

Appendix G: Chloride Technical Report

Chloride Loading in the Upper Beaver Brook Watershed – Current and Future Conditions

I-93 Exit 4A Final Environmental Impact Statement

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

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ABBREVIATIONS AND ACRONYMS

AoT	NHDES Alteration of Terrain permit program
AU	Assessment Unit for water quality assessment – collection of stream reaches within a watershed
Beaver Brook	Assessment Unit (AU) NHRIV700061203-16 within the Upper Beaver Brook Watershed (Level 12 Hydrologic Unit 010700061025)
BMP	Best Management Practice
CLD	CLD Consulting Engineers (As of August 7, 2017; Fuss & O’Neill, Inc.)
CWA	Clean Water Act
FY	State Fiscal Year
LBG	Louis Berger Group
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
Normandeau	Normandeau Associates, Inc.
The Towns	The Towns of Derry and Londonderry
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WQC	Clean Water Act Section 401 Water Quality Certification

1.0 INTRODUCTION

The Towns of Derry and Londonderry, New Hampshire (the Towns) and the New Hampshire Department of Transportation (NHDOT), in cooperation with the Federal Highway Administration (FHWA), are preparing an environmental study for the Interstate 93 (I-93) Exit 4A Project (Project). The Project is located in the Towns and includes construction of a new interchange with I-93 (known as Exit 4A) and other transportation improvements to reduce congestion and improve safety along State Route 102 (NH 102), from I-93 easterly through downtown Derry, and to promote economic vitality in the Derry/Londonderry area.

The Final Environmental Impact Statement (FEIS) presents the affected environment and the direct and indirect effects (environmental consequences) anticipated from the proposed Project in accordance with the requirements of the National Environmental Policy Act (NEPA; Public Law 91-190, 42 United States Code [USC] 4321–4347 as amended) and the regulations of the Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] 1500–1508), as well as applicable FHWA regulations (23 CFR Part 771; 23 USC 138) and guidance (FHWA, 1987). Environmental consequences studied include impacts to water quality from each alternative assessed in the FEIS. The Preferred Alternative in the FEIS is Alternative A and that alternative is the focus of this report. Impacts from the proposed Project will include an increase in impervious area from additional roadway and a proportional increase in associated pollutants. Chloride, primarily from road salt used for winter road maintenance, is a pollutant of concern associated with increased impervious area.

This report provides:

- A review of the water quality regulatory environment for the proposed Project,
- An update on the status of chloride loading from NHDOT maintained roadways and municipally maintained roadways in the Towns of Derry and Londonderry in the Project area within Upper Beaver Brook watershed,
- A summary of expected chloride loading from the proposed Project and other reasonably foreseeable actions by others within the watershed, and
- A discussion of best management practices for the proposed Project and other reasonably foreseeable actions by others within the watershed that would be implemented to minimize chloride loading.

1.1 Existing Conditions

The proposed Project lies within the Upper Beaver Brook watershed (Level 12 Hydrologic Unit 010700061025) as mapped in the US Geological Survey's Watershed Boundary Dataset (NHDES, 2017a). Beaver Brook, south of the proposed Project, flows west under I-93 and then south into Massachusetts where it joins the Merrimack River in Lowell. Upper Beaver Brook has been subject to water quality investigations since 2003 in response to proposed development in the watershed, including widening and improvements to I-93 (NHDES, 2008).

1.2 Proposed Action

The preferred alternative (Alternative A) for the proposed Project passes through Londonderry and Derry, with 3.2 miles of new alignment between the proposed I-93 Exit 4A interchange and eastern Derry. There would be approximately 1 mile of roadway construction on a new alignment, 1.6 miles of existing roadway reconstruction, and 0.6 mile of roadway with no improvements. It would originate from the proposed I-93 Exit 4A interchange location and travel southeast along new alignment through a wooded area to Folsom Road, near its intersection with North High Street and Madden Road. This alternative would continue to follow Folsom Road past Ross' Corner (Manchester Road/NH 28) and continue on Tsienneto Road across NH 28 Bypass to its end at NH 102, adjacent to Beaver Lake. Alternative A would cross Shields Brook, a perennial stream with a 3,767 acre watershed, as well as one other perennial stream on Tsienneto Road and several intermittent streams.

1.3 Indirect/Foreseeable Actions

A Land Use Scenarios Technical Report (Louis Berger Group, 2017) prepared in conjunction with the SDEIS documents the development anticipated to occur if the proposed project were constructed. The Land Use Scenarios Technical Report predicts increased industrial development in Derry, increased residential development in Chester, and increased development in currently undeveloped land south and east of Exit 4A. Woodmont Commons, shown in Figure 1, is a planned, mixed-use, urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Alternative A would bisect the Woodmont East property.

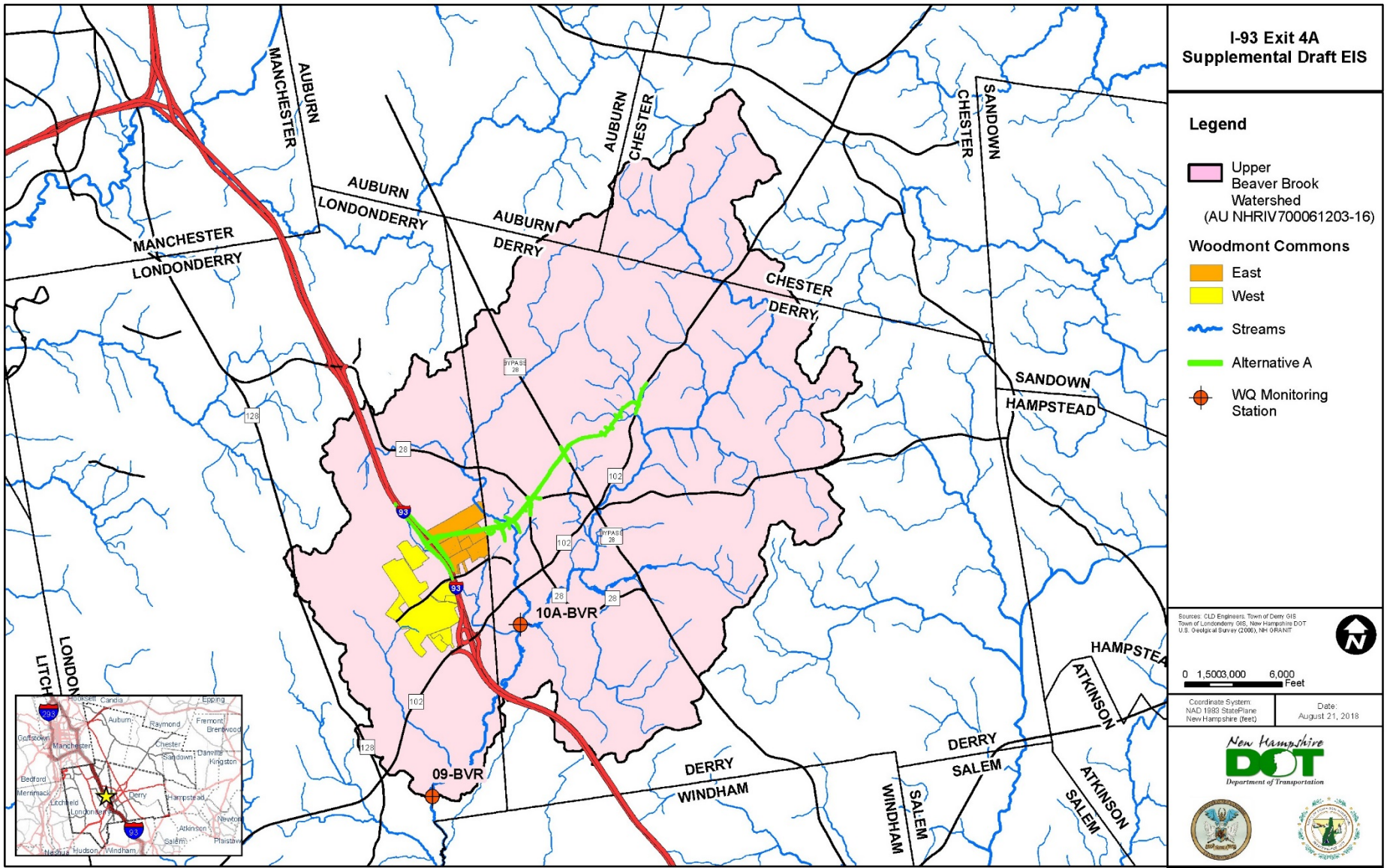


Figure 1. Upper Beaver Brook Watershed – Project Alternative A and Woodmont Commons East and West

2.0 REGULATORY FRAMEWORK

The Exit 4A project is subject to a variety of state and federal regulations and associated programs that ensure surface water quality is preserved or restored in all waters of the U.S. Impacts to waterbodies near the Alternative A alignment would necessitate involvement with these regulations as the Project proceeds through final design to construction.

2.1 Clean Water Act 303(d) and 305(b)

The Clean Water Act (CWA), as amended in 1972, established the structure by which the federal government regulates discharges into the waters of the United States. Sections 303(d) and 305(b) of the CWA requires each state to submit two reports (CWA 303(d) report and CWA 305(b) report) to the U.S. Environmental Protection Agency (USEPA) every two years, documenting the water quality status of surface waters within the state. The New Hampshire Department of Environmental Services (NHDES) Watershed Management Bureau administers the monitoring and reporting of surface water quality to the USEPA. One of the required reports is New Hampshire’s “305(b) Report” which describes the quality of New Hampshire’s surface waters and analyzes the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water.

The second report, required by Section 303(d) of the CWA requires submittal of a list of waters that:

- are impaired or threatened by a pollutant or pollutant(s);
- are not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources; and
- require development and implementation of a comprehensive water quality study (i.e., a Total Maximum Daily Load or TMDL study) that assesses pollutant loads consistent with water quality standards.

2.1.1 New Hampshire Surface Water Assessment

The NHDES process for assessing surface water quality is detailed in the “Consolidated Assessment and Listing Methodology” (CALM) that interprets New Hampshire’s Surface Water Quality Regulations (Env-Wq 1702.17). Env-Wg 1702.17 identifies the “designated uses” that New Hampshire surface waters should support (NHDES, 2017b). Designated uses are listed in Table 1.

Table 1. Designated Uses for New Hampshire Surface Waters from ENV-Wq 1702.17¹

Designated Use	NHDES Definition	
Aquatic Life	Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms.	
Fish Consumption	Waters that support fish free from contamination at levels that pose a human health risk to consumers.	
Shellfish Consumption	Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers	
Drinking Water Supply After Adequate Treatment	Waters that with adequate treatment will be suitable for human intake and meet state/federal drinking water regulations.	
Primary Contact Recreation (i.e. swimming)	Waters that support recreational uses that involve minor contact with the water.	
Secondary Contact Recreation	Waters that support recreational uses that involve minor contact with the water.	
Wildlife	Waters that provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life ^b	
Designated Use	NHDES Definition	Applicable Surface Waters
Aquatic Life Integrity	The surface waters can support aquatic life, including a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats in the region.	All surface waters
Fish Consumption	The surface waters can support a population of fish free from toxicants and pathogens that could pose a human health risk to consumers.	All surface waters
Shellfish Consumption	The tidal surface waters can support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers	All tidal surface waters
Potential Drinking Water Supply	The surface waters could be suitable for human intake and meet state and federal drinking water requirements after adequate treatment.	All surface waters
Swimming and Other Recreation in and on the Water ¹	Surface waters that are suitable for swimming, wading, boating of all types, fishing, surfing and similar activities.	All surface waters
Wildlife	The surface waters can provide habitat capable of supporting any life stage or	All surface waters

Designated Use	NHDES Definition	Applicable Surface Waters
	activity of undomesticated fauna on a regular or periodic basis.	
Designated Use	NHDES Definition	Applicable Surface Waters
Aquatic Life Integrity	The surface waters can support aquatic life, including a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats in the region.	All surface waters
Fish Consumption	The surface waters can support a population of fish free from toxicants and pathogens that could pose a human health risk to consumers.	All surface waters
Shellfish Consumption	The tidal surface waters can support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers	All tidal surface waters
Potential Drinking Water Supply	The surface waters could be suitable for human intake and meet state and federal drinking water requirements after adequate treatment.	All surface waters
Swimming and Other Recreation in and on the Water ¹	Surface waters that are suitable for swimming, wading, boating of all types, fishing, surfing and similar activities.	All surface waters
Wildlife	The surface waters can provide habitat capable of supporting any life stage or activity of undomesticated fauna on a regular or periodic basis.	All surface waters

Notes: 1 - NHDES (2017e)

2 - For assessment purposes, the designated use of "Swimming and Other Recreation in and on the Water" is split into the following two designated uses because of differences in assessment criteria:

- a. Primary Contact Recreation (i.e. swimming), which are waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water.
- b. Secondary Contact Recreation, which are waters that support recreational uses that involve minor contact with the water.

New Hampshire's Administrative Rules Env-Wq 1703 et seq. provide the thresholds for pollutants, dissolved oxygen (DO), color, temperature, and other criteria that must be met for surface waters to be in compliance. As discussed in the Consolidated Assessment and Listing Methodology, each assessment unit (AU, the waterbody or stream segment used for recording assessments) is assessed and placed in one of seven assessment categories. Categories 4A, 4B, 4C and 5 represent AUs with one or more designated uses that are considered impaired. Definitions for each of these four impairment categories are provided below:

:

- **AU Category 4A:** Impaired or threatened for one or more designated uses but does not require the development of a TMDL because a TMDL has been completed.
- **AU Category 4B:** Impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future.
- **AU Category 4C:** Impaired or threatened for one or more designated uses but does not require the development of a TMDL because the impairment is not caused by a pollutant.
- **AU Category 5:** Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL (this is the 303(d) List) (NHDES, 2017b).

For impaired waterbodies on the 303(d) list, a TMDL is calculated that establishes the maximum amount of a pollutant that can be allowed in a waterbody to achieve water quality standards for all designated uses (NHDES, 2008). A TMDL report also identifies the sources of the pollutant(s) of concern and the quantity of pollutant that could be discharged by each source while achieving water quality standards. All TMDLs are subject to public review and comment and review and approval by EPA (NHDES, 2008). A TMDL is determined as:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

Where “WLA” is the waste load allocation for point sources of a pollutant; “LA” is the load allocation for nonpoint sources of a pollutant; and “MOS” is the margin of safety to account for uncertainty and unknowns (NHDES, 2008).

2.2 Beaver Brook Chloride TMDL

In 2008, the NHDES prepared TMDL studies for four waterbodies in southern New Hampshire that were adjacent to I-93 (NHDES, 2008). One of those was Beaver Brook, AU NHRIV700061203-16 in Derry and Londonderry (Figure 1), which includes the surface waters within the Upper Beaver Brook Watershed¹. According to the TMDL, the majority (~95%) of chloride loading in the watershed is associated with de-icing activities for public and private roadways and parking lots. The TMDL was set as a load duration curve based on the chronic water quality standard (230 mg/L Cl) reduced by 10%, to include a 10% margin of safety, (=207 mg/L Cl) multiplied by each streamflow value in a four day average flow duration curve determined by NHDES (NHDES, 2008). The load duration curve expresses the TMDL in tons of chloride per day that can be imported to the watershed at a given flow and meet the chronic water quality standard (NHDES, 2008). Of the daily salt import total expressed by the TMDL, 66% is reserved for the WLA (MS4 permittees) and 34% is reserved for the LA (nonpoint sources) (NHDES, 2008). NHDES has also expressed the TMDL for Beaver Brook as an alternative form, the percent reduction goal, which establishes an annual salt load allocation in tons of salt per year (NHDES, 2008). The annual salt load allocation is not the TMDL (the TMDL is the load duration curve), but is used for implementing the TMDL by establishing a longer term goal (i.e. versus daily criteria) for watershed salt imports that can be expected to meet water quality standards. Based on empirical water quality data and annual salt imports from

¹ “Beaver Brook” as used in this document refers to the NHDES Assessment Unit NHRIV700061203-16, consistent with documents referenced in this report.

all salt sources in the watershed and including a 10% margin of safety, NHDES set the annual Upper Beaver Brook watershed salt load allocation at 9,069 tons of salt per year (NHDES, 2008). The TMDL report also sets forth the process by which each sector would be allocated an annual quantity of salt to be applied (the “salt load”). The recommended salt loads were negotiated via a Salt Reduction Workgroup, with representatives from each sector of salt applicators. Recommended salt loads per sector were established in the “*Chloride Reduction Implementation Plan for Beaver Brook – Derry, Londonderry, Auburn, Chester, NH*” (NHDES, 2011a).

2.3 NHDES TMDL Implementation Plan

A TMDL study establishes a target for reducing a pollutant(s) in order to achieve water quality standards in an impaired waterbody. A TMDL implementation plan may identify a framework for achieving load reductions through existing or necessary controls that address the identified source(s) of pollutant(s).

The *Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a) specifies a number of best management practices (BMPs) to optimize salt use efficiency and identifies activities and target dates for achieving compliance with the TMDL (see Table 2). The BMPs were identified consistent with the implementation plan goals to reduce salt loads and attain chloride water quality standards in the Upper Beaver Brook watershed while preserving winter road maintenance standards and traffic safety.

Table 2. Chloride Reduction Implementation Plan Matrix (from NHDES, 2011a)

Action		Target Completion Date of Responsible Agencies							
		NH DES	UNH	NH DOT	Towns ^a	LER ^b	RPC ^c	PS ^d	NH DOS ^e
Objective: Creation of Educational Manuals, Training Programs and Procedural/Operational Strategies									
1	State Snow and Ice BMP Manual for Roadways	2012		2012					
2	State Snow and Ice BMP Manual for Parking Lots	2012		2012				2012	
3	Develop DOT Winter Maintenance Training Program for Salt Reduction			2012					
4	Certification Training Program for Private Sector		2011						
5	Training and Certification Program for Municipal Staff		2011		2011				
6	Legislative approval of salt applicators license program	DLA ^f							
7	Legislative approval of mandatory use of snow tires								DLA
8	Develop Join Incident Protocols			2011					2011
9	Complete Driver Behavior Study	2012							
10	Adopt traffic violation procedure to address reckless driving during inclement road conditions								DLA
11	Develop winter driving training and require attendance for repeat traffic violation offenders								DLA
12	Develop training for inexperienced drivers, such as high school students				2012				2012
13	Reduce driving speed limits during inclement weather conditions			2010	2010				

	Action	Target Completion Date of Responsible Agencies							
		NH DES	UNH	NH DOT	Towns ^a	LER ^b	RPC ^c	PS ^d	NH DOS ^e
14	Hold prewinter meetings to review Level of Service				2011	2011			
15	Develop call-back ranking system				2012	2012			
16	Develop and adopt a formal snow and ice removal policy				2011				
17	Revise site plan review process to include designs and/or management strategies that may decrease chloride use				2012		2012		
18	Revise permit review process to include designs and/or management strategies that may decrease chloride use	2012							
19	Creation of a salt reduction ordinance				2015				
20	Require mandatory training for employees and contracted staff that deal with winter maintenance			2012	2012			2012	
21	Review and update Salt Management Plans every 5 years				2015				
22	Development of company operational procedure manual for snow and ice removal							2015	
23	Develop record keeping strategy for salt application			2012	2012			2012	
24	Properly store salt under cover and on an impervious surface and away from surface water			2011	2011			2011	
Objective: Snow and Ice Removal BMP Applications									
1	Modify existing equipment for pre-wetting				2012			2012	
2	Implement pre-wetting watershed wide			2014	2014			2014	
3	Implement anti-icing watershed wide			2016	2016			2016	
4	Use handheld or truck mounted spreaders			2011	2011			2011	
5	Install ground speed oriented spreaders to trucks			2014	2014			2014	
6	Use alternative snow fighting methods such as snow fences where applicable			2011	2011			2011	
7	Manage overflow parking areas based on level of use			2013				2013	
8	Properly maintain and calibrate equipment			2011	2011			2011	
9	Complete periodic inspections of parking lots and walk ways for over application of deicer. Follow up with staff/contractor on findings.							2012	
10	Adopt BMP's at all salt storage and handling facilities			2012	2012			2012	
11	Track salt use utilizing salt accounting system developed by UNH T2 ^g							2012	
12	Install AVL systems to collect real time data			2015	2015				

- Notes:
- a – Derry and Londonderry
 - b – LER - Local Emergency Responders
 - c – RPC - Rockingham Planning Commission
 - d – PS - Private Sector
 - e – NHDOS - NH Department of Safety
 - f – DLA - Dependent on Legislative Approval
 - g – UNH T2 - University of New Hampshire Technology Transfer Center

2.3.1 NHDOT Implementation Plan

A 19.8-mile section of Interstate I-93 from Salem, NH to Manchester, NH is undergoing reconstruction and widening to four lanes to improve transportation efficiency and safety with an expected completion date in October 2019². The I-93 project includes a 5.2 mile segment located within the Upper Beaver Brook watershed. In 2009, prior to NHDES' publication of the *Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a) the NHDOT prepared the *Implementation Plan to Increase the Efficiency and Effectiveness of Road Salt Use to Meet Total Maximum Daily Load for Chloride in Water Bodies along the I-93 Corridor from Salem to Manchester, NH: Beaver Brook; Dinsmore Brook; North Tributary to Canobie Lake; Porcupine-Policy Brook* which demonstrated to NHDES how NHDOT could meet the Beaver Brook chloride TMDL (NHDOT, 2009).

The I-93 improvement project required a 401 Water Quality Certification (WQC) and preparation of an Environmental Impact Statement with a Record of Decision (ROD) from the FHWA that describes measures that would be taken to minimize harm to the environment, including water quality. To date, relevant BMPs identified in the *Chloride Reduction Implementation Plan for Beaver Brook* have been implemented including actions taken by NHDOT in executing the conditions of the I-93 project 401 WQC (NHDES, 2006) and consistent with the FHWA 2005 ROD for the I-93 project EIS (FHWA, 2005). NHDOT submitted a letter dated March 13, 2018 to Fuss & O'Neill (Appendix A) that identifies all salt reduction BMPs that have been implemented to date consistent with the NHDOT Implementation Plan (NHDOT, 2009) and the NHDES Implementation Plan (NHDES, 2011a), as presented below (from Appendix A, pages 3-4). The NHDOT letter asserts, through implementation of salt reduction BMPs, compliance with all current permits (see Appendix A).

- Salt accounting - DOT meticulously monitors its salt stock in each patrol shed and reports that information annually to DES
- Pre-wetting - DOT applies liquid deicer to dry salt at time of application
- Anti-Icing - DOT applies brine directly to the pavement in advance of an oncoming storm when conditions allow
- Underbelly Plows - DOT utilizes these plows that enhance snow scraping / removal capabilities
- Ground-speed Spreader Controllers - All DOT trucks utilized out of Shed 528 have ground-speed, closed loop controllers
- Mobile Pavement Temperature Sensors - All DOT trucks located in Shed 528 have mobile pavement temperature sensors. Several road weather stations have also been established along I-93 corridor
- Equipment Calibration - DOT annually calibrates their spreader equipment prior to each season
- Enhanced Training - DOT provides enhanced training tracks participation via an online accounting system. Hired equipment operators are encouraged to attend

² <http://www.rebuildingi93.com/content/news/> Accessed 4/18/2018.

- Improved Storage Practices - DOT has just completed upgrading a depot shed in Salem which has increased indoor storage capacity
- Snow and Ice Forecasting - DOT utilizes computer software that provides forecast for plowing and salting with information feed from its Roadside Weather Information System
- Enhanced Plow Blade Technology - DOT utilizes flexible plow blades that provide better road contact and enhance snow scraping / removal capabilities
- GPS/AVL technology - All DOT spreader trucks located in Shed 528 are equipped with GPS/AVL which helps track salt usage by specific trucks and areas of interest.
- Variable Messaging Signs - VMS have been installed to warn drivers of impending or current weather and traffic conditions and set lower speed limits
- Enhanced Material Reporting Relative to Winter Severity - DOT has been reporting post-implementation salt usage relative to pre-implementation usage while adjusting for winter weather severity.

2.3.2 Town of Derry Implementation Plan

The Town of Derry developed the document *Salt Reduction Plan for: Beaver Brook* with subsequent updates (Derry, 2011a; Derry, 2016) in response to the TMDL and the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a). The 2016 Salt Reduction Plan details several measures that have been implemented to reduce salt loading in Beaver Brook (Derry, 2016):

- Purchased five salt reducing plow trucks
- Salt pre-wetting sprayers on new trucks
- Groundspeed controls on new trucks
- Pavement temperature sensors on new trucks
- Salt spreader calibration program developed and implemented to ensure accurate application rates.
- All Derry municipal operators have been trained in the Green Snow Pro Program offered by the UNH Technology Transfer Center
- Derry regularly hosts the Green Snow Pro Program training in its municipal center on Manning Street.
- Derry officials supported the passage of the Voluntary Certified Salt Applicator law each time it was presented to the legislature.
- Derry has filmed and broadcasted plow truck ride-alongs on its public access television station.
- Derry has provided ride-alongs for the DES Salt Reduction Coordinator.
- Derry public television interviewed DES and UNH salt reduction experts during a segment about the chloride contamination issues in Beaver Brook.

The town committed in 2016 to equipping nine plow trucks with Automatic Vehicle Location (AVL) technology which will allow the town to track the amount of salt applied on each salt route and will log salt applied in a central database. This system also helps avoid duplicating salting efforts by displaying a trail of where other salt applicators have been.

Derry has provided further commitments to reduce chloride applications within the town in accordance with the Beaver Brook Chloride TMDL Implementation Plan (NHDES, 2011a) and has continued to develop its stormwater program consistent with the MS4 requirements as has been documented in a letter from Derry to NHDOT (Derry, 2019). The letter (included in Appendix B of this report) outlines all chloride reduction measures planned and implemented by the Town to date and demonstrates the significant progress that has been made in the Upper Beaver Brook watershed to reduce chlorides.

2.3.3 Town of Londonderry Implementation Plan

The Town of Londonderry developed a salt reduction plan (Londonderry, 2011) in response to the TMDL and the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a). The Londonderry salt reduction plan identified a number of BMPs and implementation goals for reducing salt loads including equipment upgrades, improved equipment calibration procedures, private sector outreach, and improved weather monitoring. Londonderry reports in the document *Town of Londonderry, NH Salt Reduction Best Management Practices for the Beaver Brook Watershed Within the Boundaries of the Town of Londonderry* (Londonderry, 2018a) that as of March 2018, they have completed the following:

- Purchased five dump trucks with underbody discharge spreaders
- Salt pre-wetting and ground speed control on new trucks
- Pavement temperature sensors on new trucks
- Spreader control units on new trucks to allow adaptive road treatment
- Developed and implemented spreader calibration policies
- Developed and implemented salt use tracking policies
- Salt reduction training program is required for town staff and road maintenance contractors
- Upgraded local weather forecast service to aid road maintenance decision making process

Londonderry has continued to further develop its stormwater program and chloride reduction goals as summarized in a letter from the Town to NHDOT (Londonderry, 2019a) that outlines all the planned and implemented chloride reduction efforts to date (see Appendix C). Londonderry has also recently passed a town stormwater ordinance and regulations that include requirements addressing chloride applications in the private sector (Londonderry, 2019b,c). The Town stormwater ordinance and regulations require Green SnowPro certification and annual salt use reporting for private salt applicators that treat private roads and parking lots with 10 or more spaces (i.e., for treated surfaces within the MS4 and within a chloride impaired watershed). This legislation will help to implement the conditions of the MS4 permit, will help to reduce chlorides

from private salt applicators, and is consistent with the goals of the Beaver Brook Chloride TMDL.

2.3.4 NHDES Private Sector Implementation Plan

The 2011 Chloride Reduction Plan for Beaver Brook provides recommendations for salt reduction by the private sector including reporting of salt usage to the University of New Hampshire Technical Transfer Center. Specific elements of the implementation plan applicable to the private sector are itemized in Table 2. NHDES has also published “*Best Management Practices and Salt-Use Minimization Efforts in Chloride-Impaired Watersheds of New Hampshire – A Guidance Document for Private Developers and Contractors*” (NHDES, 2016 – see Appendix D) which reiterates elements of the 2011 Chloride Reduction Plan and provides specific guidance on how to develop an individual Salt Minimization Plan. Individual salt minimization plans identify and describe the development being maintained, and provide the following:

- Operational Guidelines
 - Winter Operator Certification Requirements – such as Green SnowPro³ Training, which is administered by NHDES
 - Weather Monitoring – How weather information is gathered and communicated
 - Equipment Calibration Requirements
 - Mechanical Removal – information such as snow storage and plowing frequency
- Salt Usage Evaluation and Monitoring – Description of salt usage monitoring and reporting
- Analysis of Alternative De-icing Materials, Site Design Considerations and Watershed Offsets

2.4 Water Quality Permits Required for the Proposed Action

2.4.1 National Pollutant Discharge Elimination System (NPDES)

The National Pollutant Discharge Elimination System (NPDES) permit program, under the authority of the CWA, addresses water pollution by regulating point sources that discharge pollutants to waters of the United States. Two permitting programs under NPDES are relevant to highway construction projects in the Project study area: the Construction General Permit (CGP) and the Municipal Separate Storm Sewer System (MS4) general permit. While a Construction General Permit will be required for the Project, only the MS4 permit has a chloride nexus and is discussed in this section.

³ Voluntary Certified Salt Applicator Program, authorized in Env-Wq 2200

Municipal Separate Storm Sewer System (MS4) Permit

The NPDES program requires that operators of Municipal Separate Storm Sewer Systems (MS4s) file a notice of intent to obtain coverage under the MS4 permit for stormwater discharge from these systems. MS4s are defined by the EPA as a stormwater conveyance or system of conveyances that is owned by a state, city, town, village, or public entity that discharges to waters of the U.S. Owners and operators of MS4s in 61 New Hampshire municipalities, including Derry and Londonderry, are required to apply for coverage under the MS4 permit program. In January 2017, EPA released the General Permits (GPs) for New Hampshire MS4s, which took effect on July 1, 2018 (USEPA, 2017). The MS4 general permit has special requirements for operators of MS4s that discharge to Beaver Brook, Dinsmore Brook, North Tributary to Canobie Lake, and Policy-Porcupine Brook. These requirements are detailed in Appendix F “Requirements of Approved Total Maximum Daily Loads” of the 2017 MS4 General Permits (USEPA, 2017).

NHDOT and Municipally Maintained Surfaces

Under Appendix F Part I.1 of the 2017 MS4 permit, municipalities (which includes NHDOT under this permit) must develop a Chloride Reduction Plan by July 1, 2019, which must be fully implemented by July 1, 2023. Elements of the municipal Chloride Reduction Plan, briefly, are:

- Tracking of salt applied (starting July 1, 2020)
- Planned activities for salt reduction such as:
 - Operational changes (pre-wetting, pre-treating salt stockpile, increased plowing prior to de-icing, monitoring of road surface temperature) – implemented by July 1, 2019
 - New or modified equipment
 - Staff training - implemented by July 1, 2019
 - Adoption of guidelines for application rates
 - Equipment calibration
 - Designation of no-salt and low salt zones
- Estimate of total tonnage of salt reduction expected
- Implementation schedule – full implementation by July 1, 2023.

Privately Maintained Surfaces

Private facilities that drain to an MS4 in the Upper Beaver Brook watershed also have chloride reduction requirements as specified in Appendix F Part I.1 of the 2017 NH MS4 permit and must be included within a permittee’s Chloride Reduction Plan. These requirements include:

- Private parking lots with 10 or more parking spaces draining to the MS4 must be identified
- Private parking lot owners and operators and private street owners and operators are required to utilize salt applicators trained and certified in accordance with Env-Wq 2203

- Private parking lot owners and operators and private street owners and operators have to report annual salt usage within the municipal boundaries to the UNH Technology Transfer Center or directly to the permittee
- Private new development and redevelopment projects are required to minimize salt usage, and track and report amounts used using the UNH Technology Transfer Center online tool (<http://www.roadsalt.unh.edu/Salt/>)

2.4.2 401 Water Quality Certificate

Proponents of federal actions that propose discharges to waters of the U.S. that require a federal permit or license, such as a permit under Section 404 or Section 402 (e.g. MS4 GP) of the Clean Water Act, are required to obtain a Water Quality Certification (WQC) through Section 401 of the Clean Water Act. In New Hampshire, the NHDES Watershed Management Bureau and the NHDES Wastewater Engineering Bureau administer this program. For projects that require a Section 404 permit from the Army Corps of Engineers and that fall under the NH Programmatic General Permit (USACE, 2017) the 401 WQC is programmatic under state WQC #2017-404P-001, and no separate application is needed. Likewise, for permittees covered under the MS4 permit, the WQC is programmatic and requires no separate filing (NHDES, 2017e). Projects that require an individual Section 404 permit from the Army Corps of Engineers or any project requiring an individual NPDES permit or Federal Energy Regulatory Commission license must apply for a WQC. WQC for NPDES permits are administered by the NHDES Wastewater Engineering Bureau while all other WQC are administered by the NHDES Watershed Management Bureau.

The NHDES Watershed Management Bureau commonly requires applicants for individual WQCs to develop and adopt a BMP-based Chloride Management Plan, as discussed in “Best Management Practices and Salt-Use Minimization Efforts in Chloride-Impaired Watersheds of New Hampshire – A Guidance Document for Private Developers and Contractors” (NHDES, 2016). The proposed Exit 4A project would be located entirely within the Upper Beaver Brook watershed and would require an individual Section 404 permit and therefore would require an individual WQC to the Section 404 permit. Accordingly, the WQC will likely require a condition that NHDOT and the Towns prepare and adopt BMP-based Chloride Management Plans similar to the Chloride Reduction Plan (Appendix F of the 2017 MS4 permit) required for the MS4 permit.

2.4.3 Alteration of Terrain Permit

The NHDES Alteration of Terrain (AoT) Bureau is also charged with oversight of the NH Water Quality Standards. The AoT Bureau issues permits for projects that disturb:

- 100,000 square feet or more,
- 50,000 square feet or more for projects within 250 feet of surface waters under the jurisdiction of RSA 483, the New Hampshire Water Quality Protection Act, or
- Projects of any size that disturb areas with a grade of 25 percent or greater within 50 feet of any surface water.

NHDOT has been granted an exemption from the requirement to obtain an individual Alteration of Terrain Permit by NHDES as detailed in an agreement signed by NHDOT and NHDES titled “Department of Transportation Terrain Alteration Permit Exemption” (NHDES, 2011b). The agreement recognizes that NHDOT projects are designed, constructed and maintained to comply with all provisions of state water quality standards under a number of state and federal regulations, standards, guidance documents, and contract provisions. These standards are listed in the agreement and are updated by NHDOT as needed (latest updated in NHDOT letter to NHDES dated July 11, 2019 [NHDOT, 2019]):

- DOT Standard Specifications for Road and Bridge Construction, specifically Sections 107 and 645 (March 2016)
- AASHTO Highway Drainage Guidelines, 4th Edition, 2007
- EPA's Developing Your Stormwater Pollution Prevention Plan-A Guide for Construction Sites, May 2007
- DOT, Best Management Practices for Erosion and Sediment Control, June 1995
- NHDES New Hampshire Stormwater Management Manual, Volumes 1, 2 & 3, December 2008
- NHDOT Guidelines for Temporary Erosion Control and Stormwater Management, 2002
- NHDOT Best Management Practices for Routine Roadway Maintenance Activities in New Hampshire, August 2001
- NHDOT *Construction Manual*; June 1, 2006
- FHWA's Guidance Manual for Monitoring Highway Runoff Water Quality, March 2001
- FHWA's Urban Drainage Design Manual, September 2009
- FHWA's Hydraulic Design of Highway Culverts, April 2012
- All applicable Federal Aviation Administration Advisory Circulars and Orders
- AASHTO Drainage Manual, 2014
- AREMA's Manual for American Railway Engineering and Maintenance-of Way Association, April 2015
- NHDOT Salt Management Plan, June 2019

The construction of the proposed Project will be in compliance with all requirements imposed under the 2011 agreement.

3.0 CURRENT CONDITIONS

3.1 Impairment Status

The 2008 chloride TMDL remains in effect for Beaver Brook (AU NHRIV700061203-16). Other reaches of Beaver Brook, NHRIV700061203-11 and NHRIV70061203-09, are listed in the most recent 303 (d) list (NHDES, 2017c) as impaired for aquatic life by chloride.

3.2 Regulated Discharges

Discharges to Beaver Brook are currently regulated by the MS4 General Permit and by existing Alteration of Terrain permits for private development and municipal infrastructure, and under the 2011 agreement between NHDOT and the NHDES Alteration of Terrain program (NHDES, 2011b).

3.3 State and Municipal Chloride Loading in Upper Beaver Brook Watershed

Annual salt use within Upper Beaver Brook watershed for NHDOT and the Towns (FY01 through FY10) was summarized in the NHDES Chloride Reduction Implementation Plan (NHDES, 2011a). Table 3 presents the annual chloride loading estimates for NHDOT Patrol Shed 528 and the municipally maintained assets for the Towns of Derry and Londonderry within the Upper Beaver Brook watershed for FY01-FY16 (NHDES, 2011a; Derry, 2018; Londonderry, 2018; NHDOT, 2018). NHDOT Patrol Sheds 508, 512, 513, and 514 are also responsible for state roadway maintenance in Upper Beaver Brook watershed but are not discussed in this report as only Patrol Shed 528 maintains state roadway within the Exit 4A project area. Other sources, including other NHDOT maintained assets, private roads and private parking lots, contribute significantly to chloride loads in the watershed, and therefore the ability of the watershed to meet the established TMDL, but are not within the scope of this report and are not presented (for a comprehensive presentation of chloride loads in Upper Beaver Brook watershed see NHDES, 2011a). Table 3 includes all reported tonnage for the Beaver Brook watershed from the Town of Derry which includes 14.4 acres of municipal parking lots, as Derry does not track municipal parking lot salt application separately, and no separate tally of salt application on municipal roadways has been published by NHDES since 2011 (NHDES, 2011a). Review of the table reveals the relatively high degree of variability in annual salt loading for Patrol Shed 528, Derry, and Londonderry. As may be expected, salt loading in Upper Beaver Brook watershed is strongly correlated with winter weather (NHDES, 2011a). A weather severity index (WSI) has been used by NHDES to evaluate seasonal salt application totals relative to overall winter severity (e.g. total snowfall, total storm hours, etc.) and a positive correlation was found ($r^2 = 0.884$) over a ten year period from 2001 through 2010 (Section 4.2, NHDES, 2011a). As of 2011, NHDES reported chloride reductions were still needed in Upper Beaver Brook watershed to meet the TMDL target total annual salt imports, even with WSI adjustments to annual salt imports (NHDES, 2011a).

Table 4 presents estimates of salt loading rates for NHDOT Shed 528 and the towns of Londonderry and Derry's municipally maintained roads. Because Derry does not track municipally maintained roads separately from their 14.4 acres of municipally maintained parking lots, all of which fall within the Beaver Brook watershed, the average salt application outside of the Beaver Brook watershed was used to calculate an estimate of the loading rate per lane mile, because it represents roadway salt use only.

Table 3. Salt Loading in the Upper Beaver Brook Watershed from NHDOT Patrol Shed 528 Maintained Roads and Municipal Sources for Derry and Londonderry: FY01 - FY16 (tons/year) (NHDOT, 2018; Derry, 2018; Londonderry, 2018)

Source	Treatment Area	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16
NHDOT Patrol Shed 528	21.70 lane-miles - salt tonnage used	642	364	611	466	622	371	304	667	495	361	384	212	329	518	590	723
Derry	Beaver Brook watershed 212 lane-miles + 14.4 acres parking lots - salt tonnage used ^a	3,241	2,209	3,621	2,312	2,947	3,404	1,354	3,795	2,909	2,310	2,178	1,254	2,520	3,432	2,772	1,650
Londonderry	Beaver Brook Watershed municipal roads ^b	1,229	616	1,185	638	1,212	678	535	1,170	828	607	809	353	718	1,090	879	578
	TOTAL (tons)	5,112	3,189	5,417	3,416	4,781	4,453	2,193	5,633	4,232	3,278	3,370	1,819	3,567	5,040	4,241	2,951

Notes: a – Derry tracks salt usage within the Beaver Brook watershed but does not track municipal road salt application separately from municipal parking lot salt application. As such, municipal parking lots are included in this total.

b – Londonderry does not track salt loading within the Beaver Brook watershed separately from other municipal roadways. The Londonderry Salt Reduction Plan reports that there are 77.9 municipally maintained roadway lane-miles within the Beaver Brook watershed (Londonderry, 2011). Londonderry reports that there are 368.8 total municipally maintained lane-miles in Londonderry (Londonderry, 2018). Beaver Brook Watershed municipal road salt application was calculated by multiplying Londonderry’s reported salt tonnage totals by 77.9/368.8.

Table 4. NHDOT and Municipal Salt Application Rate Estimates

Source	Treatment Area and Rate	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	AVG FY08-FY16
NHDOT Patrol Shed 528	21.70 lane-miles - salt tonnage used	642	364	611	466	622	371	304	667	495	361	384	212	329	518	590	723	475
	tons/lane-mile/year	29.6	16.8	28.2	21.5	28.7	17.1	14.0	30.7	22.8	16.7	17.7	9.8	15.2	23.9	27.2	33.3	21.9
Derry	Non-Beaver Brook Watershed (roads only) - 118 lane-miles ^a	1,669	1,138	1,865	1,191	1,518	1,754	697	1,955	1,498	1,190	1,122	646	1,298	1,768	1,428	850	1,306
	tons/lane-mile/year	14.1	9.6	15.8	10.1	12.9	14.9	5.9	16.6	12.7	10.1	9.5	5.5	11.0	15.0	12.1	7.2	11.1
London-derry	Town-wide municipal roads only – 368.8 lane-miles	5,818	2,916	5,610	3,019	5,736	3,208	2,533	5,541	3,918	2,873	3,828	1,669	3,398	5,160	4,161	2,738	3,698
	tons/lane-mile/year	15.8	7.9	15.2	8.2	15.6	8.7	6.9	15.0	10.6	7.8	10.4	4.5	9.2	14.0	11.3	7.4	10.0

Notes: a – Salt application tonnages for Derry municipal roads outside of the Beaver Brook watershed was used to estimate lane-mile application rates. Derry reports that total lane miles maintained by the town = 329.8. Total lane miles within the Beaver Brook watershed = 212.

3.4 Beaver Brook Chloride TMDL Monitoring

A component of the 2008 Beaver Brook chloride TMDL is the requirement for in-stream monitoring to evaluate changes in water quality following approval of the TMDL (USEPA, 2008). The TMDL specifies near-continuous (15 minute readings) specific conductance monitoring over a nine-year period from 2007-2016 at two water quality monitoring stations in the Upper Beaver Brook watershed to determine achievement of the TMDL. The two identified water quality stations are 10A-BVR (located on Beaver Brook at Fordway Ext. bridge) and 09-BVR (located on Beaver Brook at the outlet of Kendall Pond) as shown in Figure 1. Periodic chloride and specific conductance data exist for station 10A-BVR for the period 2002 through 2006. Nearly continuous monitoring data has since been collected at station 10A-BVR from July 2006 through June 2017 (NHDES, 2018) as presented in NHDES' annual TMDL Data Report and Quality Assurance Audit (NHDES, 2007, NHDES, 2008b, NHDES, 2009, NHDES, 2010, NHDES, 2011c, NHDES, 2012, NHDES, 2014, NHDES, 2015, NHDES, 2016b, NHDES, 2017d, NHDES, 2018). A nearly continuous data record also exists for station 09-BVR from July 2006 through June 2009 as presented in the NHDES' annual TMDL Data Report and Quality Assurance Audit (NHDES, 2007, NHDES, 2008b, NHDES, 2009).

A summary of water quality violations at the TMDL monitoring stations 10A-BVR and 09-BVR is presented in Table 5 as summarized from all available published data for the continuous specific conductance monitoring conducted in support of the Beaver Brook chloride TMDL study. The data presented were collected, quality controlled, and published by NHDES in their annual Data Report and Quality Assurance Audit. Numerous other water quality stations have been periodically monitored for chloride in the Upper Beaver Brook Watershed (see NHDES, 2007; NHDES, 2008a) and other assessment units in the Beaver Brook watershed are listed as impaired for chloride, including NHRIV700061203-09 (Derry, Beaver Brook, West Running Brook) and NHRIV700061203-11 (Londonderry/Derry, Beaver Brook); however, the Beaver Brook chloride TMDL identifies attainment of chloride water quality standards at stations 10A-BVR and 09-BVR, determined by a period of continuous specific conductance monitoring, as one of the primary means for determining achievement of the TMDL (NHDES, 2008a) and is therefore presented here.

In the three years of continuous specific conductance and chloride monitoring at station 09-BVR, from July 2006 through June 2009, no acute or chronic chloride water quality violations were documented. Published data are not available beyond June 2009 at station 09-BVR. At station 10A-BVR, there are eleven years of continuous specific conductance monitoring data available and in that period there were no documented violations of the acute chloride water quality standard and there were two documented violations of the chronic chloride water quality standard as presented in Table 5. Both documented chronic chloride water quality standards violations were short in duration (5.28 days from November 29 – December 4, 2007; and 5.06 days from February 5 – February 10, 2011), as presented in Table 6. There have been no further documented chloride water quality standards violations at station 10A-BVR between February, 2011 and June, 2017 (i.e. the most recent published TMDL Data Report [NHDES, 2018]). Therefore, the TMDL monitoring data have demonstrated that the number and duration of chloride water quality standards violations have decreased since approval of the Beaver Brook chloride TMDL in 2008, with no violations documented in the past six years of published TMDL Data Reports.

Table 5. Water Quality Violations Summary at NHDES TMDL Water Quality Monitoring Station 09-BVR - Beaver Brook at Kendall Pond Outlet (42° 50' 23.04", 71° 20' 58.26")

Date Range	Number of valid specific conductance data points	Percent of reporting period with valid conductance data	Number of violations of acute chloride water quality standard (1 hr rolling average)	Number of violations of chronic chloride water quality standard (4 day rolling average)	Duration of chronic exceedance(s)
7/1/06 - 6/30/07	35,001	99.89	0	0	-
7/1/07 - 6/30/08	35,108	99.92	0	0	-
7/1/08 - 6/30/09	27,583	78.72	0	0	-
7/1/09 - 6/30/10	0	0	-	-	-
7/1/10 - 6/30/11	0	0	-	-	-
7/1/11 - 6/30/12	0	0	-	-	-
7/1/12 - 6/30/13	0	0	-	-	-
7/1/13 - 6/30/14	0	0	-	-	-
7/1/14 - 6/30/15	0	0	-	-	-
7/1/15 - 6/30/16	0	0	-	-	-
7/1/16 - 6/30/17	0	0	-	-	-

Table 6. Water Quality Violations Summary at NHDES TMDL Water Quality Monitoring Station 10A-BVR - Beaver Brook at Fordway Ext. Bridge (42° 52' 21.14", 71° 19' 46.06")

Date Range	Number of valid specific conductance data points	Percent of reporting period with valid conductance data	Number of violations of acute chloride water quality standard (1 hr rolling average)	Number of violations of chronic chloride water quality standard (4 day rolling average)	Duration of chronic exceedance (days)
7/1/06 - 6/30/07	35,001	99.89	0	0	-
7/1/07 - 6/30/08	24,253	69.03	0	1	5.28
7/1/08 - 6/30/09	34,961	99.77	0	0	-
7/1/09 - 6/30/10	35,023	99.95	0	0	-
7/1/10 - 6/30/11	27,853	79.49	0	1	5.06
7/1/11 - 6/30/12	34,637	98.58	0	0	-
7/1/12 - 6/30/13	34,357	98.05	0	0	-
7/1/13 - 6/30/14	35,018	99.94	0	0	-
7/1/14 - 6/30/15	33,260	94.92	0	0	-
7/1/15 - 6/30/16	35,118	99.95	0	0	-
7/1/16 - 6/30/17	34,587	98.71	0	0	-

Table 7. Water Quality Violation Periods at NHDES TMDL Water Quality Monitoring Stations 10A-BVR and 09-BVR

NHDES TMDL WQ Monitoring Station	Time of Start of Violation	Time of End of Violation	Duration (days)	Number of Violations
10A-BVR	11/29/2007 6:00	12/4/2007 12:45	5.28	1
10A-BVR	2/5/2011 3:45	2/10/2011 5:15	5.06	1

4.0 DIRECT IMPACTS OF THE PROPOSED ACTION

4.1 Methods

The proposed Project falls entirely within the Upper Beaver Brook Watershed. Methods used to estimate chloride loading from each potential source are as follows:

Additional chloride loading for Exit 4A was estimated by identifying which of the proposed new lane-miles, as determined by CLD Consulting Engineers (CLD)⁴ would be maintained by NHDOT and the Towns. The on-off ramps and the bridge over I-93 (1.51 lane-miles or ln-mi) would be maintained by NHDOT-Patrol Shed 528. Londonderry would maintain the 2.50 ln-mi that would be located within its town boundaries while 3.59 ln-mi would be the responsibility of the Town of Derry. Salt loading for each roadway section was assumed to equal the FY08 - FY16 historic average annual salt loading rates for each entity shown in Table 3. Thus, salt loading for Exit 4A was calculated as: Average Salt Usage (tons/lane-mile/year) as calculated in Table 4 (by Entity) x Lane-Miles Maintained by Each Entity for Alternative A = Estimated Salt Loading (tons/year) for the proposed Project. The total estimated salt loading on public roadways is the sum of estimated salt loading by NHDOT plus the salt loading from the Town of Derry and Town of Londonderry.

4.2 Results and Table

The total additional annual chloride loading estimated for the proposed Project is 99.4 tons per year.

Table 8. Estimated Future Chloride Loading on Public Roadways (per Source)

Source	Average annual salt usage FY08-FY16 (Tons/Lane-Mile/Year) ^a	Lane-Miles Maintained by Each Entity for Alternative A	Estimated salt loading for Alternative A (Tons/Year)
NHDOT Patrol Shed 528	21.9	1.51	33.1
Town of Londonderry ^a	10.6	2.5	26.5
Town of Derry ^b	11.1	3.59	39.8
		Total	99.4

⁴ CLD was purchased on August 7, 2017 and became Fuss & O'Neill, Inc. (Fuss & O'Neill).

Table Notes – a. This estimate assumes that salt application rates on all municipal lane miles within Londonderry are consistent.

b. This estimate assumes that salt application rates on all municipal lane miles within Derry are the consistent.

4.3 Chloride Mitigation

Chloride mitigation in the Upper Beaver Brook watershed is addressed for current salt users in the 2017 NH MS4 permit (USEPA, 2017), which became effective on July 1, 2018 and is discussed in Section 2.4.1. A requirement of the 2017 MS4 Permit is for permittees to develop a Chloride Reduction Plan by July 2019, as detailed in Appendix F of the permit. One of the key components to developing a successful Chloride Reduction Plan will be identifying actions (BMPs) that will be used to reduce chlorides in the watershed and achieve the waste load allocation specified in the Beaver Brook chloride TMDL. The TMDL chloride reduction implementation plan (NHDES, 2011a), developed in support of the Beaver Brook chloride TMDL, outlines a number of BMPs that can be used to achieve significant reductions in salt use by the various salt users in the watershed as discussed in Section 2.3. Many of the same salt reduction activities identified in the TMDL implementation plan are also identified in Appendix F of the MS4 permit as recommended components of a permittees required Chloride Reduction Plan. The salt reduction BMPs identified in the TMDL chloride reduction implementation plan (NHDES, 2011a) are summarized in Table 9 including the associated % chloride reduction potential for each BMP and the implementation status to date by the NHDOT and the Towns. As demonstrated in Table 9, many salt applicator BMPs which are planned or already implemented in the watershed have the potential to reduce salt use, during the specified operation, by as much as 30-50%. These actions also satisfy the salt reduction activities listed in Appendix F of the MS4 and therefore will likely be included as core components of the required Chloride Reduction Plans for NHDOT and the Towns and will likely be extended to any future actions requiring chloride mitigation, including the proposed Exit 4A Project.

The use of BMPs outlined in the TMDL chloride reduction implementation plan (NHDES, 2011) and summarized in Table 9, will likely result in significantly less salt load than could be achieved under the minimum requirements of the 2017 NH MS4 Permit, which does not require use of BMPs but rather recommends BMPs be included in a permittee's Chloride Reduction Plan (See Part I.1 of 2017 NH MS4 Appendix F). Given the current level of adoption of salt reducing BMPs in the watershed by NHDOT and the Towns, it is likely that the watershed salt load, required to be reported in 2020 per the MS4 permit, will demonstrate compliance with the TMDL waste load allocation.

Table 9. Chloride BMPs (from Table 9, NHDES, 2011a)

Chloride Reduction BMPs	Definition	Potential % Chloride Reduction^a	Implementation Status
Pre-Wetting	Application of salt brine or proprietary chemical to dry salt as it is being applied to the roadway	20% - 30%	NHDOT – Implemented Derry – Implemented Londonderry - Implemented
Pre-Treating	Application of salt brine or proprietary chemical to dry salt either before, during, or after it has been loaded into the truck.	10% - 30%	NHDOT – Planned Derry – Planned Londonderry – Not Planned
Anti-Icing	Application of salt brine or proprietary chemical up to 48 hours in advance of onset of storm.	10% - 30%	NHDOT – Implemented Derry – Planned Londonderry – Not Planned
Zero-Velocity Spreaders	Spreader ejects salt particles at the same velocity of the forward motion of the truck's traveling speed; allowing salt to drop as if the spreading vehicle was standing still.	10% - 50%	NHDOT – Not planned Derry – Not planned Londonderry – Not planned
Groundspeed Oriented Spreader Controls	Allows accurate dispensation of prescribed salt application rates irrespective of vehicle speed. Controls can be integrated to automatically vary application rate with ground temperature. Controller units can integrate GIS and wirelessly download application rate data for review	10% - 30% ^b	NHDOT – Implemented Derry – Implemented Londonderry - Implemented
Equipment Calibration	Ensures equipment application of chlorides is accurate	5 - 20%	NHDOT – Implemented Derry – Implemented Londonderry - Implemented
In-Cab Air/Ground Temp. Sensor	Installation of pavement and air temperature sensors with in-cab readout.	1% - 10% ^b	NHDOT – Implemented Derry – Implemented Londonderry - Implemented
Training, improved storage and handling practices	Training staff about various best management practices, improving storage and handling practices for loading and unloading salt	10%-25% ^b	NHDOT – Implemented Derry – Implemented Londonderry - Implemented

Notes: a. Reductions assumed do not take into account existing practices.

b. Highly dependent on existing procedures and level of adoption.

Chloride Mitigation for the Proposed Action

The Beaver Brook chloride TMDL study (NHDES, 2008) developed a daily chloride load as a function of streamflow determined to attain water quality standards. The daily load/streamflow target is problematic for managing salt applicators, given the inherent variability of daily streamflow; therefore, the TMDL study also provides an alternative expression of the maximum daily load, presented as an annual salt load (9,069 tons/year), to allow for a more realistic salt management goal and aid with implementing the TMDL. The Salt Reduction Workgroup, an interagency advisory group with representatives from NHDES, NHDOT, and other stakeholders (NHDES, 2008), is responsible for distributing the total allocation among various sectors of the Upper Beaver Brook watershed as presented in the most recent sector load allocations in the TMDL chloride reduction implementation plan (NHDES, 2011a). However, assigning sector allocations has proven to be difficult, due to the highly variable data inputs to the original TMDL, and sector allocations remain contentious. The total watershed salt allocation of 9,069 tons/year is the executable articulation of the TMDL percent reduction goal, regardless of current or future sector allocations, and is a basis for determining achievement of the TMDL.

Within the Upper Beaver Brook watershed, MS4 permittees are subject to the requirements of Appendix F of the 2017 NH MS4 permit including the requirement to “*reduce chloride discharges to support achievement of the WLA included in the applicable approved TMDL.*” The Beaver Brook chloride TMDL study provides an alternative expression of the TMDL waste load allocation as an annual salt loading allowance (commonly called the “salt load allocation”) of 9,069 tons salt/year (NHDES, 2008). The Beaver Brook chloride TMDL also does not “*include an allowance for future growth, so any future construction of additional roads or parking lots in the Beaver Brook watershed would necessitate additional load reductions elsewhere in the watershed*” (NHDES, 2008). Therefore, any future development in the Upper Beaver Brook watershed would be subject to the MS4 requirement for permittees to support achievement of the waste load allocation and it would be necessary to offset any exceedance of the salt load allocation that would result from future development through salt load reductions elsewhere in the watershed.

The means of reducing chlorides and supporting achievement of the WLA for permitted stormwater discharges, including new or increased discharges, from an MS4 to a waterbody subject to a chloride TMDL is specified in Parts 2.1.2 through 2.3.6 and Appendix F of the MS4 permit (EPA, 2017c), as discussed in Section 4.11.1. The MS4 permit has been granted water quality certification by NHDES (NHDES, 2017e) and, therefore, any discharges authorized under the MS4 permit are also certified to meet state water quality standards, including discharges to waterbodies subject to an approved TMDL such as Beaver Brook. Through adherence to the conditions of the MS4 permit and the associated WQC, new or increased discharges can be authorized while ensuring that such discharges do not cause or contribute to an exceedance of water quality standards.

NHDOT and the Towns have submitted notices of intent to obtain coverage under the MS4 permit, plan to discharge stormwater from the Project as authorized in the MS4 permit and will ensure that all conditions of the MS4 permit are met in operating the Project. The Project will also require an individual CWA Section 404 permit from the USACE and will therefore require WQC from NHDES to ensure that construction and operation of the Project will be in conformance with state water quality standards. The Proposed Action will contribute an additional salt load to the watershed estimated to be 99.4 tons/year as presented in Section 4.2.

This load represents 1% of the 9,069 tons/year Upper Beaver Brook watershed salt load allocation, which is a minor increase. This additional salt load is expected to be offset within the Upper Beaver Brook watershed by NHDOT and the Towns through development and execution of Chloride Reduction Plans as required in the 2017 NH MS4. In addition, NHDOT, Derry and Londonderry plan to implement salt reducing BMPs not specified in the MS4 permit (as presented in Section 2.3) which will provide additional assurances that the Project salt load will be offset and the Beaver Brook chloride TMDL can be achieved.

5.0 INDIRECT IMPACTS OF THE PROPOSED ACTION

The proposed Project will improve access to areas currently inaccessible and will facilitate development of these areas. As such, development that will follow its completion is an indirect impact of the project. The proposed Project will likely result in additional industrial development in Derry if areas currently zoned as residential are rezoned as industrial, and if existing lower density industrial development are redeveloped. The project is also anticipated to facilitate more residential development in several towns, but particularly in Chester where 371 additional residential units are anticipated. Woodmont Commons, shown in Figure 1, is a planned, mixed-use, urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Alternative A would bisect the property. The Town of Londonderry recently granted approval of the Woodmont Commons West Phase I plan.

5.1 Methods

This analysis assumes a range of build-outs of Woodmont Commons with separate accountings for Woodmont Commons East and Woodmont Commons West (including Market Basket expansion) to clearly account for the two related but separate actions. A separate estimate for additional Derry industrial development is also provided. New private road lane-miles and parking acreage were determined by Louis Berger Group (LBG) based on the documentation provided in the Land Use Scenarios Technical Document (Louis Berger Group, 2017). Determinations for parking were made by assuming a 300 sq. ft. requirement for each expected parking space, including travel aisles associated with the parking spaces. For new private roadways, each divided roadway length was assumed to equal a single lane length while each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed.

Residential development has not been included in this calculation because the nature of residential development, including lot size and road layout, is not foreseeable. Chester is anticipated to have the largest proportion of increase in residential development, where approximately 11% of the town (1,784 acres) falls into the Upper Beaver Brook Watershed.

5.2 Results and Table

The foreseeable new parking and private roadways are summarized in Table 10. Development scenarios for the No-Build, Build (with Exit 4A) and incremental (development attributable to the project, or the difference between the Build and No-Build)

Table 10. Indirect Impacts New Parking and Roadways Summary

Development Activity	Development Scenarios with No-Build			Development Scenarios with Exit 4A			Incremental Development Attributable to Exit 4A		
	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles
Woodmont Commons East	4.70	4.43	6.18	26.38	6.14	7.53	21.69	1.71	1.35
Woodmont Commons West	19.17	6.14	8.32	27.20	7.11	19.93	8.02	0.97	11.60
Additional Derry Industrial	0	0	0	2.38	0	0	2.38	0	0

The foreseeable new actions associated with the Woodmont Commons development will contribute to future chloride loading in the Beaver Brook watershed. Chloride loading for parking was determined using the application rate used in the “Data Report for the Total Maximum Daily Loads for Chloride For Waterbodies in the Vicinity of the I-93 Corridor From Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake” (NHDES, 2007) of 6.4 tons/acre/year. This rate is in turn based on an analysis of salt use by maintainers of private roads and parking lots that was specifically prepared for the Beaver Brook TMDL titled “Salt Loading Due to Private Winter Maintenance Practices” (Sassan and Kahl, 2007). Sassan and Kahl established a range of 5.7 – 6.4 tons/acre/year, with 6.4 tons/acre/year being the average rate for educational institutions which had the best records of salt purchases and areas serviced. Sassan and Kahl acknowledge that there is a high degree of variability in salt application rate reporting from private applicators.

Chloride loading for new streets was determined from new lane-miles provided by LBG. Each divided roadway length was assumed to equal a single lane length while each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed. When additional lanes miles were added to existing roadways, the new lane-

miles were added to the new lane-miles calculation. New chloride loading was determined using the average FY08-FY16 municipal rates, per methods described in Section 3.3.

Table 11. Salt Loading Attributable to Indirect Impacts (Tons / Year)

Development Activity	Development Scenarios with No-Build			Development Scenarios with Exit 4A			Incremental Development Attributable to Exit 4A		
	Parking	Min Build-Out	Max Build-Out	Parking	Min Build-Out	Max Build-Out	Parking	Min Build-Out	Max Build-Out
Woodmont Commons East	30.1	47.0	65.5	168.9	65.1	79.8	138.8	18.2	14.3
Woodmont Commons West	122.7	65.1	88.2	174.1	75.4	211.2	51.3	10.3	123.0
Additional Derry Industrial	0.0	0.0	0.0	15.3	0.0	0.0	15.3	0.0	0.0
Total	152.8	112.1	153.7	358.2	140.6	291.0	205.4	28.5	137.3
Potential Additional Salt Load Range	264.8 – 306.5 tons / year			498.7 - 649.2 tons / year			233.9 – 342.7 tons / year		

Under these scenarios, the salt loading from incremental development attributable to the construction of Exit 4A could range from 233.9 tons/year to 342.7 tons/year.

5.3 Chloride Mitigation

The Beaver Brook chloride TMDL establishes an annual salt load allocation as an alternative expression of the maximum daily load requirement and is used as a planning and management target for various sectors in the watershed as discussed in Sections 2.2 and 4.3. Private parking lots are designated the largest sector salt allocation, approximately 35% of the Beaver Brook watershed total salt load allocation in the most recent TMDL Implementation Plan (NHDES, 2011a). Development attributable to the construction of Exit 4A would potentially contribute 233.9– 342.7 tons of salt/year, which would comprise 2.5% - 3.8% of the total watershed allocation of 9,069 tons of salt/year.

All future development (including additional development induced by construction of Exit 4A) will require implementation of reasonable and practical BMPs to reduce chloride loading, consistent with the Chloride Reduction Plans required in the MS4 permit and/or AoT permitting (as was required for Woodmont Commons Phase I, included herein as Appendix D). The 2017 MS4 permit has additional requirements for private sector salt applicators including requiring all existing and future private parking lot and private roadway owners to only utilize salt applicators

who are trained and certified according to Env-Wq-2203 Certification of Commercial Applicators, report annual salt usage to the UNH T2 Center or to the MS4 permittee, and include the private sector in a MS4 permittee's Chloride Reduction Plan. These measures will assure reduction of salt loads in the private sector including indirect impacts as well as watershed-wide.

It is reasonable to expect the annual salt load from private roads and parking lots will decrease with adoption of the 2017 NH MS4 permit due to the salt reduction measures included in the permit. While the Beaver Brook chloride TMDL does not allow for additional future salt loads, development can occur as long as sector annual salt load allocations are met. Indirect impacts could potentially contribute a future additional salt load equivalent to 2.5% – 3.8% of the total watershed allocation and while this is not explicitly accounted for in the TMDL, it is possible for the private sector allocation, including Project indirect impacts, to still meet the allocation through adoption of BMPs. Studies have shown that salt application rates on private roads and parking lots can be reduced with BMPs (e.g. Hossein and Fu, 2015) well below the 6.4 tons/acre/year assumed for this study and as used by NHDES to develop their salt load estimates for private roads and parking lots (NHDES, 2007). Because salt application has historically not been required to be tracked in private parking lots, it is unknown whether the current salt load has been reduced to the allocation goal and if not whether the salt load increase attributable to indirect impacts will need to be further mitigated beyond the current permitting requirements. As private sector salt use data becomes available as part of the 2017 NH MS4 requirements, better assessments of the Beaver Brook salt imports compared to sector allocations will be possible and will serve to further guide management of chlorides in the private sector.

6.0 CONCLUSION

NHDOT and the Towns have been implementing salt reduction BMPs in the Upper Beaver Brook Watershed since the 2008 Beaver Brook chloride TMDL was published. NHDOT reports that they are in compliance with their Permits through execution of their respective Implementation Plans for chloride (Appendix A, page 1). Londonderry and Derry report that they are continuing with implementation of their salt reduction plans (Appendix B, Appendix C). Reasonably foreseeable actions are expected to contribute additional salt loads to the Upper Beaver Brook watershed as demonstrated in Sections 4 and 5 of this document. However, additional salt loads to the Upper Beaver Brook watershed are expected to be mitigated through the BMPs already in place and additional planned BMPs outlined in various implementation plans (NHDOT, 2009; Derry, 2011; Derry, 2016; Londonderry, 2011). The 2017 MS4 permit includes requirements for salt reduction implementation and reporting by the private sector, which contributes nearly half the total salt load to Beaver Brook (NHDES, 2011a), in Derry and Londonderry. When fully implemented, the 2017 MS4 will require all existing and future private parking lot and private roadway owners to only utilize salt applicators trained and certified according to Env-Wq-2203 Certification of Commercial Applicators and report annual salt usage to the UNH T2 Center or to the MS4 permittee.

It is anticipated that development and execution of a BMP based chloride reduction implementation plan (or plans) will be required as permit conditions to satisfy all applicable state and federal permitting requirements. BMPs required to be implemented will likely be comparable to the BMPs currently implemented as part of the I-93 improvement project, with which the NHDOT reports they are in compliance, and comparable to the current BMPs

implemented by the Towns. As such, the Towns and NHDOT would meet anticipated permitting requirements through extension of planned and currently utilized salt reduction BMPs.

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APPENDIX A: NHDOT BMP IMPLEMENTATION SUMMARY

**APPENDIX B: TOWN OF DERRY, NH SALT REDUCTION PLAN FOR:
BEAVER BROOK REVISION 2**

**APPENDIX C: TOWN OF LONDONDERRY, NH SALT REDUCTION
BEST MANAGEMENT PRACTICES FOR THE BEAVER BROOK
WATERSHED WITHIN THE BOUNDARIES OF THE TOWN OF
LONDONDERRY**

**APPENDIX D: WOODMONT COMMONS PHASE I CHLORIDE
MANAGEMENT PLAN**

APPENDIX A: NHDOT BMP IMPLEMENTATION SUMMARY



THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION



Victoria F. Sheehan
Commissioner

William Cass, P.E.
Assistant Commissioner

March 13, 2018

Derry-Londonderry, 13065
I-93, Exit 4A Study
[Water Quality BMP-Based Approach]

Christopher R. Bean, PE
Executive Vice President/Division Leader
CLD/Fuss & O'Neill, Inc.
540 Commercial St (South Entry)
Manchester, NH 03101

Dear Chris;

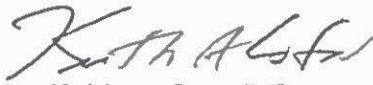
As the Exit 4A team works toward the draft Exit 4A NEPA document this spring of 2018, the Department's recommendation for our project's approach in addressing chlorides is to be consistent with TMDL Implementation plans for affected waterbodies in the Project Area (i.e.: Beaver Brook). In doing so, the qualitative analysis will need to take the following into account for the Exit 4A NEPA documentation:

1. Calculate a proposed increase in salt load for the activity, list the BMPs that can be used to mitigate the increase in salt usage, and provide project commitment to the continued employment of the BMPs in the TMDL Implementation Plans, as published, for the watershed;
2. Identify the BMPs to be included in the design and operation of the project, explain how these measures meet the requirements of the current TMDL Implementation Plans for the watershed (recommend using the narratives provided in the Implementation Plans for removal efficiencies);
3. Under Exit 4A existing conditions will need to include the operation of the I-93 fourth lane. The Department remains in compliance with the Beaver Brook TMDL Implementation Plan for chloride through the use of the following updated BMP-based approach;
 - a. Consistent with the adaptive management strategy in the I-93 ROD to the EIS, the Department has continuously and diligently worked with DES to identify and adopt various chloride reduction measures to reduce salt use in the project corridor from both DOT operations, and others. DOT has met the terms and conditions of the I-93 Water Quality Certificate (WQC) and, subsequently, the Implementation Plan developed by DES following completion of the TMDL studies;
 - b. Consistent with the I-93 WQC, Department has met all conditions, including specific chloride-related stipulations;
 - i. Condition E-6 (chloride monitoring) – performed the requested monitoring in six non-TMDL watersheds with data reports submitted to DES through FY 2012;

- ii. Condition E-7 (TMDL studies) – assisted in the development of the TMDL studies by providing funding to cover DES costs, among other efforts;
 - iii. Condition E-8 (implementation plan development) – assisted in testing chloride reduction measures that were later included in the Implementation Plans (see table below);
 - iv. Condition E-9 (implement chloride reductions in the Implementation Plans) - upgraded the Division of Operation’s winter maintenance equipment for the I-93 corridor and other State-operated roads, and implemented all the various chloride reduction measures as outlined in DES’ Chloride Reduction Implementation Plans (see table below).
 - v. Condition E-10 (DOT to implement adaptive management outlined in the I-93 ROD) - The Department contribution to additional chloride loads beyond those based on existing management practices is actually lower with anticipated reductions in the average annual road salt usage in excessive of 20% on a per lane-mile basis. This is due directly to the implementation of the suite of BMPs described in the I-93 ROD and outlined in Table 1 below.
4. With respect to the I-93 MOA, the DOT has met all the conditions specified. Consistent with the I-93 ROD and WQC, the MOA included a mechanism to fund the TMDL studies, DOT agreed to comply with the Implementation Plans, and to assist the municipalities and private sectors in complying with the Implementation Plans.

In summary, it is the Department’s recommended approach for the Exit 4A NEPA document to take a qualitative approach versus quantifying the specific salt reductions (i.e.: “counting grains of salt”). As you can see from the process noted above, our maintenance commitments and activities is best addressed through the expanded use of the BMPs identified in the DES Implementation Plan for the Beaver Brook watershed. By following these DES accepted practices, the chloride reduction goals will be achieved for the Exit 4A project.

Should you have any questions, please feel free to contact me. Thanks.


Keith A. Cota, P.E.
Chief Project Manager

KAC/kac

cc: Peter Stamnas, Director of Project Development
Kevin Nyhan, Administrator, Bureau of Environment

Table 1. Chloride Reduction BMPs Implemented by NHDOT along the I-93 Roadway

Chloride Reduction BMP	Description	Elements of the Record of Decision	Included in DES Implementation Plans
Salt Accounting	DOT meticulously monitors is salt stock in each patrol shed and reports that information annually to DES	X	X
Pre-wetting	DOT applies liquid deicer to dry salt at time of application		X
Anti-Icing	DOT applies brine directly to the pavement in advance of an oncoming storm when conditions allow	X	X
Underbelly Plows	DOT utilizes these plows that enhance snow scraping / removal capabilities	X	X
Ground-speed Spreader Controllers	All DOT trucks utilized out of Shed 528 ¹ have ground-speed, closed loop controllers		X
Mobile Pavement Temperature Sensors	All DOT trucks located in Shed 528 ¹ have mobile pavement temperature sensors. Several road weather stations have also been established along I-93 corridor	X	X
Equipment Calibration	DOT annually calibrates their spreader equipment prior to each season		X
Enhanced Training	DOT provides enhanced training tracks participation via an online accounting system. Hired equipment operators are encouraged to attend	X	X
Improved Storage Practices	DOT has just completed upgrading a depot shed in Salem which has increased indoor storage capacity		X
Snow and Ice Forecasting	DOT utilizes computer software that provides forecast for plowing and salting with information feed from it Roadside Weather Information System	X	X
Enhanced Plow Blade Technology	DOT utilizes flexible plow blades that provide better road contact and enhance snow scraping / removal capabilities		X

GPS/AVL technology	All DOT spreader trucks located in Shed 528 are equipped with GPS/AVL which helps track salt usage by specific trucks and areas of interest.		X
Variable Messaging Signs	VMS have been installed to warn drivers of impending or current weather and traffic conditions and set lower speed limits		X
Enhanced Material Reporting Relative to Winter Severity	DOT has been reporting post-implementation salt usage relative to pre-implementation usage while adjusting for winter weather severity.		X

Notes: Shed 528 in Derry performs winter maintenance activities along the southern I-93 corridor.

**APPENDIX B: TOWN OF DERRY, CHLORIDE REDUCTION PLAN
LETTER**



Town of Derry

"Derry, New Hampshire's Place to Be"

DEPARTMENT OF PUBLIC WORKS
MICHAEL A FOWLER, P.E., Director

PW20-296
September 9, 2019

Keith A. Cota, P. E. - Chief Project Manager
New Hampshire Department of Transportation
7 Hazen Drive
Concord, NH 03301

RE: Town of Derry's Chloride Reduction Plan

Dear Mr. Cota,

Beaver Brook has been identified as impaired by the New Hampshire Department of Environmental Services (NHDES) and the US Environmental Protection Agency (USEPA) for chloride concentrations that exceed state water quality standards. NHDES has completed a Total Maximum Daily Load (TMDL) analysis to quantify pollutant reductions needed to meet the state water quality standards for chlorides.

In order to meet water quality standards, significant reductions of chloride loading were required. The Town of Derry has agreed to work towards the reduction of the amount of chlorides applied during snow and ice removal operations while maintaining the Town's roadway system in accordance with the Town's Winter Maintenance and Snow and Ice Control Policy.

Since development of the TMDL and prior to development of Derry's Salt Reduction Plan, the Town had already started taking chloride reduction measures including construction of a new salt/sand storage facility and loading procedures, calibration of spreaders, preparation of draft outreach brochure targeted at the private/commercial sectors, and periodic conductivity monitoring of select tributaries to Beaver Brook.

To address the Beaver Brook Chlorides TMDL the Town of Derry developed a Salt Reduction Plan (SRP) in August 2011 (with subsequent updates through 2018) that was incorporated in the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES 2011a). The Derry SRP identified a number of BMPs and implementation goals for reducing salt loads.

In the SRP, the Town committed to providing winter maintenance to ensure the designated level of service to roadways, parking lots and sidewalks is maintained according to applicable state and local legislation while striving to minimize adverse impacts to the environment. These commitments are to be met by:

- Adhering to the procedures contained within the Salt Reduction Plan;
- Committing to ongoing winter maintenance staff training and education;
- Reporting fiscal year salt use data to the NH DES
- Re-evaluating the effectiveness of the Salt Reduction Plan as needed to incorporate new cost-effective technologies or changes in procedures.

The SRP is meant to be dynamic to allow the Town to evaluate and phase-in any changes, new approaches and technologies in winter maintenance activities in a fiscally sound manner.

As of July 2019, the following have been completed:

- Since 2007, the Town of Derry has been actively involved in the Salt Reduction Workgroup meetings, having hosted most of these meetings at the Derry Municipal Center.
- From 2011 through 2017, the Town has hosted, with no charge to the State or UNH-T2, at least 18 training workshops on salt reduction. Several of these workshop/training events were prior to formal adoption of the Green SnowPro Certification program with the remaining training workshops being held as formal Green SnowPro Certification Training for snow removal contractors.
- The Town of Derry was a strong advocate for the Salt Applicator Bill and obtained one of the sponsors of the bill. The Town also hosted public meetings with NHDES and NH State Representatives and senators to discuss the pending Salt Applicator Bill.
- In 2013, the Town took possession of 3 snow removal trucks equipped with groundspeed control, prewetting brine systems, and bottom scrapers.
- In 2014, the Town took possession of two additional trucks equipped with front and wing plows, stainless steel dump spreaders, groundspeed control, on-spot chains, and a 140-gallon brine tank with pre-wetting system.
- From 2011 through 2015, the Town of Derry Public Works and Cable TV Department produced four (4) cable TV shows on salt reduction. The first was a public service announcement titled *Reducing Road Salt Use, Protecting NH Waters* and was a collaboration with the Town of Londonderry, NHDES, and UNH-Technology Transfer Center (UNH-T2). Two additional shows, *DPW & NH Salt Reduction Initiative Winter 2014* and *Blizzard 2015: Keeping Our Roads Clear* focused on Derry's Salt Reduction initiative, best management practices, effects of salt on the environment, the state's Green SnowPro Program and tips for homeowners and business owners on more efficient deicing practices. The fourth show produced in 2015 by the Town of Derry, *Improving our Environment: Green SnowPro Program* featured NHDES Salt Reduction Coordinator and UNH Technology Transfer Center.
- Since implementation of the chloride TMDL, the Town installed 5600 linear feet of pervious pavement sidewalk in a commercial area within the watershed. In addition, pervious pavement on private commercial developments was also approved and subsequently installed at a bank and medical office park.

- The Town of Derry already constructed a salt shed for properly storing salt under cover and adopted BMPs at the salt storage facility.
- All Derry Municipal operators are required to be trained in the Green SnowPro Program offered by UNH-T2.
- Spreader calibration is performed each year prior to the start of the winter season.
- In 2014, Derry's Superintendent of Operations was publicly recognized and given an award by NHDES for "outstanding leadership in addressing salt reduction" and identified as one of the reasons the salt reduction program partners have had success so far by reaching out to private applicators in Derry and surrounding towns, and to legislators, and making substantial improvements in the Town's operations, resulting in significant decreases in salt use.

The Town will continue its outreach to commercial property owners and businesses with 10 or more parking spaces to promote salt reduction and the Green SnowPro Program.

The Town will continue implementing BMPs for chloride reduction and to review salt reduction plans every 5 years. The Town is currently in the process of updating our salt reduction plan to meet requirement of the 2017 NH MS4GP.

Very truly yours,



Michael Fowler, DPW Director

**APPENDIX C: TOWN OF LONDONDERRY, CHLORIDE
REDUCTION PLAN LETTER**



Town of Londonderry
PUBLIC WORKS & ENGINEERING DEPARTMENT
268 B Mammoth Road
Londonderry, NH 03053
Phone: (603) 432-1100 ext. 193, Fax: (603) 432-1128

September 3, 2019

Keith A. Cota, P.E.
Chief Project Manager
NH Department of Transportation
Concord, NH

Re: Town of Londonderry's Chloride Reduction Plan

Dear Keith:

Beaver Brook has been identified as impaired by the New Hampshire Department of Environmental Services (NHDES) and the US Environmental Protection Agency (EPA) for chloride concentrations that exceed state water quality standards. NHDES has completed a Total Maximum Daily Load (TMDL) analysis to quantify pollutant reductions needed to meet the state water quality standards for chlorides.

In order to meet water quality standards, significant reductions of chloride loading were required. The Town of Londonderry has agreed to work towards the reduction of the amount of chlorides applied during snow and ice removal operations while maintaining the town's roadway system in accordance with the Town's Winter Maintenance Snow and Ice Control Policy.

To address the Beaver Brook Chlorides TMDL the Town of Londonderry developed a Salt Reduction plan in 2011 (with subsequent updates in July 2019) that was incorporated into the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a). The Londonderry salt reduction plan identified a number of BMP's and implementation goals for reducing salt loads. As of July 2019 the following steps have been completed:

- Purchase of five dump trucks with underbody discharge spreaders

- New trucks include salt pre-wetting, groundspeed controls, and in-cab air/pavement temperature sensors
- Spreader control units on new trucks allow adaptive road treatment
- Spreader calibration policies were developed and implemented to ensure accurate application rates. Spreader equipment are annually calibrated prior to each season.
- Salt tracking policies were developed and implemented. Salt usage data is recorded after each winter storm event and annually reported to NHDES.
- All Londonderry municipal operators have been trained in the Green Snow Pro Program offered by the University of New Hampshire (UNH) Technology Transfer Center.
- The local weather forecast service was upgraded to aid the road maintenance decision making process.

Since development of the Salt Reduction Plan of 2011 and implementation of BMPs for reducing chlorides, the Town of Londonderry successfully achieved significant reduction of chloride imports to the Beaver Brook watershed by as much as 37% on average from 2011 – 2019.

The Town is committed to continue implementing BMPs for chloride reduction and to review salt reduction plans every 5 years and improve as necessary.

Within the Upper Beaver Brook watershed, MS4 permittees are subject to the requirements of the 2017 NH MS4 permit including the requirements to “reduce chloride discharges to support achievement of WLA included in the applicable approved TMDL.” Therefore, any future development in the Upper Beaver Brook watershed would be subject to the MS4 requirement. This will require implementing salt reducing BMPs to assure that the Beaver Brook chloride TMDL can be achieved.

The Town of Londonderry is currently going through the Public Hearing process of adopting zoning and stormwater regulations that addresses future developments implementation of BMP strategies under the local town approvals. Proposed Stormwater Zoning requires that winter maintenance operators for all private parking lots with 10 or more parking spaced within the chloride impaired watershed which include the Exit 4A project obtain Green Snow Pro certification and to report annually salt usage within the watershed boundaries to UNH Technology Transfer Center.

In 2020, the Town is planning to develop an outreach program (newsletters, factsheets, web base postings, etc.) for encouraging business with 10 or more parking spaces and currently does not flow into the town's MS4 permit area that is impaired for chlorides to obtain Green Snow Pro Certification and also to adopt site plan regulations that require Green Snow Pro Certifications.

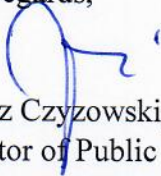
The Town of Londonderry already constructed two salt sheds for properly storing salt under cover and adopted BMPs at the salt storage facilities.

Using trucks with a salt pre-wetting spreader has already produced a substantial reduction in salt usage, however the town will still examine the possible implementation of pre-treating or anti-icing within the watershed of impaired waters. Snow fencing will be installed in locations as the need arises.

Installation of automatic vehicle location systems (AVL) is still under consideration. The additional reduction of driving speed limits on local municipal roads is not necessarily needed since the drivers are already driving at a reduced speed due to winter conditions.

The Town is also periodically reviewing its formal Winter Maintenance Snow and Ice Control Policy for implementation of BMPs for chloride reduction. The town also reviews level of service (LOS) pre and post each winter storm event.

Best regards,



Janusz Czyzowski, P.E.
Director of Public Works & Engineering
Town of Londonderry, NH

**APPENDIX D: WOODMONT COMMONS PHASE I CHLORIDE
MANAGEMENT PLAN**



The State of New Hampshire
Department of Environmental Services

Clark B. Freise, Assistant Commissioner



February 15, 2017

Pillsbury Realty Development, LLC
Attn: Ari Pollack
214 North Main Street
Concord, New Hampshire 03301

RE: Woodmont Commons, Planned Unit Development
Garden Lane and Pillsbury Road
Tax Map 10, Block 41, 52, 54-1, Londonderry, NH

Permit: AoT-1213

Dear Applicant:

Based upon the plans and application, approved on February 15, 2017, we are hereby issuing RSA 485-A:17 Alteration of Terrain Permit AoT-1213. As part of the processing of this application, DES grants approval to waiving specific requirements of Rule Env-Wq 1507.04, *Groundwater Recharge Requirements*, finding that generally elevated groundwater elevations at the site preclude reasonable opportunities to recharge groundwater, and finding that some recharge will be achieved at proposed filtration basins. It was further determined that granting the waiver would not have an adverse impact on the environment, public health, public safety, or abutting properties, and that granting the request is consistent with the intent and purpose of the rule waived. Additional documentation relative to the waiver requested is contained within the file. This permit is subject to the following conditions

1. Activities shall not cause or contribute to any violations of the surface water quality standards established in Administrative Rule Env-Wq 1700.
2. You must submit revised plans for permit amendment prior to any changes in construction details or sequences. You must notify the Department in writing within ten days of a change in ownership.
3. You must notify the Department in writing prior to the start of construction and upon completion of construction. Forms are available at: <http://des.nh.gov/organization/divisions/water/aot/categories/forms.htm>. **If any underground detention systems, infiltration systems, or filtering systems are installed, a letter must be provided, signed by a qualified engineer, stating that the individual observed such system(s) prior to such system(s) being backfilled, and that in his or her professional opinion, such system(s) conform to the approved plans and specifications.**
4. The plans, latest revision dated February 13, 2017, and supporting documentation in the permit file are a part of this approval.
5. **This permit expires on February 15, 2022.** No earth moving activities shall occur on the project after this expiration date unless the permit has been extended by the Department. If requesting an extension, the request must be received by the department **before the permit expires**. The Amendment Request form is available at: <http://des.nh.gov/organization/divisions/water/aot/categories/forms.htm>
6. This permit does not relieve the applicant from the obligation to obtain other local, state or federal permits that may be required (e.g., from US EPA, US Army Corps of Engineers, etc.). **Projects disturbing over 1 acre may require a federal stormwater permit from EPA.** Information regarding this


www.des.nh.gov

29 Hazen Drive • PO Box 95 • Concord, NH 03302-0095
(603) 271-3503 • TDD Access: Relay NH 1-800-735-2964

permitting process can be obtained at:
<http://des.nh.gov/organization/divisions/water/stormwater/construction.htm>.

7. **All stormwater practices shall be inspected and maintained in accordance with Env-Wq 1507.08 and the project Inspection and Maintenance (I&M) Manual.** All record keeping required by the I&M Manual shall be maintained by the identified responsible party, and be made available to the department upon request.
8. Winter snow and ice management activities shall be in accordance with the Chloride Management Plan, Woodmont Commons – Planned Unit Development, Londonderry, New Hampshire, received by the Department on October 18, 2016.
9. If applicable, no activity shall occur in wetland areas until a Wetlands Permit is obtained from the Department. Issuance of this permit does not obligate the Department to approve a Wetlands Permit for this project.

Sincerely,



Ridgely Mauck, P.E.
Alteration of Terrain Bureau

cc: Londonderry Planning Board

ec: TFMoran, Inc.

WOODMONT COMMONS – PLANNED UNIT DEVELOPMENT LONDONDERRY, NEW HAMPSHIRE

Chloride Management Plan

Winter Operational Guidelines

The following Chloride Management Plan is for the Woodmont Commons Planned Unit Development in Londonderry, New Hampshire. The Plan includes road salt source reduction methodologies in the categories of: road salt equipment specifications, certification requirements, stormwater management efforts, public awareness efforts, and road salt usage and monitoring requirements. Due to the evolving nature of chloride management efforts, the Chlorides Management Plan will be periodically reviewed to reflect the current management standards.

1.0 Background Information

The Woodmont Commons live-work-play development is mostly located within the Beaver Brook Watershed in Londonderry and Derry, New Hampshire. In 2006, the New Hampshire Department of Environmental Services (NHDES) and the US Environmental Protection Agency (EPA) designated the Beaver Brook Watershed, and three additional watersheds along the I-93 corridor, as impaired watersheds due to locational chloride concentrations that exceed the Total Maximum Daily Load (TMDL) in portions of each watershed. Further studies within these watersheds identified the sources of chloride loading as winter operational use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance. These studies further attributed the primary sources of chloride loading to three major user groups. Within the I-93 corridor, approximately 10-15% of the overall chloride load was attributed to winter operational activities on State roads. Public and private sector user groups, the additional two groups identified, equally accounted for the remaining portion of the chloride load.

In an attempt to reduce chloride loading derived from the use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance within the Beaver Brook Watershed, the Towns of Londonderry, Auburn, Chester, and Derry, in conjunction with the New Hampshire Department of Transportation, have developed salt reduction plans for each of the four towns within the Beaver Brook Watershed. According to the Salt Reduction Plan for the Town of Londonderry, and the additional supporting documents used to develop the plan, source reduction is identified as the most effective method for reducing chloride loading in the Beaver Brook Watershed. The primary source reduction methodologies outlined in the Salt Reduction Plan focus on increased education opportunities for municipal employees and private contractors involved with winter operational activities, more accurately calibrated application methods, enhanced forecasting, improved surface monitoring technologies, and public outreach efforts that include measures to ensure that the private sector entities located within the Beaver Brook Watershed continually adhere to the current standards.

Included in the Salt Reduction Plan for the Town of Londonderry is the NHDES Watershed Management Bureau, 2010 Draft TMDL Implementation Plan Considerations document. In this document is a table for how the TMDL allocations are broken down in each of the four impaired watersheds. For the Beaver Brook Watershed, the ten year rolling average TMDL of 5,863.4 tons/year is distributed between NHDOT I-93, NHDOT other roads, Londonderry Municipal, Derry Municipal, Chester & Auburn, Londonderry Private, Derry Private, Londonderry Future, and Derry Future. The Plan further identifies that within the Beaver Brook Watershed the Town's objective is to reduce chloride imports by 5% annually to achieve the ten year rolling average TMDL allocation.

In keeping with these expectations, the Town of Londonderry worked closely with the Woodmont Commons Management Team to ensure that the Master Plan reflected the objectives outlined in the Salt Reduction Plan for the Town of Londonderry.

2.0 Operational Guidelines – Chloride Management

All Woodmont Commons Team Managers are responsible for assisting in meeting compliance for the following protocols. It is important to note that portions of the Woodmont Commons Property is NOT located in the portion of the Beaver Brook Watershed that is impaired, runoff water leaving the property does pass through the impaired portion of the watershed. Woodmont Commons Team Managers are expected to minimize the effects of the use of de-icing, anti-icing and pretreatment materials by adhering to the strict guidelines outlined below.

The Woodmont Commons winter operational de-icing, anti-icing and pretreatment materials will adhere to the following protocols:

2.1 Private Maintenance Contracting Equipment Requirements and Training

Woodmont Commons serves as a model for private sector participation by committing to contract with snow removal maintenance providers who have been trained and are knowledgeable of the Best Management Practices (BMPs) for snow removal under reduced salt applications. Each Woodmont Commons Team Manager is responsible to know and be up to date on the current standards for snow removal under reduced salt applications. These practices are published and updated by the UNH Technology Transfer (T2) program.

All Woodmont Commons Team Managers directly involved with winter operational activities, and all private contractors engaged at the Woodmont Commons premises for the purposes of winter operational snow removal and surface maintenance, must be current UNHT2 Green SnowPro Certified operators or equivalent, and will use only pre-approved methods for spreading abrasives on private roadways and parking lots. When a salt aggregate or brining solution is applied for the purposes of snow removal or surface maintenance, it will adhere to the current BMP standard, including pre-treatment and ground speed-controlled spreaders as outlined in the NHDES August 2011 Salt Reduction Implementation Plan for the Beaver Brook Watershed.

2.1.1 Minimum Specification Requirements for De-icing, Anti-icing and Pretreatment Equipment

All private contractors engaged at the Woodmont Commons premises for the purposes of winter operational snow removal and surface maintenance, must be current UNHT2 Green SnowPro Certified operators or equivalent. All equipment utilized on the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will conform to the following specifications.

2.1.1.1 Material Spreader Control Unit

All equipment utilized for the application of road salt aggregate shall be equipped with a spreader control unit with the ability to calibrate and accurately dispense aggregate materials at a uniform density and frequency based on the forward rate of the vehicle or equivalent spreader carrier unit. At a minimum, acceptable spreader control units will include the capacity to control salt aggregates, pre-wetting equipment, ground speed orientation, and air/ground surface temperature data. The unit will also allow Woodmont Commons Operational Management password access to confirm and set calibration limits which will automatically adjust to the vehicle/carrier speed and ground surface temperature.

2.1.1.2 Brining Equipment Control Unit

All equipment utilized for the application of brining and pre-wetting solution shall be equipped

with a spreader control unit with the ability to calibrate and accurately dispense brining and pre-wetting solution at a uniform density and frequency based on the forward rate of the vehicle or equivalent carrier unit. At a minimum, acceptable spreader control units will include the capacity to directly interface with salt aggregate equipment, pre-wetting equipment, ground speed orientation, and air/ground surface temperature data. The unit will also allow Woodmont Commons Operational Management password access to confirm and set calibration limits which will automatically adjust to the vehicle/carrier speed and ground surface temperature.

2.1.1.3 Air/Ground Surface Temperature Monitors

All vehicle/carriers utilized for the application of road salt aggregate or brining and pre-wetting solution shall be equipped with an annually calibrated and operational air/ground surface temperature monitor capable of providing in-cab operator displays and automatic interface with a compatible spreader control unit. At a minimum, acceptable air/ground surface temperature monitor units will include the capacity to interface with spreader control units and be compatible with salt aggregate equipment, pre-wetting equipment, and air/ground speed orientation data. The unit will also allow Woodmont Commons Operational Management access to confirm and/or calibrate limits to ensure accurate interface with the vehicle/carrier speed and ground surface temperature function.

2.1.1.4 Electronically Controlled Hydraulic Valve Unit

All equipment utilized for the application of road salt aggregate or brining and pre-wetting solution shall be equipped with an electronically controlled hydraulic valve unit capable of providing in-cab operator displays and automatic interface with a functional spreader control unit. At a minimum, an acceptable electronically controlled hydraulic valve unit will include the capacity to interface with a vehicle/carrier spreader control unit that automatically adjusts salt aggregates, pre-wetting equipment, ground speed orientation, and ground surface temperature data. The unit will also allow Woodmont Commons Operational Management access to confirm and/or calibrate limits to ensure accurate interface with the vehicle/carrier spreader control interface.

2.1.2 Equipment Calibration Requirements

All equipment utilized on the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will conform to the following calibration requirements.

2.1.2.1 Annual Calibration Requirements

All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of the annual calibration report for each piece of equipment utilized on the Woodmont Commons premises. Each calibration report shall include the vehicle/carrier VIN number and the serial numbers for each component including, but not limited to, spreader control units, salt aggregate spreader equipment, brining/pre-wetting equipment, ground speed orientation unit, and air/ground surface temperature monitor. Annual calibration reports will be available on file in the Woodmont Commons Property Management Building and be present in the vehicle/carrier at all times. Prior to each use, each vehicle/carrier operator will perform a systems check to verify that unit settings remain within the guidelines established by the Woodmont Commons Management Team in order to accurately dispense material. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will be subject to spot inspections by members of the Woodmont Commons Management Team to ensure that each vehicle/carrier is operating in a manner consistent with the guidelines set herein or State and Municipal regulations. All units will be recalibrated and the updated calibration reports will be provided each time repairs or maintenance procedures affect the hydraulic system

of the vehicle/carrier.

2.1.3 Winter Operator Certification Requirements

All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance must be current UNHT2 Green SnowPro Certified operators or equivalent, and will use only pre-approved methods for spreading abrasives on private roadways and parking lots. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide to Woodmont Commons management two copies of the annual UNHT2 Green SnowPro certificate or equivalent for each operator utilized on the Woodmont Commons premises. The annual UNHT2 Green SnowPro certificate or equivalent for each operator will be available on file in the Woodmont Commons Property Management Building and be present in the vehicle/carrier at all times.

2.2 Improved Weather Monitoring

Woodmont Commons will coordinate weather information for use by winter maintenance contractors. This information in conjunction with site specific air/ground surface temperature monitoring will ensure that private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will make more informed decisions as to when and to what extent de-icing, anti-icing and pretreatment materials are applied to private roadways, sidewalks, and parking lots.

2.3 Increased Mechanical Removal Capabilities

Woodmont Commons will endeavor to use mechanical removal means on a more frequent basis for roadways, parking lots and sidewalks. Dedicating more manpower and equipment to increase snow removal frequencies prevents the buildup of snow and the corresponding need for de-icing, anti-icing and pretreatment materials. Shortened maintenance routes, with shorter service intervals, will be used to stay ahead of snowfall. Minimized snow and ice packing will reduce the need for abrasives, salt aggregates, and/or brining solution to restore surfaces back to bare surface states after winter precipitation events.

After storm events the Woodmont Commons management team will be responsible for having the streets swept to recapture unmelting de-icing materials, when practical.

2.4 Public Awareness Campaign

Woodmont Commons will inform all future developers, grantees, and tenants at the Woodmont Commons development of the need to reduce the use of de-icing, anti-icing and pretreatment materials on roadways, parking lots, and sidewalks.

2.5 Summary

The above-described methodologies are incorporated into the Woodmont Commons Operational Manual and are to be used to qualify and retain all private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance. This section of the Manual, as with the Town of Londonderry's Salt Reduction Plan, is intended to be an adaptive management document that is modified as required based on experience gained from past practices and technological advancements that reflect chloride BMP standards. Each member of the Woodmont Commons Management Team is required to review this document and the current standard Best Management Practices published by the UNH Technology Transfer (T2) program annually. Each member of the Woodmont Commons Management Team directly involved with winter operational guidelines is required to be certified as a UNHT2 Green SnowPro or equivalent and undergo the necessary requirements to maintain this certification annually.

3.0 Stormwater Management

Wherever applicable, stormwater in locations subject to winter operational de-icing, anti-icing and pretreatment materials will be directed to the Woodmont Commons Tiered Stormwater Management System. The Woodmont Commons Stormwater Management System is designed using a comprehensive stormwater management philosophy designed to retain and treat stormwater based on land use. Stormwater volumes and pollutant signatures vary based on land use. By identifying the potential stormwater characteristics based on the land use, stormwater management efforts may be designed to remediate stormwater pollutants at the source level prior to conveying the stormwater down gradient for additional treatment.

3.1 Woodmont Commons Tiered Stormwater Management System Overview

The Tiered Stormwater Management Plan for the Woodmont Commons Planned Unit Development (PUD) is a multifaceted proposal composed of stormwater systems at the **Site Level** and **Area Level**. These stormwater land-use goals can layer with additional land-use goals such as landscaping requirements, greenspace, greenway, active recreational, and passive open space components as defined in sections 2.4.6 PUD Site Plan Landscape Requirements and 2.3.6 Conserved Green Space and Shared Open Space Standards of the Woodmont Commons PUD Master Plan accepted by the Town of Londonderry on September 11, 2013.

Site Level stormwater management systems will focus on removal of total suspended solids (TSS), and if/where soil conditions are suitable, bio-remediation will be implemented to capture excess nutrient loads and other contaminants typically found in residential stormwater runoff.

Area Level systems will be spaced and sized to receive the stormwater from the Site Level systems, while extending the treatment processes and residence period of the stormwater treatment.

The **Area Level** systems will detain and release the treated stormwater outside of the PUD area consistent with the rates of discharge prior to the project. The **Area Level** systems will provide additional filtration and macro nutrient removal as the base rate of flow is slowed. The plants and microbial species selected will promote long-term nutrients entrainment and incorporate elements of vegetation to maintain optimum wildlife values, and bacterial and mycoremediation rates.

Much of the stormwater from the PUD on the west side of I-93 will discharge to Duck Pond in the southwest corner of the Woodmont Commons' property. The Duck Pond impoundment will be enhanced consistent with the Master Plan to promote recreational opportunities for the surrounding communities in a successional trajectory that is best suited to sustain the resource into the future.

4.0 Salt Usage Evaluation and Monitoring

The Woodmont Commons Management Team is committed to an ongoing Chloride Management Plan to aid the Town of Londonderry in its efforts towards reducing chloride imports into the Beaver Brook Watershed. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of the standardized Storm Report, which includes detailed information regarding treatment areas and the use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance on the Woodmont Commons premises. Each spring, Woodmont Commons will submit a Summary Document, including copies of the Storm Reports, operator certifications, equipment used for roadway and sidewalk winter maintenance, calibration reports and amount of de-icing materials used, to the Town of Londonderry Department of Public Works for their use in documenting the chloride usage in the Beaver Brook Watershed.

5.0 Chloride Management Plan Summary

The Woodmont Commons Management Team is committed to maintaining written documentation and adaptive management solutions for the Town of Londonderry to supplement in its efforts towards reducing chloride imports into the Beaver Brook Watershed. These efforts include minimizing chloride imports into unimpacted portions of the watershed by the implementation and enforcement of the BMP standards outlined above in section 2.0 Operational Guidelines – Chloride Management; implementation and maintenance of the efforts outlined above in section 3.0 Stormwater Management; and the adherence and adaptive management efforts outlined above in section 4.0 Salt Usage Evaluation and Monitoring.