BY ANDREW MALIZIA
STANISLAUS COUNTY PUBLIC WORKS

MIRECOMPLIANCE

& NETWORK SCREENING TOOL

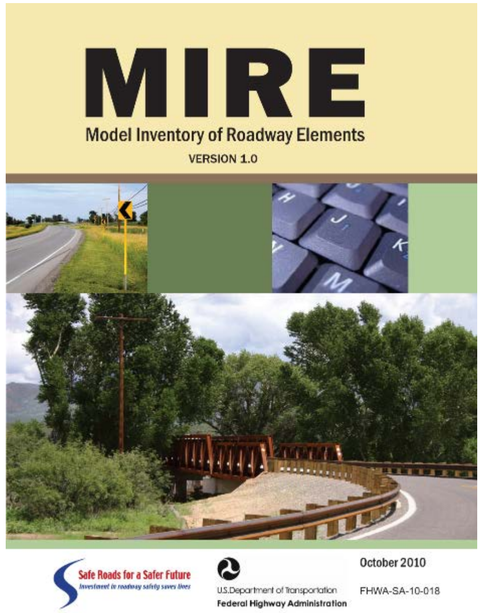
What is MIRE?

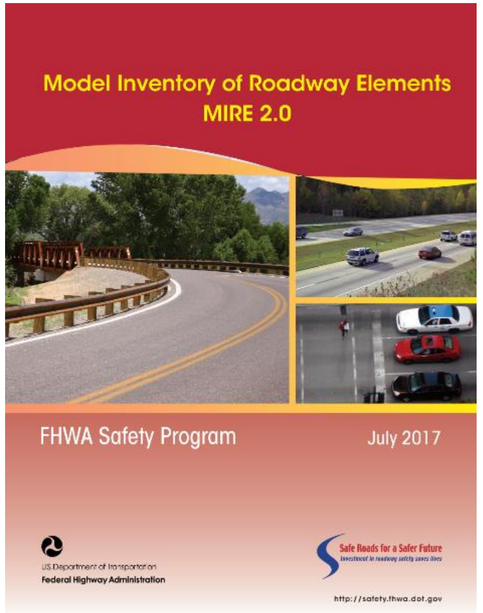
MIRE COMPLIANCE

Listing of roadway/traffic data elements and data dictionary

AT A GLANCE

MIRE HISTORY





MIRE 1.0

October 2010
- MAP-21
- Three Categories

MIRE 2.0

July 2017
- FAST Act Provisions
- Six Categories
- Identifies FDE

MIRE 1.0
Reassessed

CURRENT VERSION

MIRE 2.0

Released in July 2017

Provides a data framework to help transportation agencies improve roadway and traffic data inventories for safety analysis.

Divided into six data type categories:

1. Segments
2. Intersections
3. Intersection Legs
4. Interchange/Ramp
5. Horizontal Alignment
6. Vertical Alignment

CURRENT VERSION

MIRE 2.0

States are required to have MIRE FDE for **ALL PUBLIC ROADS** by September 30, 2026.

Because MIRE is a guideline, it is not expected that a State will collect every MIRE element, nor have all their element names and attributes match to MIRE exactly. Rather, States should take what is useful in MIRE and apply it in a way that helps improve their inventory, and ultimately lead to better data-driven decision making.

CURRENT VERSION

MIRE 2.0

CONTENTS

Each Element Includes:

- Name
- Indicator if an FDE
- Definition
- Recommended attributes
- Illustration (if needed)
- Crosswalk table (if applicable)

55. Median Type FDE

Definition: The type of median present on the segment.

Recommended Attributes:

1. Undivided
2. Flush paved median (at least 4 ft in width)
3. Raised median
4. Depressed median
5. Two-way left-turn lane
6. Railroad or rapid transit
7. Divided, separate grades without retaining wall
8. Divided, separate grades with retaining wall
9. Other divided

CURRENT VERSION

MIRE 2.0

CONTENTS

Each Element Includes:

- Name
- Indicator if an FDE
- Definition
- Recommended attributes
- Illustration (if needed)
- Crosswalk table (if applicable)

Crosswalk Table:

Dataset	HPMS	TMG	SHRP 2 RID	FMIS	NBI	LTPP	NPS RIP	HSM
Element Name	Median Type	--	Median Type	--	--	--	--	Presence/Type of Median
Element Number	35	--	--	--	--	--	--	--

Note: "--" indicates that the dataset does not include this specific MIRE element.

MIRE COMPLIANCE

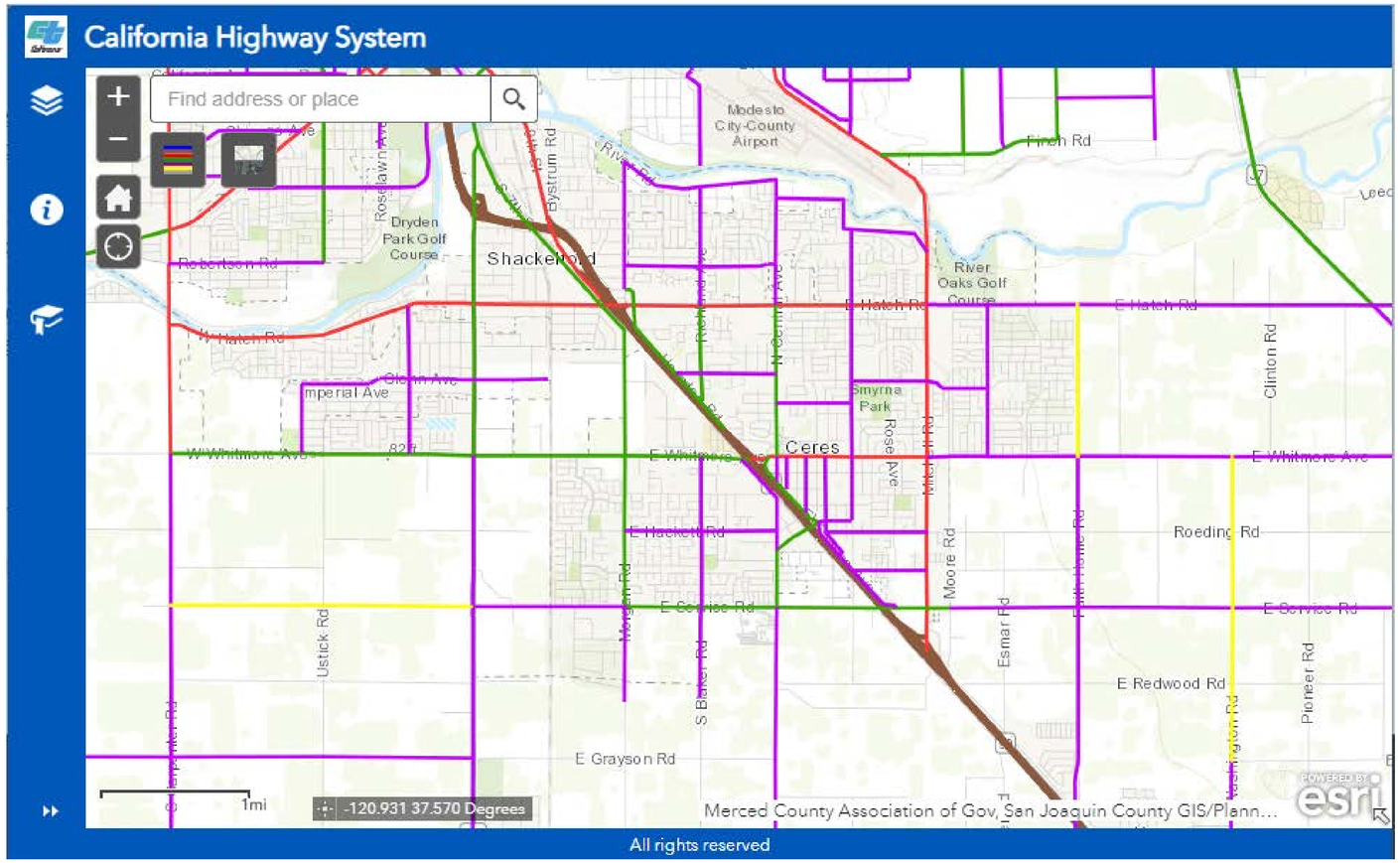
Fundamental Data Elements

MIRE 2.0

REQUIREMENTS

FDE requirements vary by facility type.

Non-Local (Functional Class 1-6)
Local (Functional Class 7)



Source: Caltrans CRS Maps Web App
https://dot.ca.gov/programs/research-innovation-system-information

FUNDAMENTAL DATA ELEMENTS

MIRE 2.0

REQUIREMENTS

FDE requirements vary by facility type.

Non-Local (Functional Class 1-6)
Local (Functional Class 7)

MIRE ID	MIRE ELEMENT
4	Type of Governmental Ownership
8	Route Number
9	Route/Street Name
10	Begin Point Segment Descriptor
11	End Point Segment Descriptor
12	Segment Identifier
13	Segment Length
18	Direction of Inventory
19	Functional Class
20	Rural/Urban Designation
21	Federal Aid/Route Type
22	Access Control
23	Surface Type
31	Number of Through Lanes
54	Median Type
79	AADT
80	AADT Year
91	One/Two-way Operations

FUNDAMENTAL DATA ELEMENTS

MIRE 2.0

REQUIREMENTS

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23	Surface Type
31	Number of Through Lanes
79	AADT

STANISLAUS COUNTY

FDE REQUIREMENTS

Fundamental Data Elements (FDE) are required by Functional Class and pavement (yes/no)

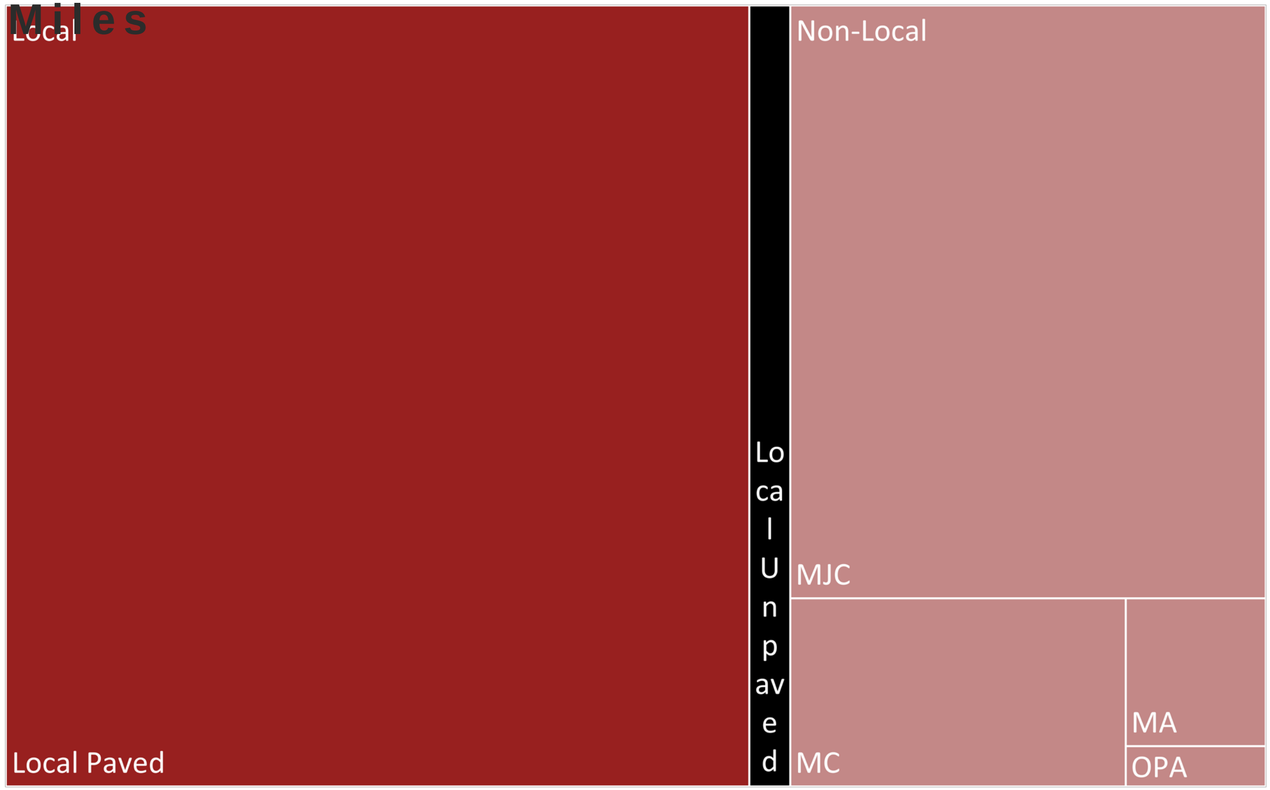
Non-Local Roads
- 26 Segment
- 8 Intersection
- 11 Interchange/Ramp

Local Paved Roads
- 9 Segment

Local Unpaved Roads
- 5 Segment

Local Paved Local Unpaved Non-Local Roads

Stanislaus County Road Network: 1507.23 Miles

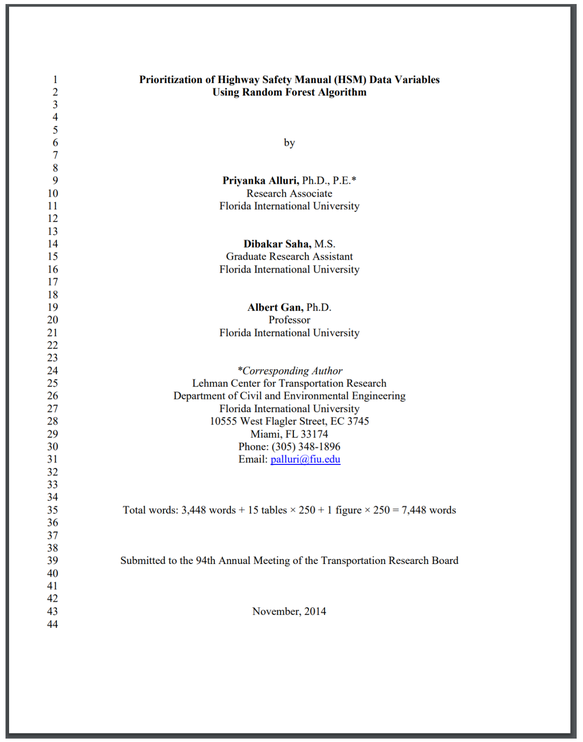


FUNDAMENTAL DATA ELEMENTS

FDE for Safety Analysis

WHAT DO WE REALLY NEED?

While all based on similar datasets, various programs and methodologies require specific subsets of data for analysis.



Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm

by

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Research Associate
Florida International University

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Florida International University

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Professor
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Email: palluri@fiu.edu

Total words: 3,448 words + 15 tables × 250 + 1 figure × 250 = 7,448 words

Submitted to the 94th Annual Meeting of the Transportation Research Board

November, 2014

Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm
http://docs.trb.org/prp/15-2257.pdf

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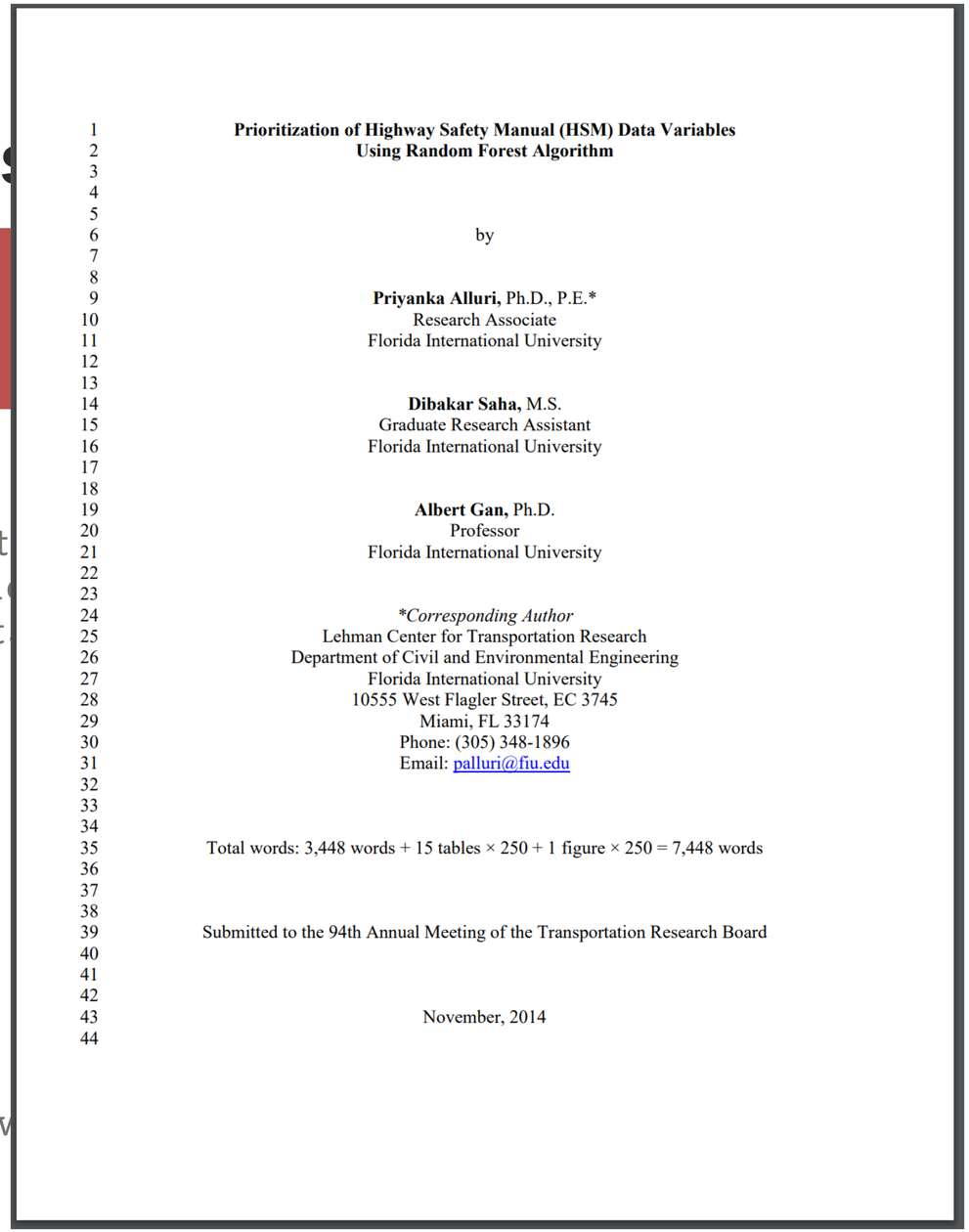

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Prioritization of Highv Random Forest Algorithm

FUNDAMENTAL DATA ELEMENTS

FDE for Safety Analysis

WHAT DO WE REALLY NEED?

FDE is the minimum set of attributes.

Through analysis, we can identify the most influential elements.

Maintaining the data will be difficult, so reducing that data maintenance need is important for success

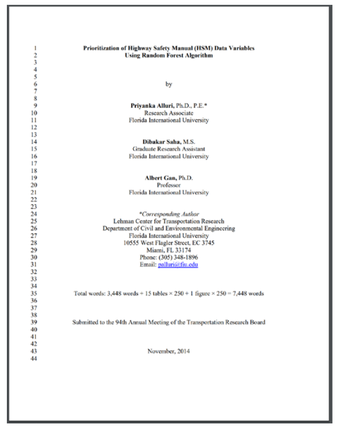

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TABLE 4 Ranking of Variables: Rural Two-way Two-lane Roads

Variables	IncNodePurity	Rank
AADT	735.7	1
Driveway density	318.9	2
Shoulder width	151.6	3
Roadside hazard rating	110.9	4
Lane width	65.0	5
Shoulder type	50.6	6
Presence of lighting	11.2	7
Presence of passing lane	5.9	8
Presence of TWLTL	4.9	9
Presence of short four-lane section	2.3	10
Presence of centerline rumble strip	1.7	11
Presence of automated speed enforcement	0.2	12

Note: Mean of squared residuals: 0.430; Percent of variance explained: 44.60%.

Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm
http://docs.trb.org/prp/15-2257.pdf

FUNDAMENTAL DATA ELEMENTS

FDE for Safety Analysis

Rural Roadway Segments

Random Forest Algorithm Results

Variables
AADT
Driveway Density
Shoulder Width
Roadside hazard rating
Lane width
Shoulder type
Presence of Lighting
Presence of passing lane
Presence of TWLTL
Presence of short-four lane section
Presence of centerline rumble strip
~~Presence of automated speed~~ enforcement

County Initial Results

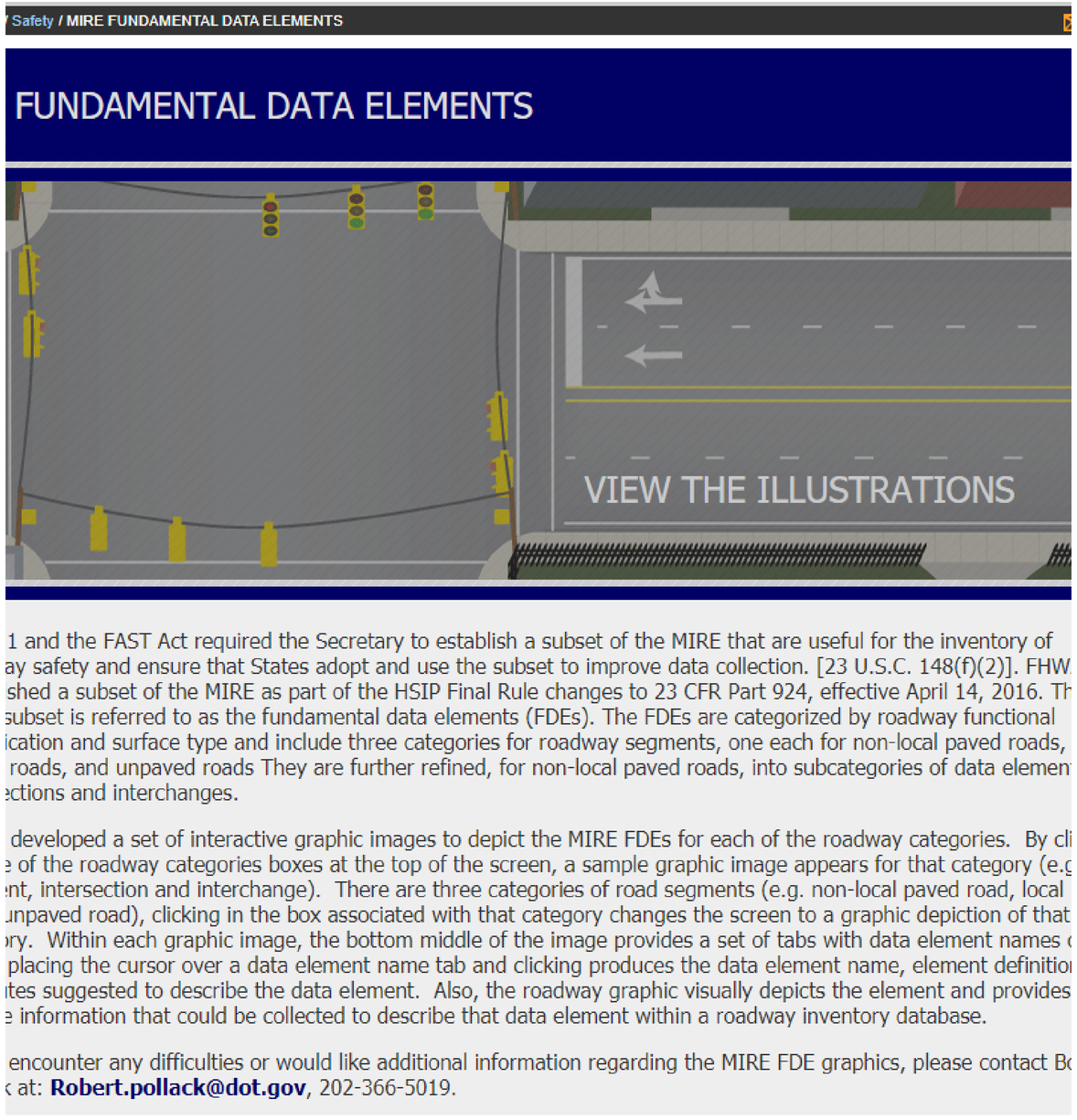
Variables
AADT
Rural 2-Lane Undivided (yes/no)
Number of Lanes
Median Width
Uncontrolled Int. Density
Lighting Presence

Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm
http://docs.trb.org/prp/15-2257.pdf

FHWA MIRE Website

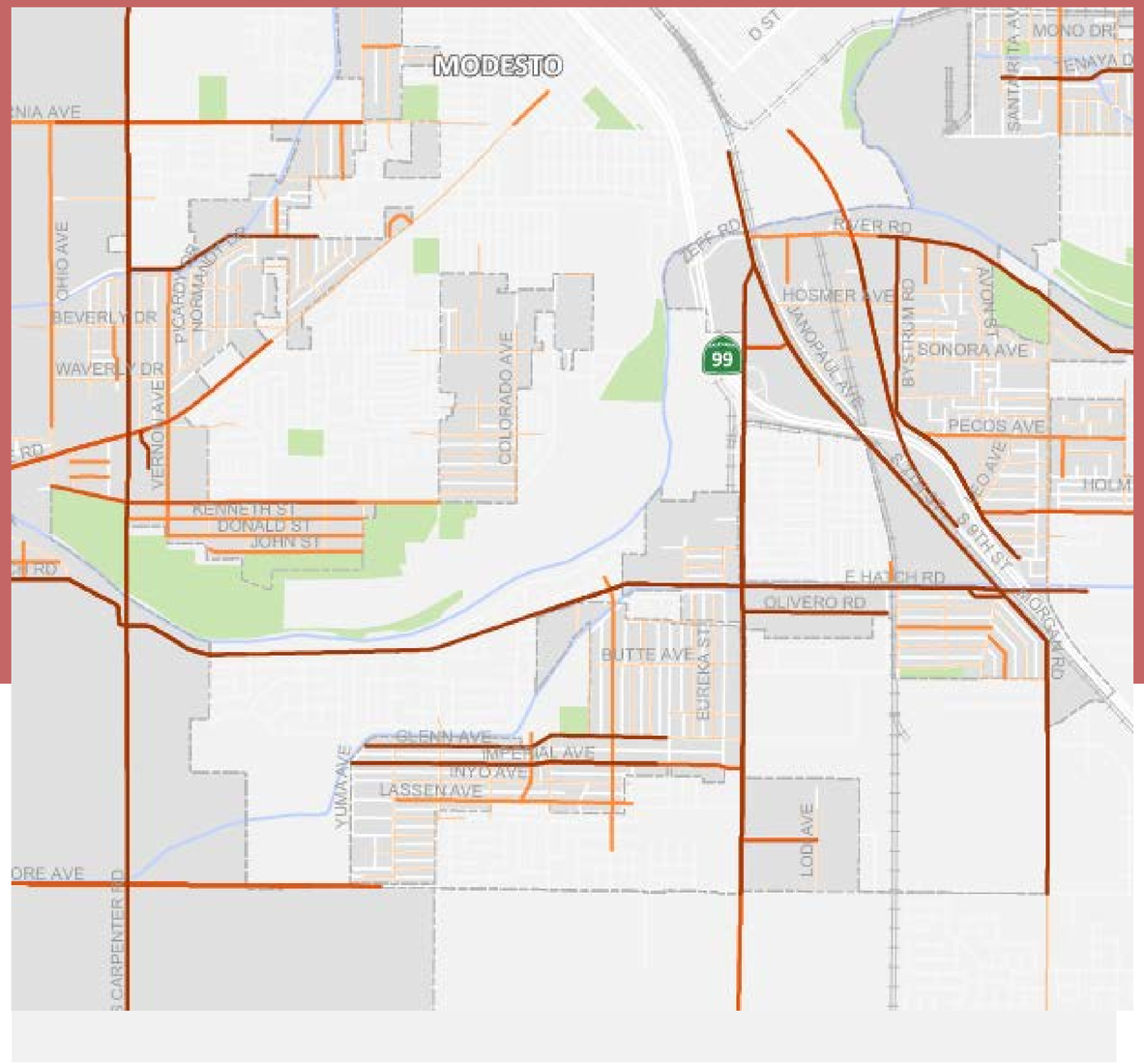
Interactive Illustrations

https://safety.fhwa.dot.gov/fde/



Stanislaus County

NETWORK SCREENING TOOL



Developing a custom network tool

DDSA TOOLS

Highway Safety Manual

- Tool lists available on the FHWA Roadway Safety Data Programs (RSDP) Toolbox Webpage and EDC-4 DDSA resource page
- Handful of Network Screening Tools
- Predominately Location Analysis Tools (Site specific input)

I felt available options were not well suited for a local agency's resources.

http://safety.fhwa.dot.gov/rsdp/toolbox-home.aspx

https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/ddsa_resources/

RESOURCES

Developing a Solution for Local Agencies

What usable data do we have?

Use available resources that are already part of our workflow

- i-SWITRS collision data
- GIS road data (Public Works/OES)
- ArcGIS Server with Enterprise Portal
- Some attributes don't vary enough to maintain data

Use new resources that are available, but require integration

Caltrans Linear Reference System

RESOURCES

Developing a Solution for Local Agencies

How much expertise (and time) do we have?

Using tools such as IHSDM or the HSM spreadsheets requires staff to be very familiar with the methodologies.
This can be time consuming, collecting location data and analyzing, then comparing.

What opportunities exist?

- Help Caltrans with MIRE Compliance
- Customizable to our needs
- Can utilize simplified defaults where data doesn't exist yet based on roadway attributes

RESOURCES

Developing a Solution for Local Agencies

Where and what are our problems?

- We typically concentrate on collision history, but not on exposure to risk.
- Network Screening tools can help:
  - Identify hard to see risks
  - Prioritize Locations, crash types, and treatments

Where are our successes?

- Identify roadway attributes that correlate with low collision rates

OPPORTUNITY

SYSTEMIC SAFETY ANALYSIS REPORT PROGRAM

Roadway Safety Audits

- We didn't even know WHERE to look
- Rural collisions are sporadic
- Correlation is difficult to find study corridors for audits
- Ends up mostly being based on total collisions
- Results in a static report

Developing an Application

- We wanted a true "program" moving forward
- Ability to update easily
- Develop priority lists, even as our priorities may change
- Expandable

NETWORK SCREENING TOOL

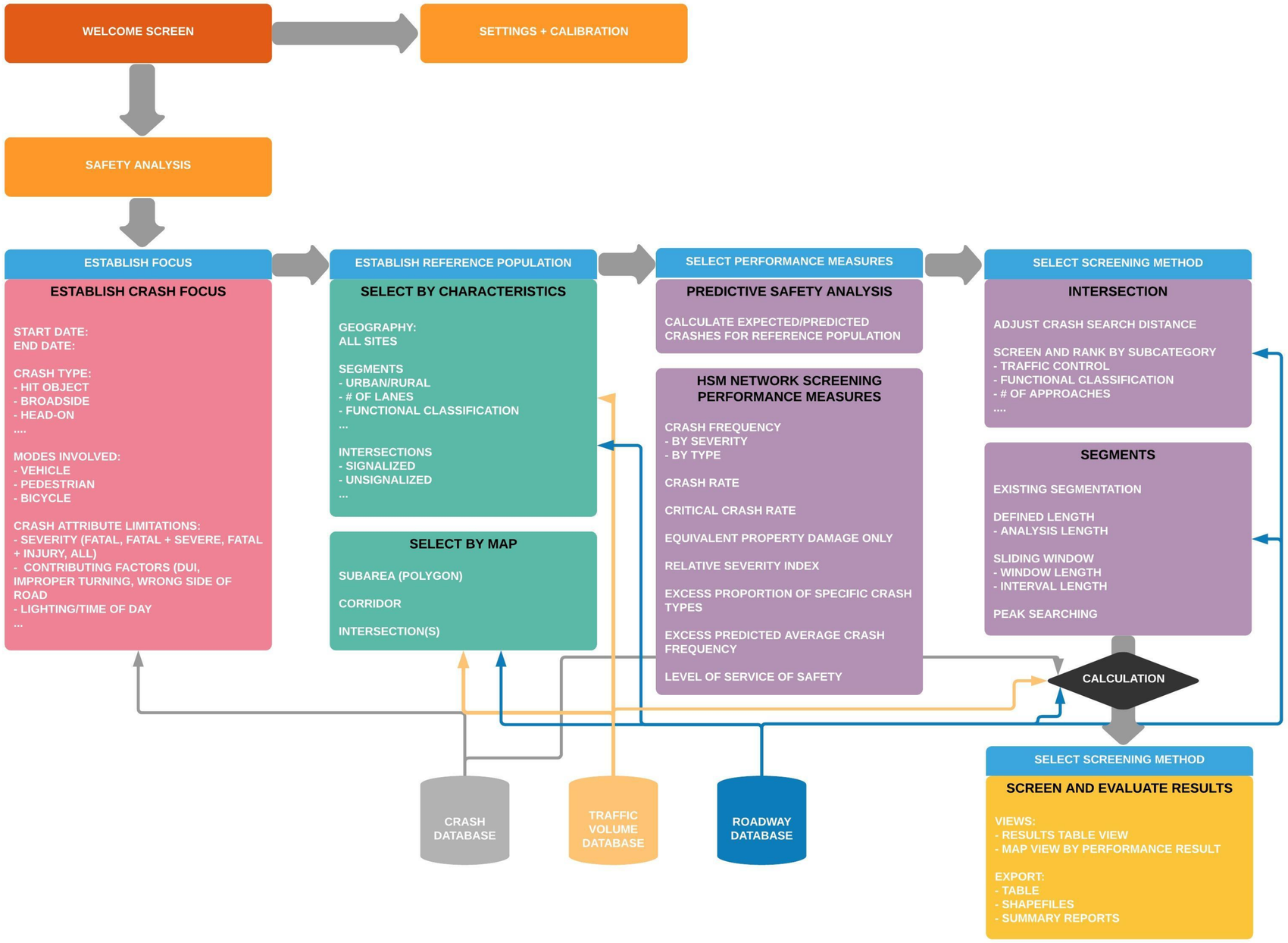
CURRENT PLATFORM

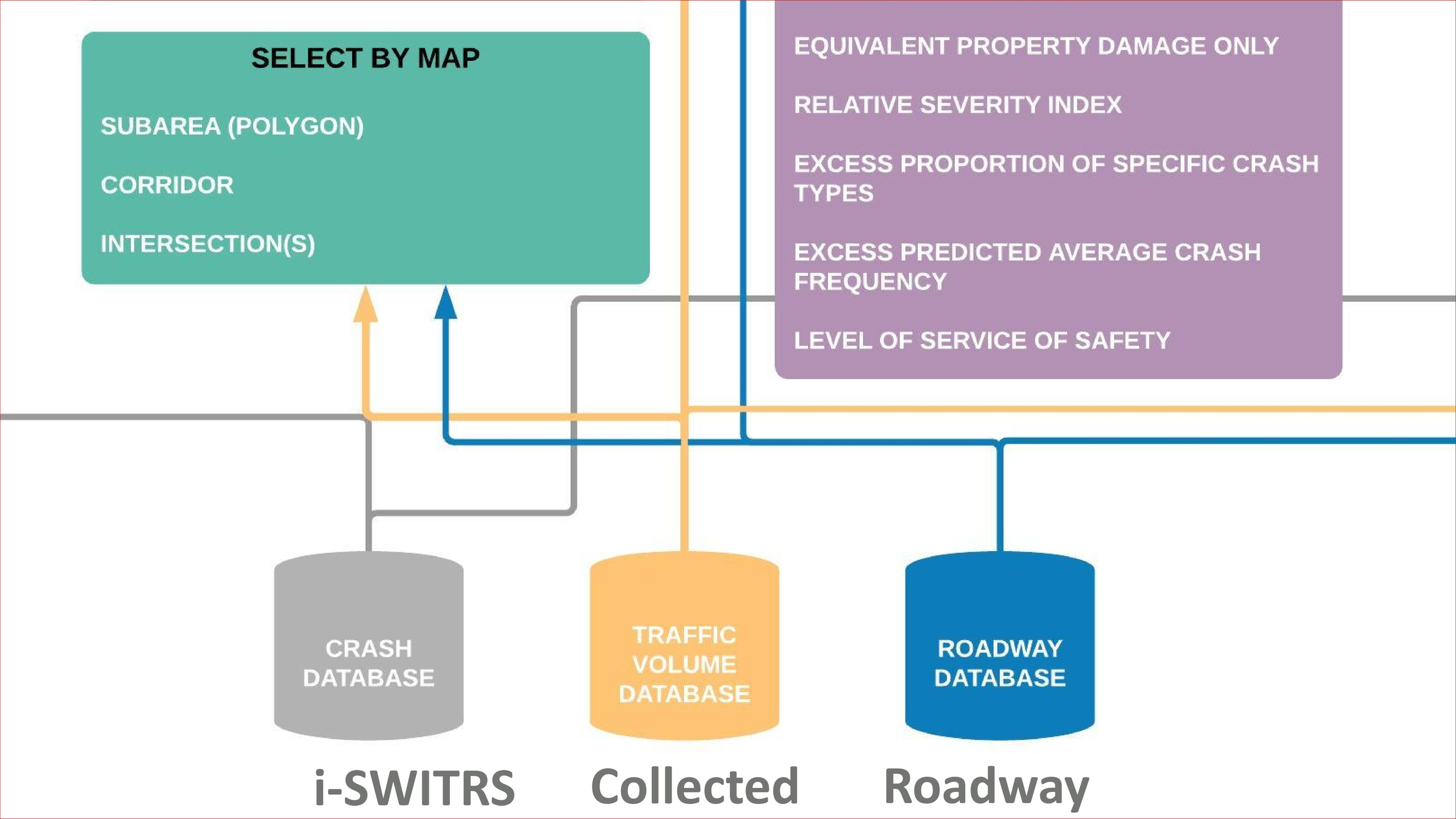
OUR APPROACH

- Data stored in MS SQL (ArcGIS Server)
- ArcGIS Web Application through Enterprise Portal
  - Requires additional python libraries for analysis.
- Data being tied to Caltrans All Roads Linear Referencing System (LRS)
- Collision Data from i-SWITRS
- ADT data from county database and estimate system using “kriging”, a geo-spatial interpolation technique.

STANISLAUS COUNTY SAFETY ANALYSIS TOOL

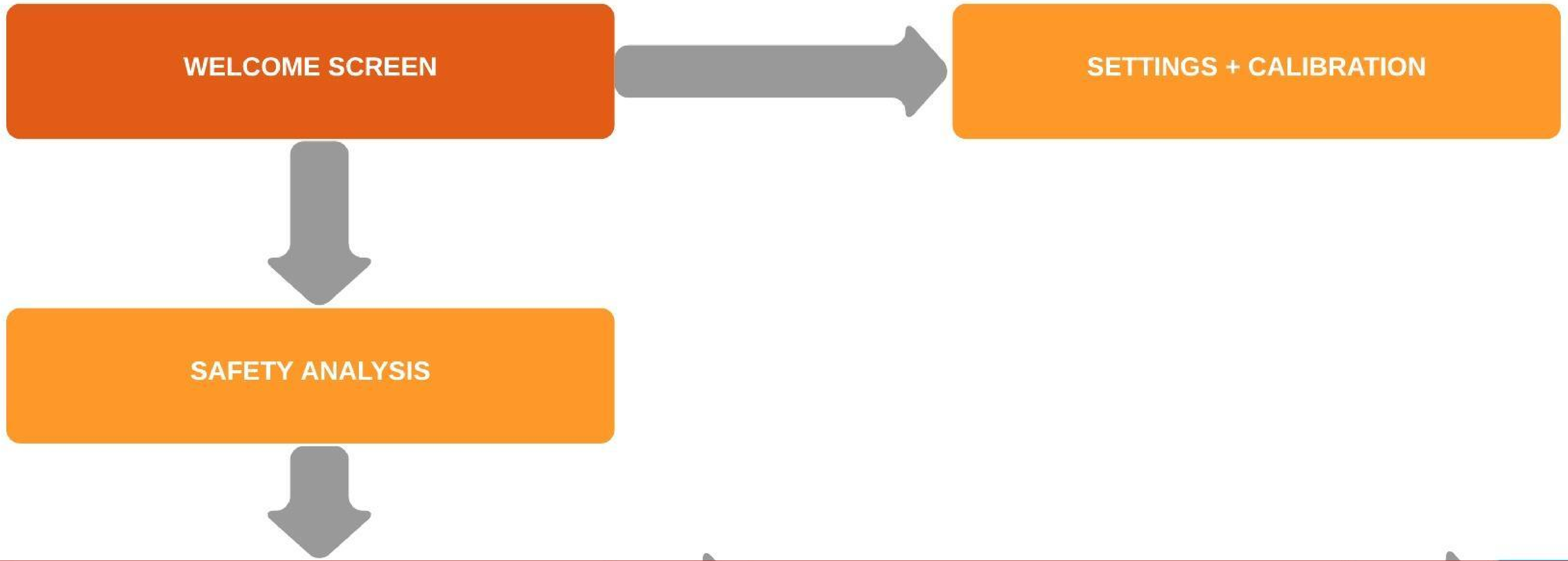
KITTELSON | January 17, 2019




SELECT BY MAP
SUBAREA (POLYGON)
CORRIDOR
INTERSECTION(S)
EQUIVALENT PROPERTY DAMAGE ONLY
RELATIVE SEVERITY INDEX
EXCESS PROPORTION OF SPECIFIC CRASH TYPES
EXCESS PREDICTED AVERAGE CRASH FREQUENCY
LEVEL OF SERVICE OF SAFETY
CRASH DATABASE
TRAFFIC VOLUME DATABASE
ROADWAY DATABASE
i-SWITRS
Collected
Roadway

STANISLAUS COU
ANALYSIS

KITTELSON | Janua



ESTABLISH FOCUS

ESTABLISH CRASH FOCUS

START DATE:
END DATE:

CRASH TYPE:
- HIT OBJECT
- BROADSIDE
- HEAD-ON
....

MODES INVOLVED:
- VEHICLE
- PEDESTRIAN
- BICYCLE

CRASH ATTRIBUTE LIMITATIONS:
- SEVERITY (FATAL, FATAL + SEVERE, FATAL + INJURY, ALL)
- CONTRIBUTING FACTORS (DUI, IMPROPER TURNING, WRONG SIDE OF ROAD
- LIGHTING/TIME OF DAY
...

ESTABLISH REFERENCE POPULATI

SELECT BY CHARACTERISTIC

GEOGRAPHY:
ALL SITES

SEGMENTS
- URBAN/RURAL
- # OF LANES
- FUNCTIONAL CLASSIFICATION
...

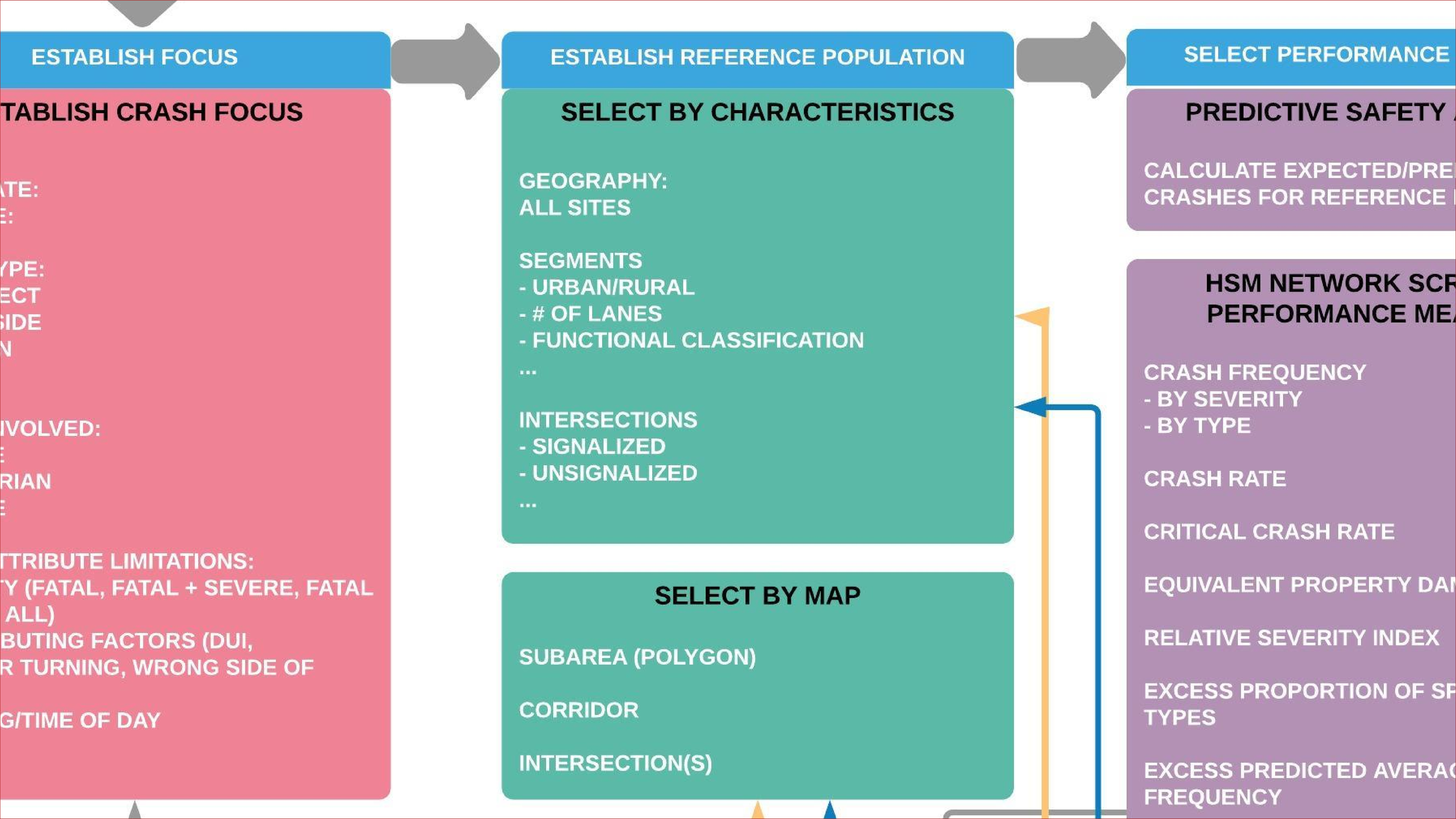
INTERSECTIONS
- SIGNALIZED
- UNSIGNALIZED
...

SELECT BY MAP

SUBAREA (POLYGON)

CORRIDOR

INTERSECTION(S)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SELECT BY MAP
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SELECT PERFORMANCE
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PERFORMANCE ME
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- BY SEVERITY
- BY TYPE
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CRITICAL CRASH RATE
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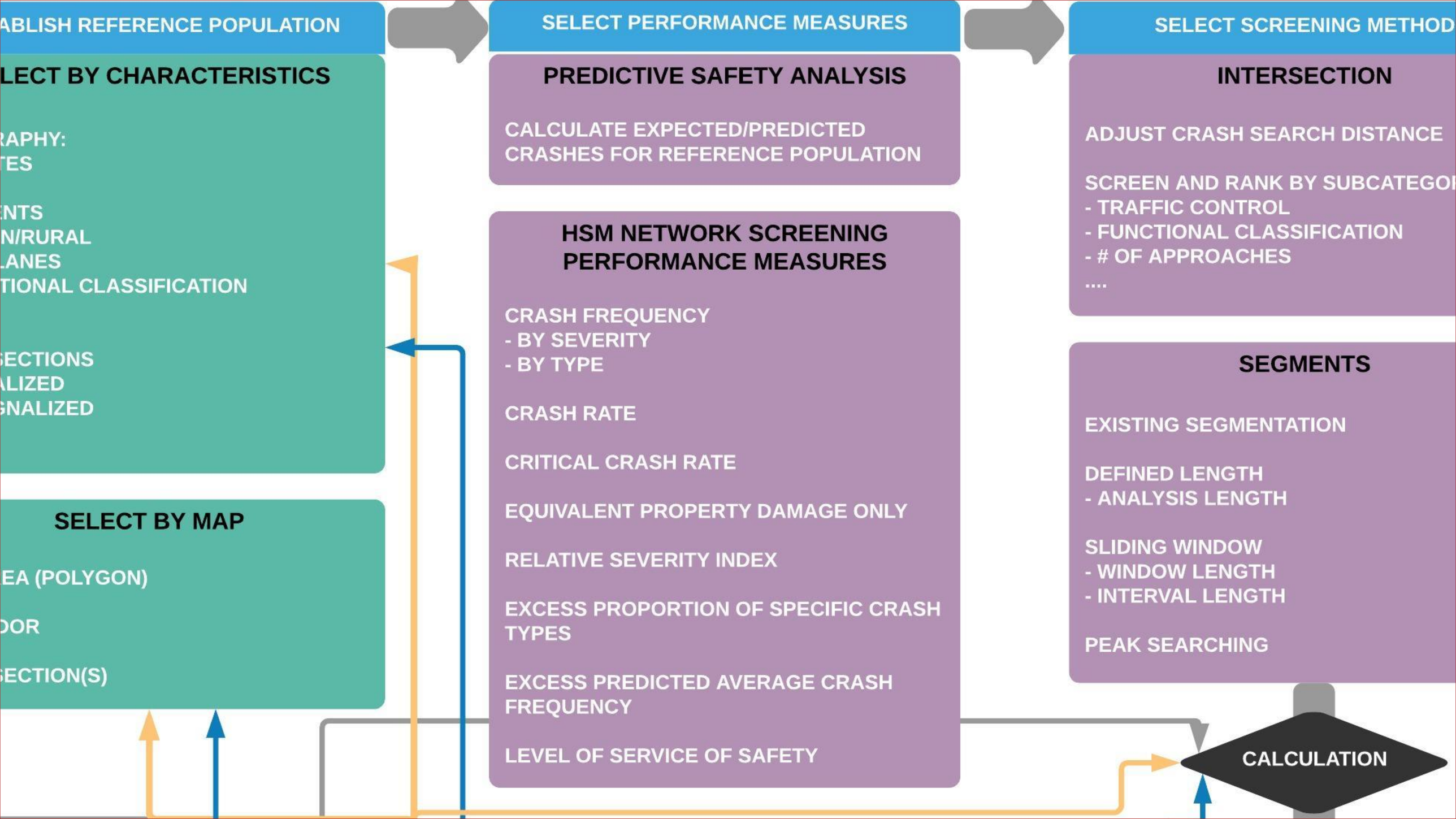
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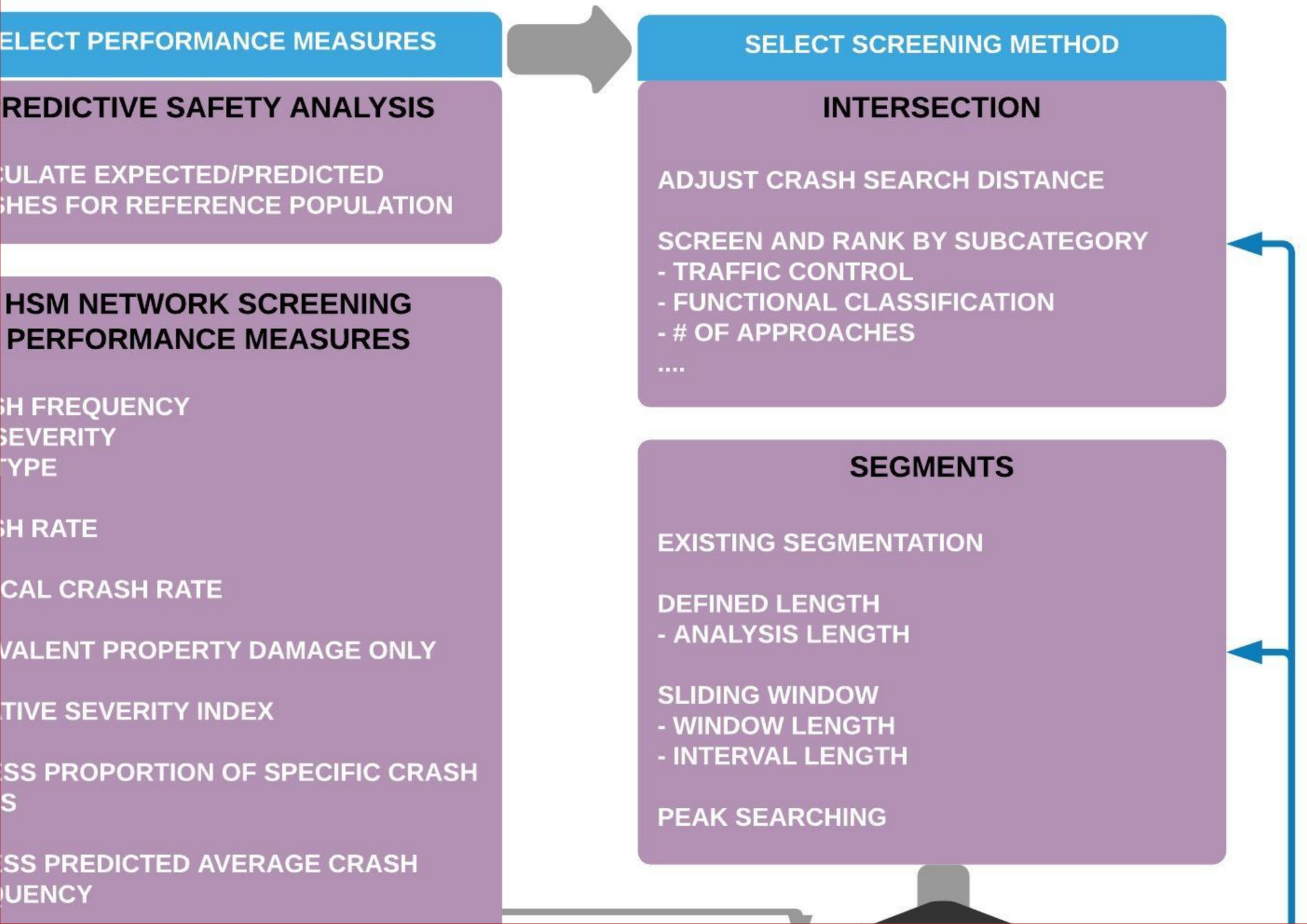
SELECT SCREENING METHOD
INTERSECTION
ADJUST CRASH SEARCH DISTANCE
SCREEN AND RANK BY SUBCATEGO
- TRAFFIC CONTROL
- FUNCTIONAL CLASSIFICATION
- # OF APPROACHES
....
SEGMENTS
EXISTING SEGMENTATION
DEFINED LENGTH
- ANALYSIS LENGTH
SLIDING WINDOW
- WINDOW LENGTH
- INTERVAL LENGTH
PEAK SEARCHING
CALCULATION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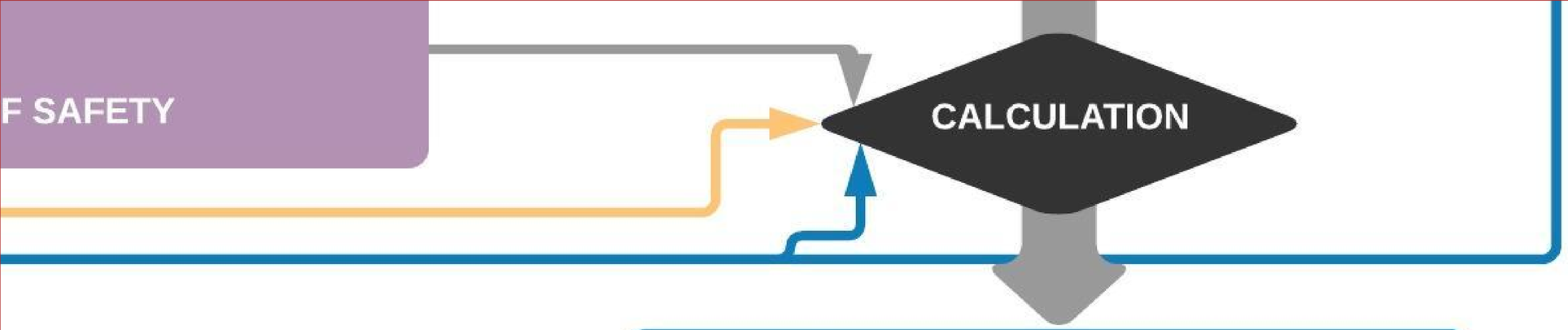


SELECT SCREENING METHOD

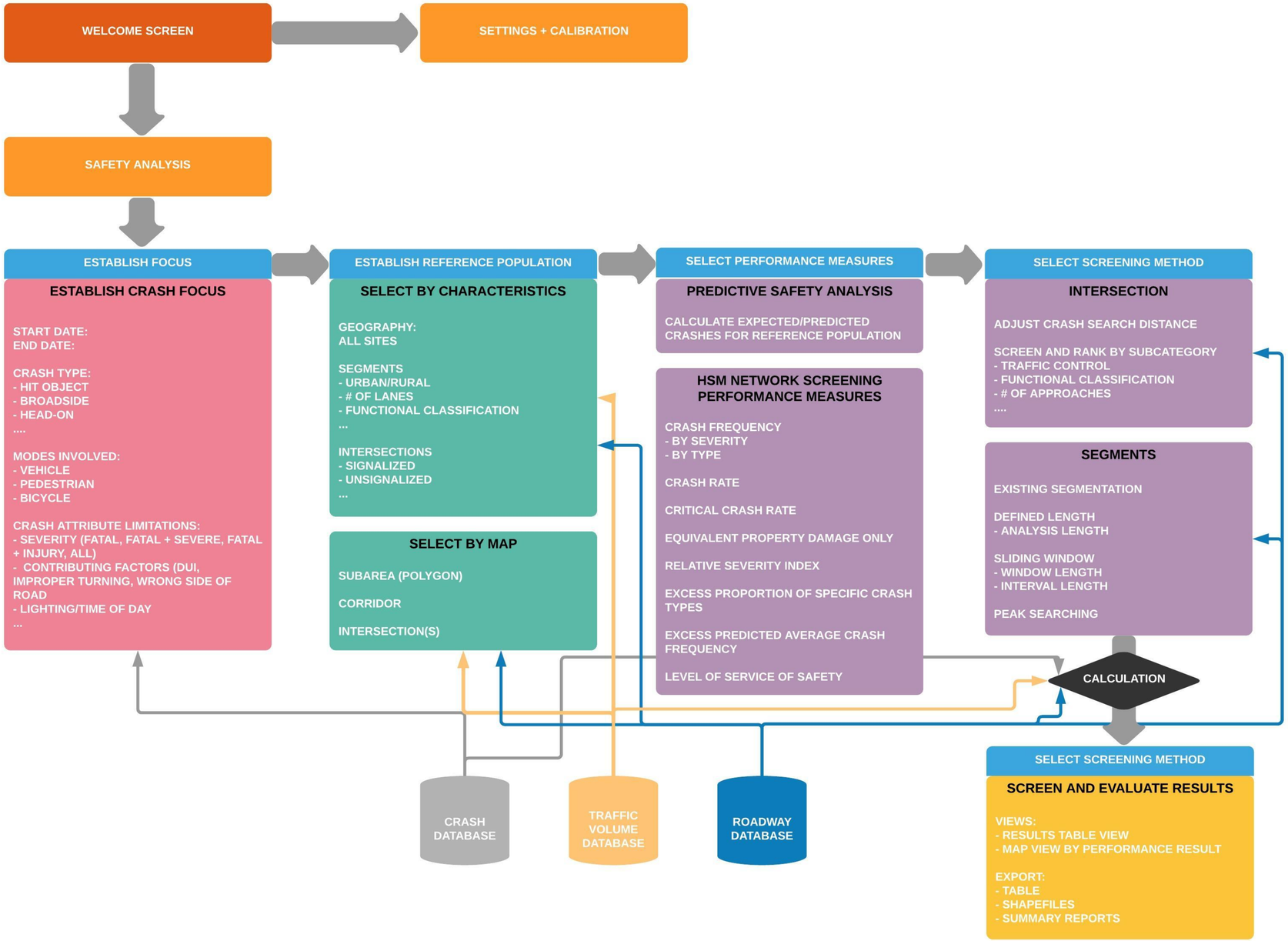
SCREEN AND EVALUATE RESULTS

VIEWS:
- RESULTS TABLE VIEW
- MAP VIEW BY PERFORMANCE RESULT

EXPORT:
- TABLE
- SHAPEFILES
- SUMMARY REPORTS

STANISLAUS COUNTY SAFETY ANALYSIS TOOL

KITTELSON | January 17, 2019



NETWORK SCREENING TOOL

CURRENT PLATFORM

WHAT'S NEXT?

- Data has been collected and processed
- SPF's have been calculated
- Priority treatments and location lists are being developed.
- The tool is still under development, specifically front-end development and integration with our enterprise server.
- All the backend work is completed
- Open source licensing options are being pursued to share with others and keep development of the tool on-going.

LINKS

- Lefler, N., Zhou, Y., Carter, D., McGee, H., Harkey, D., & Council, F. (2017. July) *Model Inventory of Roadway Elements – MIRE 2.0* retrieved from https://safety.fhwa.dot.gov/rsdp/downloads/fhwasa17048.pdf
- Alluri, P., Saha, D., & Gan, A. (2015). *Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm*. Retrieved from http://docs.trb.org/prp/15-2257.pdf
- FHWA Roadway Safety Data Program Toolbox http://safety.fhwa.dot.gov/rsdp/toolbox-home.aspx
- Every Day Counts 4 – DDSA resource page https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/ddsa_resources/

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MIRE & NETWORK SCREENING TOOL COMPLIANCE

For Local Agencies

Thank You

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