



OHIO DEPARTMENT OF  
TRANSPORTATION

# **Snow & Ice Practices**



**Division of Operations  
Office of Maintenance Administration**

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## Executive Summary

Snow and ice control is often the single largest cost item in the maintenance budget. According to statistics compiled by the U.S. Federal Highway Administration, winter maintenance costs for snow and ice removal by states exceed \$2.3 billion annually. For this reason and because of the need to keep roads open and minimize the impact on public safety, including the reduction of accidents, snow and ice control deserves special attention from all levels of highway management and maintenance personnel. The public is less tolerant of failure in snow and ice control than in any other highway function. A snowstorm affects the entire community and often the entire state. Unless a storm is handled capably by maintenance forces, it can upset the daily routines of individuals, adversely affect business, and endanger public safety and public servants.

To effectively and efficiently address the needs for snow and ice removal on 43,000 lane miles of highways, the Ohio Department of Transportation (ODOT) has to its disposal 1,700 plow trucks, 3,000 employees, and 650,000 tons of salt stored at 200 locations around the state. Depending on the severity of the weather, each winter ODOT uses between 300,000 and 900,000 tons of salt with an average yearly usage of 600,000 tons. In total, snow and ice control can comprise 40-45% of the annual operating expense with approximately \$50 million spent annually on labor, equipment, and materials.

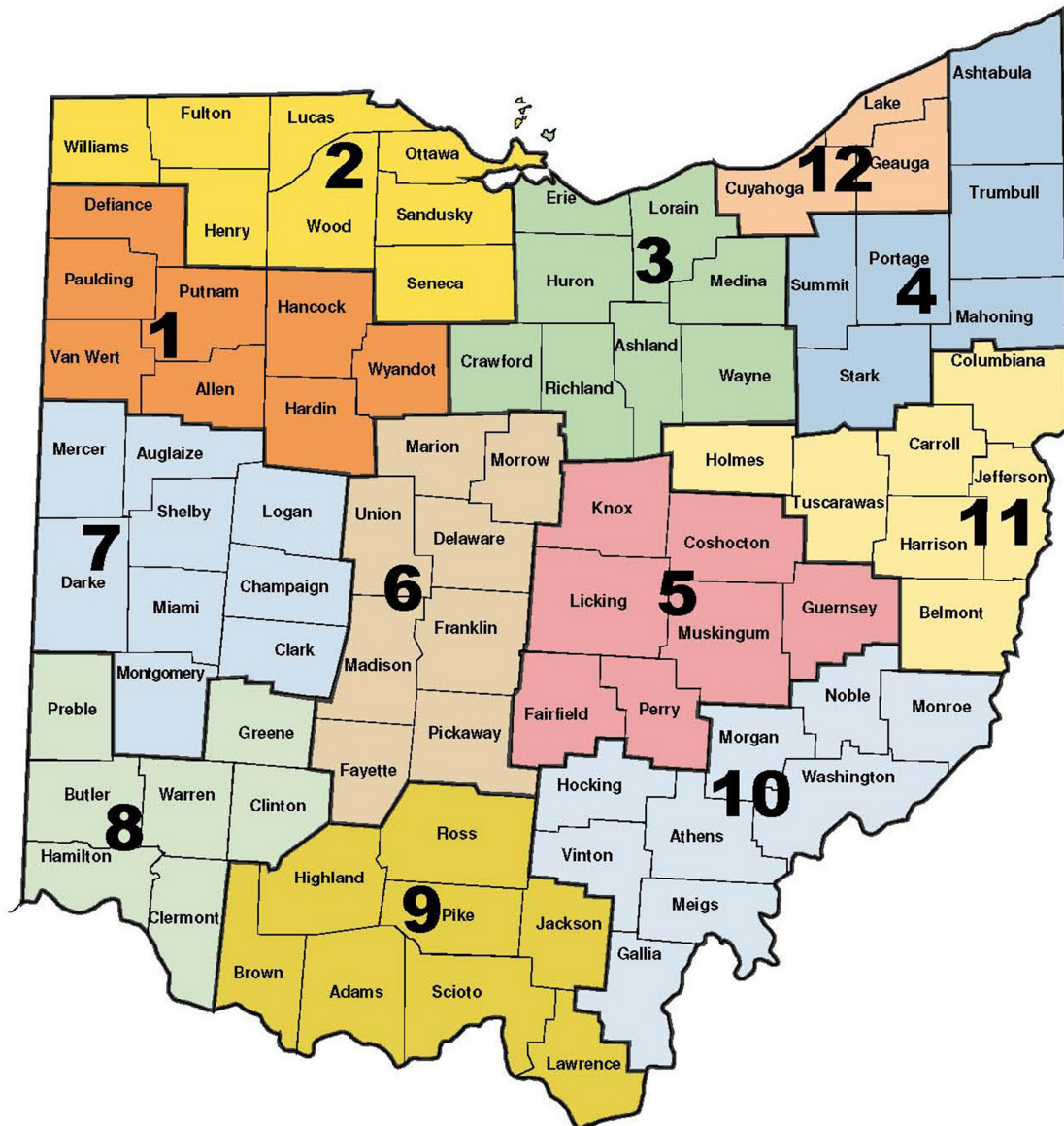
ODOT's snow and ice removal program begins in the counties with support from the districts and central office. Each county, through coordination of the district, takes steps to adequately plan and prepare for the approaching winter season. This plan includes equipment readiness, truck routing, call-out procedures, supplemental drivers, emergency equipment rental, training, and material inventory control. As winter sets in, the counties utilize their snow and ice control plans to treat and remove ice and snow from the roadways during winter weather events.

Through the years, ODOT has developed, used, and continues to use several tried and true practices that support snow and ice control efforts. These practices range from equipment and materials to guidance, applications, and research. Although some practices have been more successful than others, all contribute to the overall success of ODOT's snow and ice operations. The Office of Maintenance Administration has compiled several of the snow and ice practices in the following report and accompanying compact disc.

The snow and ice practices are divided into five categories: Equipment, Materials, Guidance, Applications, and Research. Each snow and ice category contains practices ODOT has developed, adopted, or tested for the purposes of enhancing snow and ice control. General information is included for each practice with additional information available through the provided links and/or points of contact listed at the end of each practice.

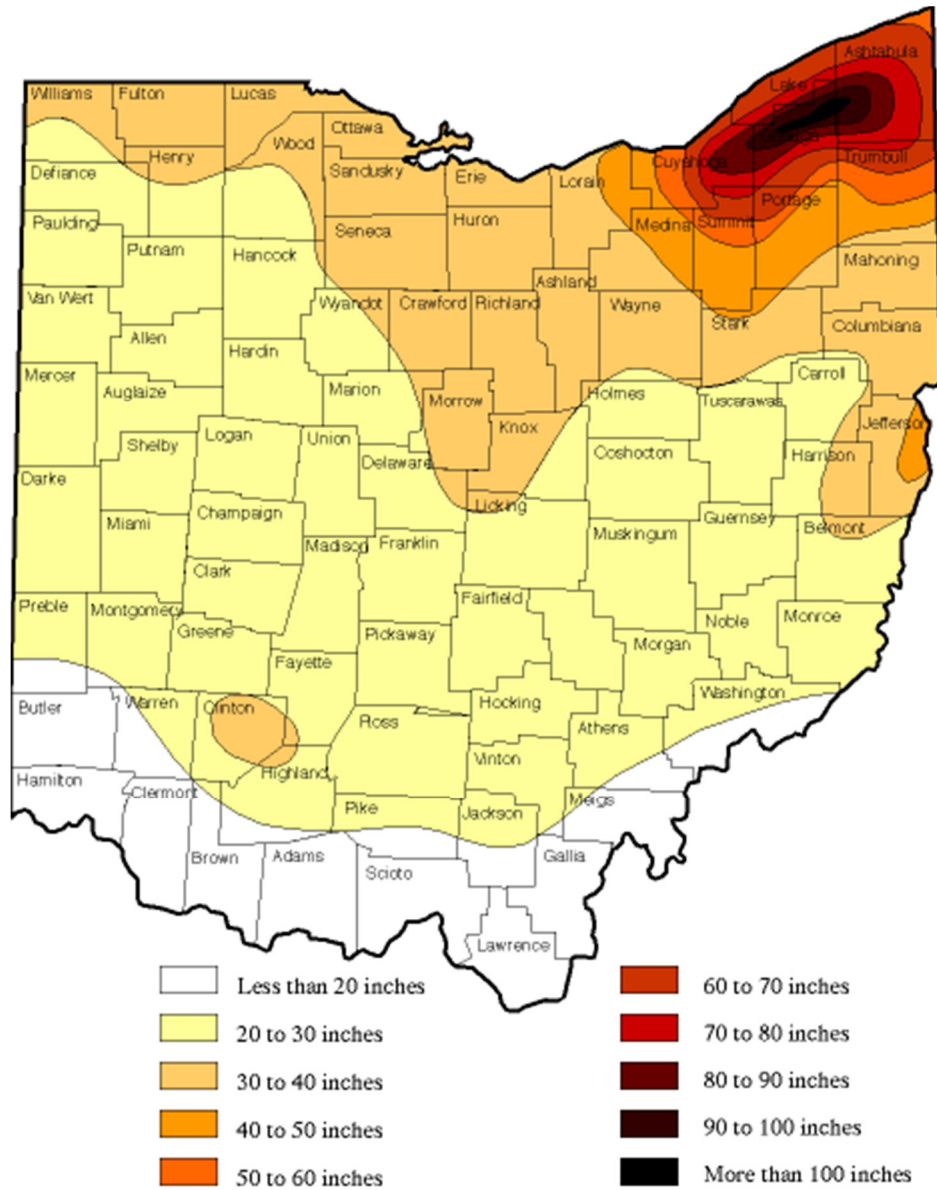
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# ODOT District Map



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# Ohio Annual Snowfall



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## Equipment

### Stainless Steel Truck Beds and Material Spreaders

All new dump trucks purchased by ODOT are now equipped with stainless steel beds and material spreaders. In comparing stainless steel to mild steel beds and spreaders, it was determined that the maintenance cost of mild steel beds and spreaders were more than twice the cost of stainless steel. Since their implementation seven years ago, the stainless steel beds and spreaders have required minimal maintenance.



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### On-Board Wetting and Direct Application Systems

ODOT trucks are equipped with onboard wetting systems that apply brine or other liquid materials such as calcium chloride to dry rock salt as it exits the truck. Previously, any pre-wetting application had to be applied to the entire load of salt prior to leaving the maintenance facility. This process resulted in uneven liquid to dry material application and premature corrosion of the truck and its systems. In contrast, on-board wetting systems are calibrated to deliver a specified quantity of liquid per ton of salt, and the application at the spinner reduces the corrosive effects of the brine by limiting direct contact to the truck.



Additionally, ODOT has trucks equipped with Direct Application Wetting Systems capable of applying large quantities of brine directly to the road surface. These systems apply brine prior to an event preventing snow and ice from bonding to the pavement (anti-icing) or during light events removing smaller quantities of snow and ice (de-icing). ODOT utilizes both removable and dedicated direct application systems. The removable systems have tanks

mounted on stands that can be loaded and unloaded on trucks as the direct application systems are needed. Conversely, the dedicated systems are usually large tanker trucks permanently equipped to apply brine to the pavement.

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## Live Bottom Truck Beds

Live bottom truck beds have a material conveyor system built in the floor of the bed. There are three types of conveyor systems available including rubber belt systems, metal drag chain systems, and auger systems. Whichever conveyor system is used, live bottom truck beds allow for material unloading without the need to raise the truck bed or install a separate hopper bed insert spreading system. However, the initial purchase price and ongoing maintenance costs are higher than that of standard truck beds.



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## Zero Velocity Spreaders

Zero velocity spreader systems are designed to minimize the bounce and scatter of salt as it exits the back of the truck and hits the pavement. Conventional spreader systems spread salt that has a forward velocity equal to the speed of the truck resulting in widespread material distribution and limited effectiveness of the application. In contrast, zero velocity spreaders are designed to spread salt in an equal velocity but opposite direction to the truck essentially reducing the salt's effective speed to zero and "dropping" it on the pavement. Ideally, this process increases the effectiveness of the salt by concentrating the





material distribution to the lane of application. ODOT has used zero velocity spreader systems in the past, but due to their increased maintenance costs and high failure rate, most systems have been removed and are no longer in use.

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### Multi-Purpose Trailer 3 (MPT3)



The District 4 office in Akron developed the Multi-Purpose Trailer 3 (MPT3) in 2007 that serves as the ultimate snow and ice removal vehicle, but it can also be used all year long for other responsibilities. When winter-ready, the unit can be used for pre-wetting salt as well as direct application of salt and deicing liquids and plowing. When summer-ready, the trailer can be used to haul slag, salt, dirt, and pavement grindings.

Three separate steel frames were constructed and galvanized. One holds six, 650-gallon tanks (total 3900 gallons) that can hold brine or a calcium chloride/brine mix for pretreating or direct application; also on board is a 140-gallon tank that can hold either calcium or a blend of calcium and other de-icers. The second frame supports a 4 ½ cubic yard hopper and salt spreader. A third frame is for the snowplow which is centrally placed underneath the trailer and anchored to the trailer frame.



The use of the same vehicle for different purposes means the district can purchase fewer vehicles during the year. The MPT3 cost approximately \$125,000.

Links: [Government Engineering Article](#)  
[ODOT Transcript Article](#)

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## Materials

### Liquid Chemicals

ODOT utilizes liquid chemicals including brine, calcium chloride, and agricultural based products for the treatment of road surfaces during snow and ice control. These products are typically used alone or in combination with each other to enhance the performance of rock salt by pre-wetting the material as it exits the truck at the spinner. This process initiates the reaction for the salt to move into solution, limits product bounce and scattering on the pavement, and lowers the salt's

effective working temperature in colder conditions. Additionally, these same liquid chemicals can be applied directly to the pavement in both anti-icing and de-icing applications.



Liquid calcium chloride and agricultural based products are purchased from ODOT contracts 127-11 and 124-11 respectively. However, the brine ODOT uses is produced in-house. All ODOT counties are equipped with brine making units and storage tanks and can produce brine for less than \$0.10 per gallon. The low production cost of brine provides a cost effective method for counties to enhance their treatment process, but all three products have their place in snow and ice control.

Some ODOT counties have tested blending brine with liquid calcium chloride and/or agricultural based liquids to further enhance the properties of brine including a lower effective working temperature, decreased corrosion, and increased residual power. Stark County in District 4 has had ample experience in this field. They have found that blending brine with small quantities of agricultural based product, usually 10%-15%, can provide a significant increase in the residual of salt on higher volume roads when anti-icing and lower the effective working temperature of brine when pre-wetting at the spinner. Other counties have blended brine with liquid calcium chloride and have found similar results. However, the solution should never contain more than 10% calcium chloride. Otherwise, the solution tends to desegregate and form solids that plug hoses on

the application equipment. Due to the complexity associated with blending products, such practices require an increased knowledge base of de-icing chemical properties and practical uses.

Links: [Liquid Calcium Chloride Contract 127-11](#)  
[Agricultural Based De-Icer Contract 124-11](#)  
[Liquid Chemicals Presentation](#)

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## Treated Salt

Treated salt is a mixture of standard rock salt and a corrosion inhibited chloride product that is designed to enhance rock salt performance by improving its effectiveness at low temperatures, limiting bounce and scatter, preventing caking, and reducing corrosion. Treated salt has characteristics similar to those achieved through pre-wetting salt with chloride as it exits the truck at the spinner. However, treated salt is delivered already enhanced with the chloride product and corrosion inhibitor. There are several products on the market that meet ODOT's specification including ClearLane, IceSlicer, and IMC CI Salt. Typically, treated salt costs approximately \$15 more per ton than standard rock salt. Statewide, ODOT counties contracted for approximately 5,000 tons with another 7,400 contracted by local entities through cooperative purchasing.

Links: [Treated Salt Contract 319-11](#)

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## Abrasives

ODOT mixes abrasives with rock salt as a means to increase the effectiveness of the salt in extreme low temperatures and on low volume roads. When salt and abrasive mixtures are applied to snow and ice covered road surfaces, abrasives help provide traction to vehicle tires and the salt aids in the melting of snow and ice. Additionally, the high cost and limited availability of salt in recent years has led managers to use abrasives as material filler. The addition of abrasives reduces the quantity of salt applied to the road consequently extending salt supplies.



The types of abrasives used across the state vary due to availability and cost. The most common are sand, crushed lime stone, coal cinders, and slag from steel mills. However, the greater the angularity and hardness of the abrasive, the more traction it will provide motorists. For example, river sand does not provide the same level of traction as crushed limestone because the river sand has round edges and the crushed limestone as ridged edges. Additionally, some Ohio limestone is too soft and rapidly breaks down under the weight of traffic providing little traction. After several applications, it is important to limit the accumulation of abrasives on the road surface as abrasives lose their effectiveness on bare pavement and actually reduce traction at intersections, turn lanes, and other areas where it accumulates. Although using abrasives can reduce material cost, the removal of excess abrasives must be considered in any potential savings. Therefore, due to the high cost of using vacuum trucks to remove material, ODOT limits the use of abrasives on roadways with enclosed drainage structures.

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## Biodiesel

During calendar year 2011, ODOT is required by the Ohio Revised Code to use 1.3 million gallons of B20 biodiesel. B20 is a blend of 20% neat (produced from any fat or oil) and 80% regular diesel. When combined, the neat, regular diesel, and temperature flow additives must be blended uniformly. Otherwise, pockets of unblended fuel will gel at cold temperatures causing pump station fuel filters and truck fuel filters to plug. If this occurs, large-scale equipment failures can inhibit snow and ice removal during winter events. Due to past experience of these issues crippling ODOT's snow and ice trucks at times when they are most needed, the Office of Maintenance Administration opposes the use biodiesel during winter months.

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## Guidance

### Snow & Ice Treatment Practices

Snow and ice control has been, and remains, ODOT's signature service during the winter season as the Department understands the overwhelming need for clear and safe roads during the winter months. With recent increases in the cost of fuel and salt, the Department has intensified its efforts to utilize the best training for snow and ice crews, the most up-to-date technologies, and the best practices that will improve efficiency, reduce costs, and ensure continued safety. As a result, ODOT has adopted snow and ice treatment practices that provide the traveling public with safe roadways but doing so within the most efficient manner possible. These practices include:

- Increased use of grit
- Communication and employee buy in
- Monitoring application rates at the driver level
- Increased use of liquid Calcium Chloride
- Encouraging manual and electronic calibration of equipment
- Utilizing contract weather forecasting service
- Increased awareness and use of Road and Weather Information System (RWIS)
- Increased anti-icing prior to weather events
- Encouraging pre-wetting of all solid material
- Continued use of route prioritization maps
- Adherence to existing policies regarding route treatment
- Procurement of additional wetting systems for current fleet

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### Anti-icing

Anti-icing is a proactive method of snow and ice control that takes place prior to snow falling or ice forming on the roadway surface. It provides pre-treatment to the pavement surface in an effort to prevent the formation of frost, black-ice, or the bonding of frozen precipitation to the pavement surface. Additionally, pre-treatment of a pavement provides critical response time to remote areas once an event has started. When properly implemented, the practice of anti-icing helps to reduce the amount of chemicals needed for efficient snow and ice control.





Prior to the onset of an event, ODOT applies anti-icing liquids, usually a sodium chloride and water mixture known as brine, to road surfaces. This 23% brine solution is applied at approximately 40 gallons per lane-mile in a stream pattern sufficient to merely dampen the pavement. After the water evaporates, a salt residual is left on the pavement that is reactivated when moisture occurs. This reactivation process assists in the prevention of ice formation and bonding on the pavement surface. Once snow or other frozen precipitation begins, traditional snow and ice removal methods are employed.

ODOT has documented best practices for anti-icing procedures as operational guidelines for establishing a uniform anti-icing program or “Pre-Treatment Plan”. The guidelines provide support for the commitment to anti-icing as well as practical guidance for daily operations including application timing and warranting conditions. The Pre-treatment Guidelines were initially developed in 2001 and implemented in January of 2002.

Links: [Pre-treatment Guidelines](#)

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## Salt Contract Modifications

The 2008-2009 winter season introduced the need for change in ODOT’s approach to securing salt contracts for winter maintenance. The season brought unprecedented circumstances requiring innovative techniques and approaches from the winter maintenance community. Declining budgets coupled with increases in daily operating costs and limited supplies of needed resources made it extremely difficult to achieve and maintain established levels of service. Various agencies across the state, including ODOT, found themselves without the salt supplies needed to perform winter maintenance. Understanding the magnitude of this situation and its potential impact was vital to the creation and implementation of an action plan that optimized strategy and minimized risk.

Prior to any contract modifications, ODOT traditionally let a single contract in August for the purchase of rock salt and awarded the contract to the low bidder on a county by county basis. Interested venders submitted a price per ton of salt delivered to the counties based on each county’s proximity to the salt mines and stock piles, shipping costs, and total quantity needed. As a result, each county paid a different price per ton of salt. The contract contained several provisions including minimum and maximum purchasing requirements of 50% and 150% of the statewide estimated quantity, seven day delivery windows, and requirements to convey/pile the salt into the storage facilities. Additionally, approximately 200 local entities participated in the contract through the Department’s cooperative purchasing program.

The 2007-2008 winter season proved to be severe across the country setting record salt sales. In fact, many highway maintenance agencies struggled to find available salt supplies to finish the season. ODOT alone used over 900,000 tons, approximately 300,000 tons above normal. By the end of the season, national salt supplies were diminished and demand to refill storage facilities was high.

Heading into the 2008-2009 season, numerous Midwestern highway maintenance agencies bid their salt contracts early and increased order quantities in an attempt to replenish diminished salt supplies and ensure adequate supply through the end of the upcoming season. These measures, combined with the August bid, negatively impacted ODOT's first attempt to secure contracts as salt supplies had already been committed elsewhere. As a result, bids were not received in 43 of ODOT's 88 counties. A second contract was quickly let with modified language including reduced estimated quantities, revised minimum and maximum purchase requirements (80% min, 100% max), and relaxed delivery timeframes. The second bid reduced some of the risk for the vendors and produced contracts for 18 additional counties with 25 remaining un-bid.

The Department was able to limit the effects of the salt crisis by obtaining other available deicing products and allocating salt from counties that had contracts to counties that did not. However, ODOT realized there were valuable lessons to be learned regarding the impacts of industry logistics and risk-management as it pertained to securing salt bids. As a result, it was apparent the Department had to modify the existing bid process and contract language to prevent a similar crisis from occurring again. Lessons learned include:

- Salt industry production and logistics affect our operations
- Severity of previous winter affects the following year's salt demand
- Weather is a risk that is factored into salt prices
- Contracts that share risks realistically are win-win for the maintenance agency and vendor
- Roadway agencies can reduce their risks and their costs
- Increase storage capacity to accommodate annual average usage
- Communicate with your supplier to understand both party's expectations and priorities
- Bid early
- Take early delivery

From the lessons learned, ODOT modified the bid process and contract language. These modifications include:

- Moved the bid date from August to early May taking advantage of an earlier bid date to avoid missing opportunities of available product
- Split the existing contract into the Spring Fill-up and Winter Use contracts
  - Spring Fill-up Contract
    - Allows counties to replenish salt supplies after winter
    - Ensures vendors 100% of the contract quantity would be purchased
    - Reduces estimated quantities needed for the Winter Use contract
    - No cooperative purchasing

#### Winter Use Contract

- Adjusted minimum and maximum purchase requirements of 50% and 150% respectively to 80% and 120% sharing some of the contract risk with the vendors
- Allows cooperative purchasing
- Relaxed contract delivery provisions
  - Expanded product delivery windows
  - Increased available delivery hours
  - Eliminated piling/conveying requirements to allow dumping of the product

Through the implementation of these modifications, ODOT has successfully secured salt contracts in all 88 counties for the past two seasons with prices comparable to those of other Midwestern department of transportation agencies. The local entities participating through cooperative purchasing has increased from less than 200 in 2007-2008 to over 450 in 2010-2011, and with this increase, the total contract quantity has grown from 1.25 million tons to 2.7 million tons. Of this total quantity, ODOT is responsible for just over half a million tons with the remaining belonging to local entities.

Links: [Spring Fill-up Contract 318-11](#)  
[Winter Use Contract 018-11](#)

For more information contact:

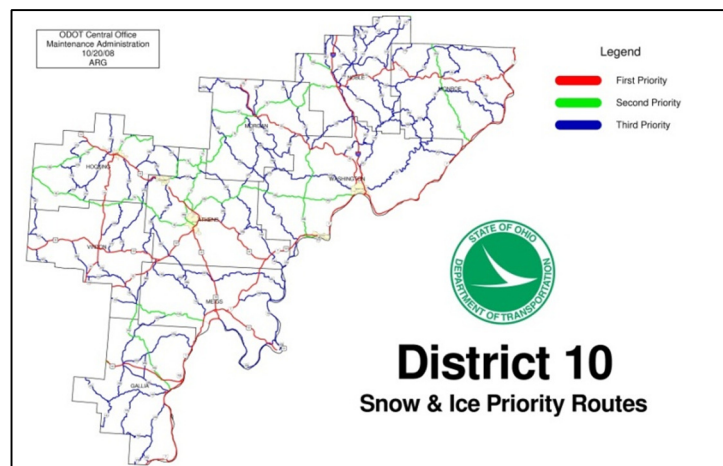
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## Snow & Ice Priority Routes

As part of the ODOT's efforts to conserve salt, all state maintained highways were prioritized for snow and ice control based upon the needed level of service. ODOT districts were tasked to assign each section of road in their district as first, second, or third priority. Then during snow and ice operations, state maintained highways would be treated based on their priority and the guidelines given in the Route Application Guidelines (RAG).



Prioritizing roads for snow and ice treatment is an effective method for reducing operating costs as long as the roadways remain safe. This is especially true in rural areas where lower traffic counts allow for modified treatment of the roads. ODOT utilizes road prioritization during snow and ice operations to help keep operational costs down. By treating a third priority road differently from a first priority road, districts can save on material, labor

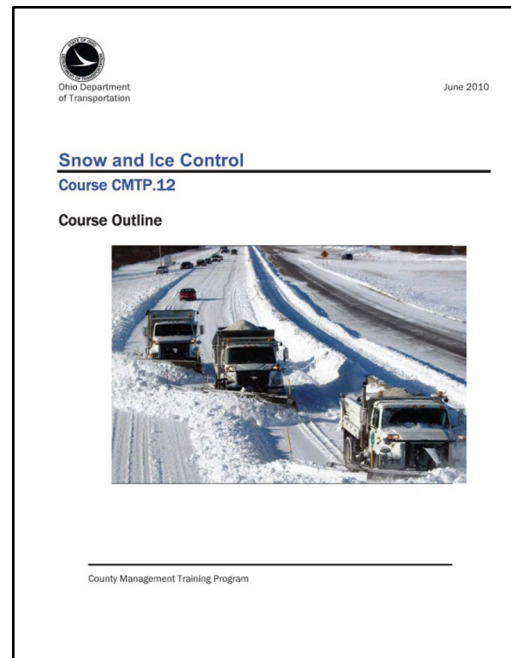


## Snow & Ice Training

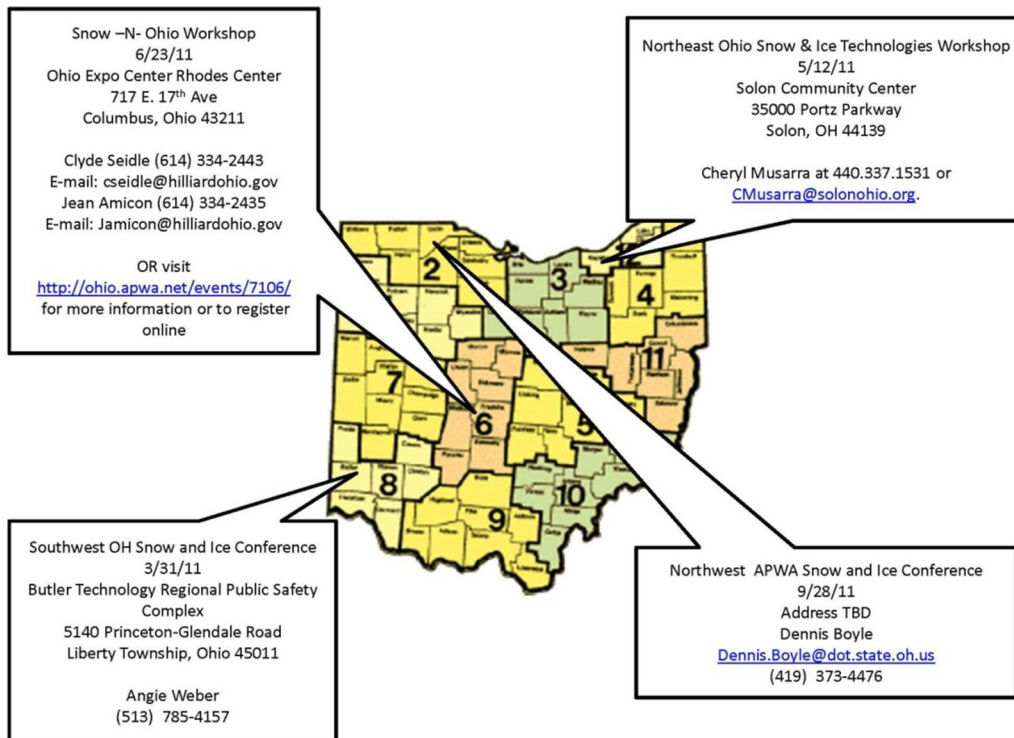
Numerous snow and ice training opportunities for state and local governments are made available through ODOT and the Office of Maintenance Administration. Internally, the Office of Maintenance Administration offers assistance to district and county annual snow and ice refreshers for operators and management staff. Additionally, assistance is provided upon request for any dry run events. Each year statewide training sessions are conducted on weather issues, contract weather services, and use and application of the Road Weather Information System (RWIS). The Office of Maintenance Administration has developed and instructs ODOT's Highway Technician Snow and Ice course as well as the County Manager Training Program Snow and Ice course. Each year the Office also conducts the Director's Cup Rodeo showcasing ODOT's top performing truck and loader operators from across the state.

Since 2007, staff from the Office of Maintenance Administration has performed the annual snow and ice circuit-rider training for LTAP. This outreach serves small and large communities alike and provides resources and references designed to assist locals with methods to improve the effectiveness and efficiency of their winter operations. The program is well received and promotes good relationships with local governments statewide.

Office staff provides assistance as well with numerous local and regional snow and ice control summits and workshops. Presentations are frequently performed upon request for local governments such as those for the City of Cincinnati Snow Summit and the Butler County Engineer's Summit. All levels of assistance are provided for the planning and conducting of regional snow and ice conferences that typically hosts over 200 attendees each. Conferences such as the Northeast Ohio Snow and Ice Technologies Workshop, now in its sixth year, and the APWA Southwest Ohio Snow and Ice Control Conference, now in its second year, are huge successes for state and local governments alike offering the forum for information and peer exchange among those dedicated to winter operations. 2011 will see the development of two additional APWA conferences, one to be held in central Ohio and the other in the Northwest as an effort to bring quality training and information sharing to all regions of the state. In addition to staffing from Central Office, assistance is regularly provided at the regional conferences through the respective districts offering the opportunity for networking and relationship development on the local level.







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## Recommended Performance Method (RPM) Book

By way of the annual Snow & Ice and County Operations Quality Assurance Reviews (QARs), the QAR Team has encountered several innovations and best practices developed by county and district personnel know as Recommended Performance Methods (RPMs). The RPMs include equipment modifications, computer applications, and operational procedures that are innovative methods used to improve operations. However, these innovative ideas rarely reach beyond the district boundaries and even the county boundaries. As the QARs provide an excellent opportunity to discover these practices, they also provide an avenue to promote these practices. Accordingly, the QAR team developed the RPM book to share the innovative ideas found during the QARs with other counties across the state. At each visit, a copy of the book is distributed to the county. The book is regularly updated as new RPMs are discovered.

Links: [RPM Book](#)

For more information contact:

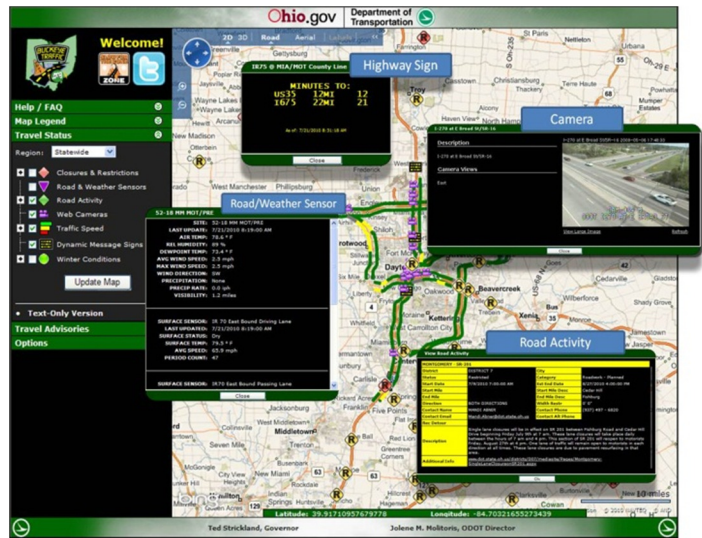
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## Applications

### Buckeye Traffic

Buckeye Traffic ([www.buckeyetraffic.org](http://www.buckeyetraffic.org)) is a website and application that provides Ohio travelers with up to date information on road conditions, traffic, construction, and other activity affecting roadways managed by the Ohio Department of Transportation. Information in Buckeye Traffic is updated frequently and comes from a variety of sources, such as pavement sensors and monitoring stations, traffic cameras, and through direct input by ODOT personnel.



Buckeye Traffic is an application that targets continuous improvement. It has also become one of ODOT's avenues to communicate with the public. Public users can now receive information by accessing the site or by using popular social networking sites. ODOT offers rush hour alerts for Ohio's major metropolitan areas on Twitter.com. Travelers can sign up to receive brief messages, or tweets, from ODOT's six different Twitter accounts (Akron, Cincinnati, Cleveland, Columbus, Dayton and Toledo). Tweets will **ONLY** occur for significant construction activities and major traffic incidents ODOT is made aware of during peak morning and evening rush hours.

Buckeye Traffic has now begun to incorporate traffic speeds into the application that allows users to view current traffic speeds in urban regions where Freeway Management System (FMS) traffic speed sensors have been installed. Dynamic Message Signs allow users to display dynamic message sign (DMS) devices in the map; and Highway Advisor Radio messages are also able to be viewed.

Buckeye Traffic data is captured in a database. The data can be queried through GQL for historic and analytic purposes.

Links: [www.buckeyetraffic.org](http://www.buckeyetraffic.org)

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## Contracted Weather Consulting Services

Timely weather information is critical to the manager. Although there are many weather information resources to choose from, all originate with the National Weather Service (NWS). NWS provides and coordinates base forecast models from around the world and maintains all of the primary radar and satellite devices. Radio, television, and internet weather re-distributing services are helpful, but ODOT retains a private weather consulting company which collects NWS data and interprets it specifically for snow and ice operational use. ODOT's agreement includes the following services:

### Qualified Staffing

Qualified meteorologists are on duty 24x7x365, holidays included. Meteorologists have formal meteorological training from an accredited college, university, or military institution and have at least four years of forecasting experience.

### Telephone Consultation

Live meteorological consultation via a toll free telephone number is provided to ODOT managers as needed, 24x7x365, holidays included. The consultant answers questions about published weather forecasts and alerts and offer knowledgeable information regarding current and expected weather conditions.

### Online Consultation

A blog-like forum is hosted and maintained by the consultant, which supports written questions and requests for road maintenance-specific meteorological consultation from ODOT staff. Questions and requests posted to this forum are answered in the blog forum of the Internet system within 15 minutes. Answers are provided by a qualified, experienced meteorologist who is familiar with Ohio's regional weather patterns. Questions, requests, and responses are available to ODOT staff on a 24x7x365 basis. This feature is supported on ODOT's authorized mobile access services.

### Pre-Storm Briefings

When requested, the consultant organizes and provides pre-storm conference call briefings for ODOT winter maintenance operations staff and other related governmental agencies authorized by ODOT before each major winter storm forecast to affect Ohio. The briefings include information specific to ODOT districts including:

- Expected storm behavior
- Amount, type, start, and stop times of significant precipitation
- Pavement temperatures and forecasts
- Probability that the forecast event will occur and any alternate storm behaviors that may be experienced
- Wind speed and direction; especially with respect to blowing/drifting snow and reduced visibilities
- Post storm conditions to address blowing/drifting snow, temperatures, re-freeze of pavement, etc.

Specific questions from ODOT management and field staff are answered during these conference calls and a written summary of the forecast briefing is provided following the call. A toll-free conference call number is supplied by the consulting service which can support up to 200 callers from ODOT simultaneously.

### Site-Specific Weather and Pavement Forecasts

171 site-specific weather and pavement condition forecasts which coincide with existing ODOT Road and Weather information Systems locations are provided by the consultant. Weather and condition data is extracted from ODOT's RWIS and included in the forecast model.

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## Road and Weather Information System (RWIS)

The National Weather Service (NWS), which provides resource data for all radio, television and internet weather providers, does not provide certain weather and condition information determined to be critical to highway Snow and Ice Operations. Specifically:

1. **Pavement Temperature** – Snow & Ice operations are directly impacted by the temperature of the pavement. Pavement temperature influences when a road surface treatment will begin or end, as well as what type of treatment is appropriate. Monitoring pavement temperatures provide insight as to how a selected treatment option is likely to perform. This then allows operational adjustments during an event based on actual data. NWS does not provide highway pavement temperature information.
2. **Pavement Condition** – Because of the natural limitations of radar and satellite, precipitation start times can be early or late by several hours.
  - a. **Precipitation which starts too early** can allow moisture to bond with a frozen pavement, creating a driving hazard and requiring de-icing operations which are approximately ten times more expensive than ODOT's preferred anti-icing solution. This often occurs when snow is falling but not detected by radar because the snow cloud is below the radar beam.
  - b. **Precipitation which starts too late (or not at all)** forces the agency to waste valuable resources such as fuel and overtime waiting on precipitation which radar and satellite



images indicate is imminent but is not hitting the ground because of dry air at the surface level. NWS has no detection method, which can accurately report when precipitation is falling on Ohio highways.

Faced with these challenges, ODOT purchased and installed 171 Environmental Sensing Stations (ESS) as part of a statewide RWIS. These stations are along every major Ohio highway and in all 88 counties. The system includes over 400 embedded pavement sensors which monitor the surface and sub-surface temperature of the pavement, as well as wet/dry conditions. Many also are capable of sensing salt on the roadway.

ODOT's RWIS is fully owned and managed internally by the agency in a model of cooperation between the Division of Information Technology who collects and manages the data, providing access to ODOT employees and the Division of Operations, who provides major funding and human support in highway maintenance. Field repairs are generally contracted out.

Employees access ODOT's RWIS 3 ways:

1. **Buckeye Traffic** provides RWIS information to the general public.
2. **ODOT's Weather Service Consultant** – RWIS data is collected via a public ftp site and populated within the consultant's contracted website. The purpose is to provide the employee with a one stop web location for all available weather products along with real time information.
3. **Scan Web** – Vendor created, ODOT maintained client-server software which provides the employee with a high level of data flexibility for determining condition trends, start/stop times, weather and condition changes and graphical reports. An excellent management tool for comparing a storm history to resources applied.

The RWIS and Scan Web Solutions, along with comprehensive weather and software training has greatly improved ODOT's snow and ice operations by equipping front line managers and first responders with a better understanding of how weather works, how it impacts operations, and how to monitor and react to changing conditions.

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## **Weather Support Services**

Weather data which can affect pavement conditions must be both timely and easily understood in order to be useful to the frontline manager, who has a multitude of tasks during winter operations. Often, forecasters and forecast products use models and meteorological terms which are difficult to follow. To address this, ODOT has a snow and ice response team, including a Road and Weather Information Systems (RWIS) Coordinator. Their job is to collect, decipher, and re-distribute pertinent weather and condition data. The data is then sent internally to frontline managers before and during weather



events. This group also provides continuous training and informational insights on the operational use of ODOT's as well as other weather systems, including the following:

#### **"RWIS Insights"**

RWIS frontline manager and first responder training that covers:

- methods of access into the system;
- how to read and interpret available data,
- how to use RWIS data in operations planning,
- how to use RWIS in storm tracking
- how to use RWIS history data,
- how to use RWIS data in after action reviews

#### **Weather Workshops**

Intensive, regional (district) and county workshops provide users with practical, working insights of weather service products and services, such as:

- Radar (why it sometimes doesn't help)
- Satellite Images
- Weather Systems Types and Patterns
- Atmospheric Conditions (dew point)
- Precipitation Issues
- Salt and Other Ice Fighting Materials

#### **Storm Monitoring and Consultation**

Prior to and during weather events, this team monitors changing weather conditions, interprets forecasts and informs pre-determined ODOT personnel of relevant information. This team is on call from October to April and continuously on duty during any major storm event. The team answers questions, researches information, and sends text message updates to managers as needed.

Additionally, when needed, this group provides assistance with:

- Emergency approvals for repairs or purchases,
- Emergency re-allocation of equipment assets from other ODOT facilities less impacted by the event.

#### **Pre-Storm Teleconference Briefings**

This team provides coordination of statewide pre-storm teleconferences with ODOT management personnel and ODOT's weather consulting company as well as the National Weather Service. During these conferences, high level information from Senior ODOT Leadership or policy/procedure updates are also shared as needed.

These pro-active steps allows the ODOT Headquarters to partner with district and county management and first responder teams in accomplishing effective snow and ice control statewide. This enables our entire agency to be second to none in snow and ice control.

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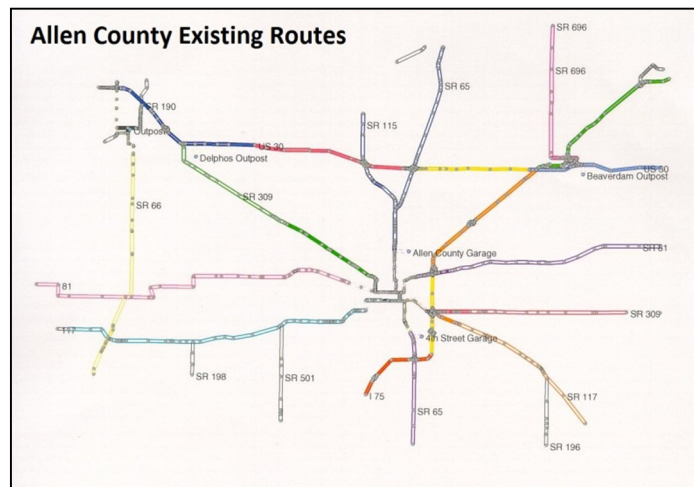
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## WinterPlan

ODOT utilized WinterPlan, a snow and ice route optimization software program, in an attempt to reduce route cycle times and increase the efficiency of snow and ice routes across the state. The program used several variables input by the user including county garage location, outpost location, number of trucks, truck capacity, material application rate, treating speed, and deadheading speed to optimize the snow and ice routes for any one county. After the software completed the route optimization, the resulting routes were



plotted on a map and information such as route distances and completion times were available to the user. Ideally, the optimized routes could then be compared to the existing routes to improve efficiency. However, the program had several limitations that prevented it from providing real-life routing scenarios. For example, the software had trouble routing complex interchanges and ramps within urban areas. As a result, urban areas could not be evaluated. Additionally, the program was extremely time-consuming to operate and cost prohibitive to purchase for all counties. Due to these drawbacks, the program was discontinued.

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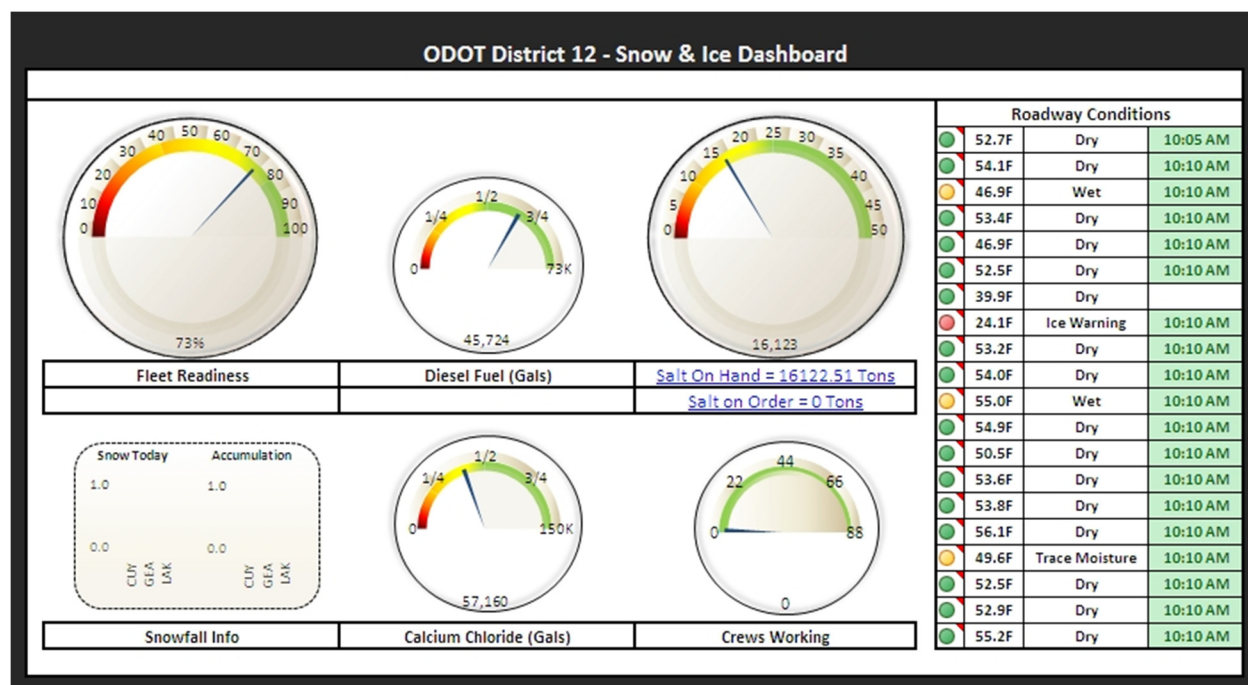
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## Snow & Ice Dashboard

The staff in District 12 created a "Dashboard" that displays and summarizes all critical data on a district wide basis as used within their winter operations. It automatically updates every 15 minutes providing the most current available information as related to the district's winter operations. By centrally locating all associated data, the "Dashboard" prevents managers and administrators from needing to look at several different applications to find and summarize critical winter maintenance information.

At a quick glance the District’s status of all critical operational resources can be viewed through the “indicator gauges” representing:

- Fleet Readiness
- Diesel Fuel – Gallons on hand
- Salt – Amount on hand and amount on order
- Snowfall – Amount per county with both daily totals and total accumulations
- Calcium Chloride – Gallons on hand
- Crews working
- Roadway Conditions – Surface condition and temperature for each of the District’s 20 Road & Weather Information System (RWIS) sites



Information to populate the “Dashboard” indicators is pulled from various data sources and identified as separate tabs within the master spreadsheet in the event specific details are required on any particular attribute. Spreadsheet tabs include: Main Gauges, Operational Readiness, Truck Reports, Road & Weather Information System (RWIS) Status and Data, Fuel Data, Truck Data, Salt Data, Calcium Data, Crews Working, Gauge Metrics, and Salt on Order.

Links: [Snow & Ice Dashboard](#)

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## Salt Usage Awareness

District 12 has developed a Salt Usage Awareness spreadsheet for each maintenance garage to better track overall salt usage and to help their plow drivers become more aware of their usage per lane mile. Standard bucket volumes were measured for various sizes of front loaders in the district; small (2.10 CY), medium (2.50 CY), and large (2.75 CY). As the drivers load their trucks, they are required to count the buckets of salt loaded. At the end of their shift, each driver records the total number of buckets loaded and the total number of miles driven on their daily snow and ice operations report. This information is then entered in the salt usage awareness spreadsheet which calculates total facility usage and miles driven as well as the pound per mile usage for each driver and the facility. The total facility usage is then transferred to the Daily Work Report and entered in the Transportation Management System (TMS) database. The usages per mile calculations allow managers to compare driver application rates. Any anomalies are used as teaching points with the drivers to improve operations.

02 2 11		Enter The Transaction Date Here				<input checked="" type="radio"/> Small (2.1 CY) <input type="radio"/> Medium (2.50 CY) <input type="radio"/> Large (2.75 CY)					
<b>WARRENSVILLE SALT USAGE AWARENESS 02-02-11</b>											
<b>(12:00 AM-4:30 AM)&amp;(12:00AM-8:30 AM)</b>				<b>8:00:00 AM - 4:30 PM</b>				<b>12:00 PM - 8:30 PM</b>			
<b>Shift 1</b>	<b>Miles</b>	<b>Buckets</b>	<b>Lbs/Mi</b>	<b>Shift 2</b>	<b>Miles</b>	<b>Buckets</b>	<b>Lbs/Mi</b>	<b>Shift 3</b>	<b>Miles</b>	<b>Buckets</b>	<b>Lbs/Mi</b>
G Lewis	125	8	296	Victor Brown	88	5	263	Antonio Clark	54	2	171
J. Stirmire	83	8	445	Bill Weimer	125	6	222	Omar Parker	186	12	298
B. Bivins	102	4	181	Joe Arcuri	135	10	342				0
Jackson	97	7	333	Joe Marnix	253	10	183				0
D. Camp	115	2	80	Keith Moore	50	1	92				0
Schenek	150	3	92	Maurice Davis	157	9	265				0
Looymans	150	6	185	Brian Keefe	200	7	162				0
Ponticelli	148	6	187	Paul Sota			0				0
G. Head	46	4	402	Enrico Banks	120	1	39				0
F. Turpin	145	5	159	Ron Wilson	198	6	140				0
K. Jacobs			0				0				0
J. Derthic			0				0				0
L. Scott			0				0				0
<b>Shift 1 Totals:</b> 1161 Miles, 53 Buckets (122.43 Tons)				<b>Shift 2 Totals:</b> 1326 Miles, 55 Buckets (127.05 Tons)				<b>Shift 3 Totals:</b> 240 Miles, 14 Buckets (32.34 Tons)			
<b>Shift 4</b>				<b>8:00PM - 12:00PM</b>				<b>2.1</b>			
G Lewis	53	0	0					G Lewis	53	0	0
J. Stirmire			0					J. Stirmire			0
B. Bivins			0					B. Bivins			0
Jackson	21	4	880					Jackson	21	4	880
D. Camp			0					D. Camp			0
Schenek	60	4	308					Schenek	60	4	308
Looyman	71	3	195					Looyman	71	3	195
Ponticelli	43	0	0					Ponticelli	43	0	0
G. Head			0					G. Head			0
F. Turpin			0					F. Turpin			0
K. Jacobs			0					K. Jacobs			0
J. Derthic			0					J. Derthic			0
L. Scott	53	3	262					L. Scott	53	3	262
<b>Shift 4 Totals:</b> 301 Miles, 14 Buckets (32.34 Tons)								<b>Shift 4 Totals:</b> 301 Miles, 14 Buckets (32.34 Tons)			
<b>TOTAL FACILITY MILES</b> 3028				<b>TOTAL FACILITY BUCKETS</b> 136				<b>TOTAL FACILITY TONS</b> 314.16			
								<b>AVG FACILITY DAILY LBS/ML</b> 207.5			
<b>COMMENTS:</b>		FORECAST - ACTUAL -						Submit File			

Links: [Salt Usage Awareness](#)

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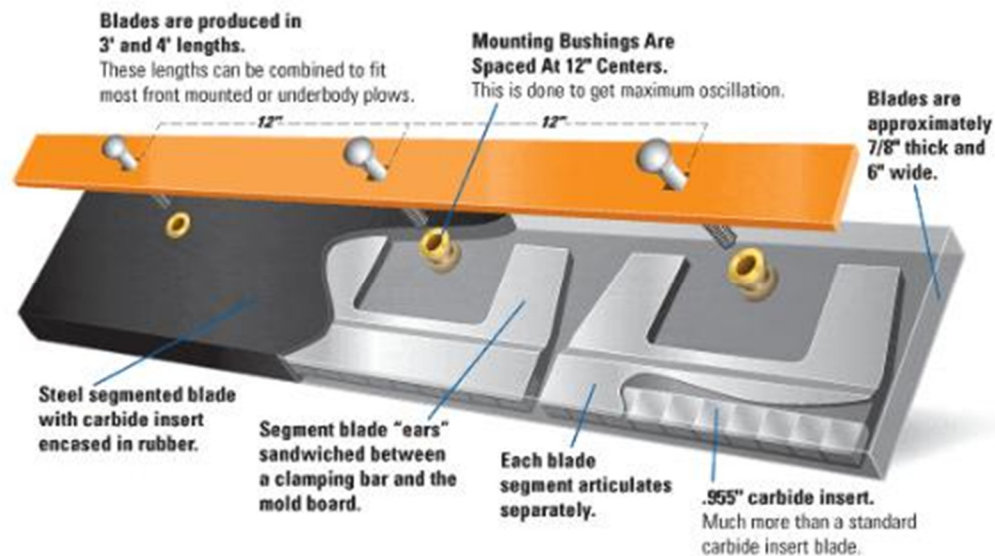
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## Research

### Joma Plow Blade Evaluation

The Office of Maintenance Administration developed a report consolidating and summarizing information acquired through the Ohio Department of Transportation's and other highway maintenance agencies' experiences with Joma plow blades. Benefits of the Joma blade include no metal-to-metal contact between the blade and plow, vibration and noise reduction, and better conformation to the contour of the pavement. Proponents of the Joma blade contribute these factors to longer blade life when compared to the life of conventional steel blades. In fact, ODOT's Lake County has experienced four times longer blade life when using Joma blades, and their mechanics have spent seven times fewer labor hours repairing Joma blades compared to repairs made to steel blades. Other agencies have experienced similar increased blade life and reduced blade maintenance including the Franklin County Engineer's Office and the Pennsylvania Department of Transportation.



Links: [Joma Blade Evaluation Report](#)

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## Tow Plow

District 4 is currently testing ODOT's first Tow Plow on I-90 and SR 11 in Ashtabula County. The Tow Plow, on loan from Viking-Cives Ltd. of Mount Forest, Ontario, Canada for the 2010-2011 winter season, allows Ashtabula County to more efficiently and effectively utilize their snow and ice resources. A plow-equipped tandem truck pulling the Tow Plow can clear and treat 22 feet of pavement, essentially clearing the same width of pavement and treating the road surface with the same quantity of material as two plow trucks and two plow drivers. The Tow Plow is equipped with a six ton capacity hopper and material spreader. However, a wetting system and liquid storage tank can be added. Although modified, the existing hydraulic controller operates the plow including swinging the plow to the right and left, lowering and raising the plow blade, and controlling the material output of the spreader. At the conclusion of this winter's testing period, ODOT will evaluate the results and consider adding the Tow Plow to the snow removal fleet.



Links: [ODOT District 4 New Release](#)  
[Tow Plow Video](#)  
[Viking-Cives Tow Plow Brochure](#)

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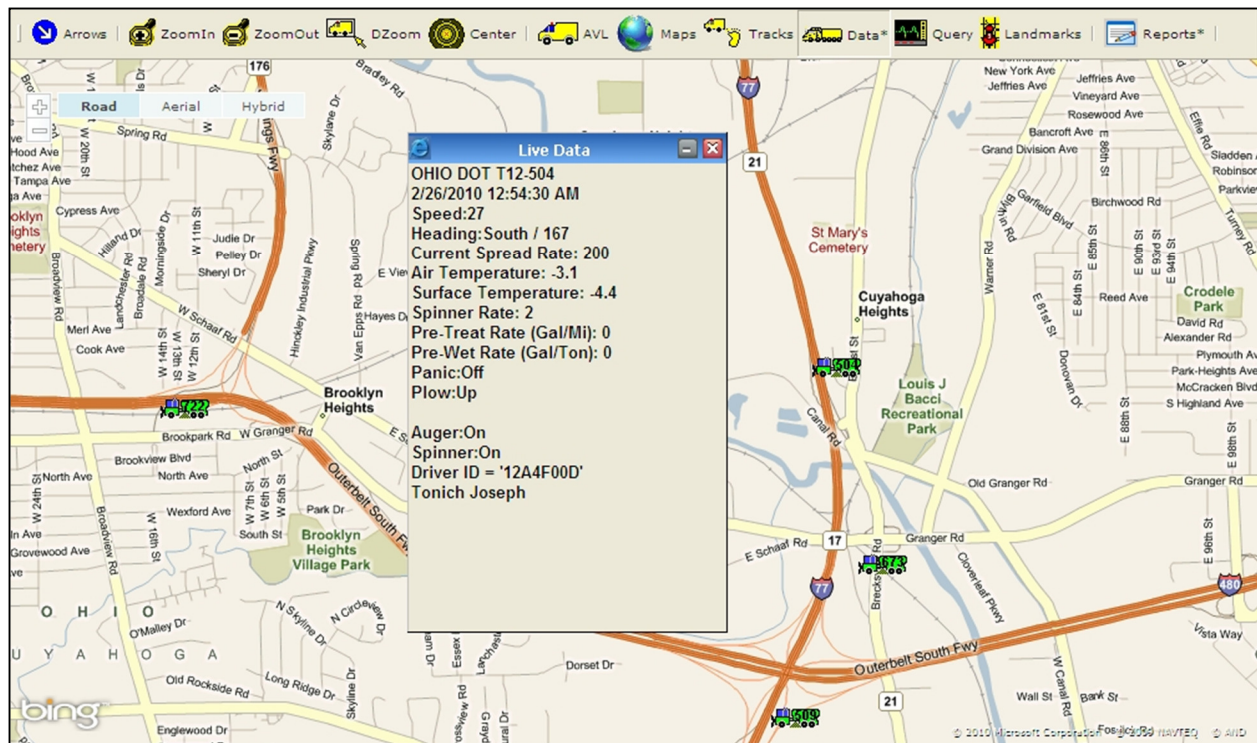
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## GPS/AVL Resource Management Pilot

The Office of Maintenance Administration in conjunction with District 12 is currently conducting the GPS/AVL Resource Management System Pilot at the Independence Yard in Cuyahoga County. Ten trucks are equipped with GPS units that interface with and collect data from the Pengwyn hydraulic controller, RoadWatch temperature sensor, and plow position sensor. The system allows its users to track snow and ice vehicles as well as manage the resources used to fight winter storms. By means of cellular technology and a standard web browser, each vehicle's location, speed, direction, plow position, spinner status, spinner rate, auger status, solid material application rate, liquid material application rate, pavement temperature, and air temperature is tracked and displayed on a dynamic mapping system in both real-time and historical modes. Snow and ice operations managers can utilize the GPS/AVL system to monitor their operations and make decisions based on the real-time information they are receiving from the system.



## Pilot Goals

1. Determine the benefits and advantages of using the system in managerial decision making during winter operations
2. Estimate any potential cost savings the system may provide based on material, fuel, labor, etc.
3. Validate the accuracy and reliability of the data collected
4. Assess all the information collected by the system to determine the data's relevancy to winter operations
5. Establish user buy-in to the system by communicating with and involving the truck operators
6. Automate daily logs for snow and ice control – M&R 661
7. Improve efficiency of snow routes and cycle times
8. Evaluate all technical aspects (hardware, software, communications, etc.) of the system to find and repair any flaws prior to expanding the program
9. Determine the viability of moving forward with full scale implementation

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## Loader Scale Informational Report

With the increase of salt prices in recent years, many highway maintenance agencies have invested in loader scales to assist in measuring salt usage and tracking salt inventory. As a result, the Office of Maintenance Administration prepared an informational report on loader scales to gain a better understanding of how the scales work, who are the companies that manufacture the scales, and what benefits could the scales potentially provide. The report provides general information to parties interested in purchasing or testing loader scales including scale operation, data acquisition, past experiences, current users, and equipment cost.



Links: [Loader Scales Informational Report](#)

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## Alternate Color Strobe Lights

Throughout the past year, ODOT has explored various ways to minimize rear end collisions involving plow trucks during snow and ice events. For the most part, these collisions have been the result of excessive speed and inattentiveness of the driver rear-ending the plow truck. However, if the trucks were more visible to the motoring public, could the number of collisions be reduced? Therefore, the Office of Equipment Management began researching alternate colored strobe lights that could possibly make the trucks more visible.



As per the Ohio Revised Code, ODOT plow trucks are required to operate with amber warning lights. Initial research provided varying opinions both for and against the effectiveness of amber lights. According to the research, one major disadvantage of amber, yellow, and red warning lights is that these colors penetrate blowing snow and fog less effectively. Additionally, the traveling public has become complacent to the warning effect of amber lights as dump trucks, tow trucks, garbage trucks, and other utility vehicles with amber lights are common place on highways. As a result, the Office of Equipment



Management has obtained and is currently testing various colors of strobe lights including red, white, green, blue, amber, and purple with the goal of determining which colors are more visible in winter conditions. Each strobe has four LEDs that can be all one color or a combination of two colors. If one color or combination of colors is found to be more effective, the new color or colors may be incorporated with the existing front and mid-mount amber strobe lights to create a unique color pattern for ODOT plow trucks.

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### Real Time Traction Tool (RT3)

From 2001 to 2010, ODOT incorporated the Real-Time Traction Tool (RT3) as a tool to aid both managers and drivers in snow and ice operations. The RT3 developed and manufactured by Halliday Technologies, Inc., provided continuous, “real-time”, objective road grip/friction information to the operators of vehicles fitted with this equipment via an in-cab mounted display box. Two types of



RT3 systems were utilized by ODOT, an “underbody” style, attached to the underside of snow trucks and a “tow-behind” style, attached to pickup trucks via a Reese hitch. The underbody style was used by an operator responsible for treating pre-assigned routes while the tow-behind style was suited for a supervisor who wished to have roads in his jurisdiction ‘patrolled’ to determine if, or when, snow trucks should be deployed, or whether an existing deployment could be terminated.



Through the years, ODOT gradually increased the deployment of the RT3, but much of its use prior to 2008 was ‘experimental’ in nature. The purpose of the experimentation was to evaluate the unit’s durability, and to verify the accuracy, repeatability, and reliability of the grip readings. A significant amount of data was collected and analyzed over multiple years by the Office of Maintenance

Administration. The analysis performed indeed confirmed the accuracy, repeatability, and reliability of the readings, as well as the durability of the unit.

Prior to the onset of the 2008-2009 winter season, it was established that the primary goal of the upcoming season's RT3 program would be to determine to what extent departmental cost savings could be realized through ODOT's deployment of RT3's. As a result, Franklin County in District 6 escalated the use of the RT3 units to the highest level and deployed sixteen units throughout the county. Three separate winter events from the 2008-2009 winter season were analyzed. Through usage of the RT3, cost savings for each event were estimated to be \$9,662 (a 69% reduction from the normal course of treatment), \$11,918 (26% reduction), and \$20,651 (40% reduction). A more detailed analysis and comprehensive overview of ODOT's experience with the RT3 is included in RT3 Report 1 titled "Analysis of Halliday Real-Time Traction Tool (RT3) Deployment & Potential Cost Savings for ODOT - Franklin County: Winter 2008-2009."

Moving into the 2009-2010 winter season, the RT3's were again deployed in the same manner as the previous winter. However, since the RT3's use as a cost saving device had already been proved, the focus shifted to determining if the RT3 could be used to measure the performance of ODOT's snow and ice operations. During the evaluation, the following issues were identified that illustrate the difficulty in using the RT3 to measure the performance of snow and ice operations.

- Grip/friction data alone is not a sufficient measure of performance of snow and ice operations.
- The web user-interface currently used does not provide a truck's salt usage.
- The small number of RT3's in use makes it impossible to measure the performance of an entire county for a single winter event. Consequently, an overall post-winter measure of performance of the county cannot be determined.
- The web user-interface currently used to access grip data is inadequate.

A more detailed analysis of the RT3's use in the development of a snow and ice operations performance measure is included in RT3 Report 2 titled "Use of Halliday Real-Time Traction Tool (RT3) to Measure Performance of Snow & Ice Operations – Franklin County: Winter 2009-2010."

Early in 2011 after several years of testing and analysis, the Office of Maintenance Administration decided to move on from the experimental and research phases of the project and proposed moving responsibility of the RT3 program to the districts. Subsequently, the districts currently using RT3 units were given the option to continue their use with all aspects of the project moving under the district's control. Citing various problems with the RT3 units including difficulty interpreting the enormous quantity of data produced, maintenance burden, safety hazards, radio interference, and driver distraction, the districts opted to end participation in the program. Based on these responses, high cost of the units, problems with the accompanying website, and recommendations made in the second RT3 report, the Office of Maintenance Administration determined it was in the best interest of the Department to discontinue the RT3 program.



Links: [2008-2009 RT3 Report 1, Potential Cost Savings, April 24, 2009](#)  
[2009-2010 RT3 Report 2, Performance Measures, July 22, 2010](#)

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## Clear Roads

Clear Roads is an ongoing pooled fund research project aimed at rigorous testing of winter maintenance materials, equipment, and methods for use in highway maintenance. Launched in 2004 by experienced winter maintenance professionals, Clear Roads fulfills the need for practical experience-based research. ODOT has been an active member in Clear Roads since 2005 and has contributed to and benefited from the research conducted by the members including the Winter Safety Campaign and the Multiple-Blade Snowplow Project.

Links: [www.clearroads.org](http://www.clearroads.org)

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## Winter Safety Campaign

The Winter Safety campaign was launched by Clear Roads in 2007 and is used by many DOTs across the country including ODOT. Many state and local agencies have customized the campaign materials to promote their own messages within their area of influence. With the help of numerous volunteer public information officers from around the country, Clear Roads has initiated a national multimedia winter driving safety campaign using the slogan "Ice and Snow...Take It Slow." Clear Roads has developed a standard logo and a range of sample campaign materials for customization by state and local organizations for their winter safety programs. ODOT has utilized the Winter Safety campaign in an effort to remind the traveling public to remain safe during winter driving conditions. These efforts have included partnering with Wal-Mart to display informational posters at store entrances, providing promotional literature to the public, and placing "Ice & Snow...Take It Slow" decals on all of District 12's snow plow trucks.





Links: ["Ice & Snow...Take It Slow" Wal-Mart Poster](#)

["Ice & Snow...Take It Slow" Info Card](#)

["Don't Crowd the Plow" Poster](#)

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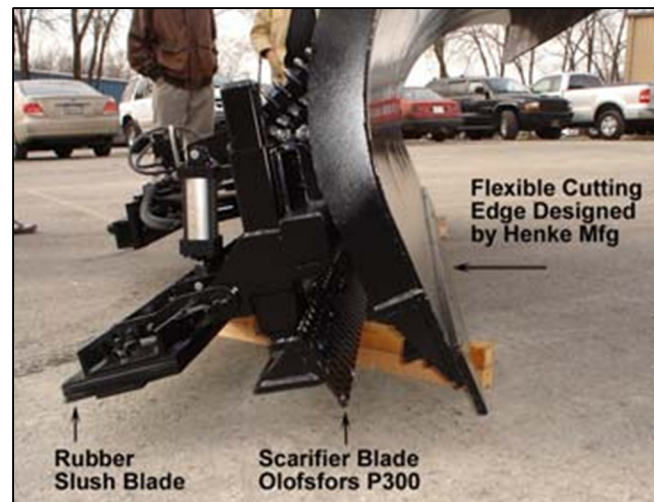
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### Multiple-Blade Snowplow Project

In conjunction with four other Clear Roads member states – Indiana, Iowa, Minnesota, and Wisconsin – ODOT recently participated in the Clear Roads Multiple-Blade Snowplow project. The group initiated a request through Clear Roads to explore possible interest of private sector entities to design a multiple plow blade system as an alternative to the traditional front-mounted snowplow blade. Interested parties were asked to submit proposals for a snowplow that utilized a series of blades to remove snow and ice from pavement surfaces. Each blade had to perform under the different road conditions encountered by operators including pavement contours, hard pack, ice, snow, and slush.



Links: [Multiple-Blade Snowplow Project Final Report](#)

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## Aurora Program

ODOT participates in the Aurora Program, a group of U.S., Canadian, and European highway maintenance agencies that collaborate in the research, development, and deployment of Road and Weather Information Systems (RWIS). Launched in 1996, the program conducts research initiated and funded by the member agencies for the purposes of improving highway maintenance via RWIS through the advancement of road condition and weather monitoring and forecasting. Participation in the Aurora Program enhances ODOT's winter operations through the sharing and exchange of valuable RWIS and road weather related information on a national and international level.

Links: [www.aurora-program.org](http://www.aurora-program.org)

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