Salt Management Plan

Department of Public Works

The following plan has been developed to identify the actions required to effectively manage road salt for winter maintenance activities consistent with guidance provided under the Maryland Statewide Salt Management Plan.

12/1/2014

1.0 INTRODUCTION

1.1 Overview

The Maryland State Legislature passed two bills in 2010, House Bill 0903 and Senate Bill 0775 that required the establishment of a Statewide Salt Management Plan. The legislature tasked the Maryland State Highway Administration (SHA) in conjunction with the Maryland Department of the Environment (MDE) with developing a road salt management best practices guidance document by October 1, 2011, for use by local jurisdictions and the state to minimize the adverse environmental impacts of road salt runoff in the state. These Best Practices for Salt Management cover the use of salt from its delivery, storage and handling at salt storage locations to its placement on highways during winter storms and to post storm cleanup operations. The following Best Practices should be seen as a starting point in an agency's plan to minimize the impact of salt on the environment in Maryland.

The objective and goal of the Statewide Salt Management Plan is to provide a framework for highway agencies to deliver safe, efficient roadway systems during winter storms in a cost effective manner while recognizing their obligation to do so in the most environmentally sensitive manner practicable.

To be effective, a Salt Management Plan should contain principles that define the basic goals of a jurisdiction in delivering service to the public while meeting agency missions. These include:

Public Safety
Effective winter storm maintenance has a direct impact on safety of the roadway users and on the personnel performing the maintenance. In the development of this plan, safety will be the primary goal.

Environmental Protection
Since the use of salt in high concentrations can have a negative impact to the roadside environment and to receiving waters of Maryland, the development of Best Management Practices contained in this plan will consider practices that minimize the use of road salt, thereby reducing the environmental impacts.

Efficient Transportation System
Efficient transportation systems are necessary in maintaining the mobility necessary for economic stability and in providing the quality of life expected by a jurisdiction's constituency. Salt Management Plan development should factor in these requirements.

Fiscal Responsibility
State, county and local jurisdictions are bound by budgets determined by their governing bodies. The Salt Management Plan for these jurisdictions must be within their financial capabilities.

Continual Improvement

In order to progress in the reduction of salt usage and the resultant environmental impacts, goals, technologies, practices, materials and equipment need to be revisited on a re-occurring basis to determine if changes can affect salt usage or can bring about reduced environmental impacts. Since these changes may have a fiscal impact on agency budgets, there must be recognition that the changes may be incremental.

Local Development of Salt Management Plans

Because of the variances in state, county and local transportation agency resources and mission objectives, Salt Management Plans should be locally developed. The plans should define the key elements of an environmental management program. Commitment to the plan should include accountability, goals, measurement of progress, communication, reporting, and its periodic review. This will assure that the local Salt Management Plan is a living document that provides for continual improvement.

1.2 Purpose of this Document

This purpose of this document is to set out a policy and procedural framework for enabling the Department of Public Works to continuously improve on the management of road salt used in winter maintenance operations consistent with the best practices for salt management outlined in the Statewide Salt management Plan. This local plan is meant to be dynamic to allow the Department to evaluate and phase in any changes, new approaches and technologies in winter maintenance activities in a fiscally sound manner. At the same time, any modifications to the Department's winter maintenance activities must ensure that roadway safety is not compromised.

1.3 Responsibilities

Everyone within the Department of Public Works and supporting agencies connected to winter road maintenance has some responsibility for developing, implementing and reviewing the success of the Salt Management Plan. It is through a cooperative effort that the Department of Public Works will reduce the environmental effects of its road salt while maintaining safe roads.

2.0 SALT MANAGEMENT FRAMEWORK

2.1 Vision, Mission, Mandate

Vision: Anne Arundel County will be recognized as a leader in improving winter maintenance operations while reducing environmental impacts and ensuring public safety.

Mission: The Department's operations staff will optimize the use of deicers on all County roads while striving to minimize salt impacts to the environment.

Mandate: The Department's operations staff will provide safe winter conditions for vehicular and pedestrian movements as required by the level of service policies and funding established by the Administration and Council.

2.2 Policy Statement

The County will provide efficient and effective winter maintenance to ensure the safety of users of the road network in keeping with applicable best practices and accepted standards while striving to minimize adverse impacts to the environment. These commitments will be met by:

- adhering to the procedures contained within the Salt Management Plan;
- monitoring, reviewing and updating the Salt Management Plan on an annual basis to incorporate new technologies and/or new developments and to ensure the effectiveness of the Plan; and
- committing to ongoing winter maintenance staff training and education.

2.3 Application

The Salt Management Plan is to be endorsed by the Director of Public Works and will apply to all County employees and contractors who are involved in winter maintenance operations.

2.4 Key Plan Tenants

According to the Statewide Salt Management Plan, the following Best Practices should be seen as a starting point in implementing a plan to minimize the impact of salt on the environment in Maryland. They include:

- Safety and Mobility
- Establishment of Goals
- Winter Materials
- Material Storage and Handling
- Winter Equipment
- Winter Operations Training
- Winter Storm Management

- Post-Storm Operations
- Data Analysis and OFI's
- Public Education and Outreach
- Testing of New Technologies, Equipment, & Strategies

2.5 Safety and Mobility

The State Highway Administration (SHA) acknowledges that highway agencies are keenly aware of their goal to provide safety and mobility during winter storms in a cost-effective manner while minimizing environmental impacts to the maximum extent practicable. However, the reality of winter storms makes achieving safety and mobility in a cost-effective and environmentally favorable manner difficult to achieve, with both outcomes at times in conflict with each other. The principal driving force that often decides the hierarchy in this potential conflict is the defined level of service (LOS) an agency provides its citizens.

2.6 Establishing Goals for Achieving Reduction in the Environmental Impact of Salt

The Statewide Salt Management Plan (SMP) starts with the premise that winter materials can have a negative impact on the environment. The SMP aims to manage and lessen the impact:

- Measurement of salt usage is desirable
- Annual % goals in salt reduction are not always realistic; analyze trends
- Long term goal of reduction is both desirable and responsible

2.7 Equipment and Materials

Winter operations require specific equipment and materials to obtain the desired LOS. The equipment and materials require activities to properly store, handle and maintain.

- **Salt** is the primary snow and ice control material used because it is effective, inexpensive, easily stored, and readily available. While it will continue to be the most important material for fighting winter storms for the foreseeable future, agencies should look for ways to minimize its use.
- **Liquid Salt Brine (23%)** is used by SHA and other agencies primarily in anti-icing operations (direct liquid application) prior to storms to prevent snow and ice from bonding to pavements, is easily manufactured, and whereas salt begins to lose its effectiveness at 20 degrees, brine, which has a freeze point of -6 degrees, continues to work when salt cannot.
- **Liquid Magnesium Chloride** has a freeze point of -23 degrees and can work in winter storms with very cold pavement temperatures, is used to pre-wet salt, but is not typically used for direct liquid application as it can make highway surfaces slippery, under certain atmospheric conditions, during the hours leading up to the start of the storm.
- **Liquid Calcium Chloride** has a freeze point of -62 degrees, is used during extremely cold winter storms and is usually used to pre-wet salt.

- **Abrasives** (sand or crushed stone) are sometimes used in winter operations although these materials have no snow melting characteristics. Abrasives can clog drainage structures, contribute to air pollution and be discharged to receiving waters. Anne Arundel County has discontinued the use of abrasives.
- **Salt structures** should be well maintained. Properly maintained structures along with good housekeeping allow agencies to safely keep salt in its structures, and avoid environmental impacts.
- **Good housekeeping limits environmental impact** and there are a variety of methods to prevent salt from spilling out of structures, such as straw bales, aggregates, or wooden gates at the structures' doorways. Agencies should collect salt spilled in the vicinity of salt structures during loading and unloading operations and the material should be returned to the salt structure as soon as possible. Salt should be stored on impervious surfaces, such as asphalt pads, to prevent groundwater contamination. If material is not stored in fixed structures, it should be covered with a secured tarp.
- **Salt Spill Prevention** When loading salt at storage locations, trucks should never be overloaded. If they are, salt can spill from the sides or back of the truck when it's leaving the facility or when it's on route. Overloading trucks with salt is avoidable and a clear violation of best practices for salt management. If spillage occurs, it should be addressed during a storm if time allows or at the close of the event. Another best practice is the deployment of tailgate flaps that prevent salt from spilling out of the back of dump trucks. These small triangular pieces of metal can be made in house for a few dollars but can save tons of salt over the course of a winter season. The SHA, for example, requires tailgate flaps on all state and hired trucks. There are times when salt can spill from a truck that was not overloaded. If the auger in a truck's salt spreader box becomes jammed with a large chunk of salt or debris, the operator may have to manually clear the box. At times the jam is cleared but salt falls to the pavement. At other times, a truck operator may have to raise the dump truck bed to move material to the rear of the truck. This occurs when the salt in the bed of the dump truck begins to get low. During this operation material can spill from the rear of the truck. Whenever salt spills from a truck, either from being overfilled or not, it should be swept up and placed back in the bed of the dump truck. Operators must do this in a safe fashion so as not to endanger themselves or motorists. Effective salt management does not equate with unsafe practices.
- **Spill Prevention, Control and Countermeasure** Plans (SPCCP) or Storm Water Pollution Prevention Plans (SWPPP) should include standard operating procedures for capturing salt spilled on pavements during the loading or unloading of the material and agencies should make every effort to prevent the uncontrolled release of winter materials into

the environment. Plans should consider the site topography, drainage patterns and the locations of all materials with risk of spillage.

- **Liquid Storage** for liquid deicing materials, such as salt brine or magnesium chloride, should be stored in well- maintained and labeled storage tanks. To minimize the possibility of leakage and spills from liquid storage tanks, a weekly inspection program should be implemented. Whenever drips/leaks are found, maintenance and/or repairs should be made as quickly as possible. Until such time as the repair can be completed, the leak should be contained.
- **Equipment** should meet the needs of the individual agency and the agency should purchase and employ the most effective snow fighting equipment they can buy within the confines of their budgets.
- **Dump trucks** should be equipped with well-maintained front plows that can mechanically remove as much snow as possible from highways. When appropriate, agencies should use side or "wing" plows to increase the amount of snow that can be mechanically removed from highways. Effective mechanical removal of snow equates to less salt needed to maintain a road in a safe or passable condition. Dump trucks should also be equipped with well-maintained salt spreaders and spinners that are capable of applying the required amount of salt on roads in an effective pattern that limits material waste.
- **Electronic salt spreading equipment** should be purchased and employed, whenever possible. This equipment can be used to lock-in specific application rates that will prevent operators from using more salt than an agency recommends. It can also provide very exact application rates. Finally, it can be used in salt data collection after winter storms.
- **Calibration** is necessary on all salt spreading equipment, regardless of its type, prior to the start of a winter season. This is a critical aspect of effective salt management.
- **Specialty Equipment** should be used for removal of snow from highways, when appropriate. Effective use of these specialized pieces of equipment lessens the need for salt to return a highway to a serviceable condition.
- **Hired Equipment Contract for Snow Removal Services allows a**gencies to use hired equipment to supplement its own forces if needed to maintain its prescribed level of service. Hired equipment should be equipped with well-maintained plows and spreaders to assure effective and efficient snow removal operations in general and salting operations in particular. Poorly equipped hired equipment can lead to excessive salt use. The spreader systems on contracted dump trucks should be calibrated prior to winter. It is critical that contract trucks are calibrated, and its operators are closely monitored by agency personnel to avoid improper salting.

2.8 Training Initiatives

Training is a critical component of salt management and a best practice in winter operations in general.

- **Snow College** or similar training initiative is recommended as agencies should provide training in salt management to its maintenance managers and frontline forces on a regular basis. The focus of the training should be in best practices that stress using the least amount of material without jeopardizing levels of service and safety for motorists. SHA provides a benchmark by requiring for all new maintenance personnel and 20% of its veterans to participate annually.
- **Specialized targeted training** should target specific audiences. Shop or garage managers and frontline supervisors should receive additional training in the science of snow removal operations, effective winter storm management, winter materials inventory management, the properties of salt and other winter materials, and data collection and analysis.
- **Hired equipment operator training** Special training should also be provided to hired equipment operators and temporary employees that supplement an agency's operation. This training should concentrate on the need to adhere to an agency's snow and ice control policies and procedures. A major focus of this training should be on the proper use of salt and other winter materials. SHA, for example, provides hired equipment operator training prior to bringing the contractors on board. Agencies should train hired equipment operators in all facets of plowing and salting operations, much as it does its own forces. Poorly trained hired equipment operators can use excessive amounts of salt. SHA, for example, trains its hired equipment operators using a PowerPoint presentation prior to winter. Agencies must train its frontline supervisors in the effective management of hired equipment. This assures that hired equipment operators are following an agency's policies and procedures, particularly in salt usage. SHA, for example, follows this approach and trains its frontline supervisors prior to winter.

2.9 Winter Storm Management

Winter storm management involves effective planning, execution, and review.

- **Weather and pavement condition forecast** quality is a key component of effective winter storm management. This is true 24 to 72 hours prior to a storm when planning is taking shape, during a storm as forces react to changing conditions and during post-storm operations when effective cleanup actions prevent potential safety issues. The NWS provides a strategic forecast, alerting agencies of the potential for storms well in advance of their arrival. Contracted weather and pavement condition forecasters provide the generalized forecasting provided by NWS and enhance it with localized, site specific, information. A Road Weather Information System (RWIS) network is a series of strategically located local "weather stations" that provide localized data such as type and intensity of precipitation, air temperature, wind direction and speed, dew point, and relative humidity; and pavement sensors that detect pavement temperature,

surface freeze point, and salinity concentration. The SHA, for example, relies on these three sources of information at each stage of its winter storm management.

- **Pre-storm planning** is an effective tool for managing salt usage in a storm and a best practice in winter operations. Agencies should consider pre-storm meetings with its shop or garage personnel as an opportunity to alert personnel about the latest weather and road forecasts, emphasize the need for effective plowing, reiterate the need for sensible salting, identify appropriate salt application rates, and recommend the use for additives such as salt brine or magnesium chloride.
- **Anti-icing operations** are a proven, proactive, nationwide winter strategy that should be practiced by agencies in Maryland whenever appropriate for a storm. The primary goal of anti-icing is to prevent snow and ice from bonding to a highway or bridge surface, allowing for more effective and efficient plowing and salting operations during the event. This will often lead to lower overall salt usage during storms and perhaps more importantly, increase the safety of motorists at the start of a storm.
- **Winter storm operations** begin once precipitation starts to accumulate on highway surfaces, agencies begin deicing operations with salt applications adjusted to the severity of the storm. This initial application should be pre-wetted with a liquid deicing material such as salt brine or magnesium chloride. Pre-wetted salt tends to adhere to the pavement surface, reducing the amount of salt that bounces off the highway onto shoulders or roadsides. The pre-wetted salt also begins working more quickly. The key is to get some material on the road as early as possible to prevent snow or ice from bonding to the highway surface. This will allow for effective plowing and lighter salt applications throughout the remainder of a storm. As the initial application of salt begins to lose its effectiveness and snow continues to build on highways, forces should go into plowing operations. If the initial application was successful, the buildup will be "mealy" and easy to remove with proper plowing techniques. The plow operator should apply just enough salt to keep subsequent snowfall from bonding to the pavement. This process may have to be repeated multiple times during a winter storm. If a winter storm is associated with very cold pavement temperatures, salt should always be pre- wetted with a liquid deicer to increase its effectiveness. By increasing the effectiveness of salt, less is needed. On multilane highways, plow trains should be considered in order to remove as much snow as possible in a coordinated sweep. If a plow train is effective and the surface is swept clean, minimal salt is needed to keep the highway in an acceptable condition until the train comes through again. Every effort must be made by the train to direct the applications of salt into areas where plowing has already occurred. Otherwise, trailing trucks could plow off salt just placed on the road by the lead trucks. Agencies should train their forces in effective plow train operations, a key element in salt management. Agencies should consider varying the LOS it provides motorists during storms based on type/intensity of storm, location, and time of day. For example, if a storm occurs during the overnight hours, some snow can build up on highways as long as it is not allowed to become snow packed, the highway remains passable, and is in a reasonably safe condition. In this case, an agency can use less salt than it would otherwise. Conversely, if the same amount of snow falls on the same highway prior to or

during periods of heavy traffic, more salting will be necessary to keep the road at a higher level of service.

- **Severe winter storms** create unique challenges for a salt management plan. Agencies will be called upon to provide their LOS, while fighting heavy accumulations of snow, freezing rain, or blizzard conditions. When fighting storms with heavy accumulations of snow, agencies should concentrate on plowing operations and severely limit salt applications. Plow trucks should still spread a small amount of salt to help keep the snow from packing on the road but the emphasis should be on continuous plowing.
    - Freezing rain storms also present special challenges to agencies. Freezing rain, if left untreated, will coat highways with ice, creating severe safety and mobility issues for motorists. The SHA has found that the best treatment for freezing rain is salt. The salt will prevent ice from forming on pavement surfaces but will also wash away, requiring additional applications.
    - Winter storms that occur at the start of or during rush hour traffic pose significant challenges to effective salt management. The SHA and other agencies have learned that they must place salt or other winter materials on highways prior to heavy traffic. Once traffic builds up on highways, plow and salt trucks cannot address snow buildup. In addition, snow can be "packed" on the highway surface, requiring very heavy plowing and salting to remedy it. Appropriate salting prior to rush hour is one of an agency's best tools in limiting total salt usage during this type of event.
    - Severe winter events such as blizzards or back-to-back storms create unique challenges to agencies and effective salt management. While normal plowing and salting can keep a highway in a passable condition during a typical winter storm, heavy snowfall requires more intensive plowing operations. The cycle times of plow trains are severely challenged. In these events, agencies should still apply salt, at a reduced rate, during each plow train cycle. This is critical if snowpack or icepack is to be avoided. Salting should keep subsequent snowfall in a plowable state so it can be addressed in the next plowing cycle.
    - The SHA has gained much experience from fighting back-to-back blizzards in February 2010. Agencies do not usually have sufficient equipment and personnel to run plow trains for hours on end. Equipment breakdowns can eventually affect the operation. In addition, it is critical that agencies provide adequate rest for their employees during severe storms. This keeps operators fresh so they can make good choices while plowing and salting. This also keeps repair technicians fresh so they can keep equipment operable. An appropriately rested workforce should translate into effective salt management. Some winter storms are so severe that the Governor might declare a State of Emergency and order all highway users, with the exception of emergency responders, to stay off of highways. When this occurs, highway agencies are allowed the opportunity to clear roads of snow and ice in a more effective manner. This allows highway agencies to return the network to a safe manner more quickly.

- **Stockpiling and disposal of removed snow** might be necessary during blizzards or back to back storms and it is suggested that agencies coordinate with MDE and the Maryland Department of Natural Resources (DNR) to identify storage locations for the snow in less environmentally sensitive areas. These pre-approved locations can be used to store snow, which may contain salt or other materials, until it melts over time
- **Operations in sensitive areas** may occur and agencies should coordinate with MDE to determine criteria for determining areas sensitive to exposure to salt and salt runoff. While MDE and SHA recognize the importance of all waters in Maryland, areas of high susceptibility were determined to be:
    - Wetlands of Special State Concern as defined in COMAR 26.23.06
    - Tier II waters as defined in MDE's TMDL Integrated 303D Reports
    - Wellhead Protection Program as defined in MDE's program as susceptible areas.

  In addition to the areas of high susceptibility, SHA and MDE also agreed that roadside and/or receiving waters exhibiting indicators of salt contamination will be monitored and salt management practices in those areas will be assessed to determine if changes in practices and salt usage should and can be implemented. Site specific plans in environmentally sensitive areas should be developed. A plan for a sensitive area may include reduced salt usage or no salt usage at all. It may also include the use of another snow and ice control material. The potential for reduced levels of service exists for motorists when normal plowing and salting operations are not conducted in sensitive areas. Signage alerting motorists about the reduced levels of service may be required to indicate the need to slow down and remain alert. Agencies should consider developing and testing new strategies in these areas that may lead to improved service without impacting the environment. The SHA, for example, is piloting the Maintenance Decision Support System (MDSS) at several sites in Maryland. The program provides a high resolution weather and pavement forecast for snow routes along with recommended material application rates. The program attempts to find the lowest amount of salt or other winter material application rate while still maintaining an agency's acceptable level of service.
- **Automatic Vehicle Location (AVL)** provides a critical ingredient in effective winter storm management, knowing where snow fighting equipment is at all times. The AVL system is a tool for managers to track progress during winter storms. The AVL system can also be used to determine if a truck is plowing and spreading salt, and if so, determine the material application rate. Data captured through the AVL system can be analyzed after winter storms to identify opportunities to increase the efficiency of winter operations. Finally, and perhaps most importantly, AVL is a tool to increase the safety of the drivers.

2.10 Post Storm Operations

Post Storm Operations include a variety of tasks including cleaning equipment, stockpile maintenance, and operation reviews.

- **Equipment Cleaning and Maintenance** Agencies should develop plans for equipment cleanup and maintenance after winter storms. Cleaning of snow plows and trucks should occur, whenever possible, inside the wash bays of a shop's facility. Cleaning of

salt spreaders and plow blades that have been removed from vehicles prior to cleaning should occur in a manner whereby wastewater does not discharge from the site and is discharged into a BMP. The SHA, for example, has developed site specific Pollution Prevention Plans (SWPPP) for its maintenance facilities. While the SHA shop plans are site specific, they all contain consistent requirements for equipment cleaning and maintenance. The shops are required by MDE's National Pollutant Discharge Elimination System (NPDES) Industrial Permit conditions to develop and implement a site specific Pollution Prevention Plan and a Spill Prevention, Control and Countermeasures Plan. These plans address protocols, inspections, documentation and reporting for the features or practices that have potential negative impacts to the environment. Should a plan not already exist, one should be developed.

- **Material Cleanup at Storage Facilities** should begin **i**mmediately after winter storm operations have ceased, all unused salt should be returned to a storage facility. All exposed abrasives should either be moved to a covered facility or covered securely with a tarp. If salt/abrasive mixing has occurred in an uncovered area, any remaining stockpile should be returned to the salt storage facility. SHA's SWPPP, for example, include requirements for material storage at the maintenance facilities.
- **Operations Review for Continual Improvement** is an essential best practice in winter operations in general and salt management in particular. Agencies in Maryland should consider having post storm reviews at their shop or garage level for most winter storms and agency-wide reviews for major storms. Post storm reviews should concentrate on three key elements: what worked well, what didn't work well, and most importantly, opportunities for improvement. The opportunities for improvement lead to best practices. Post storm reviews can also be used to identify "shop champions" who get their snow route cleared with less salt. The "champions" should be encouraged to share their ideas with others at the shop that use more salt for an equivalent snow route.
- **Post Storm Data Analysis** Agencies should consider capturing salt usage data by truck, snow route, shop or garage, district, and agency-wide. Shops should consider measuring their salt usage in relation to the number of lane miles served, and inches of snow fought. A good formula for measurement is "pounds of salt used per lane mile per inch of snow." In this process, agencies can measure the salt usage performance between trucks on a common route, routes within a single shop or garage, and from shop to shop or garage to garage. Agencies should consider electronic means of collecting salt usage data. Various electronic salt spreader controllers have this capability. At the close of a winter storm, data on salt usage can be downloaded from the spreader and analyzed by shop managers. SHA, for example, uses this approach in some of its shops. Agencies should also consider using AVL technology for salt usage data collection. AVL technology has the capability of identifying salt usage and when each application was made.

2.11 Data Analysis and Operations Review for Continual Improvement (OFI)

- **Recordkeeping and Annual Reports** Agencies should keep up-to-date records of all of its winter operations, especially records of salting. Records should be kept on all aspects of its winter operations at all levels of an agency. Records should be kept for each winter

event, and for each winter season. This will allow for seasonal analysis and the identification of trends. The SHA, for example, maintains up-to-date records on salt usage and other key winter objectives and performance measures and produces quarterly and annual reports for its statewide business plan. The SHA has been keeping extensive electronic records of its winter operations since 1999. The SHA tracks personnel, equipment and material usage at each of its maintenance shops. It also tracks weather and pavement conditions during winter events. The information is summarized in various reports for real time operations status and is post-processed for operations cost estimates.

- **Post Storm Data Analysis** Agencies should perform an in-depth analysis of its operations, with an emphasis on salt usage, at the close of each season. This analysis should culminate in an annual report. The annual report should serve as means for learning lessons, identifying opportunities for improvement, identifying trends, and developing recommendations for operations the following winter. The annual report can also be used by an agency's senior management to determine the need for changes in policies, procedures, processes, and expenditures and to determine any budgetary implications of identified needs.
- **Annual Winter Wrap-Up Meeting** Agencies should hold an annual meeting to review its winter operations, deepening its understanding of lessons that came out of the post storm reviews, and identifying areas of concern such as salt, management, equipment improvements, etc. The annual meeting can be used to identify key opportunities for improvement and set up teams to tackle them over the summer. It is critical that the progress of the teams is tracked closely so that the efforts come to fruition prior to the following winter. The SHA, for example, followed this approach at the close of the 2009 – 2010 winter season and made considerable progress in its subsequent operations.

2.12 Public Education and Outreach

Agencies should make every effort to provide the public with information concerning its winter operations in general and with information concerning its winter storm activities in particular.

- Agencies should consider an annual media briefing to update the radio, television and print media in their area about their winter operations program. Agencies can use this opportunity to review their experiences during the past winter, discuss their plans for the upcoming winter, and highlight new initiatives. This information is then shared, through the media outlets, with the public.
- The SHA's Office of Customer Relations and Information, for example, holds an annual "Snow Show" each fall for its outreach to the media and public. During the briefing, SHA stresses the need for motorists to be mindful of the potential dangers of driving during winter storms. They highlight their "Ice and Snow, Take it Slow" campaign. The SHA also stresses the need for motorists to give snow fighting equipment "space" to do its job. This allows SHA and contracted forces the best opportunity to clear roads of snow and ice in a safe and effective manner.
- Agencies should consider having their emergency operations centers activated for winter storms, and using them for outreach. The SHA's Office of Customer Relations and

Information, for example, provides live interviews with media representatives in a proactive manner. This allows SHA to keep the public, via the media representatives, updated on the current status of its operations and the overall condition of the highway system.

- Agencies should also consider providing customer service for its citizens during and after winter storm events via telephone and internet. An agency's maintenance shop or garage personnel or its emergency operations center can respond directly to citizen needs in a real-time manner on a localized basis. After the storm, the agency can respond to citizens' questions or concerns about its operations in their localized areas. General questions about their operations can be handled through the shop or garage managers or by the agency's office personnel. The SHA, for example, follows this format.

2.13 Testing and Evaluation of New Materials, Equipment, and Strategies for Continual Improvement

Agencies should always be striving to improve their winter operations. One way to improve operations is by trying new ideas that pose minimal risk to operations but have a substantial potential upside. The new ideas can be in the form of different winter materials, tweaking existing equipment, deploying a new spreader plow, or trying out new strategies or tactics for fighting storms. Testing and evaluating new ideas can lead to lower salt usage and is definitely a Best Practice for Salt Management.

- As agencies in Maryland strive to improve their winter operations in general and salt management in particular, they need to expand their search beyond our state's borders. There are many organizations across the country that are performing research on new winter strategies, testing new materials in laboratories, and testing and evaluating new products on highways and bridges. Agencies in Maryland should take advantage of these resources, most of which are free of charge to others in the winter maintenance community. The following links are a good start in this direction:
    - **http://www.clearroads.org/** - The Clear Roads pooled fund project provides real-world testing in the field of winter highway operations. This ongoing research program has already attracted 20 member states and is funding practical, usable winter maintenance research.
    - **http://www.aurora-program.org/** - Aurora is an international partnership of public agencies that work together to perform joint research activities in the area of Road Weather Information Systems (RWIS). This website is designed to introduce the program, the partners, and its collaborative research projects.
    - **http://www.ops.fhwa.dot.gov/weather/index.asp** - The Road Weather Management Program, within the FHWA Office of Operations, seeks to better understand the impacts of weather on roadways, and promote strategies and tools to mitigate those impacts.
    - **http://www.meridian-enviro.com/mdss/pfs/** - The Maintenance Decision Support System Pooled Fund Study leads the nationwide effort to provide research, development, and application of computer based winter maintenance

decision support, including route specific weather and pavement condition forecasting, and suggested responses to the event, based on an agency's rules of practice.

- **http://maintenance.transportation.org/Pages/default.aspx** - The American Association of State Highway and Transportation Officials (AASHTO) advocates transportation-related policies and provides technical services to support states in their efforts to efficiently and safely move people and goods. Its Subcommittee on Maintenance (SCOM) provides technical services to support high level research into preserving and maintaining a world class highway system. Its Winter Maintenance Technical Services Program addresses AASHTO's goals for the snow and ice control community.
- **http://www.wsdot.wa.gov/partners/pns/** - The Pacific Northwest Snowfighters (PNS) Association strives to serve the traveling public by evaluating and establishing specifications for products used in winter maintenance that emphasize safety, environmental preservation, infrastructure protection, cost-effectiveness and performance.

2.14 Summary

Agencies should view these Best Practices for Salt Management as a starting point in their winter operations. Agencies should adopt whatever parts of the plan works for them, as long as it results in effective salt management and the safety of motorists. Agencies should also seek opportunities to work together with various regional, county and local organizations to provide seamless operations during winter storms. The agencies need to be cognizant of the differing needs of each other, based upon public safety, geography, weather patterns, environmentally sensitive areas, available resources, budgets and constituency expectations. Maryland's highway agencies should also seek opportunities to consult with each other after major winter storms and after the completion of winter seasons to share lessons learned in Best Practices for Salt Management.

A Salt Management Plan should be a living document that is updated on a regular basis. Best Practices for Salt Management should be seen as a key tool to provide the citizens of Maryland with safety and mobility during winter storms in a cost-effective, environmentally sustainable manner.

5.0 SALT MANAGEMENT PLAN

5.1 Overview

This section will outline the practices intended to effectively manage road salt for winter maintenance activities within the County, and is organized into the following areas:

- winter maintenance policies;
- trends and data analysis
- materials ordering, delivery, storage, handling and record keeping;
- equipment upgrading, calibration and washing;
- snow and ice control training;
- weather forecasting, storm response, environmentally sensitive areas;
- technology review; and
- public outreach and education

These plans are not meant to be a comprehensive consideration of every possible best management practice, yet rather a listing of existing practices and future improvements that are seen to be beneficial and feasible considering current conditions.

5.2 Safety, Mobility, and Winter Maintenance Policies

General:	• It is intended that the various winter maintenance program policies relating to the defined level of service be reviewed on an annual basis to determine whether any revisions are required or warranted. • While staffs have established level of service and maintenance standards which have been accepted by the community at large, a formal "Sensible Salting" policy has not, as yet, been drafted.
Goal/Timetable:	• Prior to the 2015 – 2016 winter season, staff will draft a "Sensible Salting" policy that supports the goals of this Salt Management Plan. • Winter maintenance policies will be reviewed annually and updated as needed. If changes are required, Director endorsement is to be obtained.
Responsibility:	• Director, Public Works; • Deputy Director, Highways
Environmental Impacts:	Winter maintenance policies form the foundation for program delivery and can have a significant impact on the environment.
Performance Measure:	Director approved winter maintenance policy.

5.3 Trends & Data Analysis

General:	• It is intended to measure the severity of winters and how it relates to salt usage. • By analyzing trends, and adhering to a responsible plan, long-term goals can be established to lessen the usage of salt while maintaining the safety and mobility of roadway users.
Goal/Timetable:	• For the 2014 – 2015 winter season, the Department will begin to measure salt usage in relation to the number of lane miles served, and inches of snow.
Responsibility:	• Chief, Road Operations
Environmental Impacts:	Effective salt management requires an accurate accounting of salt usage in relation to storm severity in order to identify trends and set goals.
Performance Measure:	Pounds of salt used per lane mile per inch of snow.

5.5 Material Ordering and Delivery

General:	• It is intended to maintain best practices and procedures in the ordering and delivery of de-icing materials. In the fall season and as required during the winter season, salt is delivered and stockpiled inside a covered barn, dome, or shed. • To minimize salt loss to the environment, the following measures are to be taken each year with respect to material ordering and deliveries: **a)** ensure that deliveries of salt are covered with a waterproof tarpaulin if they occur in wet weather; **b)** ensure that the loading pads are kept clean of material.
Goal/Timetable:	• All deliveries are to be accompanied by a Weigh Ticket and the following information recorded: a) weigh ticket with truck number and net weight. b) weather conditions; c) tarping completed; d) hours to transfer material indoors; e) loading pad cleaned following transfer • The initial stockpiling should be completed prior to November 1st of each year. During the initial stockpiling a sample to ascertain the material gradation and moisture content should be completed and appropriate action taken should the samples fail.
Responsibility:	• District Superintendent for ensuring that the ordering and delivery practices are implemented.
Environmental	Improper housekeeping practices relating to the delivery and handling

Impacts:	of salt can increase loss to the environment. Excessive moisture in the deicing material may make this material unusable for use during the winter season.
Performance Measure:	• Percentage of deliveries tarped/delivered in good weather; • Percentage of material put into storage within 24 hours; • Loading pad is left in a clean state following transfer of material indoors; and • Compliance of housekeeping practices through periodic yard inspection.

5.6 Materials Storage and Handling

General:	• It is intended to maintain best practices and procedures for the storage and handling of winter maintenance materials. • The County currently stores salt in (7) covered barns at various Road Maintenance Yards. The inside storage area has an impervious pad. • A paved loading pad is used for loading the spreader trucks. No covered space is currently provided to load/unload material. • Barns are inspected each June as part of an annual SWPPP comprehensive facility inspection in order to identify any deficiencies to the floor or exterior areas of the structure. • The barns have good ventilation with proper lighting but lack an overhang to minimize precipitation entering the structure.
Goal/Timetable:	To maintain good practices for the storage and handling of salt or de-icing liquids, the following measures are to be followed each year: a) when loading spreaders outside the storage structure, the loading is to occur on the impervious loading pad; any material spilled during loading operations should be collected and returned back to the storage structure as soon as possible; b) spreaders should not be loaded beyond their capacity to avoid spillage during operations; c) ensure no frozen blocks of material are placed in the spreaders when loading. Any frozen blocks should be pushed into a corner of the storage structure and allowed to thaw and dry prior to introducing this material to the stockpile; d) ensure proper ventilation for the removal of noxious fumes and moisture; e) document the inspection and repair of the barn; and f) liquid storage tanks should have secondary containment; g) liquid storage tanks are to be inspected regularly for leaks;

	h) liquid storage tanks must be protected against damage from vehicles.
Responsibility:	• Road Maintenance Supervisor to ensure the guidelines for "good housekeeping practices" are implemented; • Operators to ensure that the guidelines for "good housekeeping practices" are followed.
Environmental Impacts:	Improper housekeeping practices related to the storage and handling of salt can increase the potential for loss to the environment.
Performance Measure:	Compliance through periodic yard inspection.

5.7 Material Record Keeping

General:	• It is intended to retain an accurate record of the amount of material used by routes, by vehicle, and by storm event. • At the present time, material usage by storm is manually collected. Typically, material usage is rationalized by comparing the amount of material ordered with the residual inventory. Usage information is not readily available by route, or vehicle.
Goal/Timetable:	• For the 2015 – 2016 winter season, a material tracking system is to be initiated to track material usage by vehicle, route and storm and be capable of comparing usage to benchmarked rates. To facilitate this process, staff should take full advantage of the downloading capabilities of new electronic controllers on 2016 and newer spreader trucks. • By providing an accurate record of material usage by route and vehicle and by storm, the County will be able to fine tune the amount of material to be spread for varying climatic and pavement conditions. The immediate goal will be to compare usage with benchmarked routes and to rationalize the amount of material ordered with the residual inventory. • On a seasonal basis the amount of material used versus amount stored is to be reconciled with the deliveries and the daily usage records.
Responsibility:	• Chief, Road Operations for the design and implementation of a material tracking protocol. • Road Maintenance Management Administrator for the seasonal reconciliation of material used versus delivered, invoiced, and residual inventory. • Road Maintenance Supervisor for ensuring that the necessary equipment is operating properly to measure the amount of material placed on roads, and for collecting the data.
Environmental	Effective salt management requires an accurate accounting of usage

Considerations:	by storm, route and vehicle.
Performance Measure:	Record of material usage by storm, route and vehicle together with a year-end material reconciliation.

5.3 Equipment Upgrading

General:	• It is intended that the winter maintenance fleet be capable of delivering appropriate levels of de-icing materials within a full range of climatic conditions. • Currently, no spreader units are equipped with electronic controls with data retrieval capabilities to monitor the volume and location of material spread. • The placement of an infra-red thermometer (IRT) on the spreader units would enhance the likelihood that operators will spread the proper volume of deicing material for the climatic and pavement conditions. • Currently, operations staff do not routinely use pre-wetting in their winter operations toolbox. By equipping spreader units with the ability to spray a liquid de-icing chemical onto the salt before it reaches the spinner, more material remains on the pavement and there is a faster, longer lasting effect. This translates into a reduction in material required to maintain winter roadways.
Goal/Timetable:	• As the spreader fleet comes up for replacement within the Bureau of Highway's vehicle replacement program, IRT's and pre-wet capabilities are to be added to the specification list in addition to electronic controllers.
Responsibility:	• Chief, Road Operations, contingent on appropriated funds; • Fleet Coordinator to prepare specifications for equipment upgrades.
Environmental Impacts:	Equipment upgrades will improve the capability of placing the right amount of de-icing materials in the right place at the right time and allow for an increased level of data collection which, in turn, leads to more effective use of salt.
Performance Measure:	Percentage of equipment equipped with electronic spreader controls, IRT's and pre wet capability.

5.3 Equipment Calibration

General:	• Properly calibrated equipment is one of the keys to the effective placement of deicer material on County roadways. • Currently, spreaders are not calibrated nor routes benchmarked. The spreading of material is left to operator

	experience and past practices with adjustments for road and weather conditions.
Goal/Timetable:	• The practice of calibrating the spreaders and benchmarking the routes prior to the winter season is to be implemented. As well, during the winter season as the equipment comes in for maintenance the spreader units are to be checked and recalibrated as needed.
Responsibility:	• District Superintendents; • Road Maintenance Supervisors
Environmental Impacts:	Proper equipment calibration and maintenance will ensure that the proper volume of de-icing salts can be spread onto the roadway.
Performance Measure:	• Spreaders calibrated by November 1 of each year. • Routes benchmarked by November 1 of each year. • Comparisons are to be developed over the winter season: o of material spread rates across routes, across vehicle units and across operators; o of each route and vehicle unit; and o of actual spread ratio performance against industry spread rates.

5.4 Equipment Washing

General:	• It is intended to reduce the amount of chlorides, oil grease and grit that is discharged back into the environment. • At the present time, equipment is washed at (1) indoor and one (1) outdoor location both having an oil/water separator with the wash water discharged into a sanitary sewer system.
Goal/Timetable:	The practice of washing all equipment inside is to continue to take full advantage of the oil/water separator and to minimize any discharge back into the environment.
Responsibility:	• Road Maintenance Supervisors; • Operators to ensure equipment washing is inside.
Environmental Impacts:	Vehicle wash water contains salts, oil, grease and dirt and can have an adverse effect on the environment if allowed to be discharged into the soils below and adjacent to the yard.
Performance Measure:	Percentage of vehicles washed indoors and passed through oil/water separator before being placed in readiness for the next shift.

5.12 Snow and Ice Control Training

General:	It is intended that all staff involved in snow and ice control and effective salt management are adequately trained. While all staff

	involved in snow and ice control have had winter maintenance training, there is no formal ongoing training program in place including salt management practices.
Goal/Timetable:	To ensure that all staff are trained and their training is refreshed annually in snow and ice control including salt management practices, training modules are to be provided in the following areas: a. good housekeeping practices; b. interpretation of weather and pavement conditions; c. proper use of infra-red thermometers; d. when and how to apply chemicals; e. health and safety requirements; and f. proper record keeping and review.
Responsibility:	• Chief, Road Operations to arrange for the appropriate annual training modules for all staff involved in winter maintenance activities.
Environmental Impacts:	Thorough understanding of good housekeeping practices, the measures of snow and ice control and the expectations of program delivery will result in a greater probability of success with the salt management plan.
Performance Measure:	Percentage of staff receiving snow and ice control training.

5.8 Weather Forecasting

General:	• The intent is to provide timely and accurate weather information to assist in decision making. • Currently, staff access various weather reports for current and forecasted weather information. As well, staff interface with one of three on-call Duty Supervisors who patrol roadways within each District to determine actual conditions.
Goal/Timetable:	• Prior to the 2011 – 2012 winter season, staff developed a strategic weather forecasting plan: *County Government Inclement Weather Advice.* • Discussions with the State should be initiated to explore options in providing enhanced forecasted and real time weather and pavement information on County Roads. Staff should explore the potential of tapping into SHA's RWIS stations for enhanced weather information.
Responsibility:	• Chief of Road Operations
Environmental Impacts:	The effective use of de-icing material is dependent on accurate weather information and informed decision making. Inaccurate weather information and/or poor decision making can result in untimely use of salt.

Performance Measure:	Delivery of clear, accurate weather forecasts at least 4 times daily between November and April each year.

5.9 Storm Response

General:	• It is intended to provide criteria and guidelines to standardize staff response for various combinations of precipitation, pavement temperature and traffic volumes. • Currently, staff react to visual patrols and weather reports from various sources to initiate the mobilization of the operators for plowing and de-icing action.
Goal/Timetable:	• Prior to the 2012-2013 winter season, a documented snow & ice control plan was developed to supplement the existing storm response plan. • Prior to the 2013 – 2014 winter season, formal guidelines for maintenance actions for each type of storm event, for various pavement temperatures and conditions, and for various initial and subsequent operations were prepared. • A 2 to 5 year goal will be to monitor the records of storm response in relation to the established guidelines in order to assess any necessary changes.
Responsibility:	• Chief, Road Operations; for preparing formal storm response guidelines. • District Superintendents for ensuring the implementation of appropriate storm response treatments.
Environmental Impacts:	Snow and ice control decisions that are not consistent with actual weather and road conditions will lead to inefficiencies in storm response and inappropriate material usage.
Performance Measure:	• A documented storm response plan. • Accurate and complete record of storm response.

5.11 Winter Patrol and Level of Service Monitoring

General:	• It is intended that winter road conditions are monitored in an appropriate fashion to be able to react to changing weather and road conditions and to ensure that the levels of service for the motoring public are maintained. • Currently, the Department provides a patrol to inspect and monitor County road conditions pre-event in accordance with best practices and trackers to monitor that the levels of service for the motoring public are maintained during storm response.
Goal/Timetable:	• Policies are to be reviewed annually to ensure that the

	guidelines are consistent with the County's level of service expectations.
Responsibility:	• District Superintendents for mobilizing Patrollers that monitor road and weather information and make timely responses. • Tracker Coordinators for monitoring the trackers to ensure that the level of service policies are met.
Environmental Impacts:	Accurate interpretation of conditions and appropriate levels of action to provide safe road conditions will result in timely and efficient application of winter de-icing materials.
Performance Measure:	Percentage of staff trained in snow and ice decision making. Documentation of road and weather conditions and appropriate responses to situations.

5.15 Environmentally Sensitive Areas

General:	• It is intended to understand the impacts of the winter maintenance practices on environmentally sensitive areas within the County. • To date, there has been no information available regarding the impacts of winter maintenance activities on the County's existing environmentally sensitive areas.
Goal/Timetable:	• 2015 – Highways staff in collaboration with WPRP staff will coordinate with MDE to determine criteria for determining areas sensitive to salt exposure and runoff. • 2016 - Identify and rank environmentally sensitive areas within the County. For the most vulnerable areas (highest ranked), a sampling program will be developed to explore the level of impact resulting from the County and Region's winter maintenance practices. • 2017 - A monitoring program of environmentally sensitive areas is to be initiated in order to provide a historical record of impacts resulting from winter maintenance practices within the County. • 2018 and beyond – an appropriate action plan is to be developed where practical.
Responsibility:	• Chief, Road Operations • WPRP Administrator
Environmental Impacts:	Environmentally sensitive areas that are impacted by winter maintenance practices may require unique solutions and specific action programs to mitigate the impacts.
Performance Measure:	Identification and ranking of environmentally sensitive areas monitoring test results against current practices and mitigation

	measures.

5.14 Public Education & Outreach

General:	It is intended that an overall communication strategy with respect to the County's winter maintenance program be developed to inform both staff and the public.
Goal/Timetable:	• Prior to the 2015 – 2016 winter season, a "Sensible Salting Brochure" is to be prepared and made available to the general public. • Prior to the 2013 – 2014 Winter season, a winter storm handbook was prepared for staff and should be expanded to include: a. contact list b. maintenance standards; c. material application rates; d. expected load coverage by various sizes of equipment; e. plow routes; f. operator and patroller assignments and shift coverage; g. guidelines for calibration and benchmarking routes; h. record keeping requirements; i. communication strategy with area media, school board transportation agencies and the public; j. internal and external arrangements with respect to boundary roads and State roads; k. arrangements to re-order materials; l. loader responsibilities; and m. pre-event planning for possible road closing that may occur due to reduced visibility and drifting snow or for snow removal operations.
Responsibility:	• Chief, Road Operations
Environmental Impacts:	Increased awareness of the role and management of snow and ice control in winter maintenance operations will provide the area residents and staff with a greater understanding of the challenges in combating winter storms.
Performance Measure:	Distribution of a "Sensible Salting" Brochure for the public and staff. Up to date information on winter maintenance operations on the Department web site.

5.13 Technology Review

General:	• It is intended that existing and new technologies be continually reviewed to determine their applicability in altering current

	practices.
Goal/Timetable:	• On an annual basis new technologies and proven alternative methods to combat winter storms will be reviewed. Pilot studies incorporating relevant winter maintenance methodologies will be recommended where deemed appropriate. • Consideration should be given to upgrading the Snow Removal fleet by installing an automated vehicle location system to provide enriched data on winter operations, such as: a) Locations serviced by vehicle, time and activity; a. Start, finish and idle time; b. Total hours salting and plowing; c. Total distance salted, anti-iced, b) plowed or patrolled; c) Average application rates for salt, sand, d) anti-icing, pre-wet; and e) Road and ambient temperature sensor data.
Responsibility:	• Chief, Road Operations • Fleet Coordinator
Environmental Impacts:	New techniques, procedures and technologies may provide more effective methods of monitoring and/or reducing the amount of salt entering the environment.
Performance Measure:	Annual report on new developments in snow and ice control.

5.0 MONITORING AND UPDATING THE SALT MANAGEMENT PLAN

5.1 Overview

The Salt Management Plan will be reviewed and updated as required, with new technologies and progressive advances added. The Salt Management Plan is intended as a starting point for the Department to proceed with the implementation and continuance of best management practices for winter maintenance operations. The long term goal of this plan is to protect the environment from excessive concentrations of road salts while at the same time, ensure that winter roads are kept safe.

The Salt Management Plan proposes a number of initial and long term goals and timelines for implementation by the Department. Subject to Administration endorsement, the plan elements need to be programmed into the capital and operating budget. A summary of short term and long term goals follows:

5.2 Short Term Goals

- *Winter Maintenance Policies*

The Department has established level of service and maintenance standards which have been generally accepted by the community at large. These policies form the foundation for program delivery and can have a significant effect on the environment. The goal is to review the various departmental standards relating to the winter maintenance program, and seek endorsement for the level of service and maintenance policies.

- *Record Keeping*

One of the keys to an effective winter maintenance program is to place the right amount of material in the right place at the right time. At the present time, the record of material usage is tracked manually and reconciled with the residual inventory but should be enhanced to document salt usage by route, by vehicle, and by storm.

- *Winter Maintenance Training*

A thorough understanding of good housekeeping practices, the measures of snow and ice control and the expectations of program delivery will result in a greater probability of success with the salt management plan. For this reason, it is essential that all staff involved with winter operations be provided with Winter Maintenance and Operations Training.

- *Communications*

The goal in this area is to communicate the Department's winter maintenance program and salt management initiatives to staff and to the public. The prime focus in this area will be to increase public awareness in the role of de-icing materials in snow and ice control through the development of appropriate information on the Department's web page.

- *GPS Upgrade*

It is recommended that the Snow Operations fleet be upgraded by installing an automated vehicle location system (GPS). Vehicles equipped with GPS capability will allow for the analysis and comparison of spread rates throughout a route to be assessed and adjusted to

optional rates on a real time basis if found to be inappropriate. GPS will therefore increase the level of data collection and allow for more effective delivery of winter operations. Throughout the season, GPS would assist with the analysis of complaints, as well as use against any claims against the County. This can be done since the location of a truck can be pinpointed in time throughout the storm with complete accuracy.

5.3 Longer Term Goals

- *Equipment Upgrading*

It is intended that the winter maintenance fleet be capable of delivering appropriate levels of de-icing materials within a full range of climatic conditions. The most cost-effective way of fleet upgrading is to consider changes as vehicles within the fleet come up for replacement. In this regard, as the spreader fleet comes up for replacement within the County's heavy equipment replacement program, the vehicles are to be equipped with electronic controllers, infra-red thermometers and pre-wet capabilities. The equipment upgrades will improve the capability of placing the right amount of de-icing material in the right place, at the right time and allow for an increased level of data collection which, in turn leads to more effective use of salt.

- *Environmentally Sensitive Areas*

Concentrations of chloride in the environment can have negative environmental impacts and the Statewide Salt Management Plan suggests a program to assess the levels of impact due to winter maintenance. Initially, the environmentally sensitive areas can be identified and ranked starting with the most vulnerable areas (highest ranked), a monitoring program can be developed where appropriate to explore the level of impact resulting from the County's winter maintenance practices. Over time, where appropriate, action plans are to be developed to reduce the chloride impacts on the environment.