The background of the entire page is a blue-tinted aerial view of a multi-lane highway. Overlaid on this image is a white network diagram consisting of numerous small blue dots connected by thin white lines, representing a data or traffic network. The network is most prominent in the lower half of the page, where it forms a dense, interconnected web.

MICHELIN

MOBILITY INTELLIGENCE

KEPLER MAPS USER GUIDE

Customized for:
Washington Traffic Safety Commission and Washington State Patrol

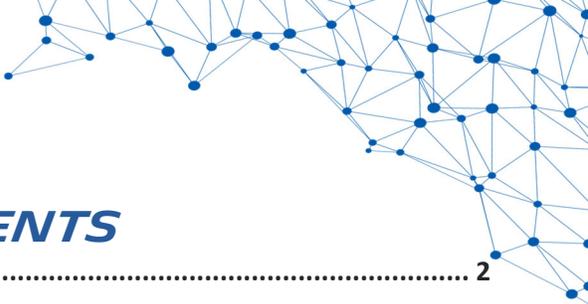


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WHAT IS A KEPLER MAP?

A Kepler map is an interactive tool that visualizes complex data on a map, making it easy to explore and understand various patterns and trends. In the context of the study on state routes in Washington state, Kepler maps display important insights such as traffic speeds, hotspots for harsh braking and acceleration, and crash locations. These maps allow users to view different layers of data, apply filters, and interact with the information to gain a deeper understanding of high-risk areas and traffic behaviors.

HOW TO ACCESS AND USE KEPLER MAPS

Opening Your Kepler Map

1. Download the Kepler Map
2. Click on the Kepler Map, which will be in your downloads folder as an .html file, to open in your preferred web browser

By using these maps, you'll be able to:

- Identify hotspots for harsh braking and acceleration
- Areas of higher severe crash risk
- Speed for a specific road segment for a given time interval
- Location of historic crashes and their severity

Together, these maps offer a powerful tool to better understand high-risk areas within Washington State, helping to improve road safety and inform future planning efforts.

FEATURES

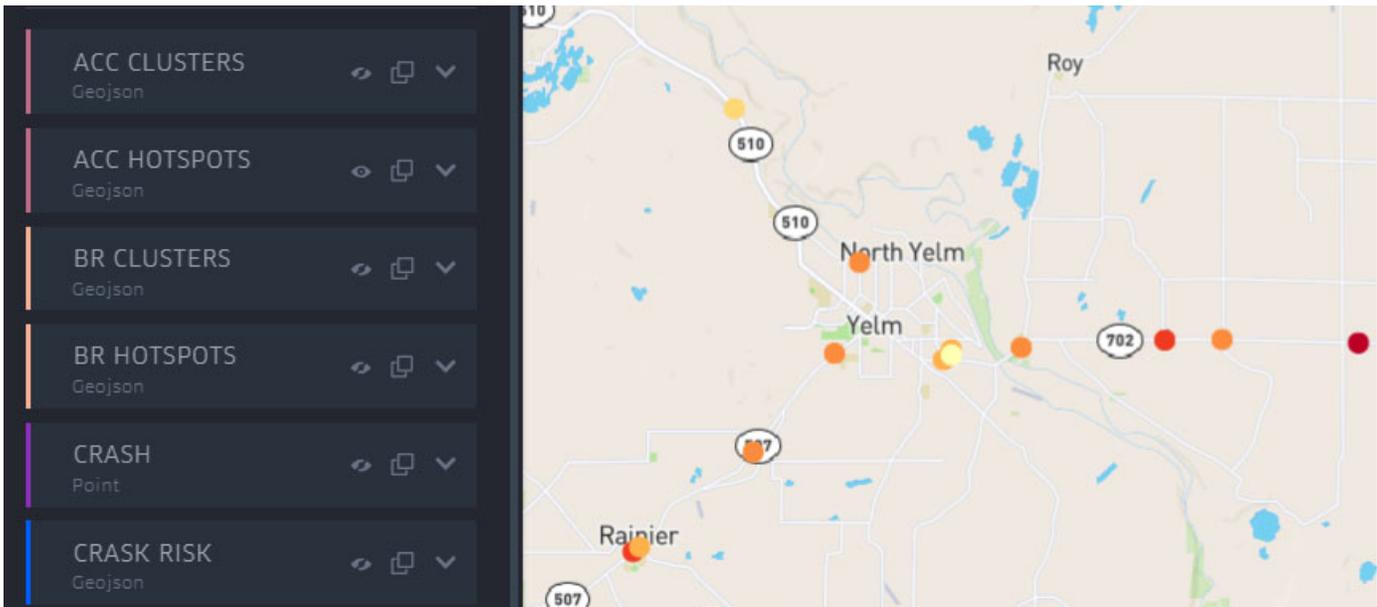
Layers & Datasets

What Are Layers?

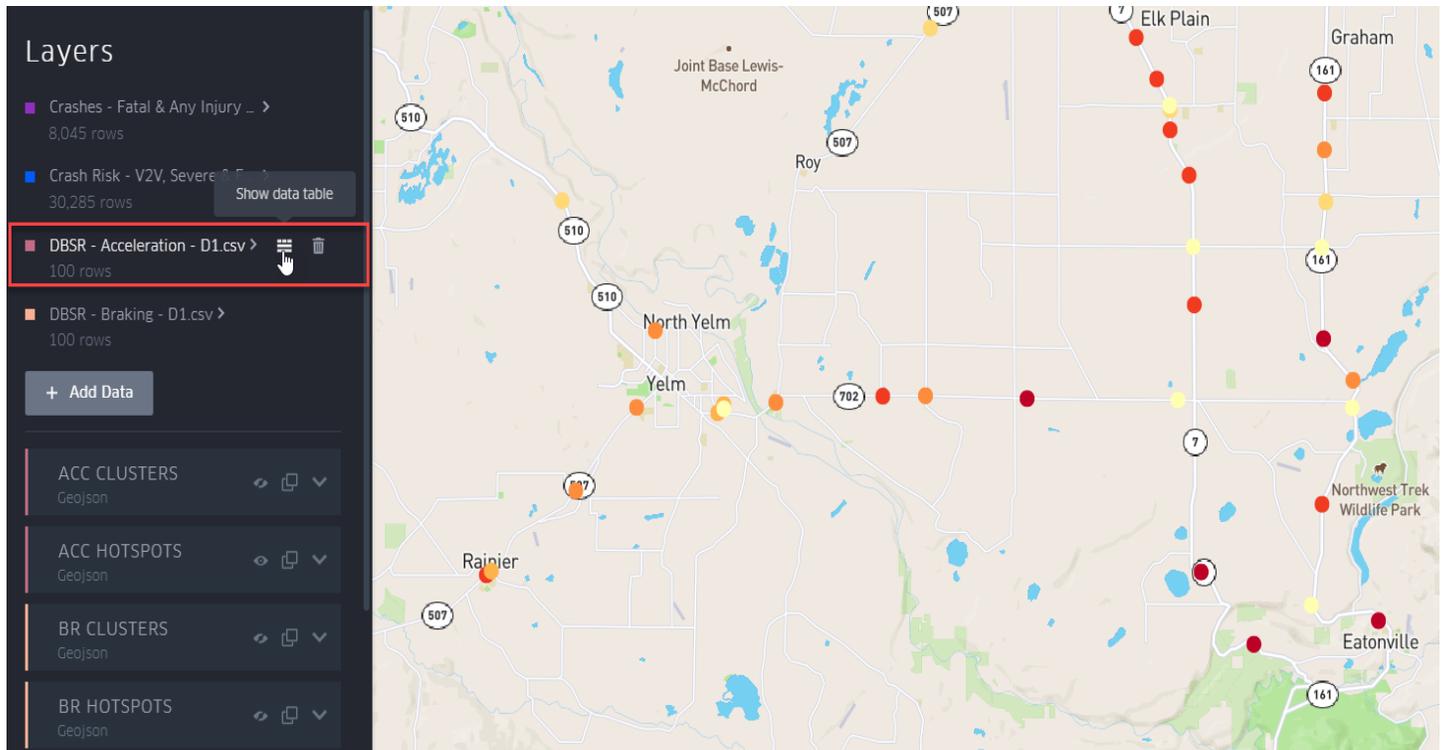
Layers are essentially different sets of information that you can see on the map. For example, one layer might show where crashes have occurred, while another shows areas with harsh braking. You can turn these layers on or off depending on what you want to focus on.

How to Use Layers:

- To view a specific layer, **simply click the eye icon next to its name**. If the eye icon has a slash through it, that layer is currently hidden.
- You can view multiple layers at the same time to see how different datasets overlap or relate to each other.



Each layer corresponds to one of the various datasets included in the map. You can view and manage these layers in the same tab where the datasets are listed. To view and export the dataset behind a layer, simply click **“Show data table”** next to the dataset name.



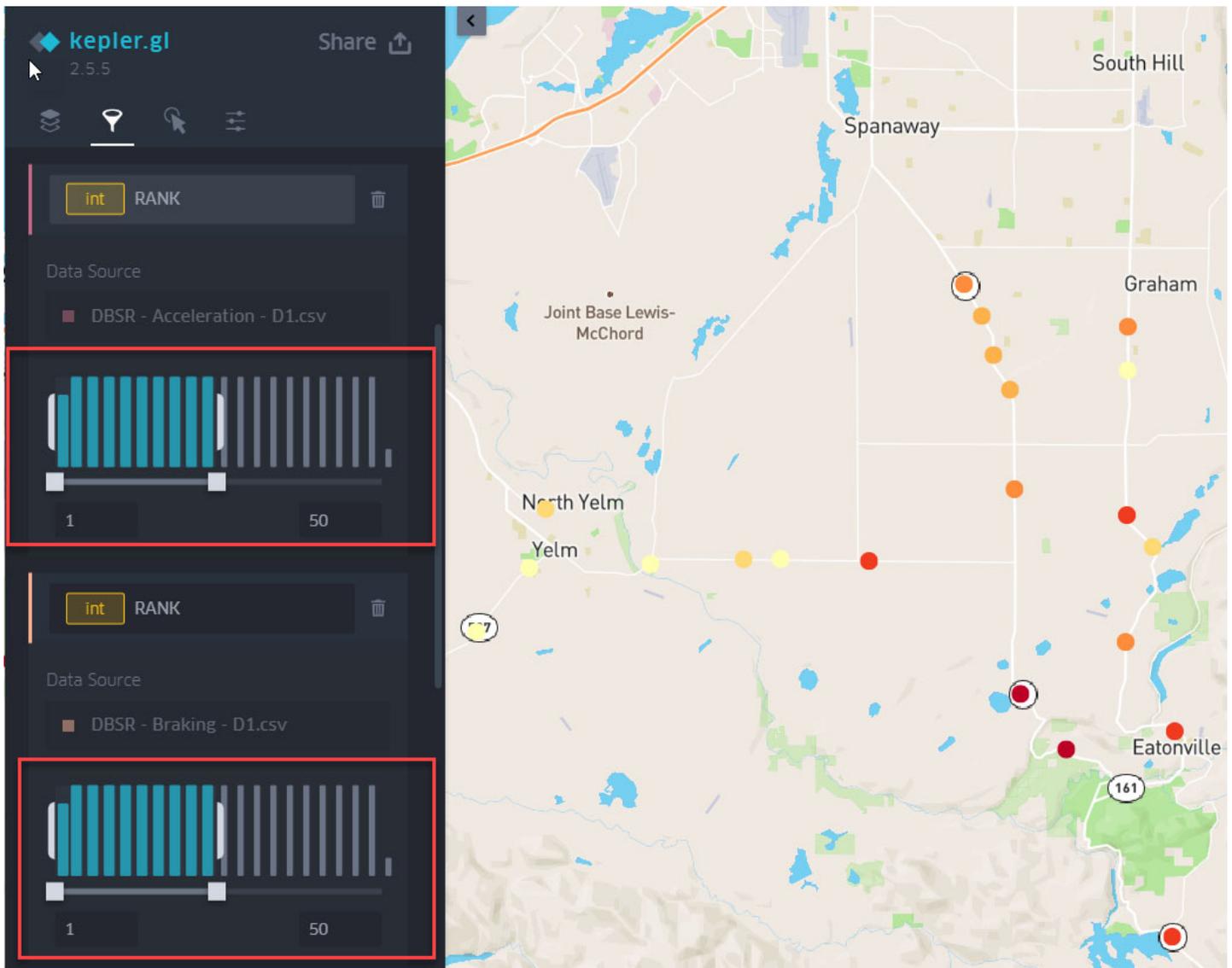
Filters

What Are Filters?

Filters allow you to narrow down the data you're looking at to specific details that interest you. For example, you might want to only see the top 50 harsh braking hotspots.

How to Use Filters:

- Select the dataset you want to filter from.
- **Click "+Add Filter,"** choose the field you want to filter by, and enter the values that interest you.
- You can filter by numbers (like showing only the top-ranked braking hotspots) or categories (like filtering for crashes involving pedestrians).
 - *EXAMPLE Filter by numbers: show all braking clusters with a Rank <250*
 - *EXAMPLE Filter by non-numeric data: Show all crashes where TYPE_OF_CRASH is 'VEHICLE'*



Interactions

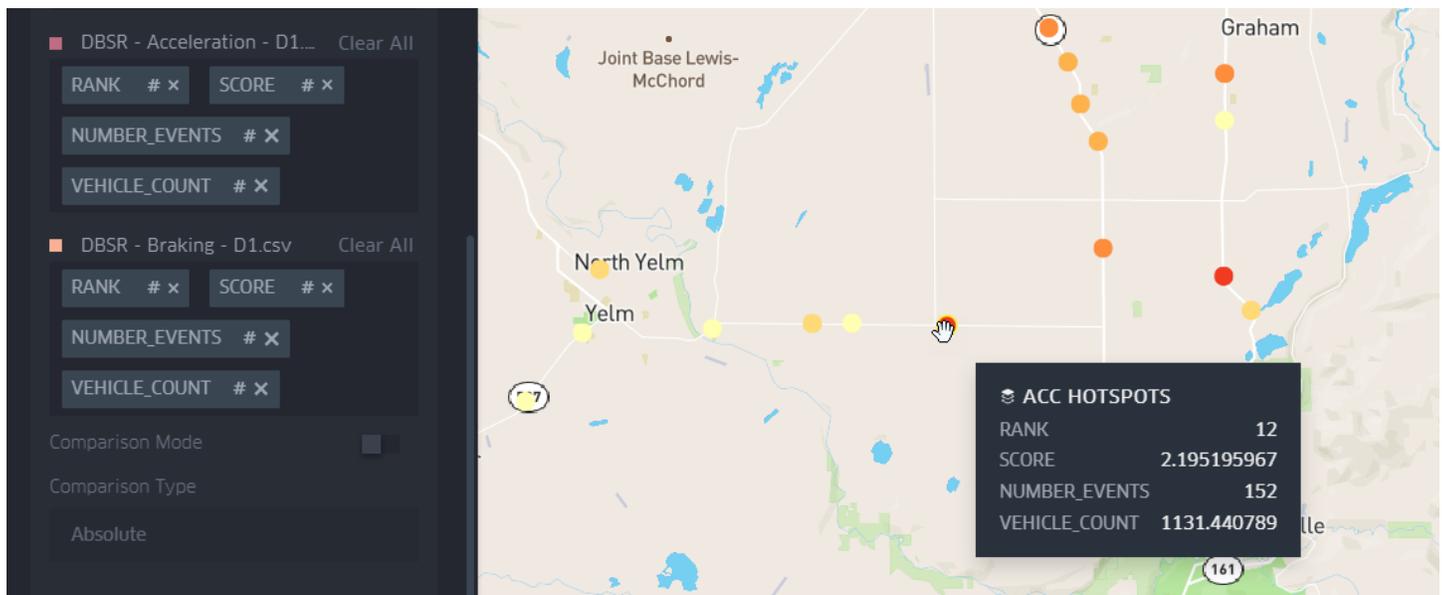
What Are Interactions?

Interactions are the ways you can engage with the map data, such as seeing additional details when you hover over a point on the map.

How to Use Interactions:

- The most useful interaction is the Tooltip, which shows extra information when you hover over a data point.
- You can customize what information appears in the Tooltip by checking or unchecking boxes next to the data fields under each dataset and add or remove fields to be displayed in the tooltip.

EXAMPLE: In the image below, data points taken from Driving Behavior Severity Ranking (DBSR) - Acceleration – D1 layer shows Acceleration Cluster that is ranked 12. The 4 variables displayed show the rank of the cluster, the score of that cluster, number of events at that cluster, and the vehicle count at that cluster.

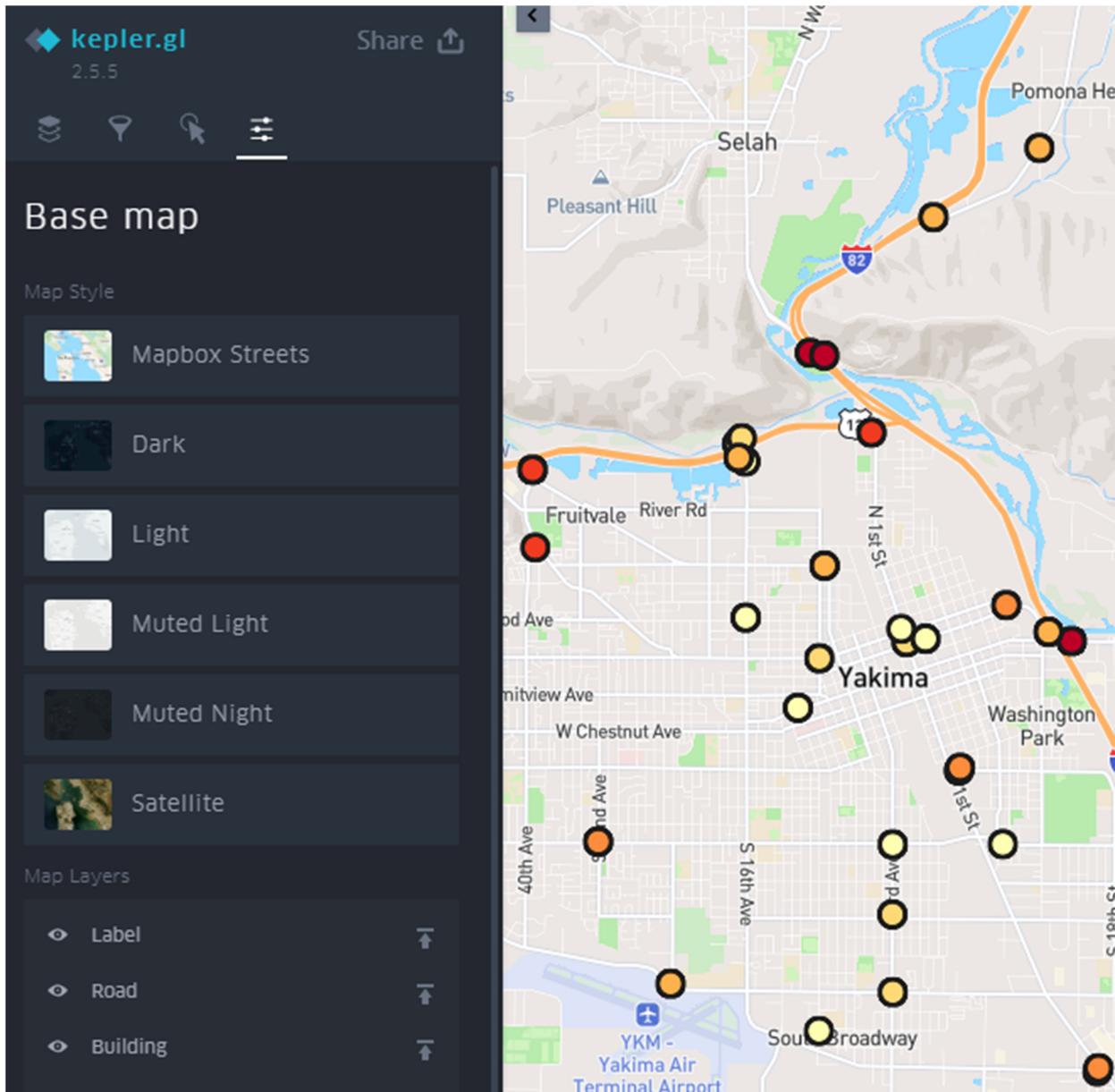


Basemap

The basemap is the background of your map. You can change its appearance to suit your preferences or needs.

How to Use the Basemap:

- You can choose different themes like light, dark, or others.
- You can decide whether to show or hide roads, buildings, and labels.



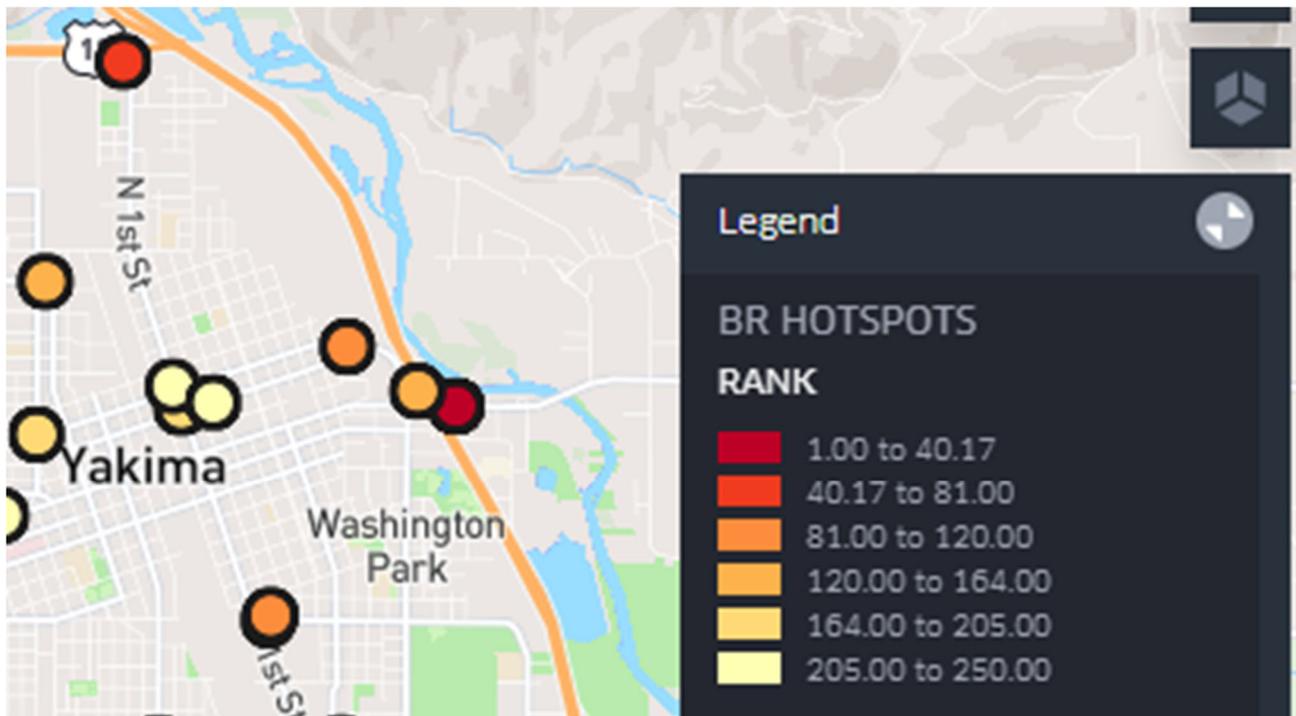
Legends

What Are Legends?

Legends explain what the colors, shapes, and symbols on the map represent.

How to Use Legends:

- Legends can be displayed or hidden as needed. They appear in the top right corner of the map and help you make sense of the data visualized on each layer.





DATA DICTIONARY

FOR THE TECHNICAL USER, PRECISE DEFINITIONS OF THE LAYERS AND COLUMNS FOUND IN THE DATASETS USED IN THESE MAPS.

Speed:

Intraweek/Intraday Period Definitions:

WKND (Weekend): Includes data from hours between 12:00 AM Saturday and 11:59 PM Sunday.

WK (Weekday): Includes data from hours outside the WKND window Monday 12:00 AM to Friday 11:59 PM

- **SPEED RISK ALL**
 - Speed risk severity groups (1 being most severe, 4 being least severe) for each road segment across all times of day.
- **WKND NIGHT**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 10 PM and 2 AM on the weekends.
- **WKND EVENING**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 6 PM and 10 PM on the weekends.
- **WKND AFTN RUSH**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 4 PM and 6 PM on the weekends.
- **WKND MIDDAY**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 10 AM and 4 PM on the weekends.
- **WKND MORN RUSH**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 7 AM and 10 AM on the weekends.
- **WKND E MORN**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 2 AM and 7 AM on the weekends.
- **WK NIGHT**

- Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 10 PM and 2 AM during the week.
- **WK EVENING**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 6 PM and 10 PM during the week.
- **WK AFTN RUSH**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 4 PM and 6 PM during the week.
- **WK MIDDAY**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 10 AM and 4 PM during the week.
- **WK MORN RUSH**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 7 AM and 10 AM during the week.
- **WK E MORN**
 - Speed risk severity groups (1 being most severe, 2 and 3 still being very severe, road segments in group 4 are not shown) for traffic between 2 AM and 7 AM during the week.

Corridors and Crashes:

- **RISKY CORRIDORS**
 - A series of consecutive road segments identified by MMI's models as being significantly riskier than normal based on several different behavior risk metrics.
- **INJURY CRASHES**
 - The latitude/longitude of historical crashes in Washington State with various flags to indicate the severity of the crash.
- **CRASH RISK**
 - A geographic dataset of all state road segments in the WSP district's road system where MMI's crash risk model assigns a probability score for severe vehicle to vehicle crashes.
- **STATE ROUTES**
 - Geographical mapping of states routes found within the state of Washington.

Driving Behavior Severity Ranking:

- **ACC HOTSPOTS**

- A set of latitude/longitude points identified by MMI's models as being the location of a dense cluster of severe acceleration events (i.e. where an abnormally high number of harsh acceleration events occur, relative to the number of trips that are taken over certain segments of road).
- **BR HOTSPOTS**
 - A set of latitude/longitude points identified by MMI's models as being the location of a dense cluster of severe braking events (i.e. where an abnormally high number of harsh braking events occur, relative to the number of trips that are taken, over certain segments of road).

STATE ROUTES

This dataset has been provided by WTSC and is used to identify all state routes within Washington State. This dataset is used to identify all the speed limits for the state routes, and any roads without a speed limit have been removed. This file does include a very few roads that were under construction at the time MMI's data was collected, and therefore for those roads there is no behavior data present.

- **geometry:** Geometric representation of the dimensions and location of each road segment.
 - **WKT_ROUTE:** The Well-Known Text (WKT) representation of the geometry field.
 - **SpeedLimit:** The speed limit for the given road.
 - **District:** WSP district a given road falls under.

DESCRIPTIONS OF COLUMNS IN MAP DATASETS:

Speed Risk Severity Group Maps

This District Risk Map contains 13 layers that show a "speed severity group", which is a metric that classifies each road segment into 1 of 4 groups based on how much speeding-related risky driving behavior is present on that road segment.

- 1 layer shows this risky behavior without specifying time of day
- 12 layers show the risky behavior in specific intraday/intraweek contexts

This metric is derived from a combination of how much the typical driver on this road segment exceeds the speed limit, and how often drivers are observed going significantly above (10+mph and 20+mph) the speed limit as well as being involved in near-misses at those high speeds.

The road segments in the highest 3 speed severity groups, in the 13 layers, all exhibit frequent speeding well above the speed limit, or abnormally high rates of high-speed near-misses, or both.

WSP_D(district number)_REPRESENTATIVE_SPEED

- **ARC_ID:** Unique identifier for road segment, based on pair of Open Street Maps (OSM) node IDs
- **ROAD_PRIORITY:** Number between 1 and 15 to classify the type of road, based on the OpenStreetMap type of road
 - 15 (motorway): Highway (Interstate Highway)
 - 14 (motorway_link): Highway (Interstate Highway)
 - 13 (trunk): Highway (Interstate Highway / US Routes)
 - 12 (trunk_link): Highway (Interstate Highway / US Routes)
 - 11 (primary): Primary Road (US Routes/ US Highways)
 - 10 (primary_link): Primary Road (US Routes/ US Highways)
 - 9 (secondary): Secondary Road (State Highways/ Urban Route)
 - 8 (secondary_link): Secondary Road (State Highways/ Urban Route)
 - 7 (tertiary): Tertiary Road (Country routes, Forest Routes, Indian Routes, National Scenic Byways)
 - 6 (tertiary_link): Tertiary Road (Country routes, Forest Routes, Indian Routes, National Scenic Byways)
 - 5 (residential): Residential and services
 - 4 (living_street): Residential and services
 - 3 (service): Residential and services
 - 2 (unclassified): Residential and services
 - 1 (road): Residential and services
- **SPEED_LIMIT:** Speed limit for a given road segment, determined by the state route file and MMI projection

- **SEPARATE_ARC_GEOM:** Geometry feature mapping the road segment to its specific location, but accounting for the different directions of lanes. This is useful to show different speed behavior heading in opposing directions on the same stretch of road
- **SPEED_LIMIT_ORIGINAL:** Speed limit for a given road segment taken directly from the state route file provided by WTSC
- **OVERALL_HS_RISK_LEVEL:** A score attributed to a given road segment by measuring the frequency of high speed and extreme speed events and normalizing for road segment length.
- **SPEED_SEVERITY_GROUP:** Categorical variable assigning each road segment into 1 of 4 groups, where group 1 has the highest high-speed-related risk, and group 4 has the least. These groups are determined by a speed severity score, which is comprised of both typical speed above speed limit as well as frequency of high-speed driving events.

Note: The following description pertains to an example of a dataset for a specific time of day/day of week dataset. This structure is consistently applied across all specific intraday and intraweek contexts, therefore each of them will not be explicitly described here.

WSP_D(district number)_SPEED_SEV_(intraweek)_(intraday)

- **ARC_ID:** same definition as above
- **ROAD_PRIORITY:** same definition as above
- **SPEED_LIMIT:** same definition as above
- **SPEED_LIMIT_ORIGINAL:** same definition as above
- **SEPARATE_ARC_GEOM:** same definition as above
- **SPEED_SEV_(intraweek)_(intraday)_GROUP:** Categorical variable assigning each road segment into 1 of 4 groups, where group 1 has the highest high-speed-related risk at this specific time of day and day of week, and group 4 has the least. These groups are determined by a speed severity score, which is comprised of both typical speed above speed limit as well as frequency of high-speed driving events.

Crashes

- **LATITUDE:** Latitude of the crash location (used in CRASH layer to visualize location)
- **LONGITUDE:** Longitude of the crash location (used in CRASH layer to visualize location)
- **ARC_ID:** road segment identifier
- **YEAR:** Year of crash occurrence
- **VH:** Flag used to indicate if a vehicle was involved in the crash
- **CYC:** Flag used to indicate if a cyclist was involved in the crash
- **PED:** Flag used to indicate if a pedestrian was involved in the crash
- **FATAL:** Flag used to indicate if a crash had any fatalities
- **SERIOUS_INJURY:** Flag used to indicate if a crash had a serious injury
- **MINOR_INJURY:** Flag used to indicate if a crash had a minor injury
- **NO_INJURY:** Flag used to indicate if a crash had a no injury
- **CRASH_SEVERITY:** Indicates the level of severity for the crash
 - FATAL: Crash resulted in at least one fatality to an occupant/operator
 - MINOR_INJURY: Crash resulted in at least one occupant/operator with a minor injury
 - SERIOUS_INJURY: Crash resulted in at least one occupant/operator with a serious injury
- **VRU:** Flag that indicates if the crash involved a vulnerable road user

Crash Risk

- **ARC_ID:** Road Segment Identifier
- **GEOM:** Geometric representation of the dimensions and location of each road segment
- **PROBABILITY:** Model-predicted likelihood of fatal or severe vehicle to vehicle crash occurring on a given road segment. A score closer to 1 indicates higher risk.
- **DISTRICT:** The WSP district to which the crash risk pertains.
- **RISK_CLASS:** The level of risk that a road user faces in this road segment. The values in this column range from LOWER_RISK TO RISK_5.
 - LOWER_RISK – probability of less than 0.50
 - RISK_CLASS_1 - probability of between 0.50 to 0.59
 - RISK_CLASS_2 - probability of between 0.60 to 0.69
 - RISK_CLASS_3 - probability of between 0.70 to 0.79
 - RISK_CLASS_4 - probability of between 0.80 to 0.89
 - RISK_CLASS_5 - probability of between 0.90 to 0.99

OVERVIEW OF ACCELERATION AND BRAKING SEVERITY RANKINGS

The MMI Driving Behavior Severity Ranking algorithm first identifies the locations in a road network that have clusters of harsh braking/acceleration events (where cluster is defined as many events happening in one or a few concentrated areas in a specific stretch of road). Then, the algorithm ranks the severity of these clusters from most to least severe, based on how commonly these events happen relative to the number of trips that happen on that road segment (in other words – a cluster with 100 events and 1000 trips would be ranked higher than a cluster with 100 events and 5000 trips, all else being equal), and how intense or harsh those events typically are.

For MMI's analysis, these clusters (also known as hotspots) are filtered down to the 250 most severe braking and 250 most severe acceleration clusters to identify the locations of the riskiest behavior patterns.

Acceleration/Braking Severity Ranking

The structure of the datasets for braking and acceleration Driving Behavior Severity Ranking (DBSR) are the same, as the MMI severity ranking model generates output in the same format when evaluating both acceleration hotspots and braking hotspots.

- **CLUSTERS:** MMI's cluster index used as a reference tool for the driving behavior severity cluster
- **CENTROID:** Latitude and longitude point indicating center of the hotspot, in geometric data format
- **AREA:** The size in square meters of a given hotspot
- **SCORE:** MMI calculated risk score
- **RANK:** Severity rank of the clusters (determined by the cluster's score)
- **NUMBER_EVENTS:** Number of driving behavior events at each cluster or hotspot
- **LENGTH_CLUSTER:** length of the cluster on the road, in meters
- **RANK_GROUP:**

HIGH RISK CORRIDORS

The high-risk corridors have been flagged and identified by MMI's model as one of the most severe corridors within each of the districts according to a variety of several metrics, ranging from behavior scores to past crash history to our predictive analytics for crash risk. Some of the corridor groups are made up of several smaller corridors flagged individually by our models, which is why there are a few slight overlaps or discontinuities.

High Risk Corridors

- **FCI_ID:** Index number for the high-risk corridor.
- **SCORE:** MMI calculated risk score.
- **CORRIDOR_GEOM:** Geometric representation of the dimensions and location of each road segment associated with the identified corridor.