	Green
Aster novi-belgii	New Belgium Aster	S5	Green
Aster puniceus	Swamp Aster	S5	Green
Aster radula	Rough-Leaved Aster	S5	Green
Aster umbellatus	Parasol White-Top	S5	Green
Athyrium filix-femina	Lady-Fern	S5	Green
Atriplex littoralis	Tropical Saltbush	S3S4SE	Green
Atriplex prostrata	Creeping Saltbush	S5	Green
Atriplex subspicata	Orache	S5?	Green
Betula alleghaniensis	Yellow Birch	S5	Green
Betula papyrifera	Paper Birch	S5	Green
Betula populifolia	Gray Birch	S5	Green
Brachyelytrum erectum	Bearded Short-Husk	S4S5	Green
Bromus ciliatus	Fringed Brome	S4S5	Green
Calamagrostis canadensis	Blue-Joint Reedgrass	S5	Green
Callitriche heterophylla	Large Water-Starwort	S4	Green
Capsella bursa-pastoris	Common Shepherd's Purse	SE	Exotic
Cardamine pensylvanica	Pennsylvania Bitter-Cress	S5	Green
Carduus crispus	Curled Plumless-Thistle	SE	Exotic
Carex adusta	Crowded Sedge	S2S3	Yellow
Carex arctata	Black Sedge	S5	Green
Carex brunnescens	Brownish Sedge	S5	Green
Carex canescens	Hoary Sedge	S5	Green
Carex conoidea	Field Sedge	S4?	Green
Carex cumulata	Clustered Sedge	S4S5	Green
Carex debilis	White-Edge Sedge	S5	Green
Carex disperma	Softleaf Sedge	S5	Green
Carex echinata	Little Prickly Sedge	S5	Green
Carex exilis	Coast Sedge	S4	Green
Carex flava	Yellow Sedge	S5	Green
Carex folliculata	Long Sedge	S5	Green

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Carex gynandra	A Sedge	S5	Green
Carex houghtoniana	A Sedge	S3?	Yellow
Carex intumescens	Bladder Sedge	S5	Green
Carex leptalea	Bristle-Stalk Sedge	S5	Green
Carex leptonervia	Finely-Nerved Sedge	S5	Green
Carex lurida	Shallow Sedge	S5	Green
Carex novae-angliae	New England Sedge	S5	Green
Carex pallescens	Pale Sedge	S5	Green
Carex projecta	Necklace Sedge	S4S5	Green
Carex retrorsa	Retrorse Sedge	S3S4	Green
Carex scoparia	Pointed Broom Sedge	S5	Green
Carex stipata	Stalk-Grain Sedge	S5	Green
Carex stricta	Tussock Sedge	S5	Green
Carex trisperma	Three-Seed Sedge	S5	Green
Centaurea nigra	Black Starthistle	SE	Exotic
Centaurium pulchellum	Branching Centaury-Plant	SE	Exotic
Cerastium arvense	Mouse-Ear Chickweed	S4?	Green
Cerastium vulgatum	Common Mouse-Ear Chickweed	SE	Exotic
Chamaedaphne calyculata	Leatherleaf	S5	Green
Chelone glabra	White Turtlehead	S5	Green
Chenopodium album	White Goosefoot	SE	Exotic
Chrysanthemum leucanthemum	Oxeye Daisy	SE	Exotic
Chrysosplenium americanum	American Golden-Saxifrage	S5	Green
Cicuta bulbifera	Bulb-Bearing Water-Hemlock	S5	Green
Cicuta maculata	Spotted Water-Hemlock	S5	Green
Circaea alpina	Small Enchanter's Nightshade	S5	Green
Cirsium arvense	Creeping Thistle	SE	Exotic
Clematis virginiana	Virgin's Bower	S5	Green
Clintonia borealis	Clinton Lily	S5	Green
Comptonia peregrina	Sweet Fern	S5	Green
Coptis trifolia	Goldthread	S5	Green
Cornus alternifolia	Alternate-Leaf Dogwood	S5	Green
Cornus canadensis	Dwarf Dogwood	S5	Green
Cornus sericea	Red Osier Dogwood	S5	Green
Corydalis sempervirens	Pale Corydalis	S4S5	Green
Corylus cornuta	Beaked Hazelnut	S5	Green
Cypripedium acaule	Pink Lady's-Slipper	S5	Green
Dalibarda repens	Robin Runaway	S5	Green
Danthonia compressa	Flattened Oatgrass	S4	Green
Danthonia spicata	Poverty Oat-Grass	S5	Green
Daucus carota	Wild Carrot	SE	Exotic
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	S5	Green
Diervilla lonicera	Northern Bush-Honeysuckle	S5	Green
Drosera rotundifolia	Roundleaf Sundew	S5	Green
Dryopteris carthusiana	Spinulose Shield Fern	S5	Green
Dryopteris cristata	Crested Shield-Fern	S5	Green
Dryopteris intermedia	Evergreen Woodfern	S5	Green
Dryopteris x boottii	a Hybrid Wood-fern	HYB	Not Applicable
Echinochloa crus-galli	Barnyard Grass	SE	Exotic
Elymus repens	Quackgrass	SE	Exotic
Epigaea repens	Trailing Arbutus	S5	Green
Epilobium angustifolium	Fireweed	S5	Green
Epilobium ciliatum	Hairy Willow-Herb	S5	Green
Epilobium leptophyllum	Linear-Leaved Willow-Herb	S5	Green
Equisetum sylvaticum	Woodland Horsetail	S5	Green
Equisetum variegatum	Variegated Horsetail	S3	Green

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Erechtites hieraciifolia	Fireweed	S5	Green
Erigeron strigosus	Daisy Fleabane	S5	Green
Eriophorum polystachion	Narrow-Leaved Cotton-Grass	S5	Green
Eriophorum virginicum	Tawny Cotton-Grass	S5	Green
Eupatorium maculatum	Spotted Joe-Pye Weed	S5	Green
Eupatorium perfoliatum	Common Boneset	S5	Green
Euphorbia vermiculata	Worm Seeded Spurge	SE	Exotic
Euphrasia officinalis	Drug Eyebright	SE	Exotic
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod	S5	Green
Festuca arundinacea	Tall Rye Grass	SE	Exotic
Festuca rubra	Red Fescue	S5	Green
Fragaria virginiana	Virginia Strawberry	S5	Green
Fraxinus americana	White Ash	S5	Green
Galium asprellum	Rough Bedstraw	S5	Green
Galium palustre	Marsh Bedstraw	S5	Green
Galium tinctorium	Stiff Marsh Bedstraw	S5	Green
Galium trifidum	Small Bedstraw	S5	Green
Galium triflorum	Sweet-Scent Bedstraw	S5	Green
Gaultheria hispidula	Creeping Snowberry	S5	Green
Gaultheria procumbens	Teaberry	S5	Green
Geranium bicknellii	Bicknell Northern Crane's-Bill	S3	Green
Geum rivale	Purple Avens	S5	Green
Glaux maritima	Sea Milkwort	S5	Green
Glyceria canadensis	Canada Manna-Grass	S5	Green
Glyceria grandis	American Mannagrass	S4S5	Green
Glyceria striata	Fowl Manna-Grass	S5	Green
Glyceria X laxa	Northern Mannagrass	S4?	Green
Gnaphalium uliginosum	Low Cudweed	SE	Exotic
Gymnocarpium dryopteris	Northern Oak Fern	S5	Green
Gymnocarpium dryopteris	Northern Oak Fern	S5	Green
Hamamelis virginiana	American Witch-Hazel	S5	Green
Heracleum lanatum	Cow Parsnip	S4S5	Green
Hieracium aurantiacum	Orange Hawkweed	SE	Exotic
Hieracium caespitosum	Meadow Hawkweed	SE	Exotic
Hieracium canadense	Canada Hawkweed	S4S5	Green
Hieracium lachenalii	Common Hawkweed	SE	Exotic
Hieracium pilosella	Mouseear	SE	Exotic
Hieracium piloselloides	Tall Hawkweed	SE	Exotic
Hieracium scabrum	Rough Hawkweed	S5	Green
Hordeum jubatum	Fox-Tail Barley	S5	Green
Hydrocotyle americana	American Water-Pennywort	S5	Green
Hypericum boreale	Northern St. John's-Wort	S5	Green
Hypericum canadense	Canadian St. John's-Wort	S5	Green
Hypericum ellipticum	Pale St. John's-Wort	S5	Green
Hypericum perforatum	A St. John's-Wort	SE	Exotic
Ilex verticillata	Black Holly	S5	Green
Impatiens capensis	Spotted Jewel-Weed	S5	Green
Iris versicolor	Blueflag	S5	Green
Juncus articulatus	Jointed Rush	S5	Green
Juncus brevicaudatus	Narrow-Panicled Rush	S5	Green
Juncus effusus	Soft Rush	S5	Green
Juncus gerardii	Black-Grass Rush	S5	Green
Juncus pelocarpus	Brown-Fruited Rush	S5	Green
Juncus tenuis	Slender Rush	S5	Green
Kalmia angustifolia	Sheep-Laurel	S5	Green
Lactuca canadensis	Canada Lettuce	S5	Green

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Larix laricina	American Larch	S5	Green
Ledum groenlandicum	Common Labrador Tea	S5	Green
Leersia oryzoides	Rice Cutgrass	S5	Green
Leontodon autumnalis	Autumn Hawkbit	SE	Exotic
Lepidium campestre	Field Pepper-Grass	SE	Exotic
Limonium carolinianum	Sea-Lavender	S5	Green
Lindernia dubia	Yellow-Seed False-Pimpernel	S2	Green
Linnaea borealis	Twinflower	S5	Green
Lobelia inflata	Indian-Tobacco	S5	Green
Lonicera caerulea	Mountain Fly-Honeysuckle	S4S4	Green
Lonicera canadensis	American Fly-Honeysuckle	S5	Green
Lotus corniculatus	Birds-Foot Trefoil	SE	Exotic
Ludwigia palustris	Marsh Seedbox	S5	Green
Luzula acuminata	Hairy Woodrush	S5	Green
Luzula multiflora	Common Woodrush	S5	Green
Lycopodium annotinum	Stiff Clubmoss	S5	Green
Lycopodium obscurum	Tree Clubmoss	S5	Green
Lycopus americanus	American Bugleweed	S5	Green
Lycopus uniflorus	Northern Bugleweed	S5	Green
Lysimachia ciliata	Fringed Loosestrife	S4	Green
Lysimachia terrestris	Swamp Loosestrife	S5	Green
Maianthemum canadense	Wild Lily-of-The-Valley	S5	Green
Malva neglecta	Dwarf Cheeseweed	SE	Exotic
Matricaria matricarioides	Pineapple-Weed Chamomile	SE	Exotic
Matteuccia struthiopteris	Ostrich Fern	S5	Green
Medeola virginiana	Indian Cucumber-Root	S5	Green
Medicago lupulina	Black Medic	SE	Exotic
Medicago sativa	Alfalfa	SE	Exotic
Melilotus officinalis	Sweetclover	SE	Exotic
Mentha arvensis	Corn Mint	S5	Green
Mimulus ringens	Square-Stem Monkeyflower	S4S5	Green
Mitchella repens	Partridge-Berry	S5	Green
Mitella nuda	Naked Bishop's-Cap	S5	Green
Moneses uniflora	One-Flower Wintergreen	S5	Green
Monotropa hypopithys	American Pinesap	S4	Green
Monotropa uniflora	Indian-Pipe	S5	Green
Myosotis laxa	Small Forget-Me-Not	S5	Green
Nemopanthus mucronata	Mountain Holly	S5	Green
Odontites serotina	Red Odontites	SE	Exotic
Oenothera biennis	Common Evening-Primrose	S5	Green
Oenothera perennis	Small Sundrops	S5	Green
Onoclea sensibilis	Sensitive Fern	S5	Green
Oryzopsis asperifolia	White-Grained Mountain-Ricegrass	S5	Green
Osmunda cinnamomea	Cinnamon Fern	S5	Green
Osmunda claytoniana	Interrupted Fern	S5	Green
Osmunda regalis	Royal Fern	S5	Green
Oxalis stricta	Upright Yellow Wood-Sorrel	S5	Green
Panicum boreale	Northern Witchgrass	S5	Green
Panicum depauperatum	Starved Witchgrass	S4S5	Green
Panicum lanuginosum	Panic Grass	S5	Green
Petasites frigidus	Arctic Butter-Bur	S4S5	Green
Phalaris arundinacea	Reed Canary Grass	S5	Green
Phegopteris connectilis	Northern Beech Fern	S5	Green
Phleum pratense	Meadow Timothy	SE	Exotic
Picea X sp.	A Hybrid Spruce	HYB	Not Applicable
Picea glauca	White Spruce	S5	Green

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Picea mariana	Black Spruce	S5	Green
Picea rubens	Red Spruce	S5	Green
Pinus resinosa	Red Pine	S4S5	Green
Pinus strobus	Eastern White Pine	S5	Green
Plantago major	Nipple-Seed Plantain	SE	Exotic
Plantago maritima	Seaside Plantain	S5	Green
Platanthera huronensis	Green Orchid		Undetermined
Platanthera clavellata	Small Green Woodland Orchid	S5	Green
Platanthera obtusata	Small Northern Bog-Orchid	S4S5	Green
Platanthera sp.	An Orchid	Not Applicable	Not Applicable
Poa annua	Annual Bluegrass	SE	Exotic
Poa compressa	Canada Bluegrass	SE	Exotic
Poa nemoralis	Woods Bluegrass	SE	Exotic
Poa palustris	Fowl Bluegrass	S5	Green
Poa pratensis	Kentucky Bluegrass	S5	Green
Polygonum arenastrum	Oval-Leaf Knotweed	S5SE	Green
Polygonum cilinode	Fringed Black Bindweed	S5	Green
Polygonum fowleri	Fowler Knotweed	S5	Green
Polygonum hydropiper	Marshpepper Smartweed	SE	Exotic
Polygonum persicaria	Lady's Thumb	SE	Exotic
Polygonum punctatum	Dotted Smartweed	S5	Green
Polygonum ramosissimum	Bushy Knotweed	S3S4	Green
Polygonum sagittatum	Arrow-Leaved Tearthumb	S5	Green
Polystichum acrostichoides	Christmas Fern	S5	Green
Populus grandidentata	Large-Tooth Aspen	S5	Green
Populus tremuloides	Quaking Aspen	S5	Green
Potamogeton alpinus	Northern Pondweed	S4	Green
Potamogeton epihydrus	Nuttall Pondweed	S5	Green
Potamogeton pusillus	Slender Pondweed	S4	Green
Potamogeton spirillus	Spiral Pondweed	S5	Green
Potentilla norvegica	Norwegian Cinquefoil	S5	Green
Potentilla simplex	Old-Field Cinquefoil	S5	Green
Prenanthes trifoliolata	Three-Leaved Rattlesnake-root	S5	Green
Prenanthes trifoliolata	Three-Leaved Rattlesnake-root	S5	Green
Prunella vulgaris	Self-Heal	S5	Green
Prunus pensylvanica	Fire Cherry	S5	Green
Prunus serotina	Wild Black Cherry	S5	Green
Prunus virginiana	Choke Cherry	S5	Green
Pteridium aquilinum	Bracken Fern	S5	Green
Puccinellia maritima	American Alkali Grass	S4S5	Green
Pyrola elliptica	Shineleaf	S5	Green
Pyrus malus	Common Apple	SE	Exotic
Quercus rubra	Northern Red Oak	S5	Green
Ranunculus acris	Tall Butter-Cup	SE	Exotic
Ranunculus repens	Creeping Butter-Cup	SE	Exotic
Rhamnus alnifolia	Alderleaf Buckthorn	S3	Yellow
Rhododendron canadense	Rhodora	S5	Green
Rhynchospora capitellata	Brownish Beakrush	S4	Green
Ribes glandulosum	Skunk Currant	S5	Green
Ribes hirtellum	Smooth Gooseberry	S5	Green
Ribes lacustre	Bristly Black Currant	S5	Green
Rorippa palustris	Bog Yellow-Cress	S4	Green
Rosa nitida	Shining Rose	S4	Green
Rosa virginiana	Virginia Rose	S5	Green
Rubus canadensis	Smooth Blackberry	S5	Green
Rubus hispidus	Bristly Dewberry	S5	Green

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Rubus idaeus	Red Raspberry	S5	Green
Rubus pubescens	Dwarf Red Raspberry	S5	Green
Rubus setosus	Small Bristleberry	S4?	Green
Rubus sp.	A Bramble	Not Applicable	Not Applicable
Rumex crispus	Curly Dock	SE	Exotic
Sagittaria Sp.	An Arrowhead	Not Applicable	Not Applicable
Salix bebbiana	Bebb's Willow	S5	Green
Salix discolor	Pussy Willow	S5	Green
Salix eriocephala	Heart-Leaved Willow	S5	Green
Salix humilis	Prairie Willow	S5	Green
Sambucus racemosa	Red Elderberry	S5	Green
Scirpus atrovirens	Georgia Bulrush	S4	Green
Scirpus cyperinus	Cottongrass Bulrush	S5	Green
Scirpus cyperinus	Black-Girdle Bulrush	S5	Green
Scirpus maritimus	Saltmarsh Bulrush	S4S5	Green
Scirpus microcarpus	Small-Fruit Bulrush	S5	Green
Scutellaria galericulata	Hooded Skullcap	S5	Green
Scutellaria lateriflora	Mad Dog Skullcap	S5	Green
Senecio robbinsii	Robbins Squaw-Weed	S4S5	Green
Sisyrinchium montanum	Strict Blue-Eyed-Grass	S5	Green
Sium suave	Hemlock Water-Parsnip	S5	Green
Smilacina racemosa	Solomon's-Plume	S4S5	Green
Smilacina trifolia	Three-Leaf Solomon's-Plume	S4S5	Green
Solanum dulcamara	Climbing Nightshade	SE	Exotic
Solidago canadensis	Canada Goldenrod	S5	Green
Solidago juncea	Early Goldenrod	S5	Green
Solidago nemoralis	Field Goldenrod	S4S5	Green
Solidago puberula	Downy Goldenrod	S5	Green
Solidago rugosa	Rough-Leaf Goldenrod	S5	Green
Solidago sempervirens	Seaside Goldenrod	S5	Green
Solidago uliginosa	Bog Goldenrod	S5	Green
Sonchus arvensis	Field Sowthistle	SE	Exotic
Sonchus oleraceus	Common Sowthistle	SE	Exotic
Sorbus americana	American Mountain-Ash	S5	Green
Sparganium angustifolium	Narrow-Leaf Burreed	S4S5	Green
Sparganium emersum	Narrow-Leaf Burreed	S5	Green
Sparganium sp.	A Burreed	Not Applicable	Not Applicable
Spartina alterniflora	Saltwater Cordgrass	S5	Green
Spartina patens	Salt-Meadow Cordgrass	S5	Green
Spartina pectinata	Fresh Water Cordgrass	S5	Green
Spiraea alba	Narrow-Leaved Meadow-Sweet	S5	Green
Spiraea tomentosa	Hardhack Spiraea	S5	Green
Spiranthes cernua	Nodding Ladies'-Tresses	S5	Green
Streptopus roseus	Rosy Twistedstalk	S5	Green
Suaeda maritima	Maritime Sea-blite	S5	Green
Taraxacum laevigatum	Red-Seeded Dandelion	SE	Exotic
Taraxacum officinale	Common Dandelion	SE	Exotic
Thalictrum pubescens	Tall Meadow-Rue	S5	Green
Thelypteris noveboracensis	New York Fern	S5	Green
Thelypteris palustris	Marsh Fern	S5	Green
Triadenum fraseri	Marsh St. John's-Wort	S5	Green
Trientalis borealis	Northern Starflower	S5	Green
Trifolium arvense	Rabbit-Foot Clover	SE	Exotic
Trifolium aureum	Yellow Clover	SE	Exotic
Trifolium campestre	Low Hop Clover	SE	Exotic
Trifolium hybridum	Alsike Clover	SE	Exotic

TABLE I2 Vascular Plant Species Found Along the Survey Route During July and August 2006 Field Sureys.

Binomial	Common Name	Population Status in Nova Scotia (ACCDC)	Population Status in Nova Scotia (NSDNR)
Trifolium pratense	Red Clover	SE	Exotic
Trifolium repens	White Clover	SE	Exotic
Triglochin maritima	Common Bog Arrow-Grass	S5	Green
Tussilago farfara	Colt's Foot	SE	Exotic
Typha latifolia	Broad-Leaf Cattail	S5	Green
Vaccinium angustifolium	Late Lowbush Blueberry	S5	Green
Vaccinium macrocarpon	Large Cranberry	S5	Green
Vaccinium myrtilloides	Velvetleaf Blueberry	S5	Green
Vaccinium oxycoccos	Small Cranberry	S5	Green
Veronica officinalis	Gypsy-Weed	S5SE	Exotic
Veronica scutellata	Marsh Speedwell	S5	Green
Viburnum nudum	Possum-Haw Viburnum	S5	Green
Viburnum opulus	Guelder-Rose Viburnum	S5	Green
Vicia cracca	Tufted Vetch	SE	Exotic
Viola adunca	Labrador Violet	S5	Green
Viola blanda	Smooth White Violet	S5	Green
Viola cucullata	Marsh Blue Violet	S5	Green
Viola macloskeyi	Smooth White Violet	S5	Green
Viola sororia	Woolly Blue Violet	S5	Green
Zea mays	Indian Corn; Maize	SE	Exotic

TABLE I3 Breeding Status of Birds Recorded in the Four Breeding Bird Atlas Squares within which the Project Area is found.

Common Name	Binomial	Breeding Status	NSDNR Population Status
Common Loon	*Gavia immer*	Probable	Yellow
Pied-billed Grebe	*Podilymbus podiceps*	Probable	Green
American Bittern	*Botaurus lentiginosus*	Confirmed	Green
Great Blue Heron	*Ardea herodias*	Confirmed	Green
Canada Goose	*Branta canadensis*	Confirmed	Green
Wood Duck	*Aix sponsa*	Possible	Green
Green-winged Teal	*Anas crecca*	Confirmed	Green
American Black Duck	*Anas rubripes*	Confirmed	Green
Mallard	*Anas platyrhynchos*	Confirmed	Green
Northern Pintail	*Anas acuta*	Probable	Green
Blue-winged Teal	*Anas discors*	Confirmed	Green
Ring-necked Duck	*Aythya collaris*	Probable	Green
Osprey	*Pandion haliaetus*	Confirmed	Green
Bald Eagle	*Haliaeetus leucocephalus*	Confirmed	Green
Northern Harrier	*Circus cyaneus*	Confirmed	Green
Sharp-shinned Hawk	*Accipiter striatus*	Confirmed	Green
Northern Goshawk	*Accipiter gentilis*	Confirmed	Yellow
Broad-winged Hawk	*Buteo platypterus*	Probable	Green
Red-tailed Hawk	*Buteo jamaicensis*	Probable	Green
American Kestrel	*Falco sparverius*	Confirmed	Green
Merlin	*Falco columbarius*	Possible	Green
Ring-necked Pheasant	*Phasianus colchicus*	Confirmed	Exotic
Spruce Grouse	*Dendragapus canadensis*	Confirmed	Green
Ruffed Grouse	*Bonasa umbellus*	Confirmed	Green
Virginia Rail	*Rallus limicola*	Probable	Green
Sora	*Porzana carolina*	Probable	Green
Killdeer	*Charadrius vociferus*	Confirmed	Green
Spotted Sandpiper	*Actitus macularia*	Confirmed	Green
Common Snipe	*Gallinago galinago*	Confirmed	Green
American Woodcock	*Scolopax minor*	Confirmed	Green
Rock Dove	*Columba livia*	Confirmed	Exotic
Mourning Dove	*Zenaida macroura*	Possible	Green
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Possible	Green
Great Horned Owl	*Bubo virginianus*	Probable	Green
Barred Owl	*Strix varia*	Confirmed	Green
Common Nighthawk	*Chordeiles minor*	Confirmed	Yellow
Chimney Swift	*Chaetura pelagica*	Confirmed	Yellow
Ruby-throated Hummingbird	*Archilocus colubris*	Confirmed	Green
Belted Kingfisher	*Ceryle alcyon*	Confirmed	Green
Yellow-bellied Sapsucker	*Sphryrapicus varius*	Confirmed	Green
Downy Woodpecker	*Picoides pubescens*	Confirmed	Green
Hairy Woodpecker	*Picoides villosus*	Confirmed	Green
Black-backed Woodpecker	*Picoides arcticus*	Confirmed	Green
Northern Flicker	*Colaptes auratus*	Confirmed	Green
Pileated Woodpecker	*Dryocopus pileatus*	Confirmed	Green
Olive-sided Flycatcher	*Contopus borealis*	Confirmed	Yellow
Eastern Wood Pewee	*Contopus virens*	Confirmed	Green
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Probable	Green
Alder Flycatcher	*Empidonax alnorum*	Confirmed	Green

TABLE I3 Breeding Status of Birds Recorded in the Four Breeding Bird Atlas Squares within which the Project Area is found.

Common Name	Binomial	Breeding Status	NSDNR Population Status
Least Flycatcher	*Empidonax minimus*	Confirmed	Green
Great-crested Flycatcher	*Myiarchus crinitus*	Probable	Green
Tree Swallow	*Tachycineta bicolor*	Confirmed	Green
Bank Swallow	*Riparia riparia*	Confirmed	Green
Cliff Swallow	*Hirundo pyrrhonota*	Confirmed	Green
Barn Swallow	*Hirundo rustico*	Confirmed	Yellow
Gray Jay	*Perisoreus canadensis*	Confirmed	Yellow
Blue Jay	*Cyanocitta cristata*	Confirmed	Green
American Crow	*Corvus brachyrhynchos*	Confirmed	Green
Common Raven	*Corvus corax*	Confirmed	Green
Black-capped Chickadee	*Poecile atricapillus*	Confirmed	Green
Boreal Chickadee	*Poecile hudsonicus*	Confirmed	Yellow
Red-breasted Nuthatch	*Sitta canadensis*	Confirmed	Green
White-breasted Nuthatch	*Sitta carolinensis*	Probable	Green
Brown Creeper	*Certhia americana*	Confirmed	Green
Winter Wren	*Troglodytes troglodytes*	Confirmed	Green
Golden-crowned Kinglet	*Regulus satrapa*	Confirmed	Green
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed	Green
Eastern Bluebird	*Sialis sialis*	Confirmed	Yellow
Veery	*Catharus fuscescens*	Confirmed	Green
Swainson's Thrush	*Catharus ustulatus*	Confirmed	Green
Hermit Thrush	*Catharus guttatus*	Confirmed	Green
Wood Thrush	*Hylocichla mustelina*	Possible	Green
American Robin	*Turdus migratorius*	Confirmed	Green
Gray Catbird	*Dumetella carolinensis*	Confirmed	Green
Northern Mockingbird	*Mimus polyglottos*	Possible	Green
Cedar Waxwing	*Bombycilla cedrorum*	Confirmed	Green
European Starling	*Sturnus vulgaris*	Confirmed	Exotic
Blue-headed Vireo	*Vireo solitarius*	Confirmed	Green
Red-eyed Vireo	*Vireo olivaceus*	Confirmed	Green
Tennessee Warbler	*Vermivora peregrina*	Probable	Green
Nashville Warbler	*Vermivora ruficapilla*	Confirmed	Green
Northern Parula Warbler	*Parula americana*	Confirmed	Green
Yellow Warbler	*Dendroica petechia*	Confirmed	Green
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed	Green
Magnolia Warbler	*Dendroica magnolia*	Confirmed	Green
Cape May Warbler	*Dendroica tigrina*	Probable	Green
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible	Green
Yellow-rumped Warbler	*Dendroica coronata*	Confirmed	Green
Black-throated Green Warbler	*Dendroica virens*	Confirmed	Green
Blackburnian Warbler	*Dendroica fusca*	Confirmed	Green
Palm Warbler	*Dendroica palmarum*	Confirmed	Green
Bay-breasted Warbler	*Dendroica castanea*	Confirmed	Green
Black-and-white Warbler	*Mniotilta varia*	Confirmed	Green
American Redstart	*Setophaga ruticilla*	Confirmed	Green
Ovenbird	*Seiurus aurocapillus*	Probable	Green
Northern Waterthrush	*Seiurus noveboracencis*	Confirmed	Green
Mourning Warbler	*Oporornis philadelphia*	Confirmed	Green
Common Yellowthroat	*Geothlypis trichas*	Confirmed	Green

TABLE I3 Breeding Status of Birds Recorded in the Four Breeding Bird Atlas Squares within which the Project Area is found.

Common Name	Binomial	Breeding Status	NSDNR Population Status
Canada Warbler	*Wilsonia canadensis*	Confirmed	Green
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Confirmed	Green
Indigo Bunting	*Passerina cyanea*	Possible	Green
Chipping Sparrow	*Spizella passerina*	Confirmed	Green
Savannah Sparrow	*Passerculus sandwichensis*	Confirmed	Green
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsonii*	Confirmed	Green
Song Sparrow	*Melospiza melodia*	Confirmed	Green
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed	Green
Swamp sparrow	*Melospiza georgiana*	Confirmed	Green
White-throated Sparrow	*Zonotrichia albicolis*	Confirmed	Green
Dark-eyed Junco	*Junco hyemalis*	Confirmed	Green
Bobolink	*Dolichonyx oryzivorus*	Confirmed	Green
Red-winged Blackbird	*Agelaius phoeniceus*	Confirmed	Green
Rusty Blackbird	*Euphagus carolinus*	Confirmed	Yellow
Common Grackle	*Quiscalus quiscula*	Confirmed	Green
Brown-headed Cowbird	*Molothrus ater*	Confirmed	Green
Northern Oriole	*Icterus galbula*	Confirmed	Green
Pine Grosbeak	*Pinicola enucleator*	Confirmed	Green
Purple Finch	*Carpodacus purpureus*	Confirmed	Green
Red Crossbill	*Loxia curvirostra*	Probable	Green
White-winged Crossbill	*Loxia leucoptera*	Confirmed	Green
Pine Siskin	*Carduelis pinus*	Confirmed	Green
American Goldfinch	*Carduelis tristis*	Confirmed	Green
Evening Grosbeak	*Coccothraustes vespertinus*	Confirmed	Green
House Sparrow	*Passer domesticus*	Confirmed	Exotic

TABLE I4. Rare or Uncommon Bird Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Likeihood Site	ACCDC RANK	NSDNR Rank
Anas acuta	Northern Pintail	Grassland, cultivated field, sandy flat, islands in lakes, marsh, pond	Unlikely	S2B	
Rallus limicola	Virginia Rail	Freshwater marshes, usually in cattails, reeds or dense grass. Occasionally in brackish marsh	Unlikely	S2B	
Poecile hudsonica	Boreal Chickadee	Boreal coniferous and mixed coniferous-deciduous woodland	Likely	S3S4	
Dolichonyx oryzivorus	Bobolink	Tall grass, flooded meadows, dense grain fields	Likely	S3B	Yellow
Euphagus carolinus	Rusty Blackbird	Cool habitats in treed bogs, swamps and damp alder swales	Unlikely	S3S4B	
Icterus galbula	Baltimore Oriole	Open and riparian woodland, deciduous forest edge, open areas with scattered trees, around human habitation	Unlikely but possible	S3B	
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	Primarily saltwater marshes but occassionally in freshwater marshes	Possible	S2S3B	Yellow
Coccyzus erythropthalmus	Black-billed Cuckoo	Deciduous/coniferous forest and open woodland	Possible	S3B	
Sayornis phoebe	Eastern Phoebe	Open and riparian woodlands, rocky ravines, farmland with scattered trees. Typically nests near water, often in buildings or bridges	Unlikely but possible	S2S3B	
Caprimulgus vociferus	Whip-Poor-Will	Open dry deciduous forest	Unlikely	S2B	
Falco columbarius	Merlin	Open habitats, nests primarily in open woodlands; occasionaly in towns and cities	Possible	S3S4B	
Sialia sialis	Eastern Bluebird	Forest edge, burned or cutover woodland, open country with scattered trees	Possible	S2S3B	Yellow
Piranga olivacea	Scarlet Tanager	Deciduous forest and woodland, mixed deciduous-coniferous forest	Unlikely but possible	S3B	
Loxia curvirostra	Red Crossbill	Coniferous and mixed coniferous-deciduous forest	Possible	S3S4	
Charadrius melodus	Piping Plover	Mostly sand, occasional gravel, or pebble beaches, especially among scattered grass tufts	Unlikely	S1B	Red
Passerina cyanea	Indigo Bunting	Deciduous forest edge and clearings , open woodland, weedy fields, shrublands, orchards	Possible	S2S3B	
Accipiter gentilis	Northern Goshawk	Mixed, often mostly coniferous forest, open woodland	Possible	S3B	Yellow
Sterna hirundo	Common Tern	Usually islands or coastal beaches with sparse matted vegetation, grassy areas	Unlikely	S3B	Yellow
Eremophila alpestris	Horned Lark	Open grassy areas with sparse vegetation and few trees. In Nova Scotia most nesting occurs at airports	Unlikely	S2B	
Tringa melanoleuca	Greater Yellowlegs	Treed bog	Unlikely	S2B,S5M	
Larus ridibundus	Black-headed Gull	Coastal waters	Unlikely	S3N	
Hylocichla mustelina	Wood Thrush	Deciduous or mixedwood forest, especially near water, ocassionally near human habitation	Unlikely	S2B	
Pooecetes gramineus	Vesper Sparrow	Open agricultural land with low vegetation. In Nova Scotia most nests are in blueberry fields	Unlikely	S2S3B	Yellow
Myiarchus crinitus	Great Crested Flycatcher	Deciduous forest edge, woodland, orchards, parks	Possible	S2S3B	
Mergus serrator	Red-breasted Merganser	Nests amid low brush and driftwood on coastal islands and sandbars	Unlikely	S2S3B	
Mimus polyglottos	Northern Mockingbird	Habitat generalist: wide range of open and partly open habitats, abundant in suburbs	Possible	S3B	
Falco peregrinus anatum	American Peregrine Falcon	Nests mainly on cliff faces	Unlikely	S1B	Red
Bucephala clangula	Common Goldeneye	Floodplain forests	Unlikely	S2B	
Sterna dougallii	Roseate Tern	Usually on offshore islands with sandy, rocky pebble beaches, among boulders and in open or grassy habitat	Unlikely	S1B	Red
Aythya marila	Greater Scaup	Lakes and coastal waters	Unlikely	S3N	
Sterna paradisaea	Arctic Tern	Offshore islands, rocky or grass-covered coasts, tundra, occasionally along inland lakes and rivers	Unlikely	S3B	Yellow

TABLE I4. Rare or Uncommon Bird Species Potentially Within the Study Area

Latin Name	Common Name	Preferred Habitat	Likeihood Site	ACCDC RANK	NSDNR Rank
Gallinula chloropus	Common Moorhen	Freshwater marshes, lakes, and ponds, usually with emergent vegetation and grassy edges	Unlikely	S1B	
Charadrius semipalmatus	Semipalmated Plover	Gravelly beacheshabitat, grassy or mossy tundra	Unlikely	S2B,S5M	
Toxostoma rufum	Brown Thrasher	Brush and shrubland, deciduous forest edge and clearings, suburbs	Possible	S1?B	
Vireo philadelphicus	Philadelphia Vireo	Deciduous and mixedwood forest	Possible	S2B	
Calidris minutilla	Least Sandpiper	Coastal bogs	Unlikely	S1B,S5M	
Progne subis	Purple Martin	Open country, rural areas, especially near water. All Maritime nests in nest boxes	Unlikely	S1S2B	Yellow
Podiceps grisegena	Red-necked Grebe (Migratory)	Shallow lakes, large ponds edged with reeds or sedges. Occasionally along quiet rivers	Unlikely	S3S4M	
Calidris maritima	Purple Sandpiper	Rocky coast lines	Unlikely	S3N	
Bartramia longicauda	Upland Sandpiper	Pastures, hay fields and similar grassy open areas	Unlikely but possible	S1B	
Sturnella magna	Eastern Meadowlark	Grassland, fields	Possible	S1S2B	Yellow
Fulica americana	American Coot	Freshwater lakes, ponds, marshes, rivers	Unlikely	S2B	
Asio otus	Long-eared Owl	Coniferous and mixedwood forest, especially near water; occasionally deciduous forest, also parks, orchards, farm woodland	Possible	S1S2	Yellow
Asio flammeus	Short-eared Owl	Dyked wet meadows, marshes, coastal bogs and grasslands	Unlikely	S1S2B	Yellow
Vireo gilvus	Warbling Vireo	Open decid and decid-conif woodland, riparian forest and thickets	Possible	S2B	
Cardinalis cardinalis	Northern Cardinal	Thickets, dense shrubs, undergrowth, residential areas; riparian thickets	Possible	S3B	
Bucephala islandica	Barrow's Goldeneye (Eastern population)	Coastal waters	Unlikely	S1N	Yellow
Cepphus grylle	Black Guillemot	Rocky shores, on coastal cliffs and at base among boulders	Unlikely	S3	
Alca torda	Razorbill	Coastal cliff, rocky shore on islands	Unlikely	S1B,SZN	Yellow
Anas clypeata	Northern Shoveler	Freshwater shallows, especially muddy, sluggish habitats and surrounding marsh vegetation; also sewage lagoons	Unlikely	S2B	
Phalacrocorax carbo	Great Cormorant	Coastal cliffs, lakes and rivers	Unlikely	S3B	
Accipiter striatus	Sharp-shinned Hawk	Near woodland, Coniferous and mixedwood forestmountainous conif/decid foest	Likely	S3S4B	
Picoides arcticus	Black-backed Woodpecker	Coniferous forest	Likely	S3S4	
Anas strepera	Gadwall	Brackish estuarine marshes and sewage lagoons	Unlikely	S2B	
Chlidonias niger	Black Tern	Fertile freshwater marshes	Unlikely	S1B	
Cistothorus palustris	Marsh Wren	Freshwater marshes dominated by cattails and bulrushes	Unlikely	S2B	

TABLE I5 Breeding Status of Birds Recorded during the Field Survey.

Common Name	Binomial	Breeding Status	NSDNR Status
Great Blue Heron	*Ardea herodias*	Confirmed	Green
Canada Goose	*Branta canadensis*	No Evidence	Green
Wood Duck	*Aix sponsa*	No Evidence	Green
American Black Duck	*Anas rubripes*	No Evidence	Green
Mallard	*Anas platyrhynchos*	No Evidence	Green
Osprey	*Pandion haliaetus*	Confirmed	Green
Bald Eagle	*Haliaeetus leucocephalus*	Confirmed	Green
Northern Harrier	*Circus cyaneus*	No Evidence	Green
Broad-winged Hawk	*Buteo platypterus*	Confirmed	Green
Red-tailed Hawk	*Buteo jamaicensis*	No Evidence	Green
American Kestrel	*Falco sparverius*	Confirmed	Green
Merlin	*Falco columbarius*	Probable	Green
Ring-necked Pheasant	*Phasianus colchicus*	Confirmed	Exotic
Spruce Grouse	*Dendragapus canadensis*	Confirmed	Green
Ruffed Grouse	*Bonasa umbellus*	Possible	Green
Semipalmated Plover	*Charadrius semipalmatus*	No Evidence	
Spotted Sandpiper	*Actitus macularia*	Confirmed	Green
Least Sandpiper	*Calidris minutilla*	No Evidence	
American Woodcock	*Scolopax minor*	Confirmed	Green
Rock Dove	*Columba livia*	Possible	Exotic
Mourning Dove	*Zenaida macroura*	Probable	Green
Great Horned Owl	*Bubo virginianus*	Possible	Green
Barred Owl	*Strix varia*	No Evidence	Green
Ruby-throated Hummingbird	*Archilocus colubris*	Probable	Green
Downy Woodpecker	*Picoides pubescens*	Possible	Green
Hairy Woodpecker	*Picoides villosus*	Possible	Green
Black-backed Woodpecker	*Picoides arcticus*	No Evidence	Green
Northern Flicker	*Colaptes auratus*	Confirmed	Green
Pileated Woodpecker	*Dryocopus pileatus*	Probable	Green
Olive-sided Flycatcher	*Contopus borealis*	Possible	Yellow
Eastern Wood Pewee	*Contopus virens*	Possible	Green
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Possible	Green
Alder Flycatcher	*Empidonax alnorum*	Possible	Green
Least Flycatcher	*Empidonax minimus*	Possible	Green
Tree Swallow	*Tachycineta bicolor*	Confirmed	Green
Barn Swallow	*Hirundo rustico*	Possible	Yellow
Blue Jay	*Cyanocitta cristata*	Probable	Green
American Crow	*Corvus brachyrhynchos*	Probable	Green
Common Raven	*Corvus corax*	Possible	Green
Black-capped Chickadee	*Poecile atricapillus*	Probable	Green
Boreal Chickadee	*Poecile hudsonicus*	Possible	Yellow
Red-breasted Nuthatch	*Sitta canadensis*	Possible	Green
Brown Creeper	*Certhia americana*	Possible	Green
Winter Wren	*Troglodytes troglodytes*	Possible	Green
Golden-crowned Kinglet	*Regulus satrapa*	Possible	Green
Ruby-crowned Kinglet	*Regulus calendula*	Probable	Green
Hermit Thrush	*Catharus guttatus*	Possible	Green
American Robin	*Turdus migratorius*	Probable	Green
Cedar Waxwing	*Bombycilla cedrorum*	Possible	Green

TABLE I5 Breeding Status of Birds Recorded during the Field Survey.

Common Name	Binomial	Breeding Status	NSDNR Status
European Starling	*Sturnus vulgaris*	Confirmed	Exotic
Blue-headed Vireo	*Vireo solitarius*	Possible	Green
Red-eyed Vireo	*Vireo olivaceus*	Possible	Green
Nashville Warbler	*Vermivora ruficapilla*	Possible	Green
Northern Parula Warbler	*Parula americana*	Possible	Green
Magnolia Warbler	*Dendroica magnolia*	Possible	Green
Yellow-rumped Warbler	*Dendroica coronata*	Possible	Green
Black-throated Green Warbler	*Dendroica virens*	Probable	Green
Blackburnian Warbler	*Dendroica fusca*	Possible	Green
Palm Warbler	*Dendroica palmarum*	Probable	Green
Black-and-white Warbler	*Mniotilta varia*	Probable	Green
American Redstart	*Setophaga ruticilla*	Possible	Green
Ovenbird	*Seiurus aurocapillus*	Possible	Green
Mourning Warbler	*Oporornis philadelphia*	Possible	Green
Common Yellowthroat	*Geothlypis trichas*	Possible	Green
Canada Warbler	*Wilsonia canadensis*	Possible	Green
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Possible	Green
Chipping Sparrow	*Spizella passerina*	Possible	Green
Savannah Sparrow	*Passerculus sandwichensis*	Probable	Green
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsonii*	Possible	Green
Song Sparrow	*Melospiza melodia*	Confirmed	Green
Swamp sparrow	*Melospiza georgiana*	Possible	Green
White-throated Sparrow	*Zonotrichia albicolis*	Confirmed	Green
Dark-eyed Junco	*Junco hyemalis*	Probable	Green
Common Grackle	*Quiscalus quiscula*	Probable	Green
Purple Finch	*Carpodacus purpureus*	Possible	Green
Pine Siskin	*Carduelis pinus*	No Evidence	Green
American Goldfinch	*Carduelis tristis*	Possible	Green

TABLE I6 Numbers of each Species Recorded in the Various Habitat Types Present in the Project Area.

Species	Habitat																				Grand Total
	AL - Agriculture Land	AP - Abandoned pasture	BM - Brackish Marsh	CC - Clear-cut	CTS - Coniferous Treed Swamp	DA - Disturbed Area	FO - Flew Over	HU - Habitat Unknown	IH - Immature Hardwood	IM - Immature Mixedwood	IS - Immature Softwood	MH - Mature Hardwood	MM - Mature Mixedwood	MS - Mature Softwood	MTS - Mixedwood Treed Swamp	OW - Open Water	PA - Pasture	RA - Residential Area	TS - Tall Shrub Swamp	TT - Tall shrub Thicket	
Alder Flycatcher				1					2											2	**5**
American Crow	3						8	2					2	1							**16**
American Goldfinch							2						1								**3**
American Kestrel				1																	**1**
American Redstart				1																	**1**
American Robin				3					2	5	1		6				4		1		**22**
American Woodcock						1			2												**3**
Bald Eagle							3									3				1	**7**
Barn Swallow							1														**1**
Black-and-white Warbler										2	1	1	3								**7**
Black-backed Woodpecker							1							1							**2**
Blackburnian Warbler													2								**2**
Black-capped Chickadee										1		1	2								**4**
Black-throated Green Warbler										3	1		4	1							**9**
Blue Jay									1	1			4	1	1						**8**
Boreal Chickadee											1										**1**
Broad-winged Hawk													1								**1**
Canada Warbler										1			1		1						**3**
Cedar Waxwing							1							2	1			1			**5**
Chipping Sparrow											1										**1**
Common Grackle							2										2	1			**5**
Common Raven								1									2				**3**
Common Yellowthroat				6	1					3	1										**11**
Dark-eyed Junco				4						5	6	1	2								**18**
Downy Woodpecker														1							**1**
Eastern Wood Pewee				1								1	3								**5**
European Starling							13										8	7			**28**
Golden-crowned Kinglet													4								**4**
Great Black-backed Gull																2					**2**
Great Blue Heron							3														**3**
Hairy Woodpecker				2									2								**4**
Hermit Thrush								1		3	1		5								**10**
Least Flycatcher												2									**2**
Magnolia Warbler										9	2		4								**15**
Mallard	1																				**1**
Merlin				2																	**2**
Mourning Dove	2									3			2								**7**
Mourning Warbler									1												**1**
Nashville Warbler					1					3				2							**6**
Northern Flicker				3			1			3		1	1								**9**
Northern Harrier							1														**1**
Olive-sided Flycatcher								1							1						**2**
Osprey							1			1											**2**
Ovenbird										2		1	11	1	1						**16**
Palm Warbler				1							6				1						**8**
Parula Warbler												1	2								**3**
Pileated Woodpecker													2								**2**
Purple Finch																		2			**2**
Red-breasted Nuthatch														1							**1**
Red-eyed Vireo										5		4	3								**12**
Red-tailed Hawk							2											1			**3**
Ring-necked Pheasant																	13				**13**
Rose-breasted Grosbeak																		1			**1**
Ruby-crowned Kinglet										1	1			3							**5**
Ruby-throated Hummingbird																		1			**1**

TABLE I6 Numbers of each Species Recorded in the Various Habitat Types Present in the Project Area.

Species	Habitat																				
	AL - Agriculture Land	AP - Abandoned pasture	BM - Brackish Marsh	CC - Clear-cut	CTS - Coniferous Treed Swamp	DA - Disturbed Area	FO - Flew Over	HU - Habitat Unknown	IH - Immature Hardwood	IM - Immature Mixedwood	IS - Immature Softwood	MH - Mature Hardwood	MM - Mature Mixedwood	MS - Mature Softwood	MTS - Mixedwood Treed Swamp	OW - Open Water	PA - Pasture	RA - Residential Area	TS - Tall Shrub Swamp	TT - Tall shrub Thicket	**Grand Total**
Savannah Sparrow			10				1										32				**43**
Sharp-tailed Sparrow																	1				**1**
Solitary Vireo											1										**1**
Song Sparrow		1		2					2	1			1				11	3		2	**23**
Spotted Sandpiper	1																				**1**
Spruce Grouse														3							**3**
Swamp sparrow					1														2		**3**
Tree Swallow																		4			**4**
White-throated Sparrow				13				1	4	10	5		3								**36**
Winter Wren										1			3								**4**
Wood Duck																	1				**1**
Yellow-bellied Flycatcher														1							**1**
Yellow-rumped Warbler					1						1	1	1	2							**6**
Grand Total	**7**	**1**	**10**	**40**	**4**	**1**	**40**	**6**	**14**	**63**	**29**	**14**	**75**	**20**	**6**	**5**	**74**	**21**	**3**	**5**	**438**