Data Assessment and Plan

Task 3.3

ODOT Freight Highway Bottlenecks Project

TGM 2D-14: Technical Memo

April 11, 2016

FINAL

Prepared by:

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1 INTRODUCTION AND EXECUTIVE SUMMARY

The project team reviewed and summarized 19 national and statewide datasets that have been applied in prior bottleneck studies or have attributes that may be able to supplement bottleneck identification in Oregon. The purpose of the review was to determine the types of data, potential application, and the benefits and constraints of the dataset with relation to this effort. It is recognized that some datasets may provide little, if any, ability to identify and/or measure the impacts of freight bottlenecks. However, all datasets were included even if they have constraints (such as cost) that may limit application, in order to provide a comprehensive analysis of the utility of the various choices. The datasets reviewed were:

Nationwide Datasets

- Freight Analysis Framework (FAF)
- Commodity Flow Survey (CFS)
- National Performance Management Research Dataset (NPMRDS)
- American Transportation Research Institute (ATRI) Dataset
- Highway Performance Monitoring System (HPMS)
- Fatality Analysis Reporting System (FARS)

Oregon/Customized Datasets

- Highway Economic Requirements System State Version (HERS-ST)
- Oregon Statewide Integrated Model (SWIM)
- Oregon Traffic Volumes
- Oregon Truck Volumes/Percentage
- Oregon Highway Inventory (posted speed, lane, curvature, grade)
- ODOT Features, Attributes, and Conditions Survey, Statewide Transportation Improvement Program (FACS-STIP) and TransGIS
- Oregon Restricted Bridges
- Weigh-in-Motion
- Crash Analysis Reporting System (CARS)
- ODOT Incident Log

Third-Party Data Available for Purchase

- TomTom Historical Profiles (ODOT owns)
- TomTom Corridor (would require additional purchase)
- INRIX (ODOT owns archived data)
- HERE (ODOT currently procuring)

Additional datasets and tools with very limited coverage were not included in the analysis. These tools (including PORTAL[1], the Portland State University TREC datahub, and Central Lane MPO's Data Portal[2]) were excluded because they only covered one metropolitan area.

General Note: Throughout this report several figures are included to provide visual examples of datasets that demonstrate the type and coverage of the data. These figures are intended to give a general idea of type format and/or coverage (and resulting application considerations) for the datasets. Figures are not intended to provide detailed resolution to be directly applied to corridor assessment.

1.1 PROJECT OBJECTIVE

Established visioning guidance and/or stakeholder feedback can provide a foundation for developing critical analysis measures, which can then dictate methodology and datasets. The Oregon Freight Plan Vision statement provides guidance for freight movement in Oregon:

> *By 2035, Oregon benefits from a reliable, multimodal freight transportation system that supports its quality of life. This multimodal freight transportation system supports a healthy economy by safely and efficiently moving goods within Oregon, regionally, nationally and internationally. The quality, dependability and efficiency of Oregon's multimodal freight transportation system encourage businesses to remain in and move to Oregon, providing jobs in a diverse set of industries.*

The project objectives are threefold:

- Identify Oregon data and analytical tools available to provide information relevant to freight movement.
- Develop data-driven freight metrics designed to reveal bottleneck locations.
- Establish an approach to prioritize freight bottleneck locations using an identified set of criteria.

ODOT has collected stakeholder feedback that provides specific areas of concern for freight movement that may be incorporated into the bottleneck analysis. These key thematic considerations include:

- Congestion/operations
- Commodity value/truck volumes
- Geometric/Spatial
- Safety/Security/Risk
- Improvement Cost-Benefit (for project prioritization)

These considerations were used to develop a definition of freight bottleneck and will ultimately be developed into specific indicators to address these study objectives and stakeholder interest areas.

For the purposes of this project:

> *A freight bottleneck is a part of the system that causes disproportionately high resource costs in the movement of freight. Freight bottlenecks may be caused by a variety of factors including*

[1] http://portal.its.pdx.edu/home
[2] http://thempo.org/648/Data-Portal

recurring congestion, traffic accidents, topography or seasonal, weather or structural roadway or bridge restrictions.

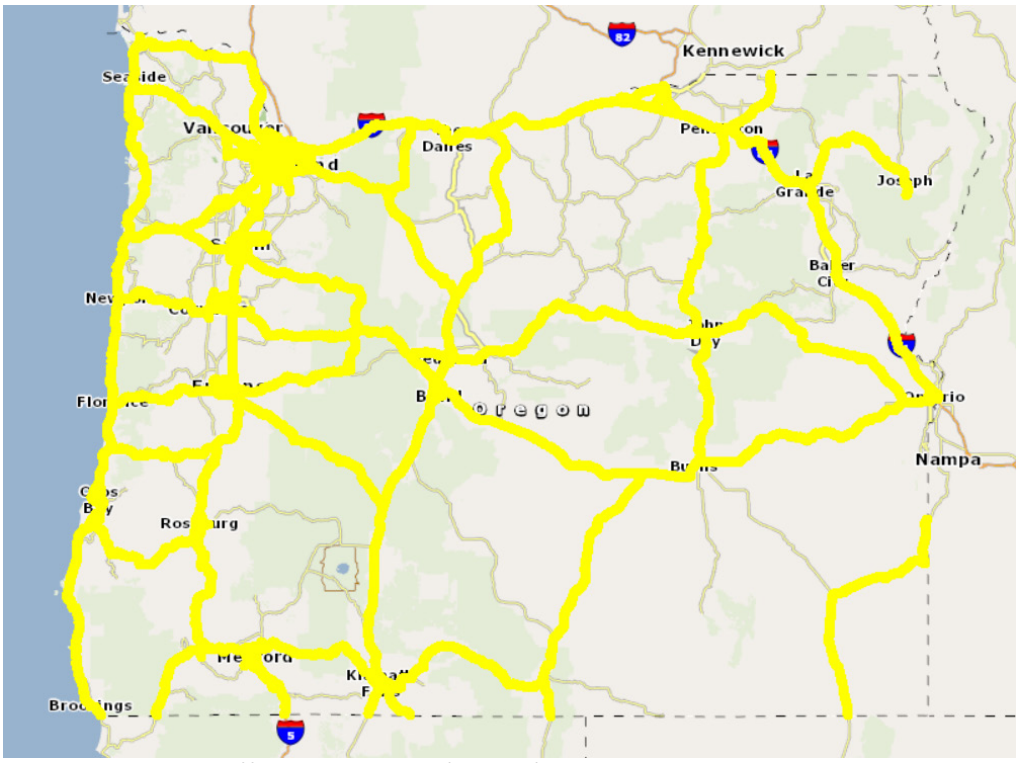
The ability of the datasets to evaluate performance on these parameters was used to review their utility throughout this memo and as summarized in Table A1. The recommendation also considers the types of measures that can be addressed with each dataset (see Tables 1 and 2).

1.2 General Observations Regarding Data

There is a wide breadth of data currently available (or readily available with purchase) to support transportation planning and operations analysis efforts. The following general observations were made about the datasets:

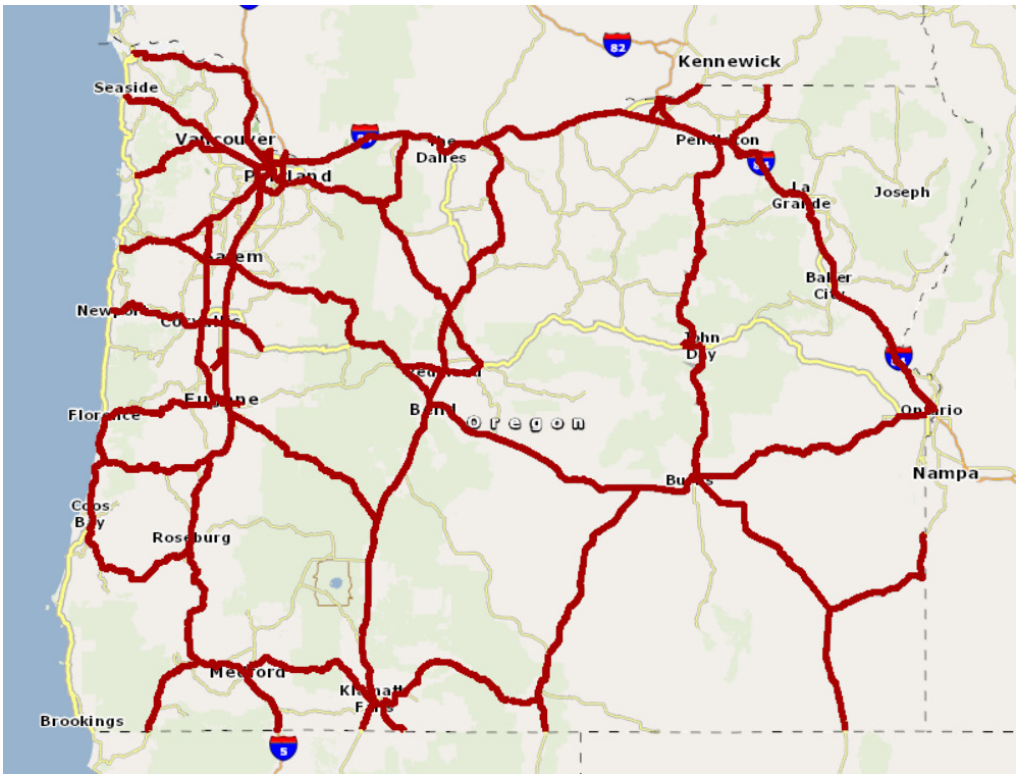
- The datasets generally capture information related to commodities, safety/operations, or roadway characteristics (such as grade or speed). No one dataset, however, captures all considerations and it will be necessary to utilize a combination of datasets to address all of the potential indicators.
- National datasets (including NMPRDS, HPMS, FAF, CFS) provide data that can be used as a resource, however, some are limited to major routes, such as the National Highway System (NHS).
- ODOT has inventoried and maintained statewide datasets through TransGIS and other tools that provides broader coverage that generally extends to all state routes.
- Since coverage varies by each dataset, some datasets may not be available in certain areas to identify freight bottlenecks. If the same combination of datasets is used to measure the entire system, there may be a need to consider the "least common denominator" of the datasets – that is, what level of facilities can be analyzed with a given dataset, or conversely, what datasets are available for a given level of facility? Therefore, in order to leverage higher quality data, where available, a combination of datasets may be applied for the same indicator in order to address differences in coverage between urban and rural areas.
- Dataset coverage and example datasets include NHS (which NMPRDS coverage is limited to), Oregon Highway Plan (OHP) freight routes, all state routes (TransGIS), and major routes in the state (which TomTom Historical Speed Profiles cover). These systems are mapped in Figure 1 through Figure 3, respectively. Figure 4 shows the coverage of Reduction Review Routes (RRR), which are the set of roads that will be analyzed for the bottleneck study. The maps are provided in order to demonstrate the differences in coverage among datasets and map shading and color are not critical for these purposes.

Figure 1. NHS Routes



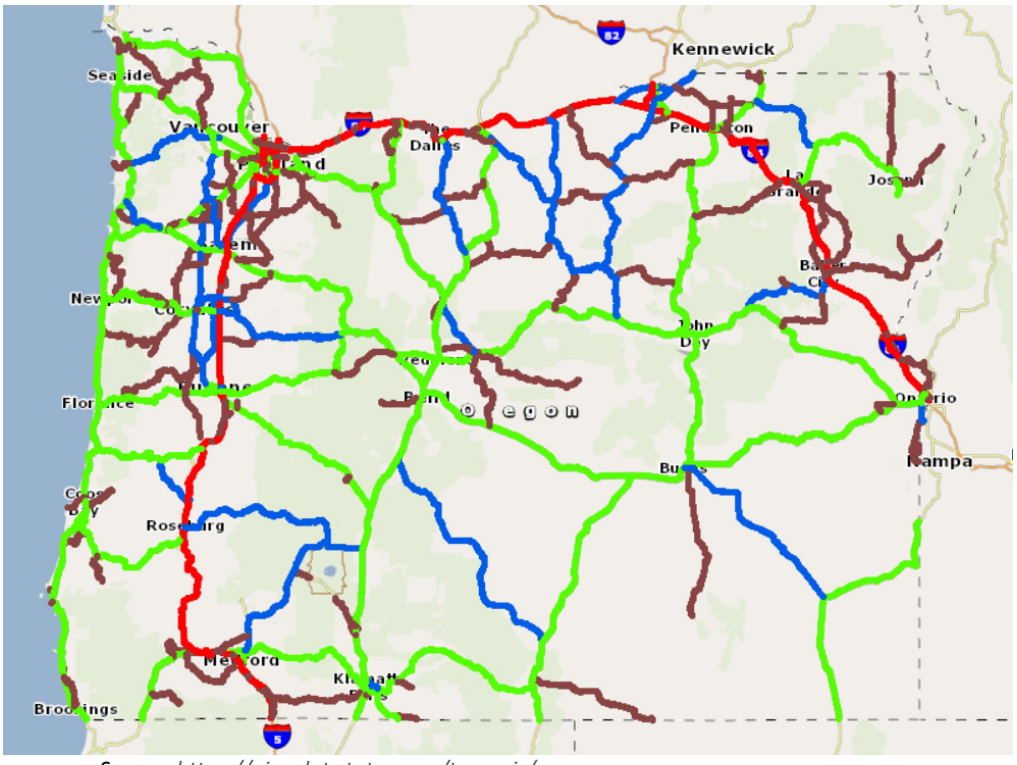
Source: https://gis.odot.state.or.us/transgis/

Figure 2. OHP Freight Routes



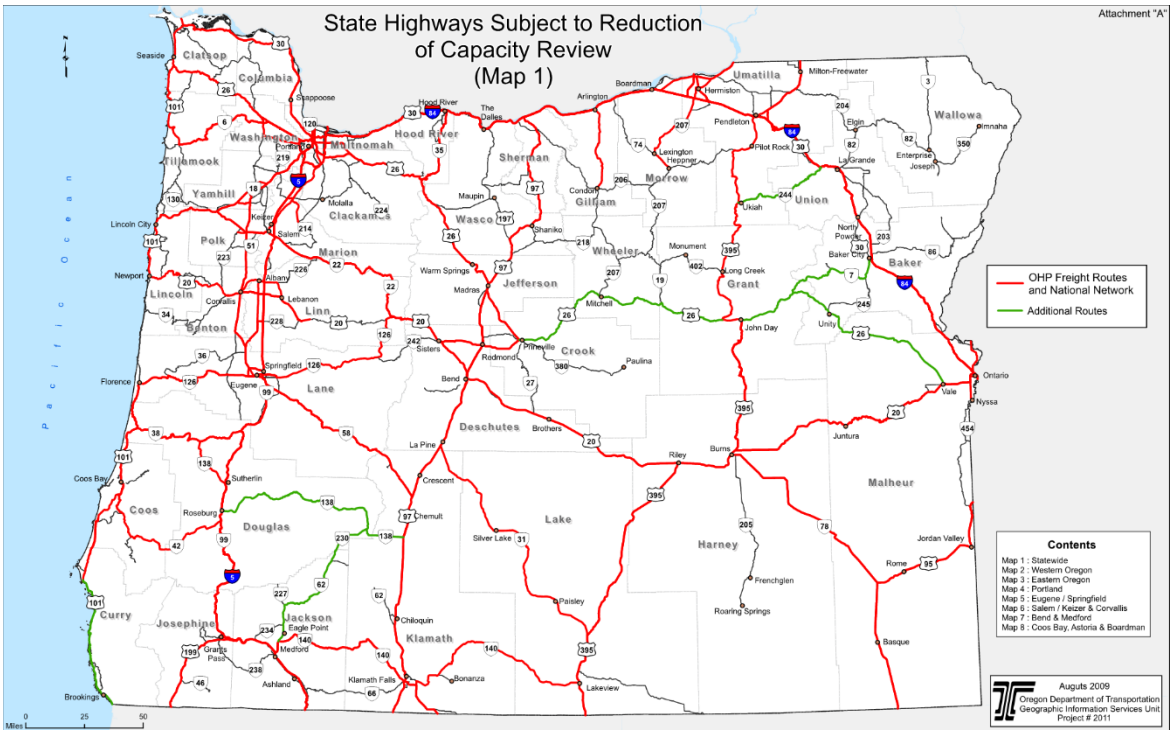
Source: https://gis.odot.state.or.us/transgis/

Figure 3. All State Routes



Source: https://gis.odot.state.or.us/transgis/

Figure 4. Reduction Review Routes (Level of Coverage to be Analyzed in the Bottleneck Study)



- While some datasets stand alone, others (such as HERS-ST) may be linked to other datasets.
- Travel time datasets that are based on probe data (such as INRIX, TomTom, HERE) are continuously and rapidly increasing roadway coverage as data collecting devices (GPS, Navigation systems, cell-phones, etc.) better saturate the market.
- A number of the datasets provide information that is related or redundant to other datasets.
- Each dataset provides benefits and challenges for identifying freight bottlenecks. Two primary challenges that could present potential risks to this analysis effort and schedule include readiness/availability of data (such as SWIM and HERE) as well as ODOT familiarity with a new source/tool (HERE).

Section two contains the review of each dataset. Findings and recommendations are contained in section three of this document. Table 1 in that section includes some types of measures that may be included for each consideration. Specific indicators, thresholds, and tiering factors will be identified in future memos. Table A1 (attached) provides an overview of each of the datasets in a matrix format.

2 REVIEW OF DATA SOURCES

The review of prior analysis efforts indicates that a number of datasets exist that can be applied to identify potential bottleneck locations. The following sections summarize the datasets listed in Table A1, attached to this document.

2.1 FREIGHT ANALYSIS FRAMEWORK

2.1.1 Overview

The Freight Analysis Framework (FAF) is produced by the Bureau of Transportation Statistics in partnership with the Federal Highway Administration. The FAF dataset starts with the Commodity Flow Survey, and then integrates additional data from a variety of sources to provide the most comprehensive description of freight flows in the U.S. that is publically available. Different FAF products are released on an ongoing basis as new versions become available.

2.1.2 Data Summary

The FAF dataset reports the tonnages, value, and ton-miles shipped by truck, rail, water, pipeline, air, multiple modes & mail, and other and unknown modes. It provides commodity detail at the 2-digit Standard Transportation Commodity Code level, which includes 43 commodity groups. FAF considers both domestic and international shipments. For domestic shipments, it reports origins and destinations at the city-level (by either Census defined Consolidated Statistical Regions or Census defined Metropolitan Statistical Areas, depending on the city) or for a category called 'rest of state' that is used when the origin or destination is not in located in an urban area. Oregon is represented by just two zones, one for the Portland metropolitan area and another one for the remainder of the state. For international shipments, FAF reports the domestic origin and destination (one of which acts as an international gateway) and the foreign region of origin or destination. The world is divided into 8 foreign regions, with Canada and Mexico having their own regions. In addition to reporting the foreign regions involved in international shipments, FAF also reports the mode used to reach these foreign locations.

FAF datasets exist for 1997, 2002, 2007 and 2012. The latest version, FAF v4.1, uses the results of the Commodity Flow Survey 2012 to develop freight flow estimates for 2012 through 2015. These estimates were generated in part by forecasting 2012 freight flows and at the same time integrating more recent freight data as they become available.

FAF v4.1 also included a forecast of freight flows out to 2045 for three scenarios of economic growth: baseline, optimistic and pessimistic. The forecast was developed by the FAF working group in conjunction with their consulting team, and it is fundamentally based on the projected growth rates of different industries in the economy. Changes in freight demand for a particular mode are based on the economic changes of the underlying industries that use that mode, and not on changes in the competitiveness of modes. FAF v4.1 only includes estimates of tons and value. Estimates of ton-miles are expected to be published later this year.

FAF also includes a network assignment data product that shows how freight flows move through the nation's highways. Previous versions of this product for 2007 figures are currently available. This analysis for 2012 or later freight flows will be published later this year. The traffic assignment relies on various models to disaggregate commodity flows to particular roadways and convert flows to equivalent trips of

different types of trucks. The models used to disaggregate flows geographically rely on data on the general distribution of economic activity within the FAF regions, not a detailed understanding of specific freight generators and attractors in those regions. This implies that the traffic assignment conducted in Oregon would be based on data from Oregon's two FAF zones. The road network used for the traffic assignment only considers NHS roads.

The models used to convert from tonnage flows to truck trips were calibrated using truck count data on highways so that total truck travel estimates approximate actual truck volumes. Even though this represents a standard approach for inferring truck travel from commodity flow data, the use of nationwide models and many simplifying assumptions limits the veracity of the results obtained on a link-by-link level (more information about the traffic assignment is provided by the FHWA[3]). The total truck traffic results for Oregon should be compared independently with truck volume estimates obtained by ODOT.

2.1.3 Application Benefits and Challenges

As mentioned before, FAF represents the most comprehensive descriptions of freight flows in the US that is publically available. This dataset can be used for:

- showing the main freight flows by commodity and mode to and from Portland and the remainder of the state (these are the geographical zones used for Oregon);
- using the FAF traffic assignment model (from version 3.5) to understand the commodity mix and value/tonnage totals traveling through the main highways in Oregon; and
- using the forecasts from FAF v4.1 to identify commodity groups or routes that are likely to see significant growth in freight flows in the future.

Some of the drawbacks of the FAF dataset for this study include:

- having limited geographic detail in Oregon (only two zones); and
- the FAF traffic assignment has questionable results for individual highways/corridors because of the approximate nature of the methodologies used given the lack of local travel information. (The Oregon statewide model, described in section 2.8, utilizes FAF data to validate and calibrate aggregated regional flows to the larger FAF zones.)

2.2 COMMODITY FLOW SURVEY

2.2.1 Overview

The Commodity Flow Survey (CFS) is a data product maintained by the Bureau of Transportation Statistics that serves as the primary source of national and state-level information on domestic shipments in the U.S. It covers the mining, manufacturing, wholesale, and selected retail and trade sectors. The dataset is created by conducting a survey of shippers every 5 years as part of the Economic Census. The CFS dataset was first compiled in 1993, and the latest version available is for 2012.

[3] http://ops.fhwa.dot.gov/FREIGHT/freight_analysis/faf/faf3/netwkdbflow/index.htm

2.2.2 Data Summary

As mentioned before, the CFS serves as the primary dataset used to develop the Freight Analysis Framework. As such, the types of information reported by CFS are similar to those described in the previous section about FAF. Typically, CFS includes around 60 to 70 percent of the freight activity that is included in FAF. Because of this, it is not advised to use CFS over FAF, unless specific circumstances require the few data items that are included in CFS and not in FAF, such as the statistical certainty of the estimates and the length of the shipments, among others.

2.2.3 Application Benefits and Challenges

The CFS does not provide any additional data opportunities for bottleneck identification relative to what is already provided by FAF.

2.3 NPMRDS

2.3.1 Overview

The National Performance Management Research Dataset (NPMRDS) is a data system developed by the Federal Highway Administration in conjunction with HERE) to provide traffic speed information throughout the National Highway System (NHS). The system was developed with the objective of helping State and Metropolitan Planning Organizations measure the performance of automobile and truck traffic.

NPMRDS was developed based on probe data from GPS instrumented personal vehicles (including mobile phones, vehicles, and portable navigation devises) and GPS instrumented trucks. The truck probe data comes from the American Transportation Research Institute (ATRI), which is the research arm of the American Trucking Association. This extensive coverage provides a large number of records, which improves the accuracy of the travel time estimates reported.

2.3.2 Data Summary

NPMRDS reports the travel times on highway segments throughout the U.S. at a 5 minute interval throughout the year. Information about the distances of the segments can be used to calculate travel speeds. The first records available are for July 2013, although archived records on the Interstate system exist back to October 2010. The dataset is updated on a monthly basis, with the latest records available two weeks following the end of the month.

Travel time information is provided for both passenger vehicles and trucks (including combined passenger vehicles and trucks) on different links of the National Highway System. Each link is identified with a name and code, including the latitude and longitude locations. Geographic Information System shapefiles are available to assign travel times to the roadway network. Travel times are reported for both directions of travel. Information about state and county locations is also included.

2.3.3 Application Benefits and Challenges

NPMPRD is a unique dataset that provides many advantages over other data products available. Firstly, it is of particular interest to this study because of the quantity of separately sourced truck data. Secondly, it is publically available and provided at no cost to public sector users. Thirdly, it provides a detailed description of travel times on NHS roads, without requiring significant data pre-processing that is usually needed to interpret GPS probe data. GPS probe data needs to be organized in a database, cleaned for outliers, tested for the veracity of the records, assigned to a roadway network, among other

steps, before it can be useful to report travel speeds and highway performance. NPMRDS has already performed all of these complex steps. Additional pre-processing might be required if a different highway network is used than the one provided by NPMRDS. For example, utilizing ODOT's State Highway Network would require the additional task of corresponding this network to the network used by the NPMRDS.

NPMRDS can be used in a variety of ways:

- compare truck speed records on NHS roads with posted speed limits to determine where and when vehicles are traveling slower than they could;
- calculate indices of travel time reliability for trucks only and for trucks and automobiles that reflect the degree to which travel times are unpredictable on highways;
- estimate the impact of recurring congestion on roadway operations from speed declines at peak hours;
- estimate the impact of non-recurring congestion by analyzing extreme deviations in travel speeds; and
- compare the travel speeds of personal vehicles against the speeds of trucks to determine locations in the system where trucks are not keeping up with regular traffic, for roads with same speed limits.

Some of the drawbacks of the NPMRDS data include:

- it does not consider vehicle travel outside of the NHS;
- it does not include information about vehicle volumes, which makes it difficult to estimate total delay and understand the number of trucks affected by unreliability or mobility challenges that are identified in the data, however other complementary datasets could be used to obtain volume information;
- the pre-processing of the GPS probe data in the development of the NPMRDS makes assumptions about when truck trips start and end using models of truck trip behavior. The imperfect nature of this analysis means that the speed records in NPMRDS might be biased and not reflect reality accurately;
- the truck fleet instrumented by ATRI with GPS devices could have different operations (and potentially more advanced vehicles) than the entire truck fleet that travels through the NHS;
- travel times reported for 'all vehicles' do not reflect the traffic volume of passenger vehicles and trucks in actuality, but rather the probe sample size available for each road;
- it has gaps in the coverage when probes are not available, however it is likely that the locations in the highway system that do not have extensive probe records do not have high truck volumes and are, therefore, not critical trucking corridors;
- it does not break down results by type of trucks; and
- it contains a large number of records, which makes it difficult to analyze using traditional \methods. MS Excel, MS Access, Matlab, and MySQL would run into processing constraints for even limited samples of NPMRDS, let alone for records throughout a state. It is recommended that Tableau, Alteryx, Knime, or big-data SQL application be used instead

2.4 ATRI

2.4.1 Overview

The truck travel times reported in the NPMRDS data come from probe data obtained by ATRI from trucks with GPS equipment. The information reported by NPMRDS provides a fairly complete summary of the ATRI GPS probe data, for most applications. This data needs to be acquired from ATRI directly, typically at a cost, and can take a wide variety of formats depending on the specifics agreed with ATRI. This data has been purchased from ATRI by planning organizations all over the US and in Canada. Purchase inquiries would be required to explore these options.

2.4.2 Data Summary

The ATRI probe data can take many formats depending on the application. An often used format records the latitude and longitude of trucks along the highway network with time-stamp information. This time-stamp information, combined with the position information, permits the imputation of instantaneous travel speeds and travel times along a corridor. Depending on the frequency of updates, it might be necessary to place the probe data on a highway network to obtain more realistic estimations of the travel distances between records.

The ATRI data can be reported for the NHS—the information used in NPMRDS—or for all the vehicle travel available. Another version of the ATRI probe data does not include time-stamp information, but simply an index indicating the order of latitude-longitude records. This version of the data cannot be used to infer travel speeds, just the locations of vehicles.

2.4.3 Application Benefits and Challenges

The applications of the ATRI truck data depend on the format available for Oregon. Some of the possibilities include:

- estimating travel speeds directly from probe records;
- having information about the density of truck travel along different routes and corridors (instrumented vehicles);
- if the probe data is available for travel outside of the NHS, then it can be used to supplement the travel speed estimates from NPMRDS, which only includes travel on the NHS;
- providing more information about outlier events that cause apparent congestion event in NMPRDS; and
- having information to understand truck stops and truck parking patterns in Oregon (and potentially isolate these effects from mobility measures of travel performance).

The main drawback with the ATRI truck data is that extensive additional processing is required to obtain useful information, which is likely outside of the scope of this bottleneck analysis. We are aware of planning departments that have spent 6+ months working to get this data into a usable format.

2.5 HPMS

2.5.1 Overview

The Highway Performance Monitoring System (HPMS) was first introduced in 1978 as a national information system that provides data about the extent, condition, performance, use, and operating characteristics of public highways in the US. This represents the primary source of information used by

the federal government for distribution of funds. Some information is provided on all public roads, although coverage is limited for the lowest functional class system .HPMS data are used extensively for assessing the impact on highway performance of highway projects. The information collected in HPMS is provided by State DOTs on an annual basis to the FHWA. HPMS is then made available for free to transportation practitioners and the public.

2.5.2 Data Summary

HPMS provides the following information:

- Extent: the mileage of the system, functional class, urban designation, county, ownership, access control, tolls, pavement type, peak k-factor, intersections
- Condition: International Roughness Index (IRI) and Present Serviceability Rating (PSR)
- Performance: traffic delay, volume-to-capacity ratio, peak k-factor, pavement deterioration, fatality and injury rates
- User: Average Annual Daily Traffic (AADT), truck AADT

2.5.3 Application Benefits and Challenges

The HPMS can serve the following two purposes:

- Explanation of causes behind observed unreliability: HPMS provides a wealth of information describing the characteristics of public roads in the U.S. This information can be used in an attempt to find possible reasons for drops in speed or increases in unreliability observed in the NPMRDS. This information could include the pavement condition, the lane configuration, presence of access control, and degree of traffic peaking.
- Estimation of truck AADT on the system for calculation of traffic delay: The travel time information found in the NPMRDS can be used to estimate or investigate the average delay faced by a typical vehicle traversing a corridor, but information is needed from another source about the number of vehicles that use the corridor at a given time of day to calculate actual delay and have an appreciation of the magnitude of unreliability events on system performance. A challenge in implementing this approach is that there is currently no crosswalk that relates the NPMRDS highway road network to the NHS network that is used to collect the truck volume data by ODOT. A crosswalk between these two networks will need to be developed at some point, but this process could take a while. An alternative would be to first identify performance hot-spots from NPMRDS and then only develop crosswalk relationships for critical highway roads until the full crosswalk is complete.
- HPMS provides information about the k-peak factors, needed to translate average daily travel volumes to peak and non-peak volumes.
- HPMS is limited because, with the exception of the interstate system, the data is a non-statistical “sample” dataset of the roadway system.

2.6 Fatality Analysis Reporting System (FARS)

2.6.1 Overview

The Fatality Analysis Reporting System was created by the National Highway Traffic Safety Administration (NHTSA) as a standardized method to collect highway fatality crash information on all state routes. This system has been used to provide descriptive statistics about fatal traffic crashes on

United States (US) highways to help suggest solutions, and to evaluate the success of safety standards or programs. FARS has been in operation since 1975, and has information for nearly a million motor vehicle fatalities. Each instance in the FARS dataset contains over 100 data elements that can be used for a variety of analysis. FARS has an extensive presence in literature, and has been used to both study and visualize safety on highways to examine various aspects of highway safety.

2.6.2 Data Summary

With over 100 data elements, FARS contains information regarding many aspects of fatal highway crashes. To be included, the crash must involve a vehicle traveling on a roadway customarily open to the public. The data includes, but is not limited to: vehicle information, alcohol levels, seatbelt usage, pedestrian and cyclist information, and non-occupant information. The data is easily and freely accessible, is standardized at the national level, and can be queried from the NHTSA website. Due to the immense costs required to input and uniform all police-reported crashes, the NHTSA devised a method to combine census, existing State files, and sample-based information to provide representative traffic crash data at a fraction of the cost.

2.6.3 Application Benefits and Challenges

FARS has been used extensively and its potential uses have been well documented and studied. The dataset allows for analysis of safety across a variety of variables, which is important to understanding the operation of the transportation system as a whole.

Benefits for this project include:

- If frequency of crash information is gathered along a corridor, specific locations of higher frequency fatal crashes can be identified.
- In addition to highlighting safety concerns, these identified locations also likely experience non-reoccurring bottlenecks.

Because the dataset focuses on highway safety and fatal crashes, its application to bottleneck identification is limited to identification of locations of frequent crashes and analysis of severity

2.7 Highway Economic Requirements System State Version (HERS-ST)

2.7.1 Overview

As described by FHWA[4], "HERS-ST is an engineering/economic analysis (EEA) tool that uses engineering standards to identify highway deficiencies, and then applies economic criteria to select the most cost-effective mix of improvements for system-wide implementation. HERS-ST is designed to evaluate the implications of alternative programs and policies on the conditions, performance, and user cost levels associated with highway systems. The model will provide cost estimates for achieving economically optimal program structures, as well as predict system condition and user cost levels resulting from a given level of investment."

[4] https://www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.cfm

The tool utilizes a standard HPMS dataset format, but is enhanced to represent 100% sample for all Oregon State Highways. ODOT maintains and uses HERS-ST for a variety of applications[5] and has also linked HERS-ST to SWIM.

2.7.2 Data Summary

Figure 4 shows the data types in HERS-ST based on v4 (which has now been updated to v5.1).

Figure 5. Data in HERS-ST (v4)[6]

Default Data

1) Year – ***Default***
2) State – ***Default***
3) Units – ***Default***
4) County – ***Default***
5) ***Section ID – Calculate***
6) Standard Sample? – ***Default***
7) Donut Sample? – ***Default***
8) ***State Control Field – Whatever***
9) Section Group? – ***Default***
10) ***LRS ID – ID***
11) ***LRS BMP – ID***
12) ***LRS EMP – ID***
14) Urbanized Area Sample – ***Default***
15) Urbanized Area Code – ***Default***
16) NAAQS Code – ***Default***
18) ***Generated FC – Calculate***
19) NHS – ***Default***
20) Unbuilt – ***Default***
21) Route Number – ***Default***
22) Route Signing – ***Default***
23) Route Qualifier – ***Default***
24) Signed Route Number – ***Default***
25) Ownership – ***Default***
26) Special Systems – ***Default***
28) Truck Route – ***Default***
29) Toll – ***Default***
30) ***Section Length – Calculate***
31) Donut AADT Vol Grp ID – ***Default***
32) Standard AADT Vol Grp ID – ***Default***
37) HOV – ***Default***
38-46) Hwy Surveillance – ***Default***
47) ***Sample Identifier – Same as #5***
48) Donut Expansion Factor – ***Default***
49) Standard Expansion Factor – ***Default***
55) ***Access Control – Calculate***
61) ***Peak Parking – Calculate***
69) ***HAA – Calculate***
71) ***VAA – Calculate***
79) ***WDS – Calculate***
90) Prevailing Signalization – ***Default***
91) ***Typical Peak Green – Calculate***
95) Peak Capacity – ***Calculate***
96) VSF – ***Calculate***
98) Year of Future AADT – ***Calculate***

Easy Data

13) Rural/Urban – Easy ➔ GIS/Video/Images/Etc..
17) Functional Class – Easy
27) Type of Facility – Easy
34) Number Through Lanes – Easy
50) Surface Type – Easy
52) Climate – Easy (***Default*** / ***Calculate***)
53) Year Improvement – Easy (***Default***)
54) Lane Width – Easy
56) Median Type – Easy
57) Median Width – Easy
58) Shoulder Type – Easy
59) Right Shoulder Width – Easy
60) Left Shoulder Width – Easy
62) Widening Feasibility – Easy (***Calculate***)
70) Terrain Type – Easy (***Calculate***)
78) PSD – Easy (***Calculate***)
80) Speed Limit – Easy
86) Directional Factor – Easy (***Calculate***)
87) Peak Number Lanes – Easy (***Calculate***)
88) Left Turn Lane – Easy
89) Right Turn Lane – Easy
92) Num At Grade Signals – Easy
93) Num At Grade Stop Signs – Easy
94) Num At Grade Other – Easy

Tough Data

33) AADT – Difficult
35) IRI – Moderate (Easy w/ PMS or ***Default***)
36) PSR – Moderate (Easy w/ PMS or ***Default***)
51) SN/D – Moderate (Easy w/ PMS or ***Calculate***)
63-68) Horizontal Class– Easy to Difficult, depends
72-77) Vertical Class– Easy to Difficult, depends
81-82) Peak & Avg SU Trk – Difficult (***Default***)
83-84) Peak & Avg CM Trk – Difficult (***Default***)
85) K-Factor – Difficult
97) Future AADT - Difficult

Source: http://www.oregon.gov/ODOT/TD/TP/CM_HERS/Poster7.pdf

2.7.3 Application Benefits and Challenges

There are several benefits to applying HERS-ST for bottleneck identification:

[5] http://www.oregon.gov/ODOT/TD/TP/Pages/CM_HERS.aspx

[6] This is the old HPMS dataset used for HERS-STv4. The current version is HERS-STv5.1, which uses the new 2010 HPMS data format.

- It includes HPMS data that has been enhanced to represent a 100% sample or fall Oregon State Highways.
- ODOT has enhanced HERS-ST with additional statewide datasets that cover many of the other Oregon specific datasets.
- ODOT staff have a good understanding of the tool development and application.

Challenges and limitations of using HERS-ST include:

- Updating the HPMS data in HERS-ST is not automated and requires some minor-to-moderate additional work.

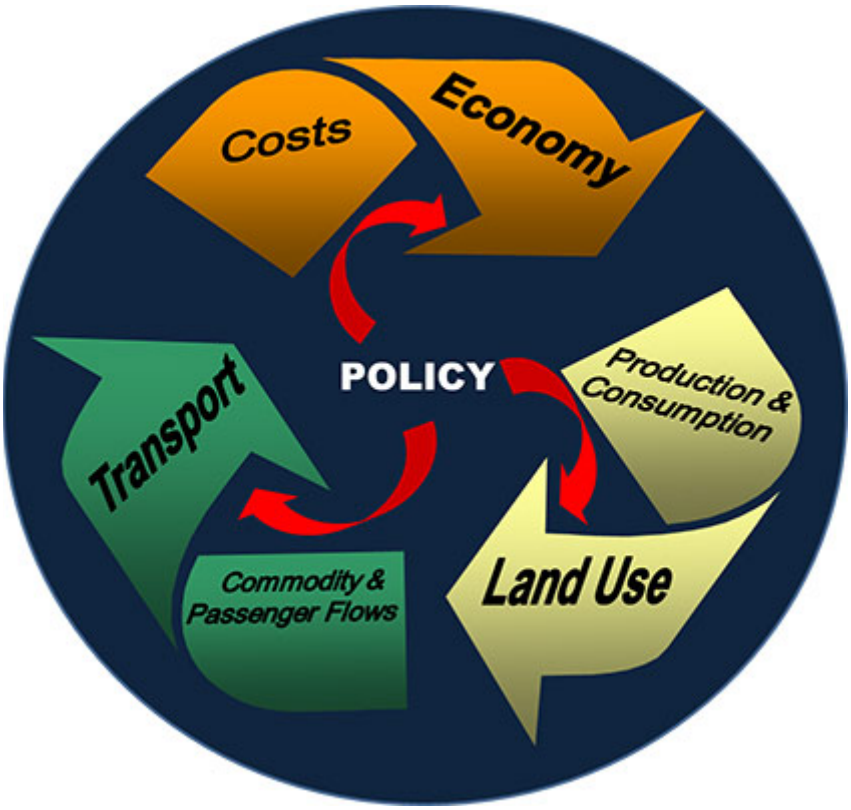
2.8 STATEWIDE INTEGRATED MODEL (SWIM)

2.8.1 Overview

The Oregon Statewide Integrated Model (SWIM) combines the dynamic interaction between Oregon's economic, land use, and transportation systems into one unified modeling tool. SWIM is made up of eight sub-models:

- Economic Model to determines the growth of the state's economy
- Population Synthesizer
- Aggregate Land Development which identifies land availability and allocates new development
- Activity Allocation model that gives spatial location to economic transactions
- Activity-based passenger travel
- Commodity-based commercial travel model
- Highway and transit assignment which allocates trips to routes

Figure 6. Oregon Statewide Model



Source: http://www.oregon.gov/ODOT/TD/TP/pages/statewide.aspx

ODOT is nearing completion of an update (v2.5) to the second generation (v2.0) SWIM model, which is anticipated to be ready in the next few months.

2.8.2 Data Summary

SWIM models the statewide movements through and among the 36 counties within Oregon, bordering counties, and external zones (used to approximate movements beyond the border counties). The previous section provides an overview of modules within the model that are connected and can provide sources for data.

Specific economic sectors and commodity types included in the model are provided in the development documentation: http://www.oregon.gov/ODOT/TD/TP/docs/statewide/og2d_wctr.pdf

Projections are based on long term employment and population forecasts, and commodity flows use 2007 FAF as a guide. However, SWIM is not forced to conform to FAF flows. Commodity flows must conform to industry production patterns – input-output model patterns. Therefore, SWIM represents post-recession patterns by using the DAS economic forecast with observed data up to September 2015.

2.8.3 Application Benefits and Challenges

Benefits for using SWIM include:

- Represents economic flows of households and industries
- Allocates commodities across screenline (and potentially using major corridors in the v2.5 update) throughout the state
- Can be used to identify and prioritize corridors that support significant commerce (relative to other corridors) within Oregon and those that provide travel through the state

Limitations to the SWIM include:

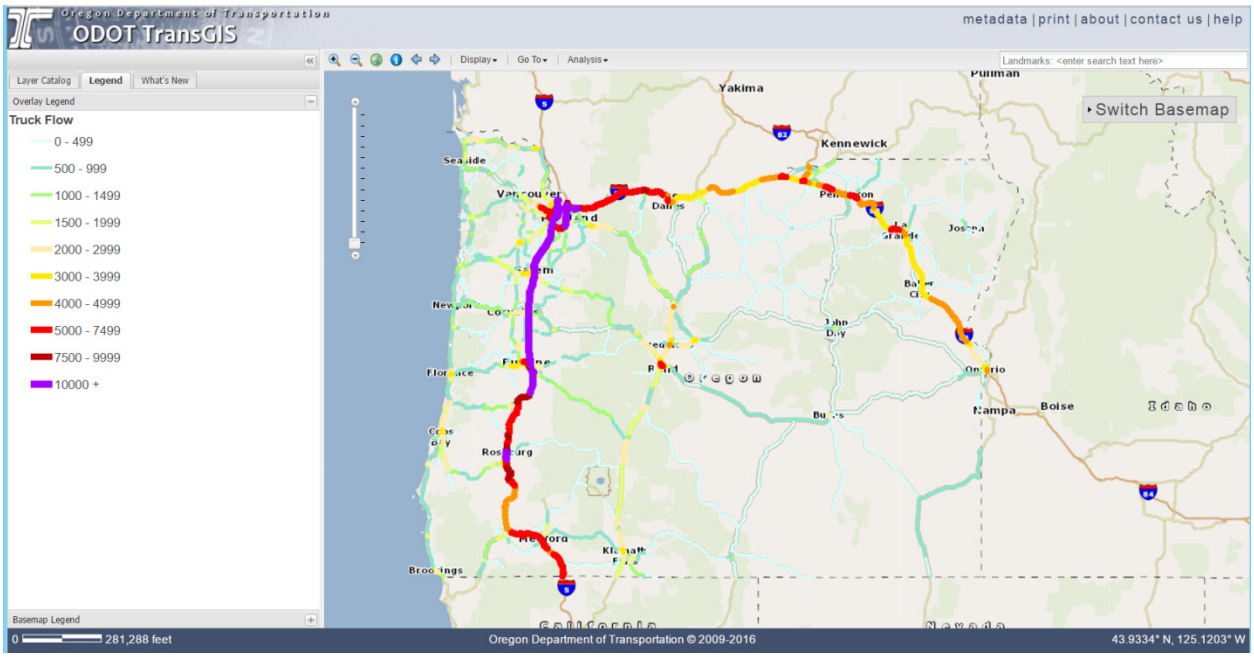
- The network is heavy on the state highways and light on the local roads and highways. Thus, traffic assignment results are not refined to the extent needed to evaluate bottleneck solutions without further network refinements and calibration. SWIM network does not reflect restrictions impacting different truck configurations, the tool has “autos” and “trucks” and “generalized transit” (not coded bus routes) and fixed transit (lite rail, Amtrak).
- SWIM 2.5 is still in development, and has not been subjected to exhaustive sensitivity testing. It is possible that there are some policy scenarios where its response will not conform to expectations, and SWIM outputs will therefore need to be analyzed responsibly.

2.9 ODOT Traffic Volumes

2.9.1 Overview

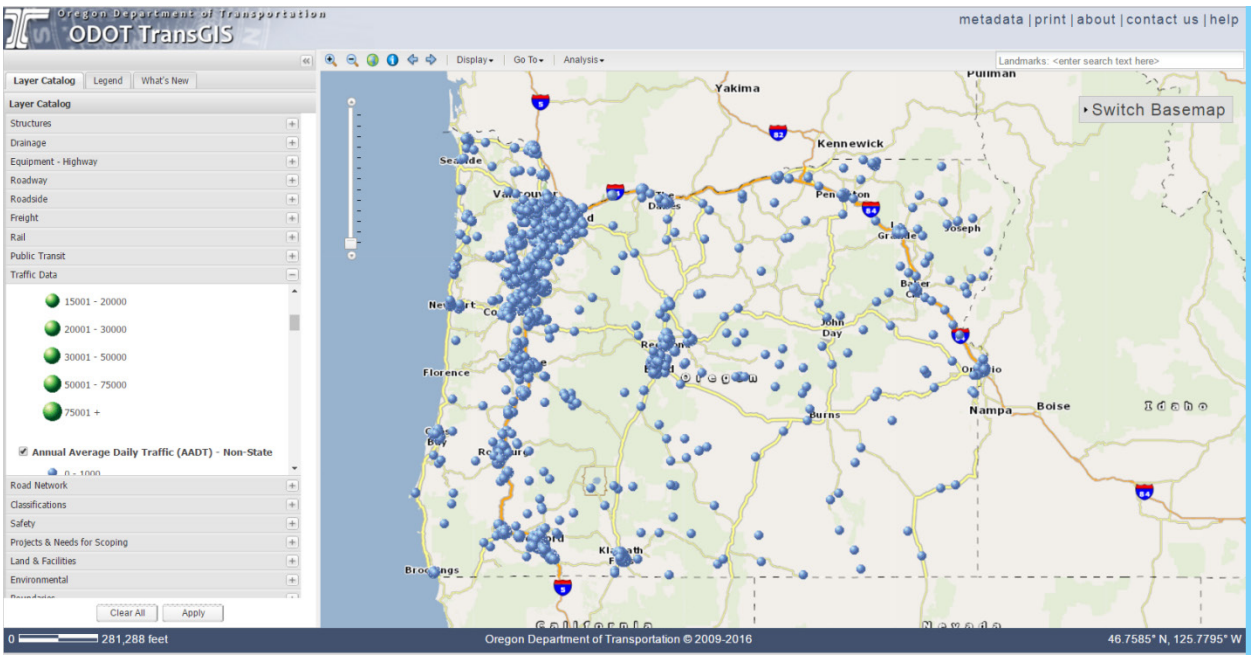
ODOT develops traffic volumes annually that cover the entirety of the state highway network, often shown as a “flow map”, as shown in Figure 6. Volumes are developed from various sources, including continually running Automatic Traffic Recorder (ATR) stations and sporadic tube counts. A selection of major non-state roads are also included as point counts. Figure 7 demonstrates the statewide coverage of these data sources. ODOT Traffic Volumes provide the basis for a wide range of highway analysis products, are produced by ODOT and can be accessed for free.

Figure 7. ODOT Truck Volume Flow Map



Source: image from TransGIS

Figure 8 ODOT Non-State Volume Locations



Source: image from TransGIS

2.9.2 Data Summary

Volumes include the Annual Average Daily Traffic (AADT), design hour factor (k-factor, used to obtain 30th Highest Hour vehicle volume from AADT), projected AADT, and ton-mileage truck volumes.

Percentages by FHWA 13 Category classification[7] (based on vehicle size) are provided as well. The entire dataset is updated annually, though some classification count locations may be up to three years old. At ATR stations data is collected continually, is available in hourly summaries, and can provide seasonal and daily volume profiles.

2.9.3 Application Benefits and Challenges

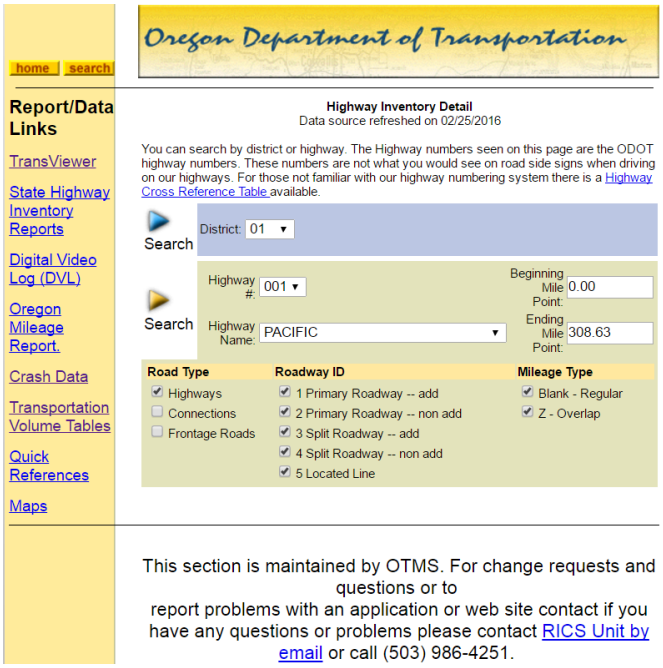
Data is available in GIS format as both points and continuous segments along state highways. The volume data provided is a foundational element for many types of traffic analysis and would be valuable for locating areas with heavy freight traffic and/or where congestion will be most impactful. However, there is coarse spatial and temporal resolution for this data which may limit its usefulness for locating fine-grained bottlenecks. Speed and travel time are not included.

2.10 ODOT Highway Inventory

2.10.1 Overview

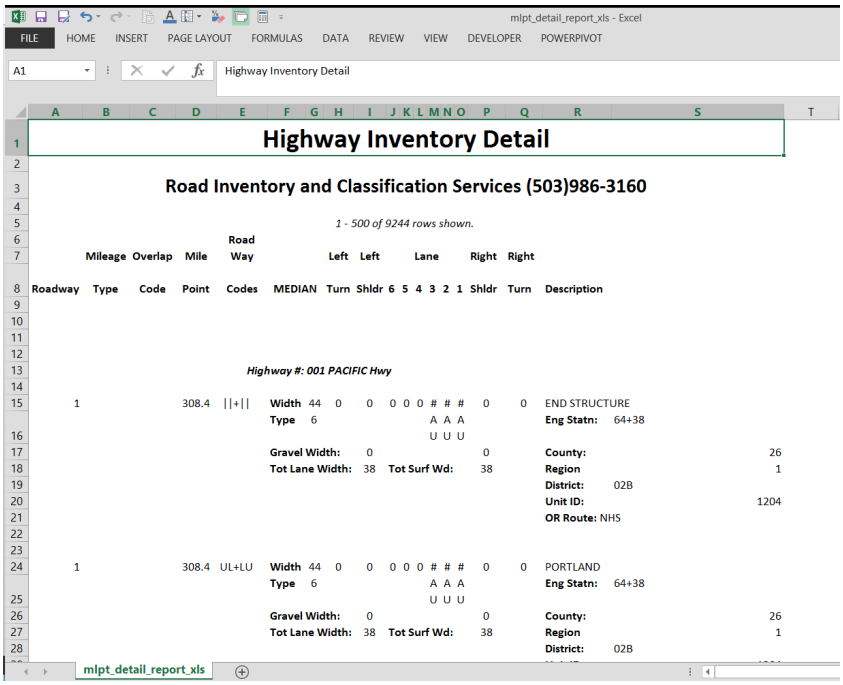
The ODOT Highway Inventory (TransViewer), shown in Figure 8 and Figure 9, includes information on lane geometry and materials, roadway and roadside structures, vertical grades, and horizontal curves. Data is available from ODOT at no additional cost. Records are retrieved by highway number and milepoint range queries on a web interface, the public version of which is limited to 500 records per query. All state highways are included.

Figure 9. ODOT Highway Inventory (TransViewer)



[7] https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm

Figure 10. ODOT Highway Inventory (TransViewer) Detail



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FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER POWERPIVOT

A1 Highway Inventory Detail

Highway Inventory Detail

Road Inventory and Classification Services (503)986-3160

1 - 500 of 9244 rows shown.

Roadway	Mileage Type	Overlap Code	Mile Point	Road Way Codes	MEDIAN	Left Turn	Left Shldr	6	5	4	3	2	1	Right Shldr	Right Turn	Description		
					Highway #: 001 PACIFIC Hwy													
	1		308.4	||+||	**Width** 44	0	0	0	0	0	#	#	#	0	0	END STRUCTURE		
					Type 6						A	A	A			**Eng Statn:**	64+38	
											U	U	U					
					Gravel Width:	0								0		**County:**		26
					Tot Lane Width:	38	**Tot Surf Wd:**							38		**Region**		1
																District:	02B	
																Unit ID:		1204
																OR Route:	NHS	
	1		308.4	UL+LU	**Width** 44	0	0	0	0	0	#	#	#	0	0	PORTLAND		
					Type 6						A	A	A			**Eng Statn:**	64+38	
											U	U	U					
					Gravel Width:	0								0		**County:**		26
					Tot Lane Width:	38	**Tot Surf Wd:**							38		**Region**		1
																District:	02B	

mlpt_detail_report_xls

2.10.2 Data Summary

The data provides basic information about the road geometry and roadside context, which is critical to locating physical bottlenecks or other features that may contribute to bottleneck circumstances. The data source is updated frequently relative to changes in the features represented, although the database doesn't note when those updates were made.

2.10.3 Application Benefits and Challenges

Data provides direct insights into physical constraints that can affect freight movement. However, web query format and data format (which is in Excel, but not a flat file) may make integration with other datasets challenging. Some of this data is also available through TransGIS and/or FACS-STIP in a format that integrates with other datasets more easily.

2.11 ODOT FACS-STIP AND TRANSGIS

2.11.1 Overview

The Features, Attributes, and Conditions Survey, Statewide Transportation Improvement Program (FACS-STIP) provides a reliable and centralized asset database for providing basic inventory and condition information to ODOT staff. FACS-STIP is available internally to ODOT through a web map interface that facilitates "Asset Data to Go" spreadsheet export of features by highway milepoint in a user-defined query area.

TransGIS provides GIS data covering a similar range of features, and is available publically though a web map interface and through ftp download of statewide GIS files.

FACS-STIP and TransGIS are produced by ODOT and available for no additional fee.

Figure 11. ODOT FACS-STIP

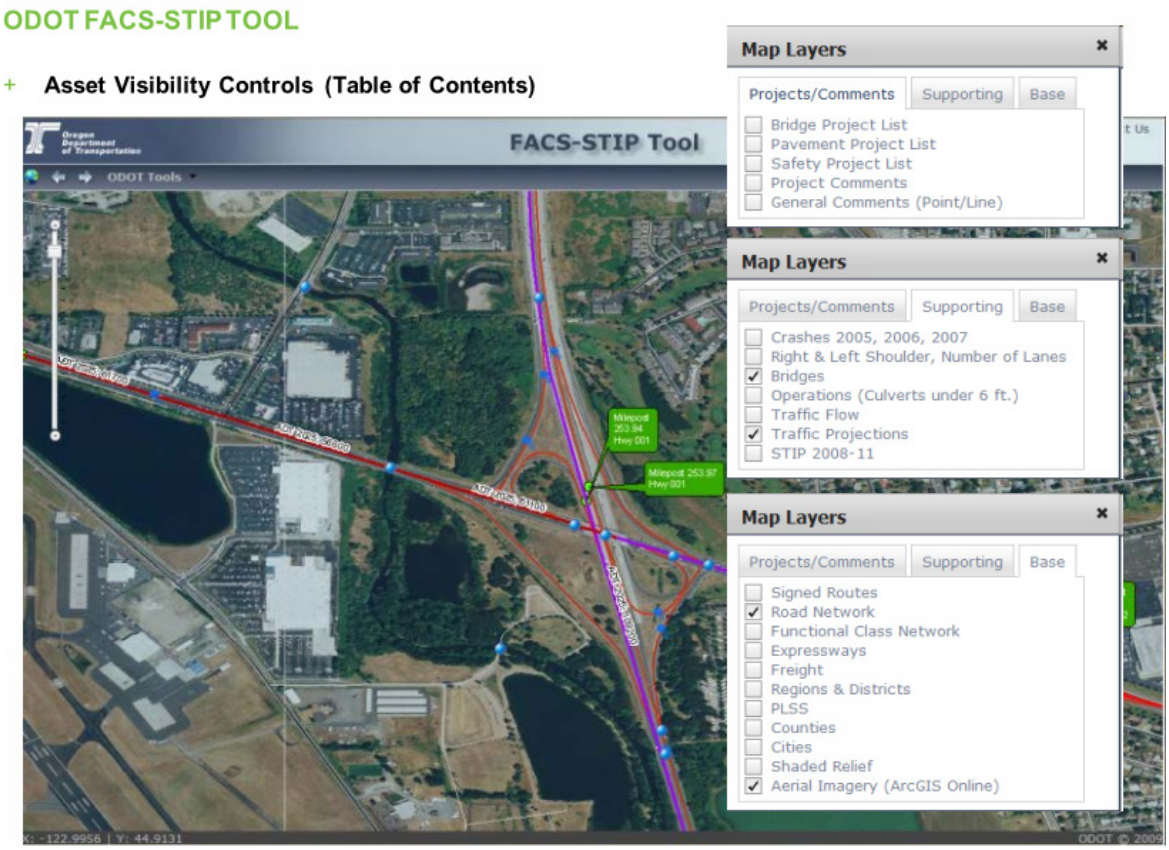
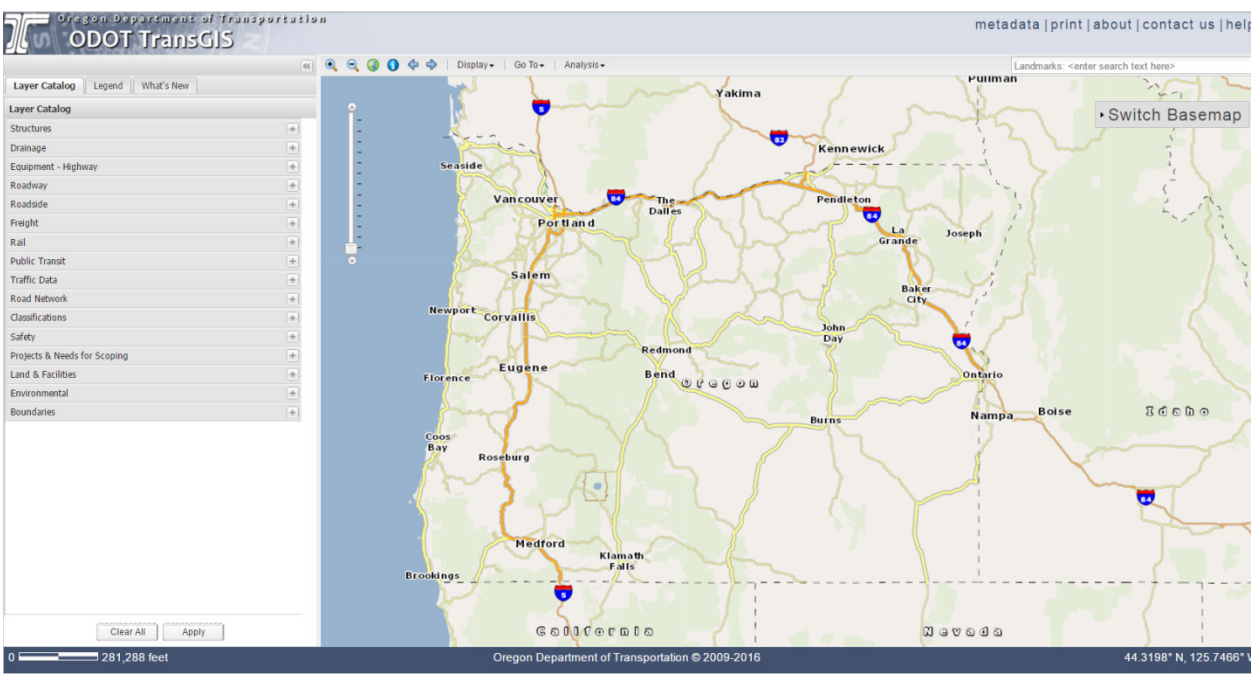


Figure 12. FACS-STIP GIS Map Interface



2.11.2 Data Summary

FACS-STIP and TransGIS provide access to many ODOT inventory datasets, including the others reviewed here (volumes, lanes and shoulders, highway classifications, posted speeds, bridges, crash records). Other unique inventory items include ITS sites, pavement conditions, rail crossings, milepoints, traffic barriers, right and left turn lane locations, and political and environmental boundaries.

Data is provided for all state highways, and a small selection of non-state roadway information is available as well.

2.11.3 Application Benefits and Challenges

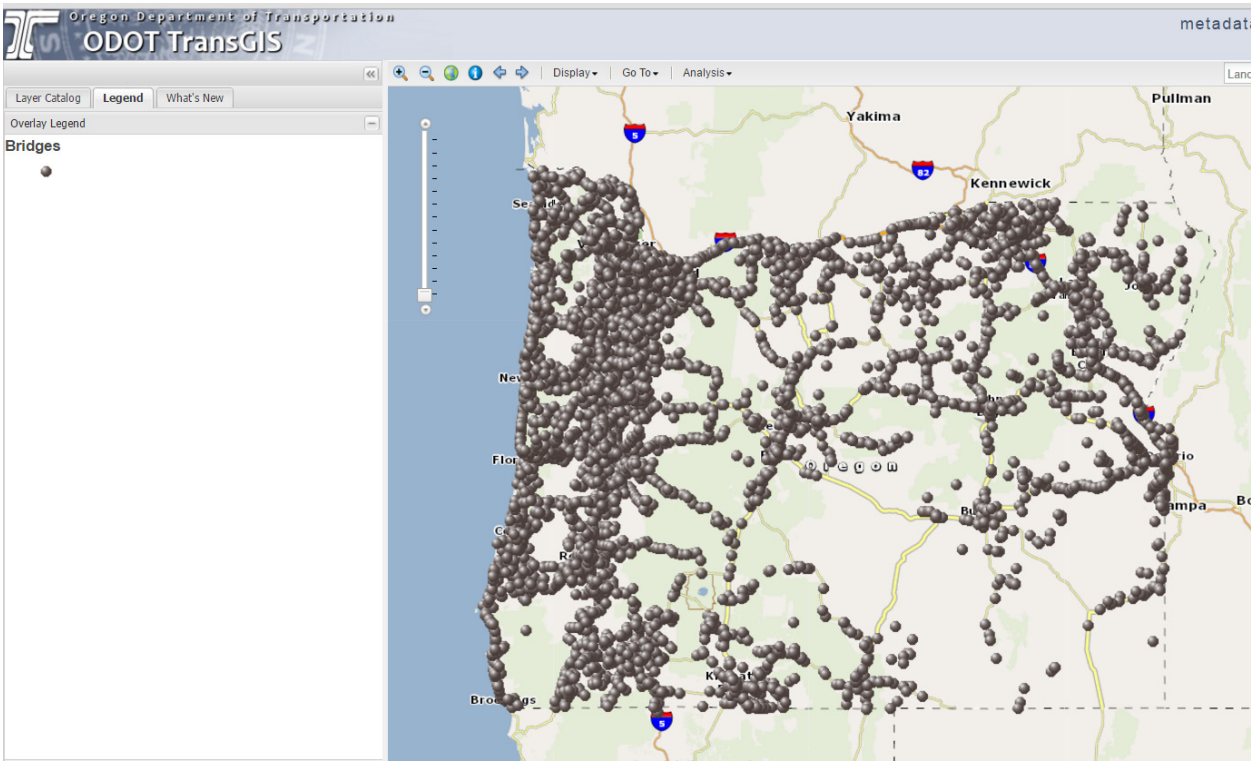
FACS-STIP and TransGIS provide foundational information about a range of assets and highway characteristics that would be useful for analytical context, including traffic volumes, freight routes, lane, shoulder, and pavement conditions. Data is well formatted for GIS analysis and integrates well with other ODOT data. It is generally static data (manually updated as changes are identified), however, and does not represent changing traffic conditions.

2.12 ODOT Restricted Bridges and Routes

2.12.1 Overview

As part of FACS-STIP and TransGIS, ODOT maintains data from bridge inspections statewide. This covers all publicly accessible bridges, excluding those that are maintained by the federal government. Data is available at no additional cost. Motor Carrier Unit also has several lists of restricted routes, which may be due to grade/curvature or other infrastructure elements.

Figure 13. FACS-STIP GIS Map Example



2.12.2 Data Summary

Data is available in GIS, and updated annually although individual bridge assessments may be significantly older. Bridge characteristics include flags for structurally deficient bridges, functionally obsolete bridges, weight restricted bridges, and bridges with low vertical clearance. It also includes details on structure type and condition, owner, permitting information, length, width, and number of lanes.

2.12.3 Application Benefits and Challenges

Restricted bridge data could be used to identify physical bottlenecks and evaluate the effect of detours, including an assessment of freight network redundancy or resiliency. Data is provided in GIS format that integrates well with other ODOT datasets, although the data is static and does not represent traffic conditions.

2.13 ODOT Incident Log

2.13.1 Overview

The ODOT Incident Response programs in Region 1 and Region 2 produce incident logs which describe the time, location, and attributes of incidents and the ODOT response to the incidents. Incident Response personnel typically patrol the major freeways and highways in the regions, but can respond to incidents reported anywhere in the region. Generally, the incident log can be used to identify non-recurring events that temporarily impede the flow of traffic. The Incident Logs are automatically created as a component of the Computer Aided Dispatch and Automatic Vehicle Location technology used in the program. Data is produced by ODOT and does not require additional fees.

The ODOT Incident Response program has been formally assessed through multiple reports, typically using the incident logs integrated with other volume and crash data.

2.13.2 Data Summary

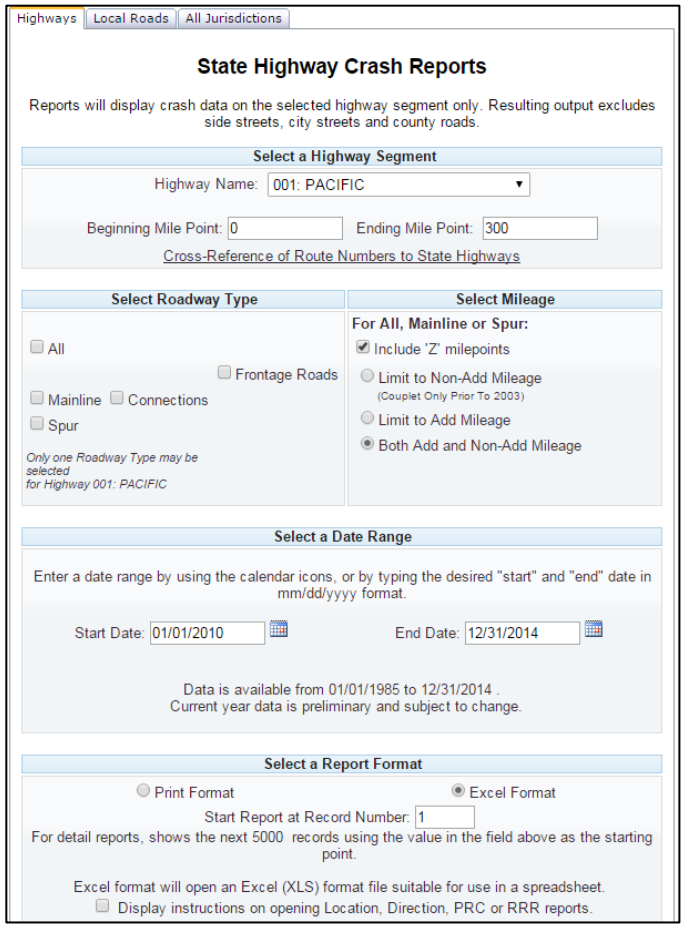
The data is available on request from ODOT regions in tabular form, and describes the onset, response, and resolution of incidents on ODOT highways. Data attributes include the location of the incident (by milepoint and lat/long), the details of vehicles involved (including identifying trucks), the impact of the incident (lanes closed), response actions taken (vehicles dispatched, ITS sign messages), and the duration until the incident has been cleared.

2.13.3 Application Benefits and Challenges

Incident log data provides unique insight by characterizing the cause, response, and resolution of non-recurring sources of congestion. Such data can identify patterns that help to convey the relative frequency and impacts of incidents (which also may be reflected in travel time datasets). The data is limited to Region 1 and Region 2, with most records on major highways. Previous analysis efforts have demonstrated the value of the data, but have also shown that records require additional processing and integration with other sources to provide meaningful insights.

Records are downloadable using filter criteria such as city, county, or route (with beginning/ending mileposts). The data is available in a database format that includes coordinates to facilitate mapping. Additional processing is generally required to confirm location due to two common issues: coordinates do not always match descriptions, and sometimes a in incident will be flagged for an intersection (when it should be a segment) or vice-versa. Due to the nature of the broad coverage of the system, and the

number people submitting the data record (generally the person that was involved in the crash, who may not have prior experience filling out the form), there is some inconsistency in how crashes are coded, and fields may contain errors.



2.14 Crash Analysis Reporting System (CARS)

2.14.1 Overview

Maintained by ODOT, the Crash Analysis Reporting System keeps track of reported vehicle crash data. This data can be queried online, and a variety of report outputs are available for the user to select. Various annual reports and crash summaries are also made available through ODOT. This dataset has been used to examine safety concerns and the underreporting of crashes. While crashes may not involve trucks directly, trucks are impacted by the resultant delays. This dataset can be used to identify and evaluate non-recurring bottlenecks by examining corridor level crash information and frequency of crashes.

2.14.2 Data Summary

The dataset includes a large number of crash attributes which include, but are not limited to: location, road characteristics, proximity to intersections, weather conditions, crash severity, and collision type. Annual reports put out by ODOT include summary statistics and comparisons to previous years. This may include changes in percentage of fatal crashes, reasons for crashes, number of crashes involving cyclists or pedestrians, as well as more in-depth reports. All these data are freely accessible and individual queries can be run to examine specific portions of roadways. Grouping frequency of crashes by mile-marker will allow for the determination of locations where crashes are more likely to occur and thus are more likely to result in bottlenecks. Because fatal crashes are likely to be included in the FARS database, there is overlap between the two datasets. However, because this dataset includes more than just fatal crashes, it is more useful for identifying bottlenecks. This data is also available as a layer on ODOT's TransGIS web mapping tool.[8]

2.14.3 Application Benefits and Challenges

This dataset is beneficial because it is free, has been archived for many years, highlights safety concerns, and has broad coverage. Because this dataset is for all vehicle crashes, not just fatalities, it is more

[8] ODOT TransGIS: https://gis.odot.state.or.us/transgis/

comprehensive than FARS. As a result, the dataset can be used to examine safety concerns on roadways, as well as examine these concerns over time. Crash data also lends itself easily to mapping or spatial analysis.

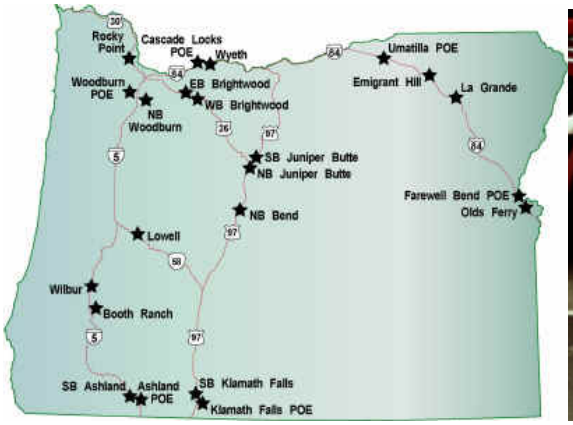
The challenges for this dataset include the usability of the querying tools and the level at which it can be used to examine bottlenecks. Because it is a dataset of crash information, it is only applicable in instances where a crash occurs and is reported. There are many other reasons a bottleneck may occur that cannot be identified with this dataset. In addition, the tool used to select and examine crash information is cumbersome due to the user interface.

2.15 Weigh-in-Motion

2.15.1 Overview

Oregon collects Weigh-in-Motion (WIM) data from twenty-two stations across the state (displayed below). The program started in the 1990's as Slow Weigh-In-Motion (SWIM) and is now also encompasses the Green Light Preclearance Program. While Oregon was one of the first states to implement such a system, it is now used by a variety of states across the country. Instead of having trucks stop to be weighed, the system works by recording information as a truck passes over a scale built into the road (shown below). This has been shown to save both time and money for trucks, operational costs for the state, and decrease overall pollution, as the vehicles do not have to stop to be weighed at stations and the weighing is done automatically and without operator cost.

Current WIM loop detection provides data on axle weight, vehicle speed, time, station locations, among other vehicle characteristics. This dataset has been used to analyze and describe truck volumes and axle weight/spacing, as well as to examine reductions in pollution that result from using the system. This data can also be used to examine seasonal or weather related variability in truck traffic.



2.15.2 Data Summary

The data has been collected and archived by ODOT in varying degrees since the 1990's, with only the more recent years of data containing speed information. Data is continually being collected at the 22 locations, and includes speed, axle weight, truck length, and various other vehicular descriptors. Data can be grouped by time of day or season to provide insight into a variety of truck trends.

2.15.3 Application Benefits and Challenges

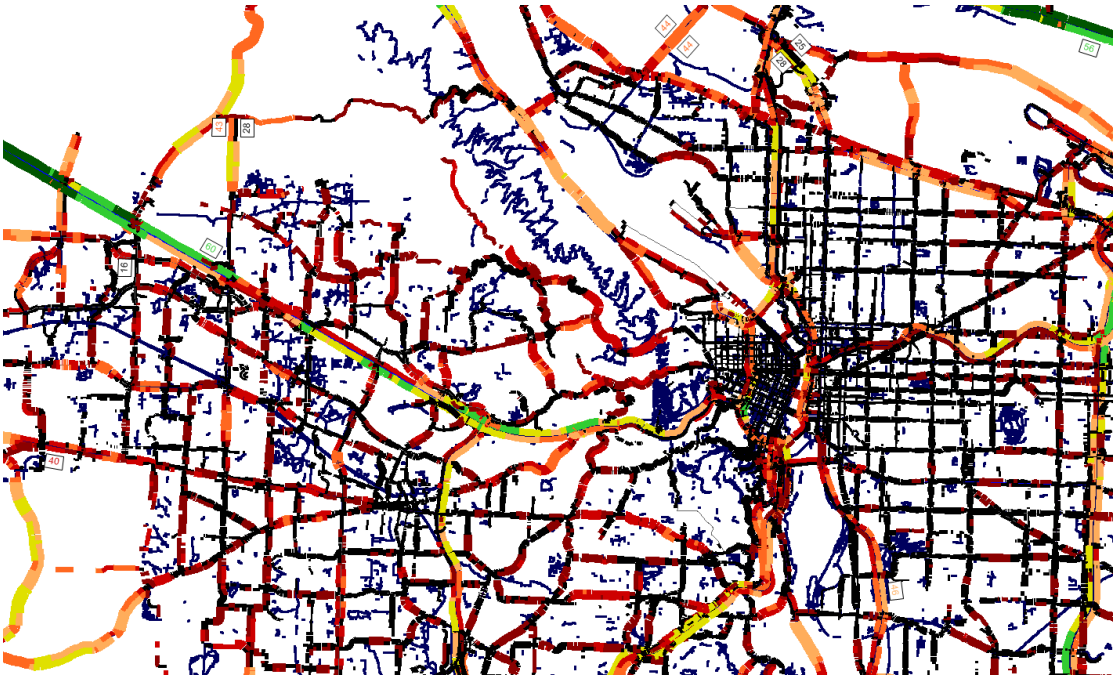
With a limited number of locations across Oregon and not having WIM loops to detect trucks in all lanes, the ability of these data to identify bottlenecks is limited, and only applicable to locations within close proximity to station. However, the data provides the option to examine frequency, time-of-day, and seasonal variance among trucks. Furthermore, for such analysis, the dataset extends back to the 1990's and allows for examination of changes in traffic patterns with respect to time. Although the data collected is only a sampling of trucks on the system, such analysis could include the growth in total number of trucks, which routes are used, and changes in vehicle weight or vehicle classification.

2.16 TomTom Historical Speed Profiles

2.16.1 Overview

The TomTom Historical Speed Profiles provide a broad, statewide coverage of approximated weekday and weekend travel speeds by hour of the day. The dataset does not contain detailed, statistical data that other travel time datasets may contain, rather it includes fitted (pre-defined) speed profiles based on empirical speed data. This dataset was purchased by ODOT and is available as data fields accessed within the Visum proprietary software program. The data was considered for the Portland Region Westside Freight Access and Logistics Analysis, but was ultimately not used since it did not capture some unique operational patterns. For example, the significant peak hour delay at ramp meters for freeway access was not reflected in the dataset. Figure 13 shows an image of the data in the Portland region, which indicates broad, nearly complete coverage of the collector roadway system (which is better than many other datasets).

Figure 14. TomTom Historic Speed Data in Portland Region



2.16.2 Data Summary

As shown in Figure 13 (which includes a Portland region window to demonstrate the density of coverage, which is generally representative of other areas of the state), the dataset covers most collector and higher roadways. However, while the roads may have a fitted profile, the precision of the estimated speed profile may be limited on low volume roads. Additionally, roads with unusual local travel patterns (e.g., peaks caused by adjacent land uses or operational patterns, such as peak period ramp metering) might not fit pre-defined speed profiles. The data includes both weekday and weekend average speeds by hour of the day, but does not contain any underlying raw data statistics or variability.

2.16.3 Application Benefits and Challenges

The two primary benefits are that the dataset is that is has broad coverage throughout the state and it is easily mapped using the Visum interface. However, the challenges and limitations, include:

- Speed profiles are approximate and may not match actual conditions (profiles are "best fit" matches).
- Speed profiles do not contain any information related to reliability. Only one value (average) is provided for each hour of the day.
- Data is 2010; no newer data is available.
- Data is not freight specific.
- There are limited observations in less dense areas

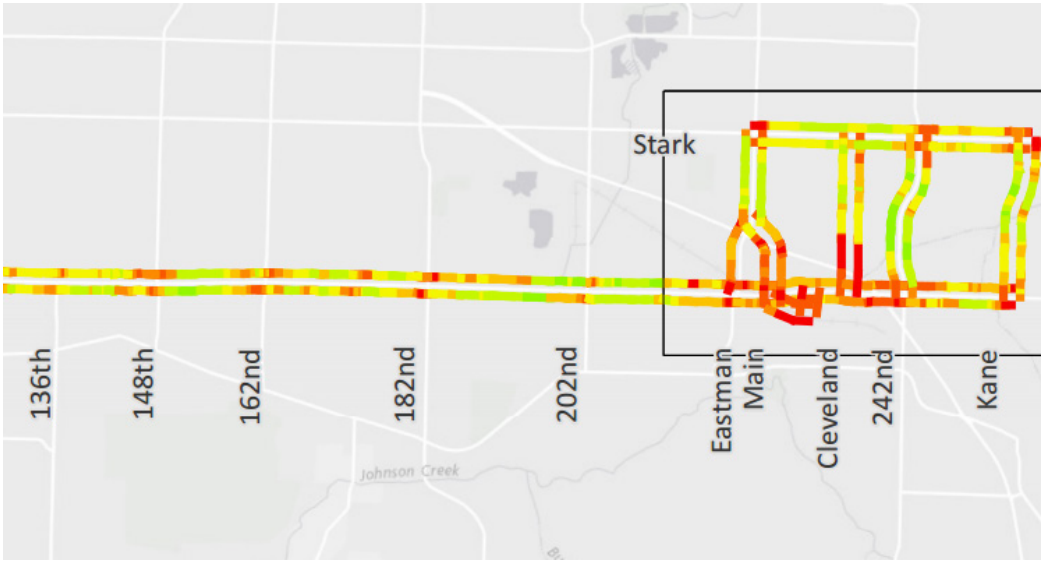
2.17 TomTom Custom Travel Time (TrafficStats)

2.17.1 Overview

TomTom TrafficStats is a travel time product, based on probe data, which includes statistical travel time data by corridor. This dataset contains more detailed data than Historical Speed Profiles, however it

would also require an additional purchase. The data has been applied for corridor planning studies in Oregon and offers higher resolution[9] than other typical travel time datasets (e.g., INRIX and INRIX XD or HERE), segmented down to the "decision point", which is typically a street segment. This data resolution provides an improvement over the traffic message channel (TMC) (and even "sub TMC") based resolution typically used in other travel time datasets. Figure 14 shows an example of the arterial resolution in the Portland metro area.

Figure 15. TomTom Travel Time Data on a Corridor



2.17.2 Data Summary

Once "credits" for the data have been purchased, the data can be queried and filtered through a web-interface and downloaded as a .csv file along with a shapefile for mapping. The data is available in 15-minute periods and includes mean travel time and other statistics (including standard deviation and percentile values) for reliability calculations. The data can be reported for individual segments and aggregated to the corridor level, however there is no differentiation for freight.

2.17.3 Application Benefits and Challenges

While the dataset provides very detailed segments, it would likely be cost-prohibitive for statewide application. The additional detail is better-suited to corridor studies and may be unnecessary for a broad, statewide application.

2.18 INRIX

2.18.1 Overview

ODOT has previously purchased travel time probe data from INRIX. During the time period that ODOT had a license to use the web-based Analytics Tool, the dataset was applied for a number of planning

[9] While other datasets may provide data at sub-TMC levels (such as INRIX XD), link segments can still typically range from 0.5 to 1.5 miles in length along arterial corridors and not provide a granularity that captures the operational impacts of individual intersections and traffic control along the corridor.

studies in Oregon (including Portland Region Westside Freight Access and Logistics Study). However, while ODOT still retains access to the historical data archive, manual manipulation of this dataset is more cumbersome.

2.18.2 Data Summary

ODOT's historical INRIX data covers approximately 2010 through 2013 and is available in 1-minute intervals. The data is summarized by segment (TMC) and covers most of the state system. Additional coverage on the arterial system improved towards the end of the period but is not available in prior years. The dataset includes travel time statistics for each segment by time of day. The Analytics Tool (access is no longer available to ODOT due to expiration of the agreement) could be used to map the data, aggregate by corridor, and select reliability metrics. The Analytics Tool also included a proprietary bottleneck indicator that has been used in prior studies as a method for determining bottlenecks.

2.18.3 Application Benefits and Challenges

The INRIX data offers a robust dataset of historical travel time data and reliability. While INRIX data has the same limitations of all probe datasets (data is a sampling and some processing is required), the statistical measures that are offered are generally a good reflection of the raw data and notes are provided where data has been estimated to fill a gap (through this requires a raw data download). However, future processing would require manual database and mapping tools that could be very time intensive. Some effort would be required to determine the extent of data coverage during the various historical periods.

2.19 HERE

2.19.1 Overview

The HERE dataset, based on probe data, would cover most major facilities and provide additional coverage beyond what is included in NPMRDS.

2.19.2 Data Summary

The HERE data is available through the Iteris web interface back to 2012 in five-minute increments. The web interface allows the data to be queried and filtered by location and other considerations such as month, day, time, etc. The specifics of the dataset and user interface will be based on the negotiated contract with ODOT.

2.19.3 Application Benefits and Challenges

The HERE dataset offers ODOT's latest and best resolution travel time database. Due to the wider coverage, the data might be used to supplement corridors where NPMRDS does not reach. In addition, this dataset might provide better resolution and more filter parameters than what is available through NPMRDS.

This dataset is not currently available to ODOT, but may be so in the near future. As a result, ODOT has limited knowledge about specifics of the product application that could impact methodology. Further, specific roadway coverage is unknown and there may be gaps in some rural areas. Finally, it may be a time intensive process to query and link these datasets to other existing datasets for analysis.

3 RECOMMENDED DATA PLAN

The following section summarizes our recommended approach for dataset selection to identify bottlenecks. Additional details related to specific indicators, performance measures, thresholds, and potential tiering will be identified in future memos.

3.1 ASSESSMENT OF DATA OPPORTUNITIES AND CONSTRAINTS

The following findings noted in the general observations summarize the overall opportunities and constraints of the datasets:

- The reviewed datasets, together, capture information related to commodities, safety/operations, or roadway characteristics.
- A number of the datasets provide information that is related or redundant to other datasets.
- Since coverage varies by each dataset, some datasets may not be available in certain areas to identify freight bottlenecks. If the same combination of datasets is used to measure the entire system, there may be a need to consider the "least common denominator" of the datasets – that is, what level of facilities can be analyzed with a given dataset, or conversely, what datasets are available for a given level of facility?
- Each dataset provides benefits and challenges for identifying freight bottlenecks. Two primary challenges that could present potential risks to this analysis effort and schedule include readiness/availability of data (such as SWIM and HERE) as well as ODOT familiarity with a new source/tool (HERE).

Key constraints driving the selection of a data plan for this bottleneck analysis are:

- Does the dataset provides measure that address critical concerns identified by stakeholders and the project team?
- Is the dataset readily available? Some datasets may enhance the analysis but may be cost or schedule prohibitive.
- Can the dataset be applied by ODOT staff within the project schedule?

3.2 RECOMMENDED DATA PLAN

The recommended data plan is based on a review of the available data and various bottleneck considerations. These considerations are based on vision provided in the Oregon Freight Plan, project objectives and stakeholder feedback. While specific measures and indicators will be identified at a later time, the data plan is intended to provide comprehensive coverage of these general considerations and flexibility to address specific criteria or combinations of criteria to identify and prioritize bottlenecks.

No single dataset is inclusive of all of the bottleneck considerations. While all datasets have limitations and constraints, the recommended combination of datasets will best address critical considerations in an achievable manner.

In order to best leverage available data, a preferred combination of datasets is recommended and may be supplemented with other datasets, as needed, to fill gaps (such as lack of coverage). Some datasets may have generally good coverage in urban areas but need to be supplemented with other data in rural areas where coverage is poor. An example of this approach would be using readily available NPMRDS

data to provide operations data for the majority of routes and using other probe data that requires additional processing (INRIX or HERE) to supplement other corridors that are not covered. This approach will maximize the value of existing datasets while strategically focusing effort on filling remaining gaps.

Datasets will be used to identify the location and criticality of bottlenecks. The recommended general considerations and datasets that would be used to address them are:

- Congestion / Operations (Indicators and Tiering) – The primary source of operational data will be provided by NPMRDS, although HERS-ST can also be used to provide truck counts. NPMRDS is recommended as the primary tool since it provide truck operations on the NHS system, updated on a monthly basis.
    - Other probe datasets with additional coverage (such an INRIX or HERE) will be used to supplement the operational data and fill data gaps for locations that are not included in NMPRDS.
    - HER-ST is also recommended since it provides volume information and complete coverage of the RRR system.
- Commodity (Tiering) – SWIM is the recommended source for commodity information since it incorporates simulation of commodity flows from input-output models of industry production activity based on the official Oregon economic forecast at fine spatial levels (500 zones).
    - Application specifics will be determined as the update to v2.5 is completed, but it is anticipated that this dataset would be used as the sole source of commodity information.
    - Other commodity datasets (FAF and CFS) are already reflected in SWIM through the calibration and validation process.
- Geometric / Spatial (Indicators and Tiering) – HERS-ST provides the geometric (such as grade, curves), spatial attributes, and general characteristics (such as highway type and ODOT region) for all state routes.
    - TransGIS also includes spatial components that can be useful, but Is not recommended as a primary dataset since it would require manual processing and manipulation. It is recommended as a supplemental dataset since some of these components may be included during the tiering process to account for security/safety qualitative measures (as noted below).
- Security / Safety / Risk (Indicators and Tiering) – Various considerations related to safety and system redundancy can be covered with TransGIS, which provides spatial mapping of crashes. While some additional effort may be required to aggregate and analyze the data, it provides comprehensive coverage of the state and incorporates sufficient high level information provided in other datasets (such as CARS and the Highway Inventory). TransGIS may also be used for assessing system redundancy and potential issues related to bridges or other system considerations.

Table 1 identifies the considerations and types of measures of primary concern. While a number of datasets potentially cover the various measures, Table 1 also identifies those that appear to best meet the various constraints. Specific indicators, thresholds, and potential tiering factors will be identified at the next stages of the project.

Table 1. Recommended Data Sources for Consideration Areas

Type of Concern/Consideration	Potential Measure Types	Potential Purpose/Use	Recommended Source(s)
Congestion/ Operations	Speed, Delay, Travel Time, Reliability, Truck Volume	Identify/Tier bottlenecks	NPMRDS, HER-ST (volume), Other probe data (supplemental to support data gaps)
Commodity	Type, Value, Tonnage,	Tier bottlenecks	SWIM
Geometric, Spatial	Grade, Curves, Region, Highway Type, Connections	Identify/Tier bottlenecks	HERS-ST
Security/Safety/Risk	Redundancy, Seismic, Collisions, Weather	Identify/Tier bottlenecks	TransGIS

Additional data sources that were reviewed but are not recommended at this time typically provide similar types of data. However, they are not included due to cost and/or schedule impacts. Table 2 lists these additional sources, the data coverage they provide and the recommended source.

Table 2: Summary of Alternate Data Sources

Data Source	Data Type	Recommended Source
FAF	Commodity	SWIM
CFS	Commodity	SWIM
NPMRDS	Operations.	Recommended source
ATRI (Detailed data beyond NPMRDS)	Operations	NPMRDS
HPMS	Operations	HERS-ST
FARS	Safety	TransGIS
HERS-ST	Geometric/Safety/Operations	Recommended source
SWIM	Commodity	Recommended source
ODOT Traffic Volumes	Operations	HERS-ST
ODOT Highway Inventory	Geometric	HERS-ST
ODOT FACS-STIP and TransGIS	Geometric, Spatial	Recommended source
ODOT Restricted Bridges	Geometric	TransGIS
Weigh-in-Motion (WIMS)	Commodity	SWIM
ODOT Incident Log	Security/Safety/Risk	TransGIS
Crash Analysis Reporting System (CARS)	Safety	TransGIS
TomTom Historical Speed Profiles	Operations	NPMRDS
TomTom Traffic Stats	Operations	NPMRDS
INRIX	Operations	NPMRDS
HERE	Operations	NPMRDS

Table A1: Summary of Data Sources

Data Source	Data Type	Measures/ Metrics	Coverage	Data Fidelity / Age	Availability/Cost	Application/ Usability	Project Benefit	Challenges / Limitations
FAF	Freight flows by commodity and mode between FAF zones	• tonnage • value • ton-miles	• Nationwide, including domestic and international • Oregon flows are divided between Portland and Other.	• Published every 5 years • Latest version (4.1) includes estimates from 2012 to 2015, with forecasts to 2045	Free from USDOT	• identify key economic sectors generating freight in Oregon, providing information on critical supply-chains • describe the commodity mix and freight totals on main highways in Oregon using the traffic analysis feature • use the forecasts to identify supply-chains and corridors that are likely to see the fastest growth in the future	• Can be used easily to understand aggregate commodity flows to and from Oregon, particularly travel by truck • Contains an appropriate level of commodity detail, and allows for the isolation of truck freight flows	• limited geographic detail in Oregon • questionable results for individual highways/corridors due to the approximate nature of the methodologies used for the traffic analysis product
CFS	Freight flows	• tonnage • value • ton-miles	(see FAF)	• Published every 5 years • Latest version includes estimates from 2012	Free (USDOT)	Same as FAF, although it includes a subset of the freight flows included in FAF	As easy to use as FAF and includes a couple of additional features (statistical certainty and trip length)	Partial source data for FAF and, therefore, redundant and less comprehensive
NPMRDS	Probe data of passenger vehicles, trucks, and combined.	Travel times and speed on NHS.	National vehicle travel on the NHS	• Updated monthly • Historical information back to July 2013	Free for State DOTs and MPOs.	• develop a wide variety of mobility metrics of travel speeds • develop a wide variety of travel time reliability metrics to isolate frequency and location of recurring and non-recurring congestion events		• only covers NHS • doesn't include vehicle volume information • has limited information to understand outliers • only reports one truck type • can contain a large number of records making it difficult to interpret using traditional approaches • may require additional geographical processing • not linked with other data
ATRI	GPS location	Individual records of latitude and longitude of instrumented trucks, with timestamps.	Nationwide wherever trucks travel	Released on a case-by-case basis	Not free	• estimate travel speeds outside of NHS coverage of NPMRDS • detailed information about the causes of outlier records • identify and isolate the influence of truck parking	More detailed data than NPMRDS	• limitations depend on the specific version available to ODOT • requires substantial pre-processing.
HPMS	Variety of roadway performance data provided by state's from a variety of sources (traffic counts, etc.)	Metrics include descriptions of the public roads in the US and information about performance on these roads, including usage, condition, and congestion.	Nationwide, all public roads in the US. Weaker coverage for lower functional class roads.	Yearly.	Free to the public sector.	• information about traffic volumes that would be needed to estimate delay and the relative importance of observed bottlenecks • information about the characteristics of the roads that can be used to explain observed challenges in mobility and unreliability	Represents a comprehensive data system with many applications.	• extracting the vast data available • integrating it with other data products • Non-statistical Sample data; Interstate system is 100% coverage.
FARS	Reported fatal crashes with accompanying crash characteristics provided by states to federal database on a voluntary basis.	Fatal Traffic Crashes (over 100 data elements)	Nationwide, highways	Rolling updates, operational since 1975	Free (available from NHTSA)	• examine overall highway safety, the effectiveness of safety programs, or vehicle safety standards • corridor level could be examined with a little data analysis • identify non-reoccurring bottlenecks	• Wealth of information • mapping available • highlight safety concerns • freely accessible • extensive existing body of literature • shows trends	• not freight specific • some analysis needed to examine bottlenecks • difficult to run a query due to volume of data • limited to fatal crashes
HERS-ST	HPMS data within an analysis tool that can be used to evaluate needs and priorities	See HPMS	See HPMS	See HPMS	Free (ODOT produced)	Compare project alternatives and corridors	• ODOT familiarity • linkage with SWIM	• gaps in probe data outside Portland • lacks speed data • difficulty in updating HPMS inputs.

Data Source	Data Type	Measures/ Metrics	Coverage	Data Fidelity / Age	Availability/Cost	Application/ Usability	Project Benefit	Challenges / Limitations
SWIM	FAF commodity flow information embedded in travel model	• commodities • origin/destination for demand using major routes	36 Oregon counties, plus border counties and externals	Version 2.0 ready in April 2016		• traffic assignment in Visum • economic analysis • production activity	• ODOT familiarity • previously linked with HERS-ST	Version 2.0 still in testing with limited prior application
ODOT Traffic Volumes	Traffic volumes, including truck volumes and percentages, collected at automatic traffic recorder (ATR) stations around Oregon	• AADT Volume • FHWA 13-Category Vehicle Category Percentages • design hour factor (k-Factor) • ton-mileage • projected AADT	All State highways (continuous data) and limited Non-State roadways (point data)	• Annual updates at most locations (current data from 2014) • ATR stations have hourly fidelity.	Free (ODOT produced)	• data available in GIS format or tabular by milepoint • spatial location expanded from point counts to ranges to provide continuous coverage on State facilities	• good coverage • easily mapped • information on vehicle classifications and flows.	• coarse spatial and temporal resolution • does not include speed or travel time data • generally redundant with HPMS/HERS-ST which compiles this with other data
ODOT Highway Inventory	Roadway geometry and characteristics from inventories	• lane and shoulder width and type • vertical grades • horizontal curves	All State highways	Data refreshed approximately monthly	Free (ODOT produced)	Data available in excel format through web query by highway number and milepoint range.	Can be used to identify physical constraints that may slow freight.	• static data does not reflect vehicle traffic characteristics • excel format is not a flat tabular file • web interface returns small subsets
ODOT FACS-STIP and TransGIS	Roadway characteristics from Statewide inventories	• ITS Sites/Signals • pavement • safety • posted speed • freight/RR routes • other asset information	All State highways	Catalogs are refreshed as underlying source data is updated (generally annually or less frequent)	Free (ODOT produced)	Data available in GIS, web map, and excel format through web-map or MP query	• good coverage • easily mapped • context for volume, speed and travel time data	• generally static data • does not reflect vehicle traffic characteristics
ODOT Restricted Bridges	Bridge Characteristics	• weight restrictions • height limits	Public bridges statewide (excluding federally-maintained bridges)	Dataset us updated annually (most recently in 2014) although individual bridge inspection dates are older	Free (ODOT produced)	Available in GIS, includes detour length	• mapped • comprehensive condition information for bridges • help characterize freight network redundancy	Generally static data
Weigh-in-Motion (WIMS)	Vehicle weight/speed from 22 stations located along Oregon Interstates	• axle weight • vehicle classification • speed	• 22 total locations on interstates and highways statewide • implemented in some other states	Available in various forms since mid-1990's	Free (ODOT maintained)	Seasonal variability in truck weights and speeds at 22 locations across Oregon	Examines time trends in truck movement	• limited by number of locations where data is gathered • doesn't directly examine bottlenecks
ODOT Incident Log	Event records from computer dispatch used for traffic incident management program	• incident type • location • lanes blocked • time • duration to clear.	ODOT Region 1 and Region 2	Data recorded live through CAD and AVL, available soon after	Free (ODOT produced)	• available geocoded and by milepoint • includes flags for freight vehicle involvement and lane blockage duration	• integrates well with other data sources • has been used previously for congestion analysis	• limited geographic coverage • need to process the data before use
Crash Analysis Reporting System (CARS)	Crash/Safety data collected from police reports	Vehicle crashes	Statewide, all functional classes	• current data through 2014 • data goes back to 1985 but summaries and reports extend back 10 years • can select date range for data outputs	Free (ODOT maintained)	• Corridor summaries would have to be manually retrieved and non-reoccurring bottlenecks identified with corridor crash frequency analysis • Provides useful information on road safety • Can map crash locations through TransGIS on state facilities.	• well documented by ODOT • corridor analysis capability • data queries freely accessible • highlights safety concerns • easily mapped • shows trends over time • more robust data than FARS	• query outputs in difficult format • limited to crash data
TomTom Historical Speed Profiles	Approximated average speed profiles from empirical probe data	Approximate Speed (all vehicles)	Statewide, collector and higher designation	Weekday hourly, 2013 data	Free (ODOT procured)	• data housed in Visum model • can create a statewide plot • corridor summaries or bottlenecks would have to be manually retrieved.	• good coverage • easily mapped	• not freight specific • profiles are approximated • 2010 data, not updated

Data Source	Data Type	Measures/ Metrics	Coverage	Data Fidelity / Age	Availability/Cost	Application/ Usability	Project Benefit	Challenges / Limitations
TomTom Traffic Stats	Average and statistical speed data from probe vehicles	Speed for all vehicles (mean, percentiles)	User Defined Route on major roadways (including arterial and some collector coverage)	Filter selection from individual days, periods	$20K+	Web-based data download to .csv output and shapefiles	Higher resolution than most travel time datasets	Would require data agreement (cost and schedule impact)
INRIX	Average and statistical speed data from probe vehicles	Numerous speed and reliability statistics (all vehicles)	State routes and some arterials	• 1 minute intervals, 2013 calendar year • Segments can be multi-mile	Free (historical data, see limitations)	Past use was web based, but additional use would require manual mapping and database, such as Tableau	Proprietary "bottleneck" analysis tool is web-based	• ODOT no longer has access, data agreement would take time and budget • manual data reduction takes time and significant effort.
HERE	Average and statistical speed data from probe vehicles, including trucks	Numerous speed and reliability statistics (all vehicles)	Similar to INRIX coverage, better than NHS	• one-minute increments • historical data back to 2012.	Free (ODOT contract in development)	Web-based data queries and statistics through Iteris.	• good coverage • most recent ODOT speed and travel time data • includes trucks	• data agreement not final (schedule unknown) • limited current application and awareness of coverage and potential additional processing • not linked with other data