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Use of Dashboards for Winter Operations Case Study: Ohio Department of Transportation

Clear Roads Project 22-05: Use of Dashboards for Winter Operations

December 2024

Technical Report Documentation Page

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16. Abstract Public works agencies at state and municipal levels have invested a large amount of personnel and funding resources in dashboards to improve winter maintenance operations. This document is one of the five case studies conducted for the Clear Roads project entitled *Use of Dashboards for Winter Operations*. This case study report summarizes the Ohio Department of Transportation's experiences and lessons learned in using dashboards to support winter maintenance. The case study identifies the purpose of each Ohio DOT dashboard, the performance measures tracked, the data sources, how the dashboards are maintained, difficulties encountered, and key lessons learned.			
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1. Overview of Ohio DOT Dashboards for Winter Operations

This section provides an overview of this Case Study report detailing how the Ohio Department of Transportation (Ohio DOT) has used dashboards for winter operations.

1.1 Case Study Background

This research project is being funded through the Clear Roads pooled fund program to develop Case Study Reports documenting how multiple State DOTs and public works agencies use dashboards for winter operations.

1.2 Agency Characteristics

Ohio DOT is divided into 12 districts as shown in Figure 1.

Figure 1 Ohio DOT Districts

ODOT manages 42,700 total lane miles with 1,700 state-owned plow trucks with over 2,360 state employees and 350 seasonal workers. ODOT maintains 95% of the state-owned roadways. In the 2022-2023 winter season, ODOT applied approximately 403,800 tons of sodium chloride and 9,126,000 gallons

of liquids (sodium chloride brine and calcium chloride brine). The cost of salt last season was $60.20 per ton resulting in $25.0 million dollars for material costs. The average accumulated winter season index was 238[1]. These data were reported to Clear Roads Winter Data Survey.

1.3 Agency Interviews

An interview was conducted virtually with Ohio DOT staff on Wednesday January 24th, 2024, at 12 PM EST on use of dashboards for winter operations. Table 1 contains a listing of the staff interviewed and the subjects discussed in those meetings. Appendix B to this report contains meeting minutes from the interview.

Table 1 Staff Interview Details

Staff Interviewed	Date / Time	Subjects Discussed
Dean Alatsis	Jan. 24th, 2024 / 12:00 PM	Dashboard objectives
Ryan Lowe, PE		Description of each dashboard
Tim Filla		Limitations of each dashboard
Stephanie Marik, PE		Process for developing a new dashboard
Joshua Thieman		Data accuracy
		Data storage and management
		Dashboard maintenance
		Costs
		Benefits of dashboards
		Recommendations and lessons learned
		Future enhancements

2. General Overview of Winter Dashboards

The ODOT started dashboarding with a goal to transform the data on spreadsheets into user friendly dashboards. While they have not developed dedicated dashboards for snowplow Global Positioning System (GPS)/Automatic Vehicle Location (AVL) data, they recognize the potential and do offer a mobile-friendly GPS/AVL dashboard and are piloting a "real-time evaluator" tool. The real-time evaluator tool, or in other words the real-time snow and ice dashboard, visualizes current conditions such as vehicle speed and weather data. Vehicle speed data are gathered from probe data, and weather data are obtained from road weather information system (RWIS). Additionally, ODOT has a Snow and Ice Performance

[1] https://mrcc.purdue.edu/research/awssi/indexAwssi.jsp

Evaluator Tool Dashboard that is a comprehensive solution for analyzing post-storm snow and ice removal performance across districts. The Snow and Ice Performance Evaluator Tool performs post-storm analysis and shows the route recovery performance metric, aiding managers in evaluating staffing and operational efficiency. ODOT does a Mobile AVL Dashboard to view number of trucks available in a district, compared to how many being used at a glance on a mobile device. The Snow and Ice Dashboard is a crucial tool for maintaining efficient snow and ice removal throughout the season. It requires strategic planning and resource allocation, serving as an essential resource for both district-level and county-level managers. In short, ODOT is actively weaving data visualization into their decision-making, and integrating GPS/AVL data is likely on the horizon.

2.1 Real-Time Snow and Ice Dashboard

The real-time snow and ice dashboard checks if winter maintenance goals are met during a snowstorm. It also evaluates snow and ice data in real time and allows users to view vehicle speed and RWIS data. Figure 2 shows a screenshot of the real-time snow and ice dashboard. Table 2 provides an overview of the real-time snow and ice dashboard.

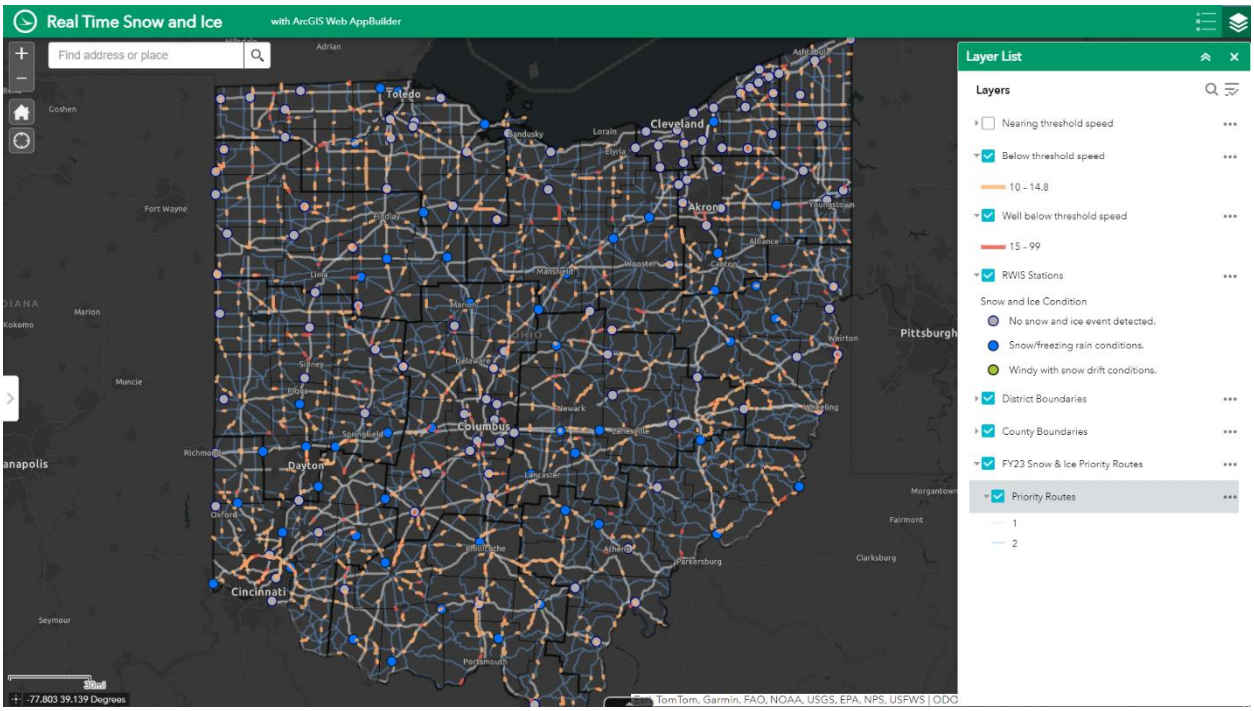


Figure 2 Real-Time Snow and Ice Dashboard

Table 2 Real-Time Snow and Ice Dashboard Overview

Purpose	Checks if winter maintenance goals are being met during a snowstorm. Evaluates snow and ice data in real time and allows users to view probe data and RWIS data. Helps aid in the allocation of resources.
Performance Measures	Speed conditions, weather conditions
Data Sources	Speed data (via INRIX), weather data (via RWIS)
Refresh Rate	Real-time/ every few minutes
Users/Access	County managers
Platform/Software	ESRI

Fueled by data from two sources, the map displays both speed and weather information. Speed data, gathered through the INRIX API, allows for comparison with expected speeds on each road segment. Deviations are highlighted in orange and red, indicating potential slowdowns and areas requiring intervention. Additionally, internal RWIS data provides real-time updates on weather conditions, allowing managers to anticipate further challenges.

With data refreshed every few minutes, the map acts as a dynamic command center. County managers can monitor performance against set goals, allocate resources strategically, and make informed decisions based on the latest conditions. This empowers them to respond proactively to storm events, enabling efficient snow and ice removal and maintaining public safety. While the dashboard is currently limited to internal access, the real-time snow and ice web map plays a vital role in keeping the county moving during winter storms.

2.2 The Snow and Ice Performance Evaluator Tool Dashboard

The Snow and Ice Performance Evaluator Tool Dashboard is a comprehensive solution for analyzing post-storm snow and ice removal performance across districts and counties. It is designed to identify routes that have not met recovery goals, with a benchmark set at 96% recovery. This tool allows for a detailed exploration of these routes. Table 3 and Figure 4 show examples of the Snow and Ice Performance Evaluator Tool Dashboard. Table 3 provides details of the real-time snow and ice dashboard.

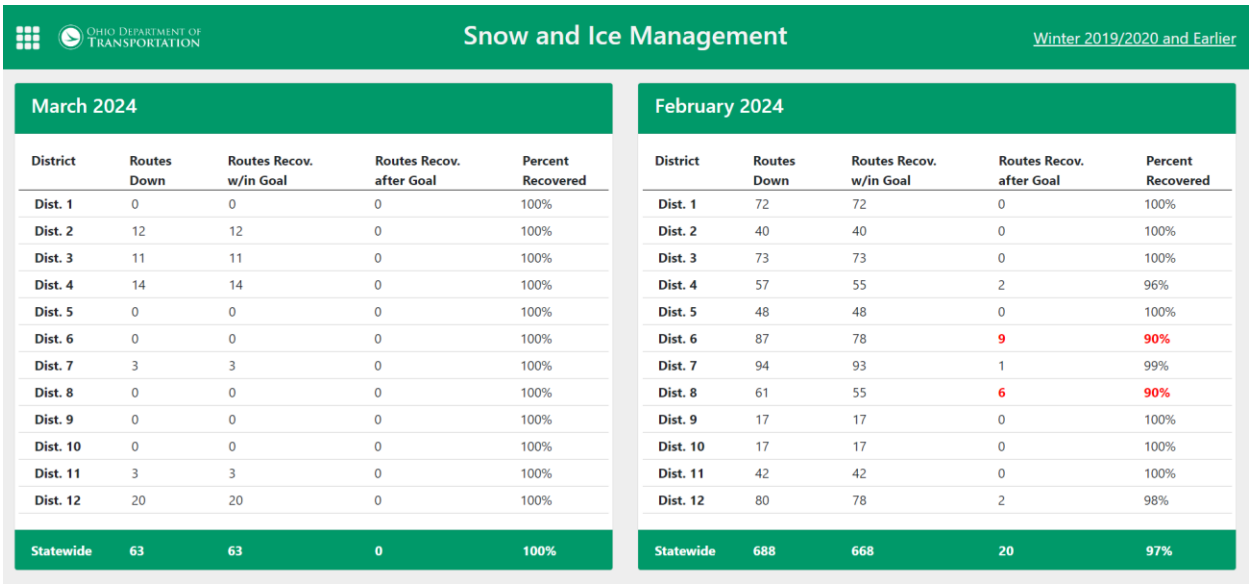


Figure 3 Snow and Ice Performance Evaluator Tool Dashboard - Statewide View

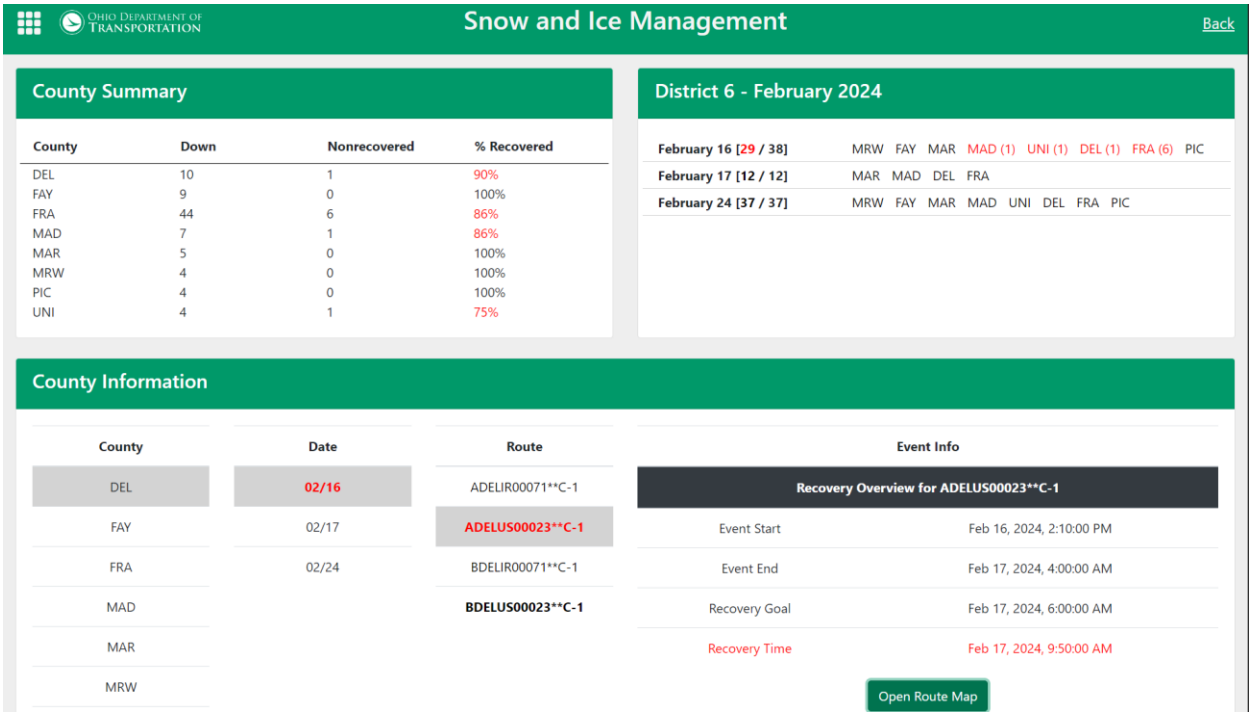


Figure 4 Snow and Ice Performance Evaluator Tool Dashboard - District View

Table 3 Snow and Ice Performance Evaluator Tool Dashboard Overview

Purpose	Determine if recovery goals are being hit after a snowstorm and organize it by district and county.
Performance Measures	Storm start, storm end, recovery goal, time recovered
Data Sources	RWIS, INRIX
Refresh Rate	Monthly
Users/Access	District highway managers and county. Results are used by leadership.
Platform/Software	Python/SQL, TSMO data warehouse
Source	https://www.apwa.org/resource/snow-ice-performance-evaluator/

As shown in Table 3, the snow and ice performance evaluator tool dashboard to determine if recovery goals are being hit after a snowstorm and organizes it by district and county. It is a comprehensive solution for analyzing post-storm snow and ice removal performance across districts and counties. It is designed to identify routes that have not met recovery goals, with a benchmark set at 96% recovery. This tool allows for a detailed exploration of these routes.

The performance measures within the dashboard are multifaceted. It tracks recovery goals and times for different priority routes, with a 2-hour goal for priority 1 routes and a 4-hour goal for priority 2 routes. The tool measures the downtime for each route based on real-time probe speed data provided by INRIX. It also defines the start of a storm based on a combination of RWIS and probe data and to end a storm, only RWIS data is considered. The probe data is then utilized to determine the route recovery which accounts for both weather conditions and speed impact. The success of recovery is measured by how quickly after the end of a storm routes return to speeds that are within 10 mph of the historical average speed recovery is achieved when a route is within 10 mph of the historical speed for at least one consecutive hour.

The dashboard utilizes multiple data sources. INRIX provides real-time speed data for tracking downtime, while RWIS triggers the start and end of a storm and helps define recovery periods. The Transportation Systems Management and Operations (TSMO) data warehouse houses historical speed data, which is used to measure recovery success.

From a technical standpoint, this dashboard is powered by Python and SQL scripts that process data and drive analysis. The results are displayed on a website that allows for interaction. After each storm, a manual trigger is activated for analysis and reporting. To keep leadership informed, quarterly reports summarizing overall performance are sent out.

The functionality of the dashboard is designed to be user-friendly and informative. A Statewide/District view allows leaders, Highway Maintenance Administrators (HMA), and Roadway Service Managers to analyze performance within their areas, while a county-wide view offers managers an overview of the effectiveness of the storm response. Route details are available for a more granular analysis, particularly for specific routes that have not met recovery goals. Managers can provide feedback to be incorporated into the dashboard about incidents that may impact recovery.

2.3 Snow and Ice Dashboard

The Snow and Ice Dashboard is a crucial tool for maintaining efficient snow and ice removal throughout the season. It requires strategic planning and resource allocation, serving as an essential resource for both district-level and county-level managers.

The dashboard tracks the usage of materials such as salt and sand throughout the season, presenting yearly totals and historical snapshots dating back to 2015. It also offers real-time insight into the current material inventory across all garages, ensuring preparedness for upcoming storms. Additionally, it allows for the analysis of labor hours, truck miles, and total costs associated with snow and ice removal efforts, offering valuable insights into operational efficiency. Figures 5 through 7 show examples of the dashboard.

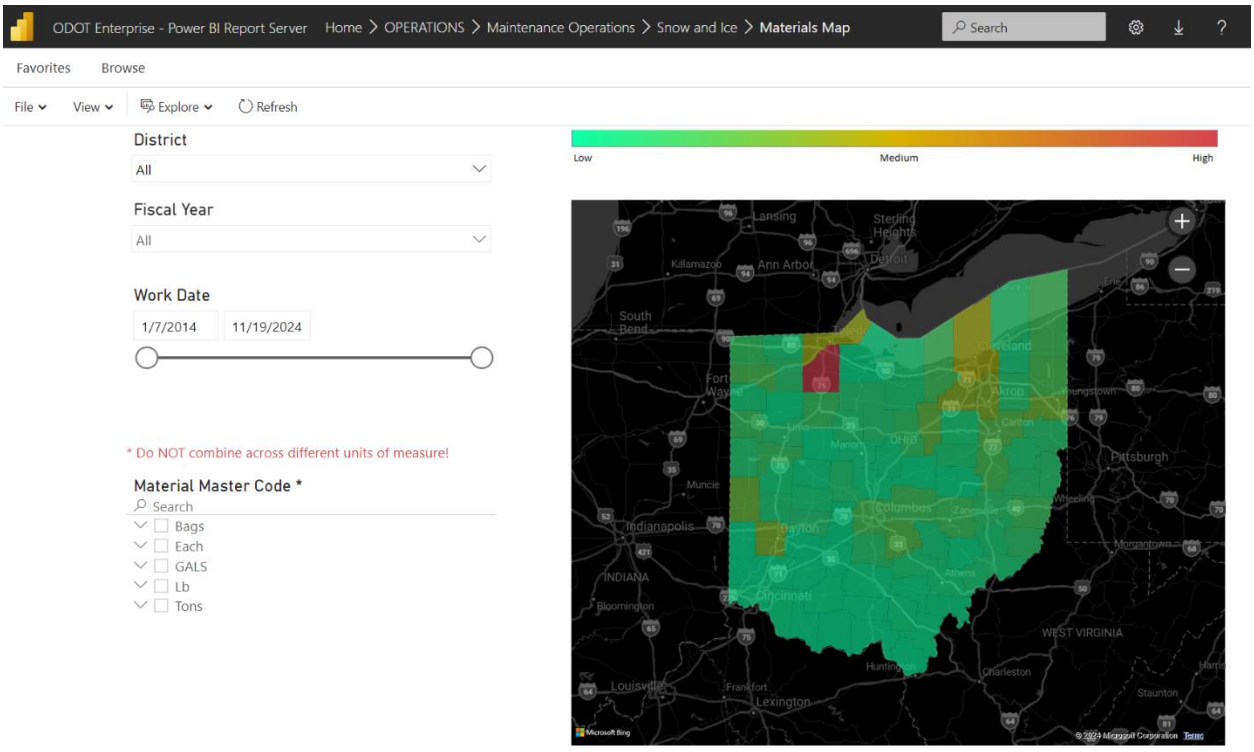


Figure 5 Snow and Ice Material Map

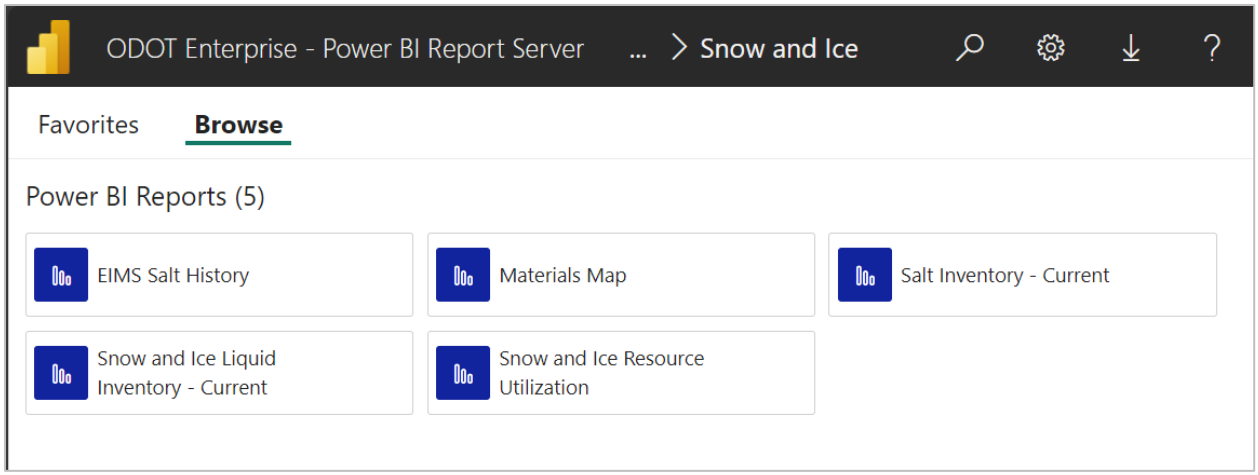


Figure 6 Snow and Ice Maintenance Operations

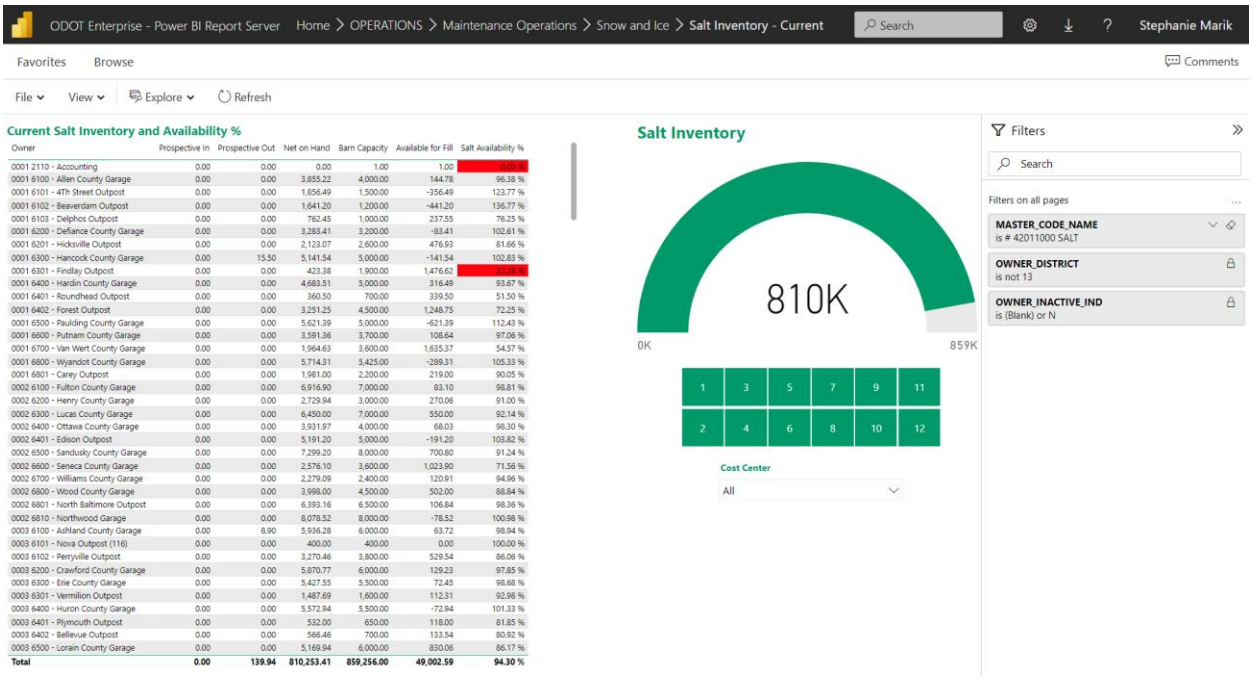


Figure 7 Snow and Ice Dashboard

As shown in Table 4, The Snow and Ice Dashboard Resources Reporting Dashboards are a crucial tool for maintaining efficient snow and ice removal throughout the season. They require strategic planning and resource allocation, serving as an essential resource for both district-level managers and the HMA.

Table 4 Snow and Ice Resources Reporting Dashboards Overview

Purpose	Provides an overview of materials and costs for each season
Performance Measures	How much material was used in the season, totals per year, labor hours, truck miles, total cost, historical records, current inventory, average salt usage
Data Sources	Inventory Management System (via EIMS)
Refresh Rate	Daily
Users/Access	District level, Highway Maintenance Administration (HMA)
Platform/Software	PowerBI

The dashboards track the usage of materials such as salt, and deicer liquids, throughout the season, presenting yearly totals and historical snapshots dating back to 2015. They also update material in the system of record within the next business day. As materials are entered into Enterprise Information Management Systems (EIMS) providing nearly real-time insight into the current material inventory across all garages, ensuring preparedness for upcoming storms. Additionally, they allow for the analysis of labor hours, truck miles, and total costs associated with snow and ice removal efforts, offering valuable insights into operational efficiency.

All information displayed on the dashboards are directly pulled from the EIMS inventory management system, ensuring data accuracy and consistency. Updates occur daily at midnight, reflecting any changes made within the EIMS system. However, delays may occur if garages experience high workloads and have not updated the system promptly.

The dashboards offer several benefits to their users. District managers gain instant visibility into material usage across their respective districts, enabling proactive monitoring and resource allocation. The HMA can eliminate the need for daily inquiries to individual districts, improving overall communication and operational efficiency.

From a technical standpoint, the dashboards use PowerBI as a platform, providing a user-friendly interface for data visualization and interaction. They allow users to track salt and other material usage, monitor salt shed capacity and inventory, and access daily snapshots of resource utilization.

Several enhancements are planned for these dashboards. These include integrating data from the salt usage dashboard with a separate ordering system, offering a more comprehensive view of resource management. A similar dashboard dedicated to tracking liquid de-icing materials is also under development, further expanding the scope of winter resource monitoring. Different time frames, usage coming from inventory system, database shows usage in a particular day,

2.4 Mobile AVL Dashboard Overview

The Mobile AVL Dashboard has been developed to load easily on a mobile phone, providing a user-friendly interface for real-time spot checks. Although the map may take a little longer to load, it provides a comprehensive view of all trucks available in a district and how many are out on the routes.

The primary purpose of the dashboards is to serve as an AVL/GPS - hydraulic/salt treatment dashboard. Users can select a district and pull all truck data from the last 30 minutes, including salt application rate and speed. Despite some issues with the accuracy of the hydraulics data systems, the mobile dashboards provide valuable insights into AVL on the fly, allowing users to see trucks up/down and crews working on snow and ice. An example of the dashboard is shown in Figure 8.

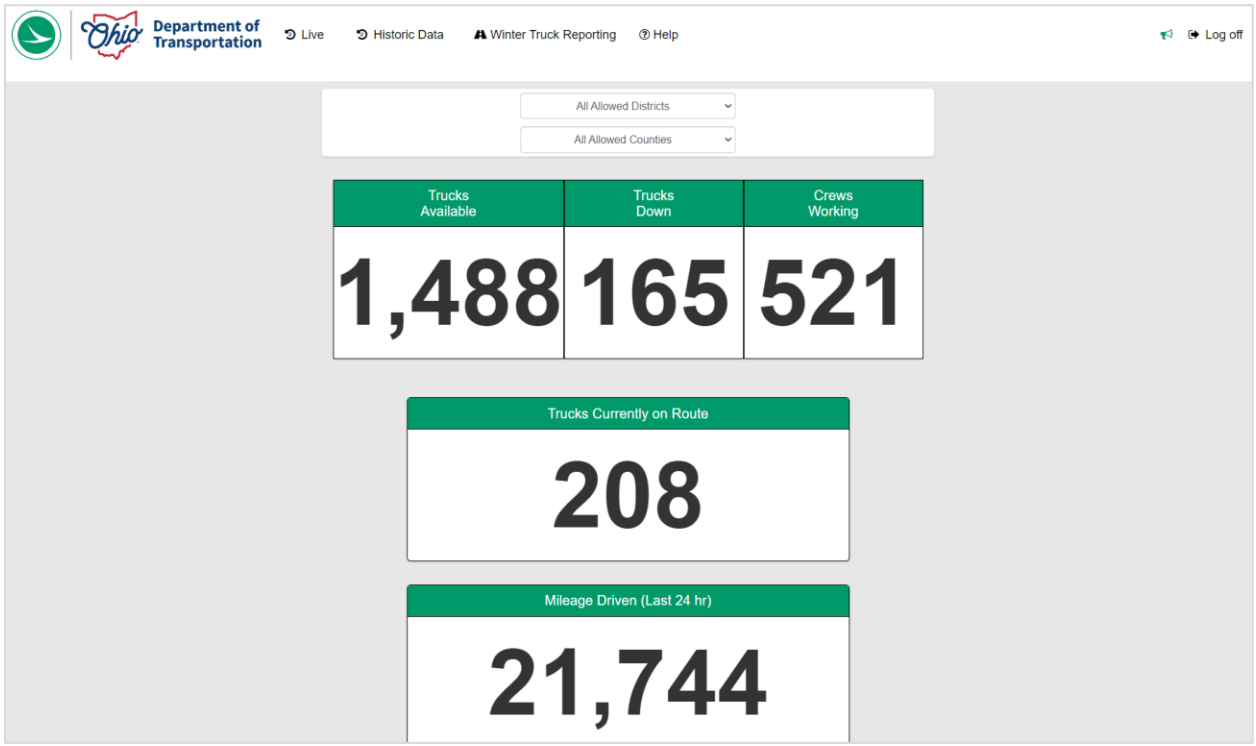


Figure 8 Mobile AVL Dashboard

As shown in Table 5, the purpose of the Mobile AVL Dashboard is to view the number of trucks available in a district, compared to how many being used. Can also view salt application rate and speed based on district. The Mobile AVL Dashboard has been developed to load easily on a mobile phone, providing a user-friendly interface for real-time spot checks. Although the map may take a little longer to load, it provides a comprehensive view of all trucks available in a district and how many are out on the routes.

Table 5 Mobile AVL Dashboard Overview

Purpose	To view the number of trucks available in a district, compared to how many are being used. Can also view salt application rate and speed based on district. Used to view AVL data quickly on mobile devices.
Performance Measures	Application rate, speed, and miles driven
Data Sources	AVL, manual winter truck reporting
Refresh Rate	Real-time
Users/Access	Public and leadership
Platform/Software	AVL website
Source	https://www.odotgpsavl.net/Account/Login?ReturnUrl=%2F

The dashboards utilize GPS/AVL data to track trucks currently on the route, specifically those outside of the geofence of the garage. They also include a Truck Usage History Dashboard and a Winter Truck Reporting feature. The latter requires manual updates every morning by daily morning entry, every 2 hours during storms, and shift changes. These updates populate the dashboard with the latest truck availability information.

The primary purpose of the dashboards is to serve as an AVL/GPS - hydraulic/salt treatment dashboard. Users can select a district and pull all truck data from the last 30 minutes, including salt application rate and speed. Despite some issues with the accuracy of the hydraulics data systems, the mobile dashboards provide valuable insights into AVL on the fly, allowing users to see trucks available and crews working on snow and ice.

Performance measures include tracking trucks up/down, crews working on snow and ice, and miles driven (both 24 hours and 2 hours). The data sources for these dashboards include AVL and manually entered data from county managers or timekeepers, reported every morning and every two hours during an active event.

The dashboards refresh in real time, providing up-to-date information for users. They are particularly useful for communication, allowing the public and leadership to stay informed about ongoing operations. The dashboards are hosted on the AVL website, ensuring easy access for all users.

3. Development of Dashboards

In the development of winter dashboards, the need for a dashboard typically arises when central figures in dashboard management, notice repeated requests for specific data or when higher management seeks specific information. Their involvement streamlines data management, reducing their workload, and

although field staff rarely request dashboards directly, there is a desire for more accessible data representation.

Dashboards are constructed based on specific needs. Requests for development funding are submitted to the IT department, which then evaluates the most suitable tools and options based on the intended use of the dashboard. This discussion continues until the foundational structure of the dashboard is established. The traffic management team oversees the performance of these dashboards. While there is no formal process for evaluating the performance of these dashboards, familiarity with the software and data can aid in identifying potential inaccuracies or areas for improvement. The team of people with PowerBI skills has been instrumental in the development of the dashboards and assists in managing the servers on the backend.

During the development process, several challenges were encountered, including the creation of scripts for goal calculations due to their complexity. The assistance of a senior developer was invaluable in addressing these issues and redesigning the scripts. Data quality has also been an issue and must be checked to ensure the most accurate readings are being used. These checks are performed manually and have quality thresholds in place to ensure standard procedures are followed.

4. System Operations and Maintenance

The hosting of these dashboards for viewing occurs through the following methods:

- Publicly accessible sites on the website, and
- Internal agency dashboards.

These systems are maintained by senior developers and the IT department. The software for these dashboards includes PowerBI, Python, and SQL. ODOT had no issues or concerns in the system operations and maintenance of their dashboards.

5. Benefits and Lessons Learned

The implementation of these dashboards has yielded numerous benefits to ODOT. ODOT Districts now have access to vital, relevant data at any time. The use of GPS/AVL data allows for real-time tracking of truck locations. Districts can utilize the available data to make informed decisions, and the impact of these decisions on routes can be measured. Leadership can use the information provided by the dashboards to make strategic decisions, and the communication division can use the data to highlight ODOT's efforts to assist the public and promote its work.

6. Plans for the Future and Potential Enhancements

Several enhancements are planned for the future. These include adding liquids to the dashboards, merging salt ordering data in the Services and Support section, and enhancing the front end of the

dashboard that displays the financial year summary. ODOT is exploring new data sources and may potentially create additional dashboards related to weather data.

7. Key Point

- The ODOT started dashboarding to transform the data on spreadsheets into user-friendly dashboards. While they have not developed dedicated dashboards for GPS/AVL data, they recognize the potential.
- They offer a mobile-friendly GPS/AVL dashboard and are piloting a "real-time evaluator" tool that analyzes routes and publishes insights on recovery times, aiding managers in evaluating staffing and operational efficiency.
- The purpose of the snow and Ice dashboard is to check if winter maintenance goals are being met during a snowstorm. The dashboard also evaluates snow and ice data in real-time and allows users to view probe data and RWIS data and helps aid in the allocation of resources.
- The snow and ice performance evaluator tool dashboards are used to determine if recovery goals are being hit after a snowstorm and organize it by district and county. Snow and ice dashboards provide an overview of materials and costs for each season.
- From a technical standpoint, the dashboards use PowerBI as a platform, Python, and SQL scripts.
- The mobile AVL dashboard is to view the number of trucks available in a district, compared to how many are being used. You can also view salt application rate and speed based on district.
- The dashboards refresh in real-time, providing up-to-date information for users. They are particularly useful for communication, allowing the public and leadership to stay informed about ongoing operations. The dashboards are hosted on the AVL website, ensuring easy access for all users.
- ODOT is actively weaving data visualization into its decision-making, and further integration of GPS/AVL data with dashboards is likely on the horizon.
- One of the major benefits of the dashboards is that Ohio DOT can pull information quickly and accurately.
- Also, these dashboards have evolved over the years so the data can be compared between historical to current data in near real time without waiting for monthly reports.

Appendix A - Survey Response

Contact Information

Name	Dean Alatsis
Title	Program Administrator
Agency	Ohio DOT
Email	dean.alatsis@dot.ohio.gov
Phone	614-466-8465

Survey Information

1. Do you have any dashboards (with interactive performance measures) using data of winter maintenance operations?	Yes
If yes, how many?	6+
1A. If you answered yes to the previous question (you do have dashboards) please briefly describe how each on is used.	GPS / AVL - Vehicle tracking, usage OHGO - Incidents, Construction, Cameras, Travel Delays Weather Hazards RWIS TTRI - Traffic Time Reliability Index RTSI - Real Time Snow and Ice - collects processes and reports data related to snow events & SNIPE - Snow and Ice Performance Evaluator - identifies and locates snow events and determines where ODOT was able to meet recovery goals. TMC - Traffic Management Center - Monitors and responds to events and incidents/accidents.
2. Do you find these dashboards useful during an event in real-time?	Yes
3. Do you find these dashboards useful after an event, such as after-action reports?	Yes
4. Do you use the dashboards to inform beneficial / best practices?	Yes
5. What data are you using in your dashboard(s)? (Select all that apply)	8
Automatic Vehicle Location/Global Positioning System (AVL/GPS)	X
Material Usage total	X
Material Usage Rates	X
Weather Data (For example: Road Weather Information System (RWIS))	X
Cycle Time	X
Plow Position	
Traffic Data (Speed and/or Volumes)	X
Connected Vehicle (CV) data	
Incident Data	X
Finance data	X
Other (please specify)	

6. What are the sources of the data in the dashboards? (Select all that apply)	8
Automatic Vehicle Location/Global Positioning System (AVL/GPS)	X
Spreader/Sprayer Controller	X
Plow Position Sensor	
Mobile Weather Sensors, etc.	X
Maintenance Decision Support Systems (MDSS)	
RWIS Stations	X
Advance Traffic Management System (ATMS)	X
Maintenance Management System	X
Probe Traffic Data	X
Connected Vehicles (CVs)	
Crowd Sourced data (e.g. Waze)	X
Other (please specify)	
7. How are the data ingested into the dashboard? (Select all that apply)	
Application Programming Interface (API) from data source	X
SQL database updated	X
Excel spreadsheets	X
CSV/Text File	X
Access Database	
Other (please specify)	
8. What is the frequency of the data refresh? (Select all that apply)	5
Minutes / Close to real-time (5)	X
Hourly (4)	
Daily (3)	X
Weekly (2)	X
Monthly (1)	
Other (please specify)	
9. How are data stored? (Select all that apply)	
Cloud-based	X
Client-Owned Server	X
Third-Party Server	
Enterprise Content Management System (For example: SharePoint)	
Other (please specify)	

10. What dashboarding platforms are used? (Select all that apply)	
PowerBi	X
Tableau	
ArcGIS	X
Internally custom created or other platform (please describe)	N/A
11. What metrics/performance measures presented on the dashboard(s) do you find most helpful for operations? And describe why they are the most helpful.	All are helpful, based on the user needs.
12. Are you able to generate static reports / outputs from the dashboard?	Yes
13. Who has access to view the dashboards? (Select all that apply)	2
Internal agency	X
Partner Agencies	
Contractors	
Public	X
Other (please specify)	
14. Who developed the dashboard(s)? (Select all that apply)	
Internal agency	X
Consultant	X
AVL / GPS Vendor	X
Other Third-Party vendor	X
Unversity	
Other (please specify)	
15. If an external entity developed any of your dashboards, were you a part of the design process?	Yes
15A. Is your dashboard customizable to fit your needs?	Yes
16. Who maintains the dashboard and data used?	ODOT / Consultant / Third Party Vendor
17. How are the data checked for accuracy and who is responsible for checking?	Spot checks are done based on abnormal results.
18. What data do you wish you had within a dashboard? And why?	More reliable weather data
19. What are the limitations of your current dashboard(s)?	
20. Do you have any enhancements to current dashboards, or new dashboards, you want to develop or are in the process of developing?	

If yes, please describe:	Always looking for ways to help function better.
21. Has your agency deployed or planned to deploy connected vehicle technology that may assist with winter operations?	
22. Has your agency used or planned to use connected vehicle data for winter maintenance dashboards?	
23. What issues has your agency experienced with developing the dashboard(s)?	
24. What issues has your agency experienced with using the dashboard(s)?	
25. What practical advice and/or lessons learned can be offered to others interested in developing and implementing dashboards to support winter maintenance operations?	Having good reliable data, in-place in advance, before implementing.
26. May we contact you with follow-up questions?	Yes

Appendix B - Virtual Interview Meeting Minutes

PROJECT 22-05: USE OF DASHBOARDS FOR WINTER OPERATIONS
SUMMARY OF OHIO DOT VIRTUAL INTERVIEW

Overview

Virtual interviews were conducted by Ming-Shiun Lee, Allison Balogh, and Mallory Crow of AECOM and coordinated with the assistance of Dean Alatsis with the Ohio Department of Transportation (ODOT) on Wednesday January 24th, 2024, at 12 PM EST.

ODOT Staff Interviews

Meeting attendees on Wednesday, January 24th included the following individuals:

Dean Alatsis

Ryan Lowe, PE

Tim Filla

Stephanie Marik, PE

Joshua Thieman

Introduction

The ODOT started dashboarding with a goal to transform the data on spreadsheets into user friendly dashboards. While they have not developed dedicated dashboards for Global Positioning System (GPS)/Automatic Vehicle Location (AVL) data, they recognize the potential. They offer a mobile-friendly GPS/AVL dashboard and are piloting a "real-time evaluator" tool. The real-time evaluator tool or in other words the real-time snow & ice dashboard visualizes current conditions like speed and weather. Additionally, separate after analysis dashboards show the route recovery based on snow & ice performance evaluator using performance metric aiding managers in evaluating staffing and operational efficiency. In short, ODOT is actively weaving data visualization into their decision-making, and GPS/AVL integration is likely on the horizon.

Real-Time Snow and Ice Dashboard

Real-Time Snow and Ice Dashboard Overview

Purpose	Checks if winter maintenance goals are being met during a

	snowstorm. Evaluates snow and ice data in real time and allows users to view probe data and Road Weather Information System (RWIS) data. Helps aid in the allocation of resources.
Performance Measures	Speed conditions, weather conditions
Data Sources	Speed data (via INRIX), weather data (via RWIS)
Refresh Rate	Real time/ every few minutes
Users/Access	County managers
Platform/Software	ESRI

During winter storms, ensuring efficient snow and ice removal is crucial for public safety and smooth operations. To achieve this, county managers rely on a specialized tool, the real-time snow and ice web map. This interactive map, not a traditional dashboard, provides crucial insights into road conditions and weather in real-time.

Fueled by data from two sources, the map displays both speed and weather information. Speed data, gathered through the INRIX API, allows for comparison with expected speeds on each road segment. Deviations are highlighted in orange and red, indicating potential slowdowns and areas requiring intervention. Additionally, internal RWIS data provides real-time updates on weather conditions, allowing managers to anticipate further challenges.

With data refreshed every few minutes, the map acts as a dynamic command center. County managers can monitor performance against set goals, allocate resources strategically, and make informed decisions based on the latest conditions. This empowers them to respond proactively to storm events, ensuring efficient snow and ice removal and maintaining public safety. While currently limited to internal access, the real-time snow and ice web map plays a vital role in keeping the county moving during winter storms.

Snow and Ice Performance Evaluator Tool Dashboard

Snow and Ice Performance Evaluator Tool Dashboard Overview

Purpose	Determine if recovery goals are being hit after a snowstorm and organizes it by district and county.
Performance Measures	Storm start, storm end, recovery goal, time recovered
Data Sources	RWIS, INRIX
Refresh Rate	Monthly
Users/Access	District highway managers and county. Results are used by leadership.
Platform/Software	Python/SQL, TSMO data warehouse

The Snow and Ice Performance Evaluator Tool Dashboard is a comprehensive solution for analyzing post-storm snow and ice removal performance across districts and the entire county. It is designed to identify routes that have not met recovery goals, with a benchmark set at 96% recovery. This tool allows for a detailed exploration of these routes.

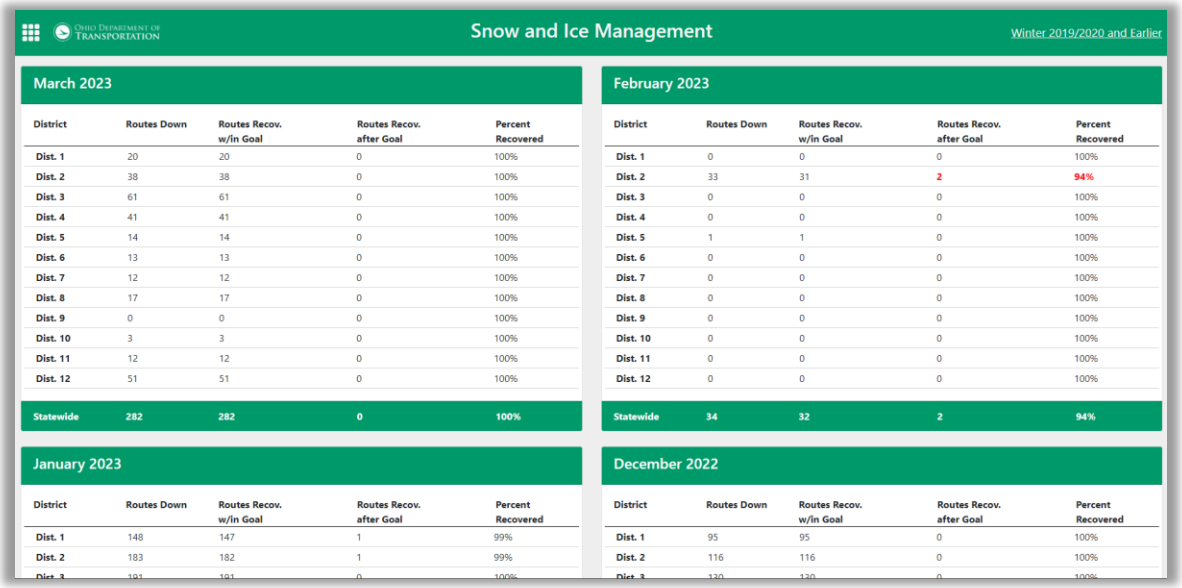
The performance measures within the dashboard are multifaceted. It tracks recovery goals and times for different priority routes, with a 2-hour goal for P1 routes and a 4-hour goal for P2 routes. The tool measures the downtime for each route based on real-time speed data provided

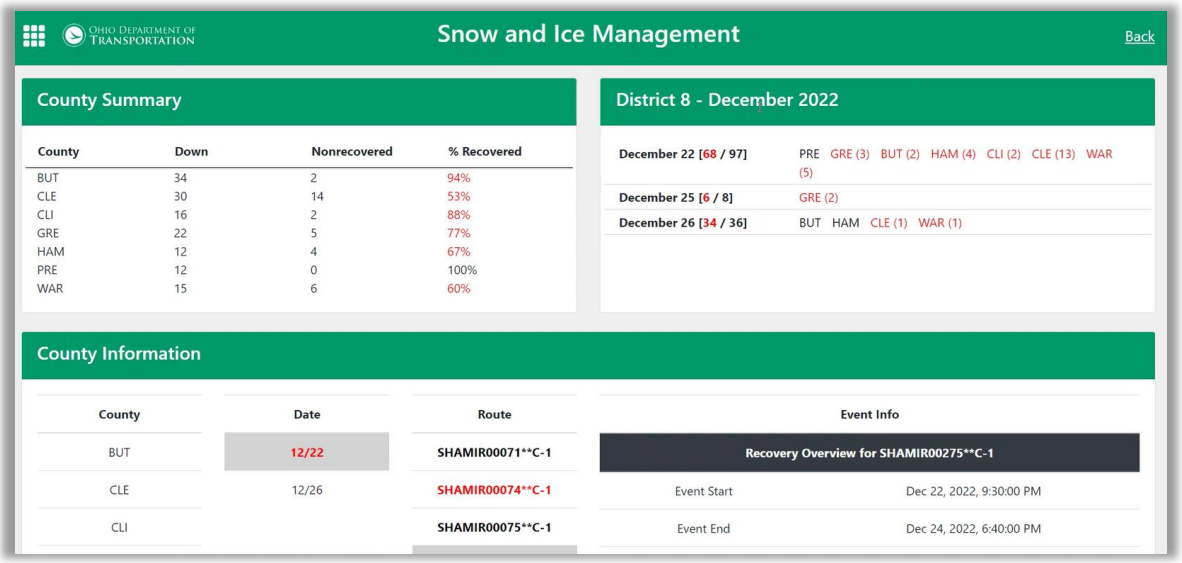
by INRIX. It also defines the start of a storm based on a combination of RWIS and INRIX data and to end a storm, only RWIS data is considered. The INRIX data is then utilized to determine the route recovery which account for both weather conditions and speed impact. The success of recovery is measured by how quickly after the end of a storm routes return to speeds that are within 10mph of the historical average speed Recovery is achieved when a route is within 10 mph of the historical speed for at least one consecutive hour.

The dashboard utilizes multiple data sources. INRIX provides real-time speed data for tracking downtime, while RWIS triggers the start and end of a storm and helps define recovery periods. The TSMO data warehouse houses historical speed data, which is used to measure recovery success.

The functionality of the dashboard is designed to be user-friendly and informative. A Statewide/District view allows leaders, HMAs, and Roadway Service Managers to analyze performance within their areas, while a county-wide view offers managers an overview of the effectiveness of the storm response. Route details are available for a more granular analysis, particularly for specific routes that have not met recovery goals. Managers can provide feedback to be incorporated into the dashboard about incidents that may impact recovery.

From a technical standpoint, this dashboard is powered by Python and SQL scripts that process data and drive analysis. The results are displayed on a website that allows for interaction. After each storm, a manual trigger is activated for analysis and reporting. To keep leadership informed, quarterly reports summarizing overall performance are sent out.





Snow and Ice Dashboard

Snow and Ice Resources Reporting Dashboards Overview

Purpose	Provides overview of materials and costs for each season
Performance Measures	How much material was used in the season, totals per year, labor hours, truck miles, total cost, historical records, current inventory, average salt usage
Data Sources	Inventory Management System (via EIMS)

Refresh Rate	Daily
Users/Access	District level, Highway Maintenance Administration (HMA)
Platform/Software	PowerBI

The Snow and Ice Resources Reporting Dashboards are a crucial tool for maintaining efficient snow and ice removal throughout the season. They require strategic planning and resource allocation, serving as an essential resource for both district-level managers and the HMA.

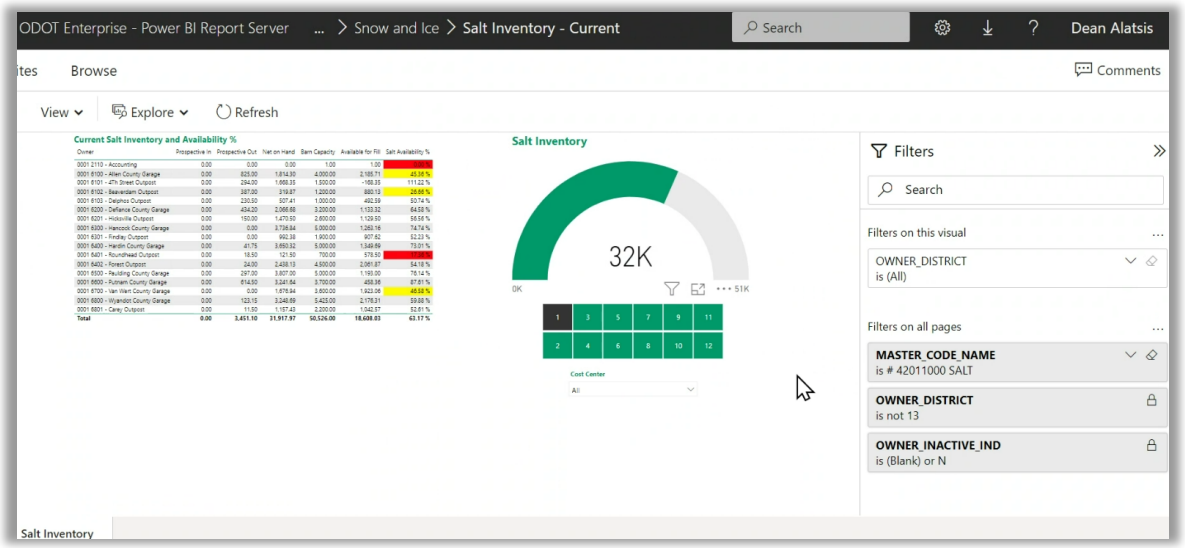
The dashboards track the usage of materials such as salt and other Materials like de-icers and liquids, throughout the season, presenting yearly totals and historical snapshots dating back to 2015. They also update material in the system of record withing the next business day. As materials are entered into EIMS providing nearly real-time insight into the current material inventory across all garages, ensuring preparedness for upcoming storms. Additionally, they allow for the analysis of labor hours, truck miles, and total costs associated with snow and ice removal efforts, offering valuable insights into operational efficiency.

All information displayed on the dashboards are directly pulled from the EIMS inventory management system, ensuring data accuracy and consistency. Updates occur daily at midnight, reflecting any changes made within the EIMS system. However, delays may occur if garages experience high workloads and have not updated the system promptly.

The dashboards offer several benefits to their users. District managers gain instant visibility into material usage across their respective districts, enabling proactive monitoring and resource allocation. The HMA can eliminate the need for daily inquiries to individual districts, improving overall communication and operational efficiency.

From a technical standpoint, the dashboards use PowerBI as a platform, providing a user-friendly interface for data visualization and interaction. They allow users to track salt and other material usage, monitor salt shed capacity and inventory, and access daily snapshots of resource utilization.

Several enhancements are planned for these dashboards. These include integrating data from the salt usage dashboard with a separate ordering system, offering a more comprehensive view of resource management. A similar dashboard dedicated to tracking liquid de-icing materials is also under development, further expanding the scope of winter resource monitoring.


ODOT Enterprise - Power BI Report Server
Snow and Ice
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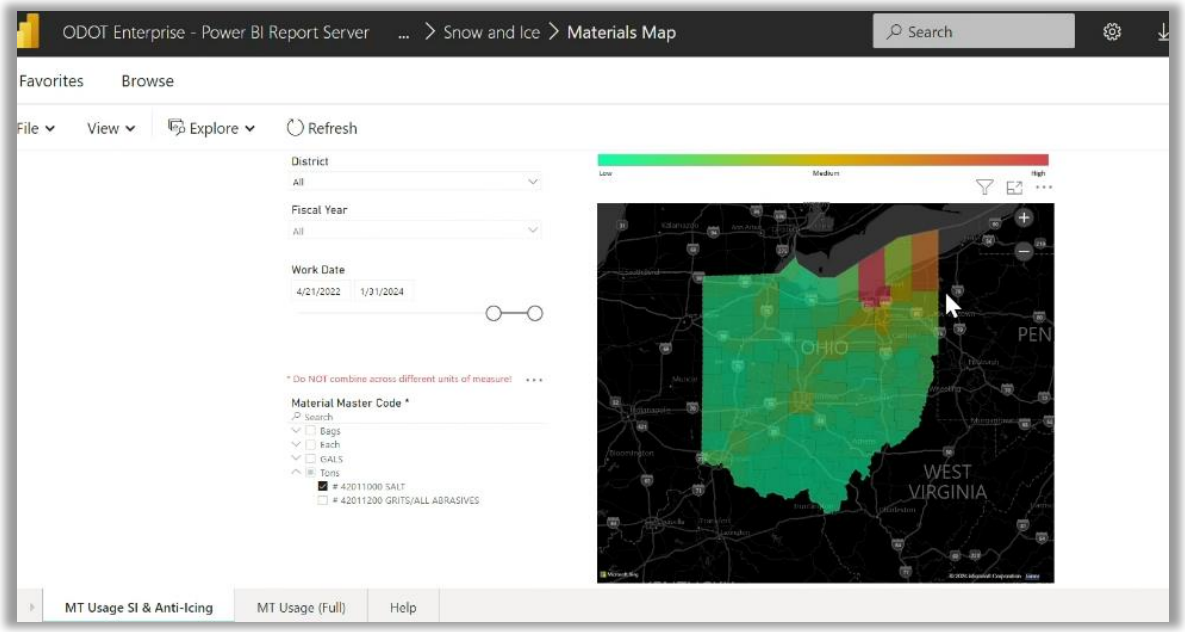
ODOT Enterprise - Power BI Report Server
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Materials Map
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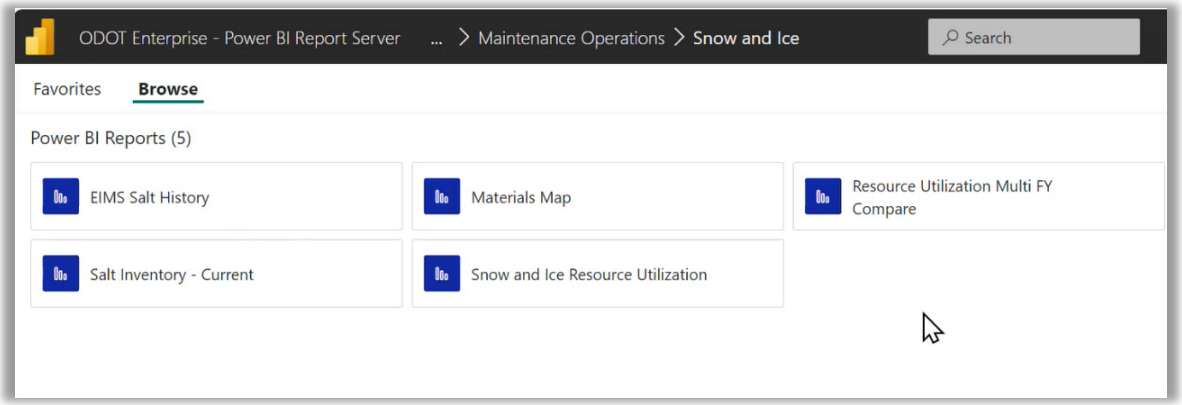
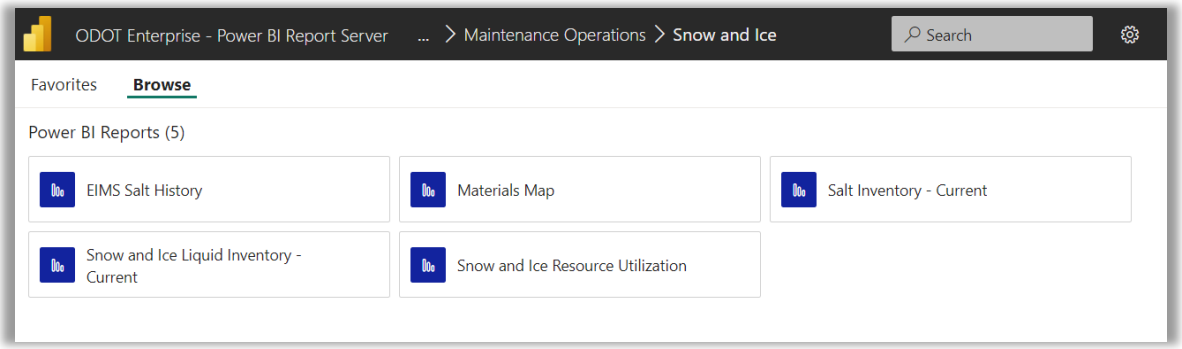




Mobile AVL Dashboard

Mobile AVL Dashboard Overview

Purpose	To view number of trucks available in a district, compared to how many being used. Can also view salt application rate and speed based on district. Used to view AVL data quickly on mobile devices.
Performance Measures	Application rate, speed, and miles driven
Data Sources	AVL, manual winter truck reporting
Refresh Rate	Real time
Users/Access	Public and leadership
Platform/Software	AVL website

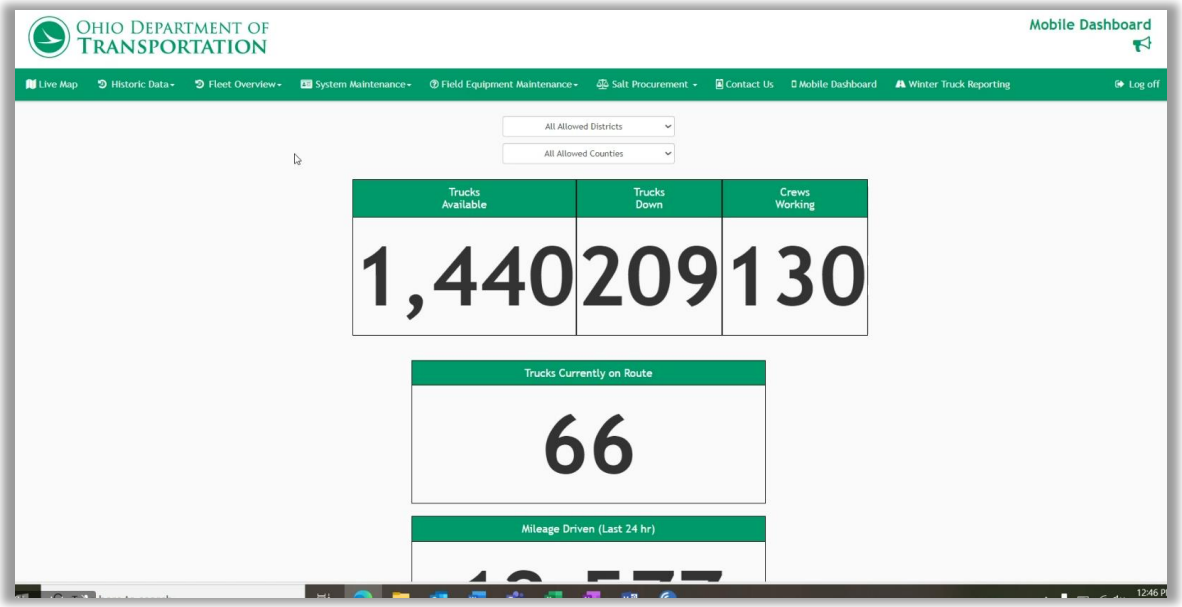
The Mobile AVL Dashboard has been developed to load easily on a mobile phone, providing a user-friendly interface for real-time spot checks. Although the map may take a little longer to load, it provides a comprehensive view of all trucks available in a district and how many are out on the routes.

The dashboards utilize GPS/AVL data to track trucks currently on route, specifically those outside of the geofence of the garage. They also include a Truck Usage History Dashboard and a Winter Truck Reporting feature. The latter requires manual updates every morning by daily morning entry, every 2 hours during storms, shift changes. These updates populate the dashboard with the latest truck availability information.

The primary purpose of the dashboards is to serve as an AVL/GPS - hydraulic/salt treatment dashboard. Users can select a district and pull all truck data from the last 30 minutes, including salt application rate and speed. Despite some issues with the accuracy of the hydraulics data systems, the mobile dashboards provide valuable insights into AVL on the fly, allowing users to see trucks available and crews working on snow and ice.

Performance measures include tracking trucks up/down, crews working on snow and ice, and miles driven (both 24 hours and 2 hours). The data sources for these dashboards include AVL and manually entered data from county managers or timekeepers, reported every morning and every two hours during an active event.

The dashboards refresh in real-time, providing up-to-date information for users. They are particularly useful for communication, allowing the public and leadership to stay informed about ongoing operations. The dashboards are hosted on the AVL website, ensuring easy access for all users.



Development of Dashboards

Dashboards are constructed based on specific needs. Requests for development funding are submitted to the IT department, which then evaluates the most suitable tools and options based on the intended use of the dashboard. This discussion continues until the foundational structure of the dashboard is established. The traffic management team oversees the performance of these dashboards. While there is no formal process for evaluating the performance of these dashboards, familiarity with the software and data can aid in identifying potential inaccuracies or areas for improvement. The PowerBI team has been instrumental in the development of the dashboards and assists in managing the servers on the backend.

During the development process, several challenges were encountered, including the creation of scripts for goal calculations due to their complexity. The assistance of a senior developer was invaluable in addressing these issues and redesigning the scripts. Data quality has also been an issue and must be checked to ensure the most accurate readings are being used. These checks are performed manually and have quality thresholds in place to ensure standard procedures are followed.

Benefits / Lessons Learned

The implementation of these dashboards has yielded numerous benefits. Districts now have access to vital, relevant data at any time. The use of GPS/AVL data allows for real-time tracking of truck locations. Districts can utilize the available data to make informed decisions, and the impact of these decisions on routes can be measured. Leadership can use the information provided by the dashboards to make strategic decisions, and the communication division can use the data to highlight ODOT's efforts to assist the public and promote its work.

Future / Enhancements:

Several enhancements are planned for the future. These include adding liquids to the dashboards, merging salt ordering data in the Services and Support section, and enhancing the front end of the dashboard that displays the financial year summary. ODOT is exploring new data sources and may potentially create additional dashboards related to weather data.