APPENDIX L

SALT MANAGEMENT STRATEGY

Highway 104 at Antigonish
Salt Management Strategy

1.0 Background

Numerous studies have confirmed that elevated chloride levels in surface waters are linked to winter maintenance activities (*i.e.* salt storage and application of road salt as a deicing agent). Significant salt releases into aquatic areas of small drainage size put these areas at high risk. Surges of high chloride concentration from road salt typically occur during the winter and thaw months. Small streams, ponds, and wetlands close to the salted highway are susceptible to high salt loading, and combined with soil erosion due to salt-damaged vegetation, can exert stress on the aquatic ecology. Rapid changes in stream chloride levels during and following the winter salting period, rather than the high absolute values of chloride, may also stress fish and other aquatic life.

Salt stored in the groundwater and soils may also be released to streams over a several month period. Salt released during low flow summer months may be more concentrated when biotic activity is the highest. It is estimated that between 10% and 50% of salt applied to roads enters into the groundwater system and between 20% and 45% of chlorides applied to roads travels through the groundwater system and re-enters surface waters. In the rural area along the proposed alignment, much of the road salt may enter the subsurface along the highway where no surface drainage exists.

Overall, harmful effects on aquatic life from salt pollution depends on oxygen supply in the water, water circulation, size of waterbody and drainage basin, temperature, length of exposure to salt, salting intensity, precipitation, topography, and type of highway drainage system.

Elevated levels of sodium chloride in soils may affect soil structure, soil pH, soil fertility, and the mobilization of trace metals. Extensive salt infiltration into soils can decrease the fertility of soils and subsequently be detrimental to plant growth.

2.0 Notification of Intent to Prepare a Salt Management Plan

As per Section 15(a) of the “Code of Practice for the Environmental Management Of Road Salts”, published April 3, 2004, the Nova Scotia Department of Transportation and Public Works (NSTPW) notified Environment Canada on June 23, 2004, that they moved forward with the development of a Salt Management Plan (SMP). The SMP was developed to comply with the requirements of the aforementioned Code of Practice. In addition, NSTPW will report

information annually to Environment Canada on their performance with respect to the SMP, as it is implemented and updated.

The SMP provides a mechanism through which NSTPW can commit to implementing salt best management practices while fulfilling its obligation to providing safe, efficient, and cost effective roadway systems. The SMP identifies four specific winter maintenance programs in compliance with the concerns expressed by Environment Canada. These concerns include:

(1) Storage and handling;
(2) Salt application;
(3) Salt vulnerable areas; and
(4) Training.

As part of the SMP, a preliminary Salt Vulnerability Map was developed. The purpose of this mapping and rating matrix is to assist in determining the order winter maintenance facilities receive new storage facilities and to determine sites where groundwater chloride levels should be monitored. Using several physical and land use factors relevant to salt mobility and impact, a preliminary map of salt impact vulnerability was generated using a GIS mapping approach. The zones of highest risk are based on hydrogeological and hydrologic constraints. The 53 NSTPW winter maintenance facilities are rated for further scrutiny based on the volumes of salt and sand stored, their mode of operation, and their location within the established provincial salt vulnerability zones. Finally, the major highways (100 Series and Trunks) and 200 and 300 Series roads are superimposed on the risk map to show areas of potential concern for future monitoring or mitigation.

This is a preliminary assessment that uses mapping that is based on readily available electronic mapping and databases. No fieldwork was done in conjunction with this mapping, and the results should be considered on a regional scale only. NSTPW plans to carry out the monitoring of chloride levels at a number of their winter maintenance facilities around the Province this in 2004/05. This will benchmark current concentrations against which future levels can be compared. Levels will be tracked to show progress (hopefully lower chloride levels) after best management practices have been implemented at these winter maintenance facilities.

A training module will be prepared for NSTPW's highway designers and planners as part of the Department's commitment to a Salt Management Plan. This training will provide them with the awareness and tools required to address salt best management practices in the planning and design stage to reduce the amount of road de-icing salt necessary to achieve NSTPW's winter maintenance standards.

3.0 Approach to the Salt Management Strategy

The following general activities will form the basis for development of an SMP for Highway 104.

- Identify salt vulnerable areas specific to the proposed alignment, using Annex “B” in the Code of Practice as a guide.
- Determine the exposure levels for negative impacts to aquatic and groundwater biota and soil (vegetation).
- Determine site specific vulnerable areas to be monitored along the proposed alignment.
- Identify applicable management strategies that can be incorporated in the design, construction, operation and maintenance of the proposed highway.
- Implement a monitoring program during winter, thaw and summer months (*i.e.* 3 events).
- Compare results to baseline samples to evaluate effectiveness of the strategy.

4.0 Salt Vulnerable Areas

Annex “B” of the Code of Practice lists a number of considerations that agencies should look for when identifying salt vulnerable areas.

Salt vulnerable areas along this specific alignment that should be considered in the management strategy include:

- Wetlands adjacent to the highway with low-dilution and long residence times;
- Areas where the addition of road salts has the potential to raise the chloride concentration, after mixing, to levels that could harm local fish or fish habitat; and
- Areas where the addition of road salts has the potential to harm the integrity of a life cycle, (*i.e.*, spawning grounds, rearing, food supply, and migration areas for birds).

5.0 Salt Vulnerable Areas Along Row Identified for Monitoring

An analysis of Salt Vulnerable Areas (Section 4) along the proposed Highway 104 at Antigonish has yielded a number of locations for monitoring (Table 1).

Table 1 Salt Vulnerable Areas for Monitoring		
Area	**Feature, Station Location**	**Importance**
1	Wetland 6, Sta. 4+150	Overwintering fish habitat
2	West River, Sta. 5+700	Type 1 salmonid habitat
3	Stream Crossing No. 11, Sta. 8+150	Type 2 salmonid habitat
4	Wetland 12, Sta. 9+000	Fish eating birds and amphibian breeding habitat, wetland plant species
5	Wetland 15	Amphibian breeding habitat, wetland plant species

6.0 Table for Evaluating Negative Impacts

The following table (Table 2) will provide guidance during the operation and maintenance of the highway by identifying concentrations of chloride in the environment at which certain negative environmental impacts are likely to occur. The three areas of concern include surface water, groundwater, and soil (vegetation). Concentrations above these levels have the potential to result in negative impacts.

Table 2 Table for Evaluating Negative Impacts			
Exposure	**Surface Water – Aquatic Biota**	**Groundwater – Groundwater Biota**	**Soil – Soil Integrity, Soil Organisms, and Vegetation**
Protective of Organisms for Short-Term Exposure	< 140 mg/L of chloride	< 140 mg/L of chloride	-
Protective of Organisms for Long-Term Exposure	< 35 mg/L of chloride	< 35 mg/L of chloride	< 60 mg Na/L and < 90 mg Cl/L
5 % of Species Experience Effects from Chronic Exposure	About 210 mg/L	About 210 mg/L	-
10 % of Species Experience Effects from Chronic Exposure	About 240 mg/L	About 240 mg/L	-
Protect Life From Acute and Lethal Effects	< 150 mg/L	< 150 mg/L	-
Damage to Plants	-	-	Concentrations of 16 mg Na/kg and 30 Cl/kg

Surface water samples taken in July 2002, November 2002, and February 2003 at 15 stream crossings along the existing alignment of Highway 104 at Antigonish to indicate elevated chloride and sodium levels, particularly in the smaller watercourses and associated wetlands. Concentrations of chloride between 200 and 300mg/L were observed in some of the smaller wetlands and up to 100 mg/L in some of the stream crossings.

7.0 Management Strategies

The following is a list of management strategies that may be considered in the design, construction, operation and maintenance of the proposed section of Highway 104, based on the salt vulnerable areas identified on this section of highway.

- Apply de-icing chemical using pre-wetting or direct liquid application and implement anti-icing principles to minimize salt application rates.

- TPW's current standard cross-section for 100 series highways has up to 6:1 side slopes and 4:1 back slopes, which reduces the potential for drifting snow.

- Berms or fences could be placed upwind of the roadway to reduce potential for drifting snow.

- Do not cut grass within the RoW (except directly adjacent to the highway) to encourage drifting immediately downwind of the berm or fence.

- Use clay or geosynthetic liners in conveyance ditches and berms to transport surface runoff past vulnerable areas where possible.

- Ensure runoff collected in median catch basins is not directed into salt vulnerable areas.

8.0 Monitoring Program

Monitoring should be carried out during winter, thaw and summer months (three events) to evaluate the effectiveness of the salt management strategy.

Test results should be compared to baseline concentrations of chloride and also to the exposure concentrations to determine if there are potential negative effects to aquatic and groundwater biota and vegetation.

Note: Halophytes are plants that are morphologically and/or physiologically adapted to grow in soils and air with relatively high levels of sodium chloride. Some of these halophyte species are well suited for use in roadside seed mixes and are better suited than conventional mixes. Such seed mixes should be investigated further as they tend to be hardier and require less maintenance.