WisDOT Sketch Planning Methodology for Traffic Operations

Finalized Sketch Planning Methodology, Data Synthesis, and Traffic Operations Scenario – Technical Memorandum #4

prepared for

Wisconsin Department of Transportation

April 2007

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WisDOT Corridor Sketch Planning Methodology for Traffic Operations

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1.0 Introduction and Summary

The Wisconsin Department of Transportation (DOT) has initiated the Traffic Operations Corridor Sketch Planning methodology project with the goal of developing a methodology and associated tool that will enable the Bureau of Highway Operation's (BHO) Intelligent Transportation Systems (ITS) program to evaluate ITS and operational projects in the same manner as traditional infrastructure projects. The sketch planning effort will develop a method for that evaluation, and will do so in a fashion that builds upon current WisDOT planning and programming processes.

Wisconsin was an early adopter of ITS, participating in such key ITS deployments as Milwaukee's Monitor system, and the Gary-Chicago-Milwaukee corridor. A scarcity of funds over the past few years has limited the deployment of ITS in Wisconsin. ITS and physical highway improvements have been viewed by some as competitive, when in reality they are complementary strategies that together can improve service to the public. Tools are needed, however, to determine the benefits and costs of ITS projects.

The Traffic Operations Corridor Sketch Planning methodology project encompasses four separate planning efforts that, when folded together, will comprise the overall Sketch Plan for statewide traffic operations:

- Corridor Planning Methodology for Traffic Operations;
- Ramp Control and Surveillance;
- Travel Warning and Information Systems; and
- Traffic Signal Systems.

This Technical Memorandum is one of a series of reports which documents the development of the Traffic Operations Corridor Sketch Planning Methodology.

In the previous report, Technical Memorandum #3, a draft Traffic Operations Corridor Sketch Planning Methodology Scenario was presented utilizing the Wisconsin Heartland corridor as an example. That scenario was developed using test data.

The subject of this report is to demonstrate the Sketch Planning methodology with real data and incorporate the updates to the methodology generated by the Sketch Planning stakeholders from WisDOT and the other consultant groups involved in the project. This report details the data collection and analysis effort, the updates to the methodology including criteria, thresholds and technologies and finally, demonstrates the Sketch Planning methodology with real data, primarily from WisDOT's Meta-Manager system.

2.0 Data Collection, Analysis, and Synthesis

2.1 DATA FOR SKETCH PLANNING METHODOLOGY

An important objective of the Study Team was to ensure that the data driving the Sketch Planning process was easily accessible from standard WisDOT sources. This not only makes the process as straightforward as possible but also helps ensure that the methodology can be revisited and updated easily in the future as part of ongoing long-range planning activities.

To meet this objective, the study team worked closely with the WisDOT Program Development and Analysis Section to find the most relevant data that met the objective discussed above. Based on their input, the Sketch Planning methodology was designed to run on three distinct datasets, the primary one being Meta-Manager data.

2.1.1 Meta-Manager Data

Meta- Manager, a comprehensive data repository for WisDOT, was developed by Division of Transportation Investment Management's Bureau of State Highway Programs to meet the data requirements for a variety of needs and performance analyses. The Meta-Manager Management System data is the best information currently available for evaluating system needs and measuring program impacts and serves as the major source of data for the Sketch Planning effort. The data are currently maintained by the Program Development and Analysis Section whose assistance was critical to the development of the Sketch Planning effort.

The Meta-Manager database is an excellent resource for assessing system condition, analyzing need and performance and supporting project development. Since the database is developed from several WisDOT databases and provides greater access to that data, users provide helpful feedback regarding the quality of the original corporate data.

The Meta-Manager geographically integrates a variety of data including pavement information, system deficiencies, safety, congestion and other information. The data also include future projections of physical condition data.

2.1.2 University of Wisconsin TOPS Lab Weather Data

Since the Sketch Planning methodology is designed to provide guidance for operationally related projects along a corridor, operationally related data outside meta-manager is also needed to drive those decisions. Weather was one of the 10 criteria selected as part of the methodology and it was therefore critical to find an appropriate weather related dataset. The weather data proposed for use in the Sketch Planning methodology was processed by the University of Wisconsin TOPS Laboratory and documented in the paper Application of Road Weather Safety Audit to the Wisconsin Highway System, (Qin, Noyce, Martin and Khan).

2.1.3 Wisconsin Event Data

Special events and their impact on the transportation system was another criterion developed as part of the Sketch Plan methodology. For this dataset WisDOT Bureau of Traffic Forecasting provided the Study Team with a list of the top eighty six special events around the state.

The remainder of this section details how the Meta-Manager, weather, and event data were utilized.

2.2 META-MANAGER ROLL-UP METHODOLOGY

The rollup process was developed to reduce the number of links representing any given corridor by aggregating series of consecutive links with similar characteristics.

This subsection describes the tools and techniques used in this process.

Several terms are presented initially here for reference:

- Sketch Plan link– a single link in the result data set that is comprised of one or more links from the Meta-Manager links database. The combined links are physically consecutive, on the same route and direction, and enable all of the criterion data important for this project can be properly aggregated.
- The Meta-Manager links comprising a Sketch Plan link are called the **member links**.
- Split Criterion – the decision parameters that determine when the "end" of a Sketch Plan link has been reached. As the process considers adding the next physically consecutive member link to the current link being rolled up, these criteria determine whether that link should be allowed to accumulate in the roll up, or if it should start the next rolled up link. The split criterion are outlined Section 2.2.2.

2.2.1 Data Preparation

The process relies heavily on the ability of the system to correctly traverse the Meta-Manager links in route, direction, and then physically consecutive order. Specifically, the system needs to be sure that the "next" link in the process is:

- On the same route,
- In the same direction, and,
- the one that starts at the same physical location as the current one ends.

It was not assumed that the order of the Meta-Manager links in the database would be as required, though in large part, the Meta-Manager data is in order on any given route and direction.

When the links progress through the rollup process, the three attributes above can safely be used as split criteria and the resulting data sets will consist of links that have unique combinations of route and direction. This is specifically intended to assist those who will be working with this data to follow the routes along a corridor.

The system goes through a process of reading through all the links in a corridor, ordering them and confirming their location through a test process. A more detailed description of this process is included in Appendix A.

After reading all links, the data preparation process then goes through all routes discovered in the data set, then through all directions discovered on that route, and saves the first link on that route and direction found and then saves the rest of the links (on that route and direction) in consecutive order – that is, it will only save a link in the database when that link's start point equals the last saved link's end point.

The process is repeated until all links are in the database, and results in 20,606 links.

2.2.2 Rolling up links

Aggregation

Once the data are used to follow each corridor and implement the three primary split criteria (route, direction, consecutive), the links can be combined into longer, representative links, thus providing fewer links to analyze.

The primary concern in combining links is to ensure that the data represented on the Sketch Plan link are properly aggregated from the member Meta-manager links. For example, it is not appropriate to take the average accident rate of the member link. Instead, it is more accurate to calculate the number of accidents for each member link (using the link's accident rate, AADT, and length), and accumulate this number. When the split criteria are applied and a new sketch Plan link is closed off the number of accidents is then used to calculate the accident rate for the rolled up link, this time using the total AADT and total length .

Fields that are aggregated in this process include:

- Accident Rate (RATE) – Weighted (by VMT) average of member accident rates. Note, the AADT used to calculate VMT is that for 2007 (AADTYR_1)
- Severity Index (SEVINDX) – This is a simple accumulation. It is understood that this value is actually the sum of a series of "counts" of certain types of accidents times a point value for each type of accident. As such, the proper accumulation is to simply add the value among multiple links.
- Percent Trucks (TRKDYR_1 and TRKYR_1) - Weighted average of member percent trucks
- AADT (AADTYR_1, AADT2030) – Recalculated by taking accumulated VMT (AADT * length) and dividing by total length
- Level of Service (LOSYR_1,LOS2030) – This value is accumulated as a simple average. However, the average itself is not strictly intended to be used in analysis. Instead, LOS values A – F are used and as such – all rolled up links will contain a constant value of A – F. This is an important split criterion and so that when LOS, as a letter, changes among links –a new roll up is initiated.
- Length (PDP_MILE) – The accumulated total length.

- Intersecting Street Name (INTS_NM) – This value is taken from the first member link that has a non-blank value in the field. It is intended to assist in locating the link on a map if necessary. However, because it may be contributed by a member link that occurs some distance from the start of the Sketch Plan link – it will not always name a crossing facility that is near the start.
- Other fields –It is noted here for reference that other fields in the Meta-Manager data that appear in the Sketch Plan link take their values from the first member link. Rather than delete these data, it has been kept in place should some manual reference need to be made back to the Meta-Manager data .

Split Criteria

The split criteria dictate when one Sketch Plan link ends and the next one begins. Many approaches were tried with the primary goal of keeping the aggregated data on the rolled up links valid, accurate and relatively homogeneous .

The roll up process allowed fewer links to be analyzed in the deployment threshold scoring process; as opposed to looking at each of 500 links along a corridor, for example, it would be easier to look at 50 "representative" links.

It was initially proposed to standardize the rolled-up links based on length, recognizing that there would be variation depending on roadway characteristics, traffic volumes and adjacent land uses. However, it became clear as work progressed that this was not an effective method defining sketch planning links. Specifically, we find that there are interesting dynamics occurring in the Meta-Manager links, sometimes over short distances. As a result some of the rolled up links are shorter than what would be preferred, but are much more accurate in representing travel characteristics and the reality that they often vary significantly over a short distance. This variation will result in different levels of need for ITS and operational projects.

This results in some links that are short and for which there are only 1 or 2 Meta-Manager member links. Except for one minor case – these "short" links are necessary to meet the objectives and data requirements of the sketch planning methodology. The exception noted is in transition areas where a two parallel links in opposite directions differ in length. The process for addressing this is documented in detail in Appendix B.

Criteria for Defining Sketch Planning Links

The entire set of criteria for splitting links is as follows:

- Route and direction – when either route or direction changes, a new link is started. In some cases, two routes may merge into one. When this happens and the Meta-Manager route name field takes it's value from the one merging in, we end up with a possible "early" split. However, this situation is not detectable in software and is believed to happen at most a few times in the entire system.

- Number of lanes –Number of lanes is an important roadway characteristic that will be useful in threshold scoring. Because we don't have a good way to aggregate this value, and averaging the number of lanes would be invalid, we must therefore split on it.
- Level of service Letter designation – Level of service is an assigned value for the Meta-Manager links. We can neither calculate or accumulate it. We investigated whether some relationship could be found amongst the other data at hand which would allow us to accurately accumulate or calculate it. However, we could not find a suitable relationship. As a result, this criteria is actually the driving criteria for splitting sketch planning links. In other words, most new links start where a value in LOS has changed significantly. (Initially, we looked at splitting where the numeric LOS value (1 – 6+) changed by a certain percentage. However, the LOS letter designation became the data used in threshold scoring analysis and the split was changed to occur where this letter changes.)
- Seasonal Factor Group – This value is relatively constant through large sections of most corridors. However, it sometimes changes suddenly for a small number of links within a corridor. To minimize this effect (causing a large number of small links), we allow a limited number of member links to continue accumulating after the point of this change. Thus, a Sketch Plan link may comprise a few member links of a different SFG – ultimately, however, the SFG change in that region is correctly captured.
- Total length – when the accumulated length reaches beyond a certain designated length, the next Sketch Plan link is started. The length specified, however, is very long (100 miles) and this rarely becomes a split point due to the presence of other factors.
- Contiguity – when the start point of a given link is further away than a specified value from the end point of the (current) last link in a rolled up link, a new Sketch Plan link is started. This proximity is currently represented by a distance of 10 feet .

Results

There are several products of the roll up process besides the sketch planning links themselves. This includes cross reference information that can be used to relate the rolled up links back to their member Meta-Manager links and vice-versa.

The output files of the process contain the following:

- The rolled up links. Each corridor is represented by its own set of files. These include:

  - <Corr>.dbf – a dBase file containing the rolled up links. This data is a subset of the Meta-Manager data set. Except for fields we've added for our purposes, the format of this file is exactly that of the raw Meta-Manager dBase file.
  - Here <Corr> represents the root name of the file, which is an abbreviated form of the corridor name. A table is presented below which links these names to corridors .
  - <Corr>.shp, <Corr>.shx – the ESRI format shape file containing the geographic information of the links in the <Corr>.dbf file – in the same order.
  - <Corr>_Raw.dbf – a dBase file, in the same Meta-Manager format, containing all the links in the corridor directly from the Meta-Manager main file.
  - <Corr>_Nodes.dat, <Corr>_Links.dat – Generated node Ids and coordinates, as well as link information for use in importing the corridor links into IDAS (ITS Deployment Analysis System) which was used extensively in the development and validation of the rollup process (to visualize the created links)

- Summary information about all links:
  - The xRef.dbf file contains one record for every Meta-Manager link (20, 606 records). This contains the Meta-Manager's id value (META_MANAG) and the id of our Sketch Plan link (which is the Segment ID and is a contiguous integer value starting at 1)
  - All.dbf contains all (rolled up) links from all corridors. It is essentially the concatenation of all the individual corridor files. Note that more than one section in the file may have any given route and direction. All other corridor link files can be considered to be "sorted" by route and direction.
  - Results.dbf contains the statistics of the rollup process. Primarily, how many links are in the corridor in the raw data, and how many links are in the rolled up data.

The results of the rollup process are indicated in the following table.

Table 2.1 Roll-up Results

	CORRIDOR	# in Source	# in Result	% Change
ALP	Alpine Valley	204	64	69%
BAD	Badger State	543	110	80%
BLA	Blackhawk	377	145	62%
CAP	Capitol	766	299	61%
CHE	Cheese Country	198	55	72%
COR	Cornish Heritage	327	92	72%
COU	Coulee Country	211	54	74%
CRA	Cranberry Country	133	45	66%
DOO	Door Peninsula	96	35	64%
84T	84th Division Railsplitters	97	47	52%
FOX	Fox Valley	512	151	71%
FRA	Frank Lloyd Wright	207	61	71%
FRE	French Fur Trade	98	28	71%
GEN	Geneva Lakes	129	53	59%
GOP	Gopher Connection	476	149	69%
HIA	Hiawatha	437	180	59%
IND	Indian Head Lakes	242	63	74%
KET	Kettle Country	108	34	69%
LAS	Lake Superior	183	47	74%
LAT	Lake To Lake	130	46	65%
LUM	Lumber Country Heritage	149	32	79%
MAR	Marshfield - Rapids Connection	233	77	67%
MIS	Mississippi River	441	115	74%
NOR	North Country	331	72	78%
PEA	Peace Memorial	381	72	81%
PES	Peshtigo Fire Memorial	122	30	75%
POT	Potato Country	236	73	69%
POW	POW/MIA Remembrance	178	38	79%
ROC	Rock River	174	73	58%
SOU	Southern Tier	279	106	62%
TIT	Titletown	495	124	75%
TRE	Trempealeau River	116	26	78%
WAU	Waukesha Connection	210	82	61%
WIL	Wild Goose	304	99	67%
WIS	Wisconsin Heartland	446	61	86%
WIV	Wisconsin River	496	93	81%
WOL	Wolf/Waupaca Rivers	180	45	75%

2.3 WEATHER DATA ANALYSIS

Weather data proposed for use in the Sketch Planning methodology was processed by the University of Wisconsin TOPS Laboratory and documented in the paper Application of Road Weather Safety Audit to the Wisconsin Highway System, (Qin, Noyce, Martin and Khan). The two general categories of data considered for use are weather observation data and weather-related crash data. Observation data include information on the occurrence and intensity of adverse weather conditions including snow, ice, rain and fog. There are a variety of observation stations in Wisconsin that are maintained by both private and public sector organizations. WisDOT has its own network of approximately 60 Environmental Sensor Stations (ESS) that provide information for use in WisDOT's maintenance activities. Information is also provided to the public through the WisDOT website (http://www.dot.state.wi.us/travel/gis/rwis.htm). This information is supplemented by data from 43 AWOS/ASOS (Automated Weather Observation System/Automated Surface Observation System) stations located at Wisconsin's airports (http://www.faa.gov/asos/map/wi.cfm). Additional stations are provided through the National Weather Service (NWS) and a volunteer observer network, the Cooperative Observing Program (COOP), that is coordinated by the NWS. The Wisconsin State Climatology Office (http://www.aos.wisc.edu/%7Esco/stations/menu.html) compiles and provides real-time information from the COOP.

While real-time weather observations are available from a variety of sources, there are several challenges involved in utilizing this information for the ITS Sketch Planning initiative:

- Real-time observations from the sources described above are relatively easy to obtain. However, in order to provide meaningful data for the sketch planning evaluation continuous archived data over a period of one year or more is required. These datasets can be costly and are also very large and difficult to manipulate.
- Weather observations are from single points that may or may not be located on a roadway. The sketch planning analysis requires that estimates be obtained for all segments of the Connections 2030 corridors.
- Some weather observation stations track precipitation intensity and amounts, while others only indicate the presence of precipitation. Many stations collect only atmospheric data, not surface temperatures, which would be helpful in establishing the presence of ice or snow on roadways. WisDOT's ESS stations, for example, provide data on surface conditions but do not provide information on precipitation intensity.

These limitations mean that significant processing of weather data is required prior to use in the sketch planning analysis. The UW TOPS Laboratory report addressed all of these issues, providing useful datasets for inclusion in the sketch planning process. Continuous data on snow, rain and fog conditions were developed from Wisconsin's AWOS stations, as well as 151 stations that are part of the NWS Cooperative Observing Program (COOP). Data from three years (2000-2002) were smoothed into a continuous surface, using a kriging process. Similar maps were developed for rainfall and fog. Fog observations, however, were available only for about 20 ESS stations. While the kriging process enables the data to be extrapolated to the entire State, the low number of specific observations for fog means the dataset is of limited value for a statewide sketch planning. Since snow generally has a greater impact than rain on transportation mobility and safety it is recommended that the snowfall data developed by the TOPS lab be used as one of measures in the sketch planning process. The data provided has been reclassified as shown in Figure 2.1. Average annual snowfall amounts have been calculated and classified into six categories. In order to make these consistent with the other variables used in the sketch-planning methodology, the six categories can be collapsed into four as follow:

- Tier 1 = < 30 inches
- Tier 2 = 30 to 59 inches
- Tier 3 = 60 to 80 inches
- Tier 4 = >80 inches

Points are assigned in a manner similar to other proposed measures. While weather observation data are continuously available, extensive processing is required to replicate the TOPS Laboratory analysis. Unlike traffic and safety data, however, climatological data do not require frequent updating in order to be used in the sketch planning methodology. If and when additional analysis is conducted by TOPS, or another organization, the dataset can be expanded and/or updated.

The second weather-related criterion is weather-related crashes. The TOPS Laboratory located all weather –related crashes that occurred in Wisconsin during the period 2000-2002. Four categories of weather condition were identified, including fog, snow, rain and ice. The methodology is described in greater detail in the TOPS Laboratory Report. A map of crash locations superimposed on corridor sketch planning segments is shown in Figure 2.2. This information overlaps to some degree with other crash data criteria but also differs in that it focuses specifically on the safety impacts of adverse weather conditions. Like the other work conducted by TOPS for this project, this was a one-time project that may or may not be repeated in the future. While the data can be considered useful for several years, they will eventually require updating. Two criteria can be used to represent weather related crash data in the sketch planning methodology:

1. Weather-related crashes as a percentage of all crashes on a segment – This provides a measure of the impact of weather on safety in a certain segment.

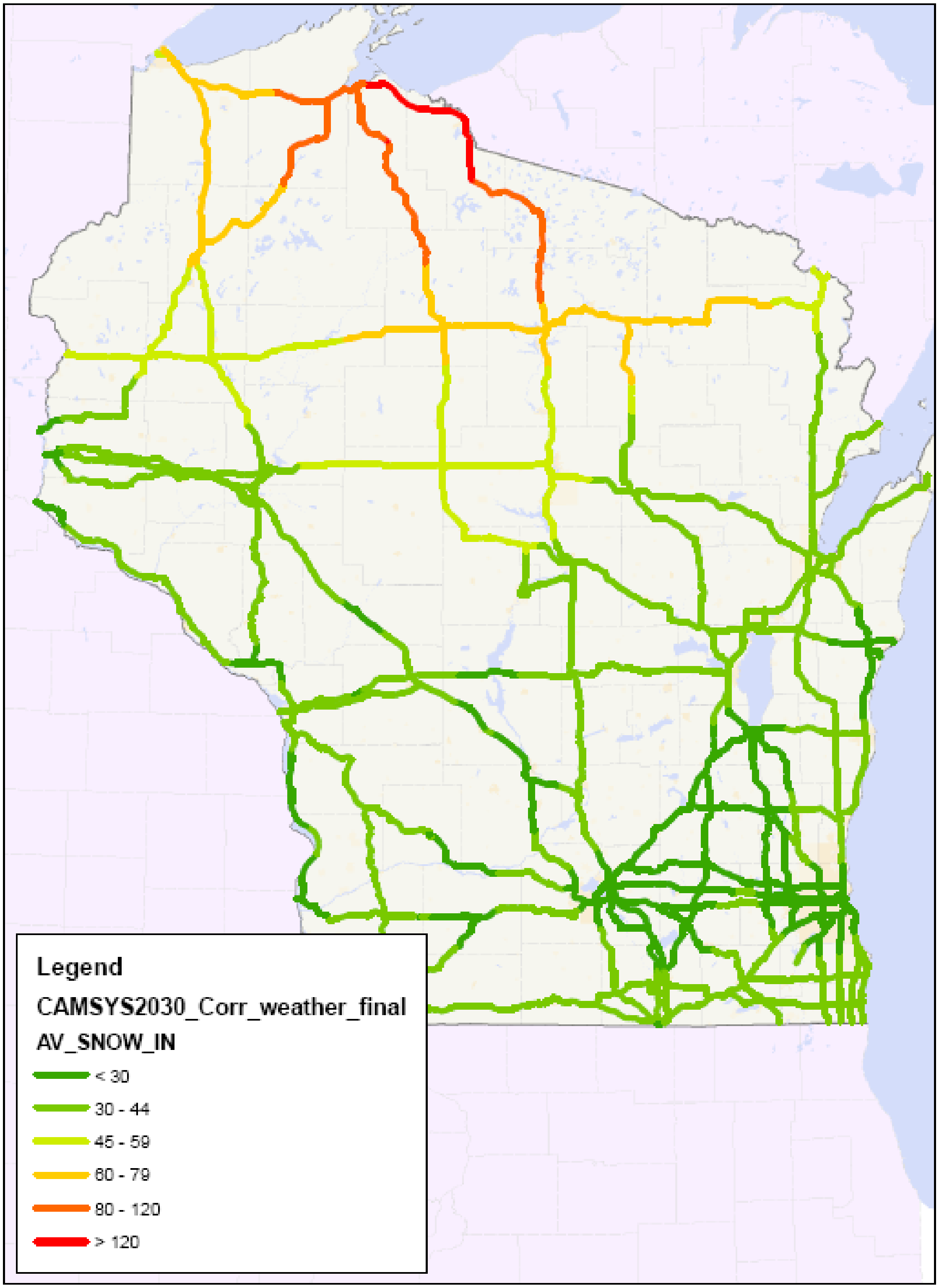

Figure 2.1 – Average Annual Snowfall 2000-2002

It can be misleading, however, on segments where there are a low number of total crashes.

2. A comparison of weather-related crash rates to statewide means can be made. This is consistent with the methodology being used for other safety-related criteria. An overall weather-related crash rate would be calculated for all 2030 Connections corridors using the formula supplied in the Meta-Manager Management System Database Report (November 2006):

$$\frac{\textit{Segment-wide crash total for the appropriate years (e.g. 5)} * 100{,}000{,}000 \textit{ (VMT)}}{\textit{AADT}^{1} * \textit{Length of segment} * \textit{appropriate years (e.g. 5)} * 365}$$

[1] *If the roadway is divided, use 50% of the AADT*

Once the mean is calculated, rates would be calculated for each segment and compared to the mean. A tiered system similar to that used for other safety related crashes would be used:

- Tier 1 = Breakpoint to be determined
- Tier 2 = Tier 1 breakpoint to 100% of mean
- Tier 3 = 100% to 200% of mean
- Tier 4 = >200% of mean

After carefully considering the two potential approaches, the Study Team recommends using the first method (annual average snowfall) to address the weather criteria. Due to the additional processing requirements and the need to have the data updated on a periodic basis, the weather related crash data was deemed an inappropriate approach for the Sketch Planning.

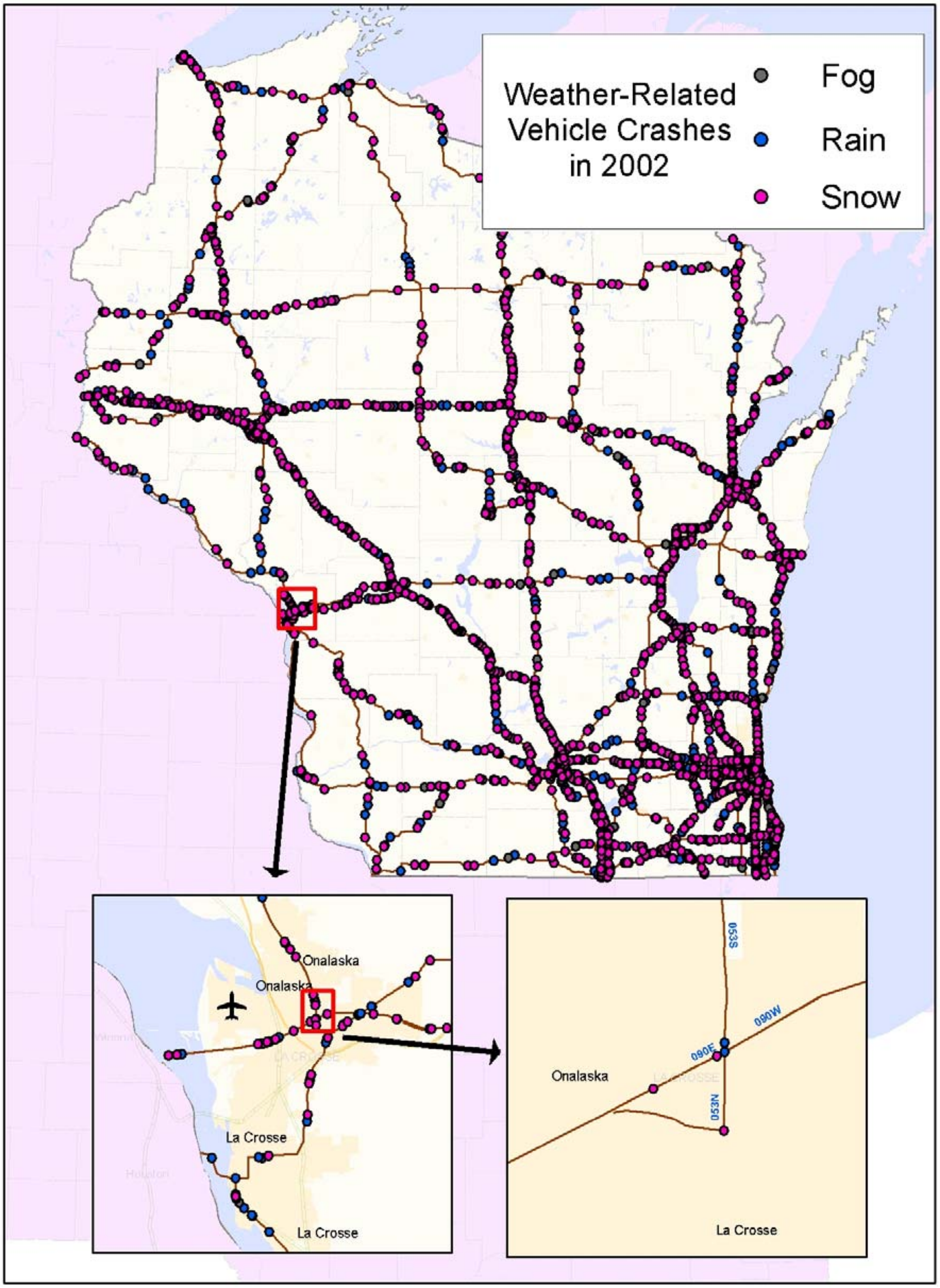

Figure 2.2 – Weather Related Crash Data

2.4 EVENT DATA ANALYSIS

The event data proposed for use in the Sketch Planning methodology was collected by the Wisconsin Department of Transportation. Staff in the Traffic Forecasting Division had previously assembled a list of events within the state of Wisconsin with greater than 10,000 individuals in attendance. The list included the names, location, duration, frequency, attendance, and dates of 86 events. This list served as the foundation for the analysis of the impact of events on the overall Sketch Plan score for roadway segments. While this list is not a recurring product of WisDOT with scheduled updates and institutional accuracy standards, it provides a solid foundation for future analyses to use to capture event impact on ITS/Operations deployments. The complete list can be found below in Table 2.2.

The first step in the analysis is to geocode the event locations. Each event/venue is searched using Google or the Wisconsin tourism web site. In cases where an address is available, it is entered into Google Earth to obtain latitude/longitude coordinates. For events that cover a larger area, an attempt is made to locate a central facility or geographic center (i.e. center of Capital Square in Madison) to locate the event.

The second step is to assign scores to the roadway network. Scores are intended to reflect the impact of an event on the transportation network and thus the need for ITS/Operations deployment. A higher score should reflect a greater need for ITS/Operations deployment due to event generated traffic and related issues. The factors considered in assigning individual event impact scores are the total event attendance and the total duration in days. The score is calculated by taking the square root of attendance per day and dividing by 100. This produces a result where scores vary from roughly .7 to 4.7 - which corresponds nicely to a 0-5 rating.

The third step is determining which segments of the roadway are affected by the presence of the event. For each point location, a buffer is calculated to determine which roadway segments may have a need for ITS/Operations deployment. The buffer is calculated by taking the square root of total attendance and dividing by 100. This produces a result that seems consistent with estimates of the ITS/Operations deployments needed to guide travelers and manage traffic for large events such as Summerfest. Using this methodology, roadway segments within ten miles of a 1,000,000 person/day event are considered to be affected. Roadway segments within one mile of a 10,000 person/day event are affected.

The final step is to assign the scores to the roadway segments. Using ESRI's ArcInfo, the segments which intersected with an event buffer, are assigned the values for all of the buffers they crossed. For example, a segment which crossed buffers with scores of one, two, and one, respectively would receive a total score of four. These values are accumulated in a new field along with the Meta-Manager data by segment. This is illustrated in the next figure.

Table 2.2 Events Utilized in Sketch Planning Analysis

Events		
Harley Davidson Celebration	Wisconsin State Fair	EAA AirVenture
PGA Golf Tournament	Great Circus Parade	Iola Old Car Show & Swap Meet
Art Fair on the Square	Sweet Corn Festival	Summerfest
Ducks Unlimited Great Outdoor Festival	Artstreet	31st Warrens Cranberry Festival Art/Craft Show
Badger Football	Packer Football	Bay View's South Shore Frolic
German Fest	Super National Truck & Tractor Pull	Greater Milwaukee Open
Irish Fest	Hilldale Brat Fest	Concerts (X-Fest, OzzFest)
Country Rock Fest USA	Oktoberfest	Madison Blues Festival
Great River Festival of Jazz	Festa Italiana	Brewer Baseball
World Championship Off-Road Races	Wisconsin State Cow Chip Throw	African World Festival
Concerts, Sports	Cinco de Mayo Springfest	Artrageous Weekend
Polish Fest	Road America 500	American Birkebeiner
Bayfest	Indian Summer Festival	Northern State Fair
Hodag Country Music Festival	Country Jam USA	World Dairy Expo
Walleye Weekend	CART FedEx Championship Series	Bucks Basketball, Sports, Concerts
Art Fair on the Green	Fish Day	Cranberry Festival
Syttende Mai Folk Festival	Holiday Folk Fair International	Green County Cheese Days
Star Spangled Celebration	Lumberjack World Championships	Chocolate Festival
Great Wisconsin Cheese Festival	Miller Lite Ride for the Arts	Wisconsin Film Festival
Prairie Villa Rendezvous	Concerts, Fairs	Klondike Days & World Championship Oval Sled Dog Sprints
Kohler/SCCA Chicago Region June Sprints	Motorola 220/CART FedEx Series	Scottish Fest/Milwaukee Highland Game
Hot Air Affair	Home of the Hamburger Celebration	NASCAR Midwest/Sat Night Races
World Championship Snowmobile Derby	Flake Out Festival	Winterfest & US National Snow Sculpting Comp
Bald Eagle Watching Days	Snowflake International Ski Jumping Trnmnt	Badger State Winter Games
Kites on Ice	Journal-Sentinel Sports Show	Big Whopper Weekend
National Hydroplane Races	Badger State Summer Games	Wisconsin Farm Progress Days
World Championship Snowmobile Watercross	Wilhelm Tell Fest	Gays Mills Apple Festival
Wade House Civil War Weekend	Watermelon Festival	Apostle Islands Lighthouse Celebration
Chequamegon Fat Tire Festival	Apple Festival	

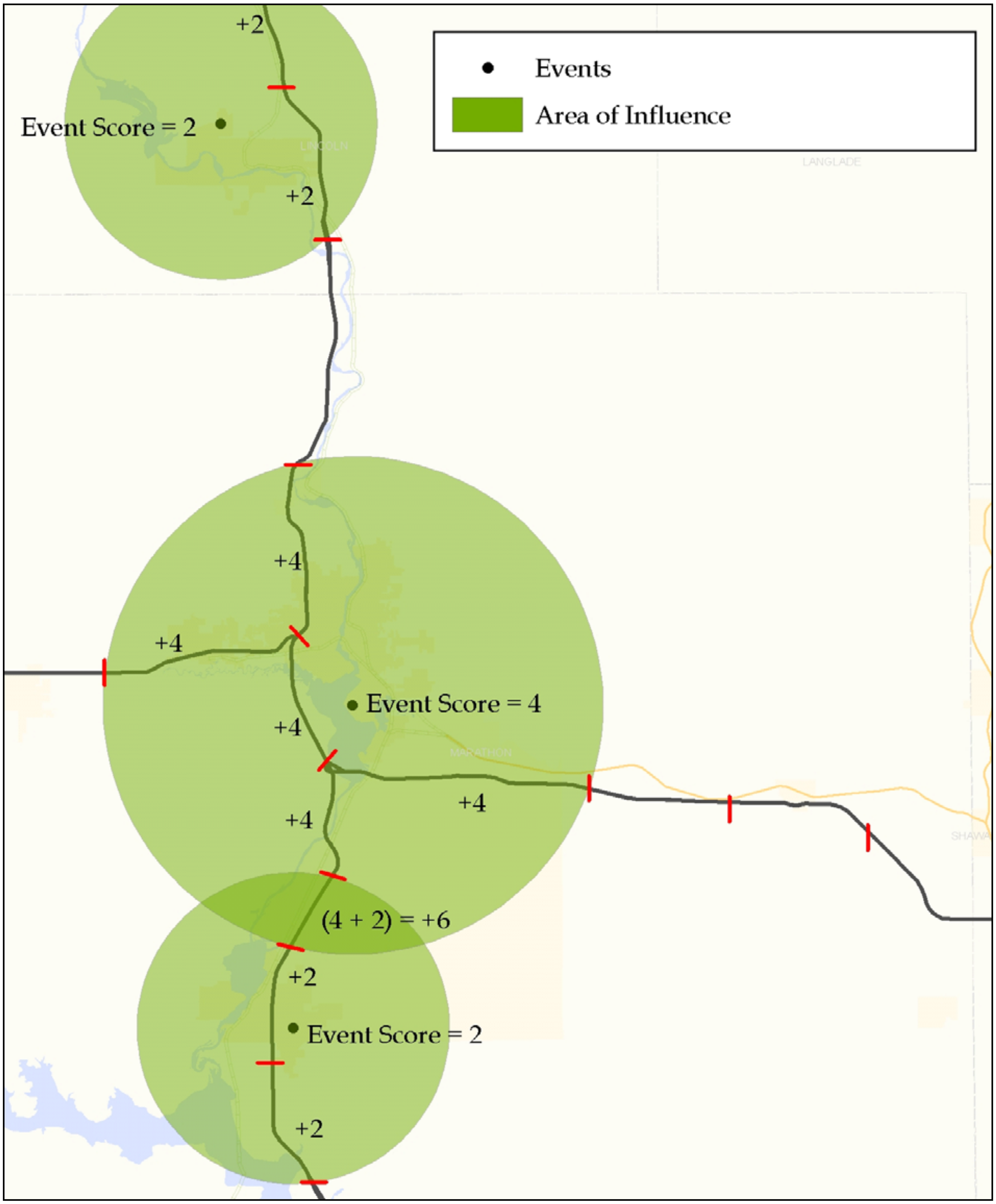

Figure 2.3 – Event Scoring Methodology

In order to calculate the impact of events on the overall Sketch Plan score for every segment, the event score is divided into four tiers as follows:

- Tier 1 = 0
- Tier 2 = 1 to 5
- Tier 3 = 5 to 10
- Tier 4 = > 10

The highest tier includes roadways in and surrounding Milwaukee (hosting Summerfest and the State Fair, as well as Harley-Davidson key anniversaries), near Oshkosh (reflecting the strong impact of the EAA AirVenture annual festival), and some roadways in downtown Madison (hosting Badger Football games and numerous downtown festivals). Tier 3 roadways frequently are found on the fringes of event centers and Tier 2 roadways are generally located near relatively isolated, rural events. Tier 1 roadways, which have no significant impact from events, include about 86% of all roadways in the 2030 Corridors. The average roadway segment event score is about 1.6.

This analysis is suitable for a sketch planning effort but does not go to the level of a focused event-generated traffic analysis. Circular buffers are used to capture the impact of an event. These are a substitute for potentially more complicated and difficult processes of assigning the impact of events on roadways. Consideration of network utilization, trip assignment, and population centers as traffic generators could be more accurate. For example, Summerfest in downtown Milwaukee is considered as having an equal impact on roadways in all directions. In reality, Summerfest is more likely to draw larger traffic volumes from population centers to the south (such as Chicago) than the north. Another element in which this methodology was simplified involves proximity. A roadway link at the outer fringes of a circular buffer is impacted in the same way as a roadway at the center of a buffer. A more detailed analysis could include incorporation of a distance factor that would provide different scores based on distance from the event.

Overall, the event data serves as a solid foundation for comparative analysis of the roadway network. The preliminary results appear to reflect reality. Provided the event list is periodically updated and checked for accuracy, this analysis is fairly easy to replicate. Figure 2.4 illustrates the results of this approach on a statewide level.

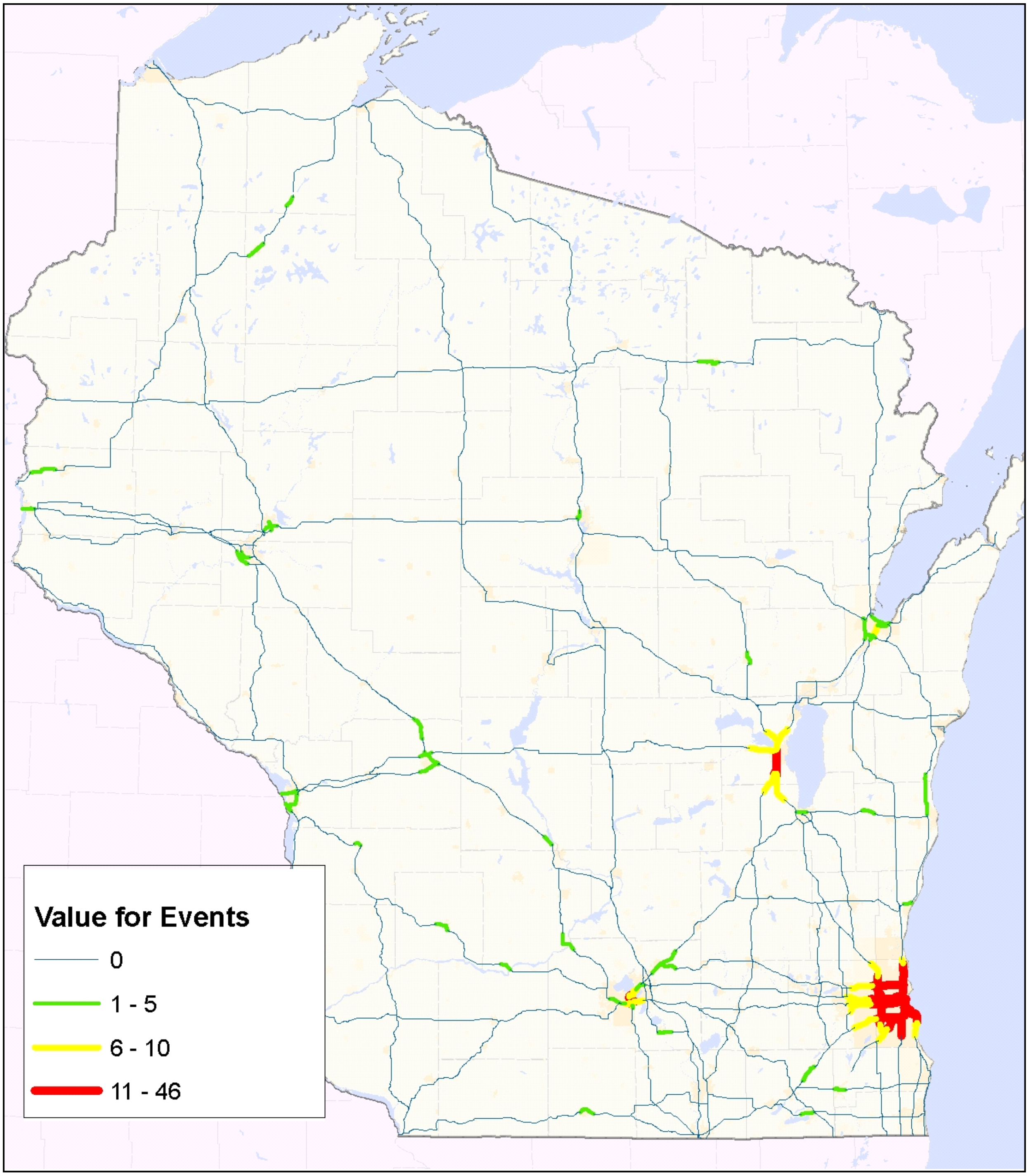

Figure 2.4 Values for Events Assigned to Roadways

3.0 Finalized Sketch Planning Methodology

In Technical Memorandum #3, a revised list of twelve criteria were developed for the Traffic Operations Corridor Sketch Planning Methodology. These twelve criteria were derived from the initial larger list of 42 criteria. As a quick review, the criteria were developed with the following characteristics in mind:

- Consistency with the criteria used in the Corridor Planning Methodology and other WisDOT planning efforts;
- Ability to realistically measure the effectiveness of alternatives;
- Allow operational alternatives to be compared with each other and with other types of improvements;
- Data are readily available, quality controlled and regularly updated; and
- Results can be easily summarized for presentation to decision-makers and the public.

Also in Technical Memorandum #3, the Sketch Planning methodology was expanded to include detailed thresholds and solutions/technologies. This methodology was also demonstrated utilizing the Wisconsin Heartland Corridor as a scenario utilizing test data.

The finalized list of criteria, thresholds, and solutions/technologies are presented in the remainder of this section. An updated scenario utilizing real data is presented later in this report in Section 4. The criteria, thresholds and solutions/technologies were all updated based on comments from WisDOT staff at the February 7th project review meeting in Madison, and with the other three functional consultant group in the weeks following. Weekly conference calls were held in which updates and additions to the methodology were discussed with the other consultant group. Finally, the methodology was updated based on the final data available from the datasets discussed above.

3.1 FINALIZED CRITERIA WEIGHTS

At the February 7th Sketch Planning stakeholder meeting in Madison. The stakeholders participated in brief exercise to establish weights to the criteria. The results of that exercise are presented in Table 3.1 below. Please note, there is no forecast HCADT in Meta-Manager. Therefore the Study Team removed it as well as the HCADT growth rate from consideration and therefore, the final total number of criteria has been reduced to ten. The points assigned to those criteria were distributed evenly among all other remaining criteria. Again these weights come directly from the stakeholders and reflect their preferences in rankings.

Table 3.1 Finalized Traffic Operations Sketch Planning Criteria Rankings

Traffic Operations Sketch Planning Criteria	Weight
Mobility	50%
ADT Base Year	10%
ADT Forecast Year	7%
HC ADT Base Year	4%
Peak Hour V/C – LOS	12%
Congestion 2020 – LOS	12%
Safety	40%
Crash Rate	15%
Crash Severity	13%
Weather Index	9%
Environmental Conditions	10%
ADT Growth	7%
Event/Traffic Generators	11%

3.2 FINALIZED THRESHOLDS

In addition to the Sketch Planning stakeholder comments the Study Team sponsored a series of weekly conference calls to discuss improvements to the methodology. The first elements addressed were the thresholds established in the draft scenario presented in Technical Memorandum #3. Table 3.2 illustrates the revised and final thresholds. The significant changes are as follows:

- **Tiers** – the number of tiers has been expanded to four. This was done to ensure a more accurate measurement of the criteria and to allow a very low scoring segment to receive a score of 0 instead of 1 point.
- **Groupings** – the number of groupings has been updated as well and now matches the classification used by meta manager. The Study Team and consultant group felt it was best to use categories or grouping which best matched WisDOT's own data. These classifications are based on the assumption that freeways, expressways, and 'other roadways' have different roadway design and characteristics between each other, but are homogenous in design and characteristics within their own grouping.
- **ADT Base year and ADT Forecast Year** - the ADT thresholds used in the initial scenario were based on research and average values along with a WisDOT benefit study. The data comes from logical segments of the volume maps. However, the Study Team and consultant group felt that the criteria would be enhanced if it were based on design characteristics as well. The "planning estimate" threshold for a road to be upgraded to add a lane is 7,500 vpl. Therefore the criteria's threshold was modified so that ADT/lane of traffic was calculated and thresholds were set at <7500, 7500-15000, 15000-22500, and >22500.
- **Peak Hour V/C and Congestion Forecast** – the consultant group recommended using AASHTO standards for this criteria. AASHTO table 2-32, page 85 was utilized.
- **Crash Rate and Crash Severity** – Several methods were considered in developing thresholds for crash related data. The first proposal for crash rates was to calculate the mean crash rate (crashes/100 million VMT) and use standard deviations from the mean to define the different tiers. Because there are still a number of very small links in the sketch planning database, the standard deviation was very large and thus did not provide a good method of breaking the tiers. After testing several other methods, it was decided that the distribution of crash rates around the median would be used to split the tiers. Thresholds were set that placed roughly equal numbers of links in the four tiers. As explained earlier meta-manager uses a severity index that is developed from rates of fatalities and serious injuries. The method used to develop thresholds was similar to that for crash rates. "Buckets" were developed to define each tier based on the distribution of the data.

- **Weather and Events** – the updated approaches to both weather and events were explained earlier in this report. It should be noted here that the SRF team greatly supported the Study Teams effort on both of theses efforts.

Table 3.2 Finalized Thresholds

	Urban Interstate [Interstate (Principal Arterial), Freeway (Principal Arterial), and Freeway (Minor Arterial)]	Urban Expressway [Expressway (Principal Arterial), Expressway (Major Arterial), Expressway (Collector), and Expressway (Major Collector)]	Urban Other [Principal Arterial, Minor Arterial Collector, Major Collector, and Minor Collector]	Rural Interstate [Interstate (Principal Arterial), Freeway (Principal Arterial), and Freeway (Minor Arterial)]	Rural Expressway [Expressway (Principal Arterial) Expressway (Major Arterial), Expressway (Collector), and Expressway (Major Collector)]	Rural Other [Principal Arterial, Minor Arterial Collector, Major Collector, and Minor Collector]
ADT Base Year						
Tier 1	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500
Tier 2	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000
Tier 3	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500
Tier 4	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000
ADT Forecast Year						
Tier 1	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500	ADT/Lane < 7,500
Tier 2	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000	ADT/Lane > 7,500 and < 15,000
Tier 3	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500	ADT/Lane > 15,000 and < 22,500
Tier 4	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000	ADT/Lane > 25,000 and < 30,000
Growth Rate						
Tier 1	<5%	<5%	<5%	<5%	<5%	<5%
Tier 2	6% to 10%	6% to 10%	6% to 10%	6% to 10%	6% to 10%	6% to 10%
Tier 3	11% to 25%	11% to 25%	11% to 25%	11% to 25%	11% to 25%	11% to 25%
Tier 4	> 25%	> 25%	> 25%	> 25%	> 25%	> 25%
HC ADT Base Year						
Tier 1	<4%	<4%	<4%	<6%	<6%	<6%
Tier 2	5% to 8%	5% to 8%	5% to 8%	7% to 10%	7% to 10%	7% to 10%
Tier 2	9% to 11%	9% to 11%	9% to 11%	11% to 13%	11% to 13%	11% to 13%
Tier 4	>12%	>12%	>12%	>14%	>14%	>14%
Peak Hour V/C						
Tier 1	LOS A, B, C	LOS A, B, C	LOS A, B, C	LOS A, B	LOS A, B	LOS A, B
Tier 2	LOS D	LOS D	LOS D	LOS C	LOS C	LOS C
Tier 3	LOS E	LOS E	LOS E	LOS D	LOS D	LOS D
Tier 4	LOS F	LOS F	LOS F	LOS E, F	LOS E, F	LOS E, F

Table 3.2 Finalized Thresholds (continued)

	Urban Interstate [Interstate (Principal Arterial), Freeway (Principal Arterial), and Freeway (Minor Arterial)]	Urban Expressway [Expressway (Principal Arterial), Expressway (Major Arterial), Expressway (Collector), and Expressway (Major Collector)]	Urban Other [Principal Arterial, Minor Arterial Collector, Major Collector, and Minor Collector]	Rural Interstate [Interstate (Principal Arterial), Freeway (Principal Arterial), and Freeway (Minor Arterial)]	Rural Expressway [Expressway (Principal Arterial) Expressway (Major Arterial), Expressway (Collector), and Expressway (Major Collector)]	Rural Other [Principal Arterial, Minor Arterial Collector, Major Collector, and Minor Collector]
Congestion Forecast						
Tier 1	LOS A, B, C	LOS A, B, C	LOS A, B, C	LOS A, B	LOS A, B	LOS A, B
Tier 2	LOS D	LOS D	LOS D	LOS C	LOS C	LOS C
Tier 3	LOS E	LOS E	LOS E	LOS D	LOS D	LOS D
Tier 4	LOS F	LOS F	LOS F	LOS E, F	LOS E, F	LOS E, F
Crash Rate (Total Crashes per Vehicle Mile)						
Tier 1	< 65.5653	< 173.3688	< 270.3232	< 37.9827	< 52.2407	< 94.4407
Tier 2	65.5653 to 98.34795	173.3688 to 260.0532	270.3232 to 405.4848	37.9827 to 56.97405	52.2407 to 78.36105	94.4407 to 141.66105
Tier 3	98.34795 to 131.1306	260.0532 to 346.7376	405.4848 to 540.6464	56.97405 to 75.9654	78.36105 to 104.4814	141.66105 to 188.8814
Tier 4	> 131.1306	> 346.7376	> 540.6464	> 75.9654	> 104.4814	> 188.8814
Crash Severity (Fatalities and Incapacitating Injuries per Vehicle Mile)						
Tier 1	< 158	< 58.85	< 140.5	< 34	< 11.5	< 31.75
Tier 2	158 to 316	58.85 to 117.7	140.5 to 281	34 to 68	11.5 to 23	31.75 to 63.5
Tier 3	316 to 474	117.7 to 176.55	281 to 421.5	68 to 102	23 to 34.5	63.5 to 95.25
Tier 4	> 474	> 176.55	> 421.5	> 102	> 34.5	95.25
Weather (Average Annual Snowfall)						
Tier 1	< 30 inches	< 30 inches	< 30 inches	< 30 inches	< 30 inches	< 30 inches
Tier 2	30 to 59 inches	30 to 59 inches	30 to 59 inches	30 to 59 inches	30 to 59 inches	30 to 59 inches
Tier 3	60 to 80 inches	60 to 80 inches	60 to 80 inches	60 to 80 inches	60 to 80 inches	60 to 80 inches
Tier 4	> 80 inches	> 80 inches	> 80 inches	> 80 inches	> 80 inches	> 80 inches
Event Generators						
Tier 1	0	0	0	0	0	0
Tier 2	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5
Tier 3	5 to 10	5 to 10	5 to 10	5 to 10	5 to 10	5 to 10
Tier 4	<10	<10	<10	<10	<10	<10

3.3 TECHNOLOGIES

The Technology groupings associated with different tiers were also updated based on comments from the stakeholders and the consultant group. One of the most significant changes was changing the number of groups. The finalized groupings are as follows:

- Detection/Surveillance
- Incident Management
- Traffic Flow Management
- Traveler information

The types of roadways included were modified (initially they were only freeways and arterials) to match the Meta-Manager facility descriptions utilized in the threshold discussion described above.

Finally, each technology grouping was also described as a continuum or spectrum depending on the application. The following figure illustrate how technologies can be applied to a corridor based on the relative score derived in the methodology. This spectrum perspective will be utilized as the other Sketch Planning consultants begin to assemble their respective functional plans. Table 3.2 illustrates the additional changes and the complete technology table.

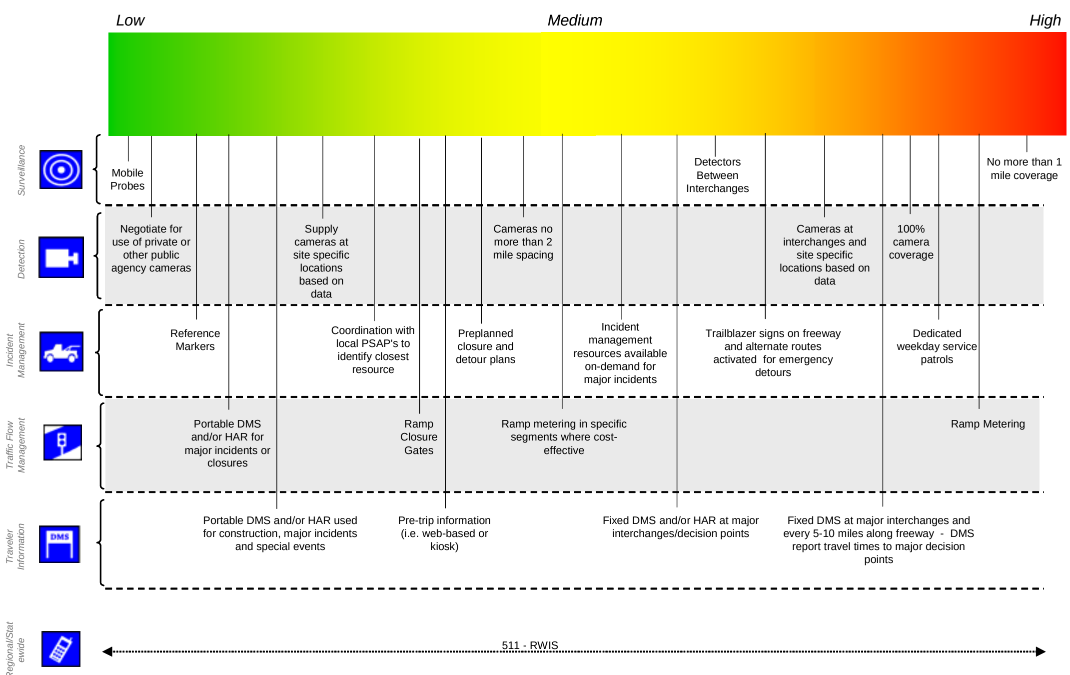

Figure 3.1 Spectrum of Deployment Density Urban Interstate/Expressway

Table 3.3 Finalized Technologies

Scoring Range Deployment Intensity	<100 Baseline Deployment	100 to 229 Low Deployment	230 to 359 Medium Deployment	360 to 490 High Deployment
Detection/Surveillance				
Urban Interstate/Expressway		Mobile Probes (Cell or Fleet)	Mobile Probes (Cell or Fleet)	
		One Fixed Detector between Interchanges	One Fixed Detector between Interchanges	No more than 1 mile spacing
			No more than 2 mile spacing	100% camera coverage
		Supply cameras at site specific locations based on data	Cameras at interchanges and site specific locations based on data	
		Negotiate for use of private or other public agency cameras		
Urban Other				Mobile Probes (Cell or Fleet)
			System detection on detour route, connector routs, and highways crossing detour route	System detection on detour route approaches, connector approaches, and crossing highways
				Install system detection at key mid-block locations on detour route
			Negotiate for use of private or other public agency cameras	Install cameras at intersections of detour route and connector routes.
			Install camera at a site location to meet specific concern	Install camera at a site location to meet specific concern
Rural Interstate/Expressway				Mobile Probes (Cell or Fleet)
		Detectors on Major Intersection Approaches	Detectors on Major Intersection Approaches	Detectors on Major Intersection Approaches
			Mid Block Detection if intersections are more than one mile apart	Mid Block Detection if intersections are more than 1/2 mile apart
Rural Other				Mobile Probes (Cell or Fleet)
			System detection on detour route, connector routs, and highways crossing detour route	System detection on detour route approaches, connector approaches, and crossing highways
				Install system detection at key mid-block locations on detour route
Incident Management				
Urban Interstate/Expressway	Reference Markers	Reference Markers	Reference Markers	Reference Markers
	Coordination with local PSAPs to identify closest resource	Coordination with local PSAPs to identify closest resource	Incident management resources available on-demand for major incidents	Dedicated weekday service patrols
		Preplanned closure and detour plans	Preplanned closure and detour plans	Preplanned closure and detour plans
				Trailblazer signs on freeway and alternate routes activated for emergency detours
Urban Other	Coordination with local PSAPs to identify closest resource	Coordination with local PSAPs to identify closest resource	Incident management resources available on-demand for major incidents	Incident management resources available on-demand for major incidents
			Install signal or round-about at critical non-signalized junctions	Install signal or round-about at critical non-signalized junctions
			Preplanned closure and detour plans	Preplanned closure and detour plans with active routing, retiming of signals
Rural Interstate/Expressway	Coordination with local PSAPs to identify closest resource	Coordination with local PSAPs to identify closest resource	Incident management resources available on-demand for major incidents	Dedicated weekday service patrols
		Preplanned closure and detour plans	Preplanned closure and detour plans	Preplanned closure and detour plans
				Trailblazer signs on freeway and alternate routes activated for emergency detours

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Table 3.3 Finalized Technologies (continued)

Scoring Range Deployment Intensity	<100 Baseline Deployment	100 to 229 Low Deployment	230 to 359 Medium Deployment	360 to 490 High Deployment
Incident Management (continued)				
Rural Other	Coordination with local PSAPs to identify closest resource	Coordination with local PSAPs to identify closest resource	Incident management resources available on-demand for major incidents	Incident management resources available on-demand for major incidents
			Install signal or round-about at critical non-signalized junctions	Install signal or round-about at critical non-signalized junctions
			Preplanned closure and detour plans	Preplanned closure and detour plans with active routing, retiming of signals
Traffic Flow Management				
Urban Interstate/Expressway	Portable DMS	Portable DMS and/or HAR for major incidents/closures	Ramp metering in specific segments where cost-effective	Ramp Metering
		Ramp Closure Gates		
Urban Other		Update signal timing on regular basis, modernize signal equipment	Closed loop systems in corridors, actuation at isolated locations where cost-effective	Signal coordination on corridor basis through closed loop or adaptive systems. Actuate signals at isolated intersections
Rural Interstate/Expressway	Portable DMS	Portable DMS and/or HAR for major incidents/closures	Portable DMS and/or HAR for major incidents/closures	Portable DMS and/or HAR for major incidents/closures
Rural Other		Update signal timing on regular basis, modernize signal equipment	Closed loop systems in corridors, actuation at isolated locations where cost-effective	Signal coordination on corridor basis through closed loop or adaptive systems. Actuate signals at isolated intersections
Traveler Information				
Urban ***Interstate/Expressway***	Portable DMS	Portable DMS and/or HAR used for construction, major incidents and special events	Fixed DMS and/or HAR at major interchanges/decision points	Fixed DMS at major interchanges and every 5-10 miles along freeway – DMS report travel times to major decision points
	511 Reports in case of major incidents, construction or special events	511 Reports in case of major incidents, construction or special events	Regular 511 Reports including incidents and general traffic conditions	Detailed 511 reports including regular updates on major freeways
	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)
Urban Other	Portable DMS	Portable DMS and/or HAR used for construction, major incidents and special events	Portable DMS and/or HAR used for construction, major incidents and special events	Fixed DMS and/or HAR at major intersection/decision points or safety "hot spots"
	511 Reports in case of major incidents, construction or special events	511 Reports in case of major incidents, construction or special events	511 Reports in case of major incidents, construction or special events	Regular 511 Reports including incidents and general traffic conditions
	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)
Rural Interstate/Expressway	Portable DMS	Portable DMS and/or HAR used for construction, major incidents and special events	Fixed DMS and/or HAR at major interchanges/decision points	Fixed DMS at major interchanges and every 5-10 miles along freeway – DMS report travel times to major decision points
	511 Reports in case of major incidents, construction or special events	511 Reports in case of major incidents, construction or special events	Regular 511 Reports including incidents and general traffic conditions	Detailed 511 reports including regular updates on major freeways
	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)
Rural Other	Portable DMS	Portable DMS and/or HAR used for construction, major incidents and special events	Portable DMS and/or HAR used for construction, major incidents and special events	Fixed DMS and/or HAR at major intersection/decision points or safety "hot spots"
	511 Reports in case of major incidents, construction, or special events	511 Reports in case of major incidents, construction or special events	511 Reports in case of major incidents, construction or special events	Regular 511 Reports including incidents and general traffic conditions
	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)	Pre-trip information (i.e., web-based or kiosk)

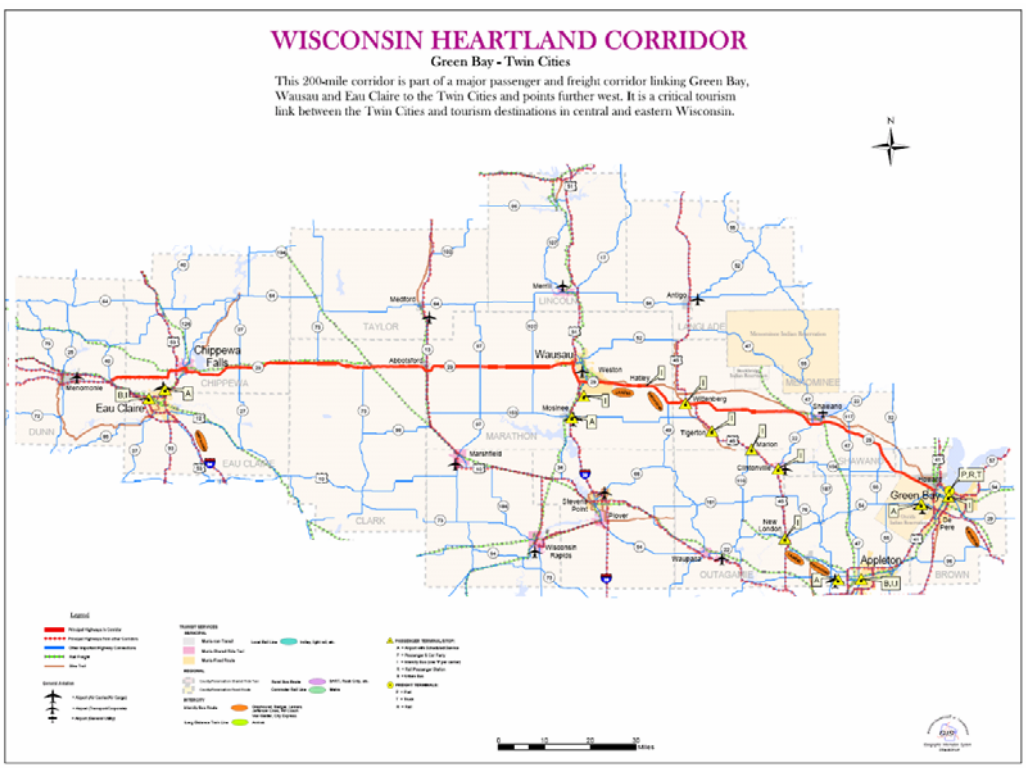
4.0 Finalized Scenario

A draft scenario was presented in Technical Memorandum #3 that demonstrated how the Sketch Planning methodology could be executed along one of WisDOT's 37 corridors. This scenario was demonstrated utilizing illustrative data.

The scenario utilized the Wisconsin Heartland corridor. This 200 mile corridor is part of a major passenger and freight corridor linking Green Bay, Wausau and Eau Claire to the Twin Cities and points further west. It is a critical tourism link between the Twin Cities and tourism destinations in central and eastern Wisconsin. It was chosen because it offered a mix of rural and urban traffic conditions as well as a having a freight and tourism component. As a reference, the Connections 2030 Corridor map for the Wisconsin Heartland is shown below in Figure 4.1.

However, now that the methodology has been finalized and the data to execute the methodology has been gathered, analyzed and formatted; a demonstrating the scenario using real data is required and is the subject of the remainder of the section.

Figure 4.1 Wisconsin Heartland Connections 2030 Corridor

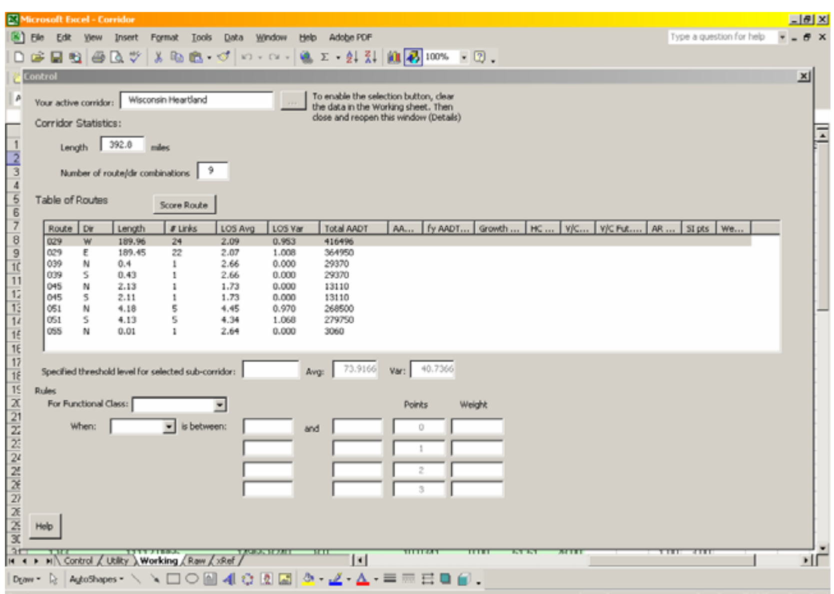


Again, the Sketch Planning methodology is a data driven process, designed to provide the functional consultant groups (and ultimately WisDOT) with all the information needed for to develop specific plans detailing required ITS/Operations infrastructure and projects throughout the state.

The raw Meta-Manager, weather and event data, detailed in the previous sections, has been complied into a single dataset within an excel spreadsheet for portability and to allow for easy analysis. This spreadsheet also contains the weights and thresholds discussed above. These two elements constitute all the information needed to execute the Sketch Planning methodology. Since there are over XX,000 Sketch Plan links in the dataset, an automated macro was developed within Excel which will score al the links on all the corridors.

This automated process also produces the xReff files needed to illustrate the results in GIS utilizing the display standards presented in the preview Technical Memorandum. The GIS related output files are produced for each corridor and reside within the spreadsheet as well. The native Meta- Manager links are also provided within the spreadsheet should further analysis be needed at this basic link level. It should be noted that this approach allows the capability to modify the methodology (including weights and thresholds) should sensitivity analyses be required or if in the future these elements need to be modified based on changing conditions. Finally, a GUI has been developed that allows the user to select a specific corridor, execute the methodology, and receive summary statistics. A draft of this GUI is presented in Figure 4.2.

Figure 4.2 Sketch Planning Methodology GUI



The Study Team, utilizing the spreadsheet and tool described above, executed the methodology for the Wisconsin Heartland corridor and those results are the remainder of this report and utilize the GIS standards and display criteria discussed in the previous Technical Memorandum. Please note there have been some modifications since the initial maps were presented. Since there are four threshold areas now, a fourth color (orange) was added to the deployment density legend. The new legend for deployment density is as follow:

- Baseline – Green, (Note, baseline replaces the previous "no deployment" tier since it was agreed that statewide applications should be presented at this level.)
- Low – Yellow,
- Medium – Orange, and
- High – Red.

Figure 4.3 illustrates the exact results of the executing the methodology and displaying the results in GIS. Figure 4.4 illustrates the application of the technologies based on the results of the threshold analysis within the methodology. Note how the steps between taking the data presented in Figure 4.3 to the final recommendations in next figure involve the expert opinions of the consultant team. The Study Team developed Figure 4.4 based on the technology matrix discussed above illustrates the types of recommendations which could be made. It is anticipated that the consultant groups will augment these recommendation during their tasks in developing the final plan.

These results will be presented to the stakeholder group on the 17th of April. Updates will be made to this process based on the comments received at the meeting. Once those comments have been incorporated, the dataset, GIS standards and methodology (including automation GUI) will be delivered to the other consultant groups. The Study Team will conduct a conference call to provide the consultant groups with guidance on working with the data and the tools. Following that process, the consultant groups will begin to develop their own functional Sketch Plans utilizing the methodology.

Figure 4.3 Sketch Planning Methodology Initial Results

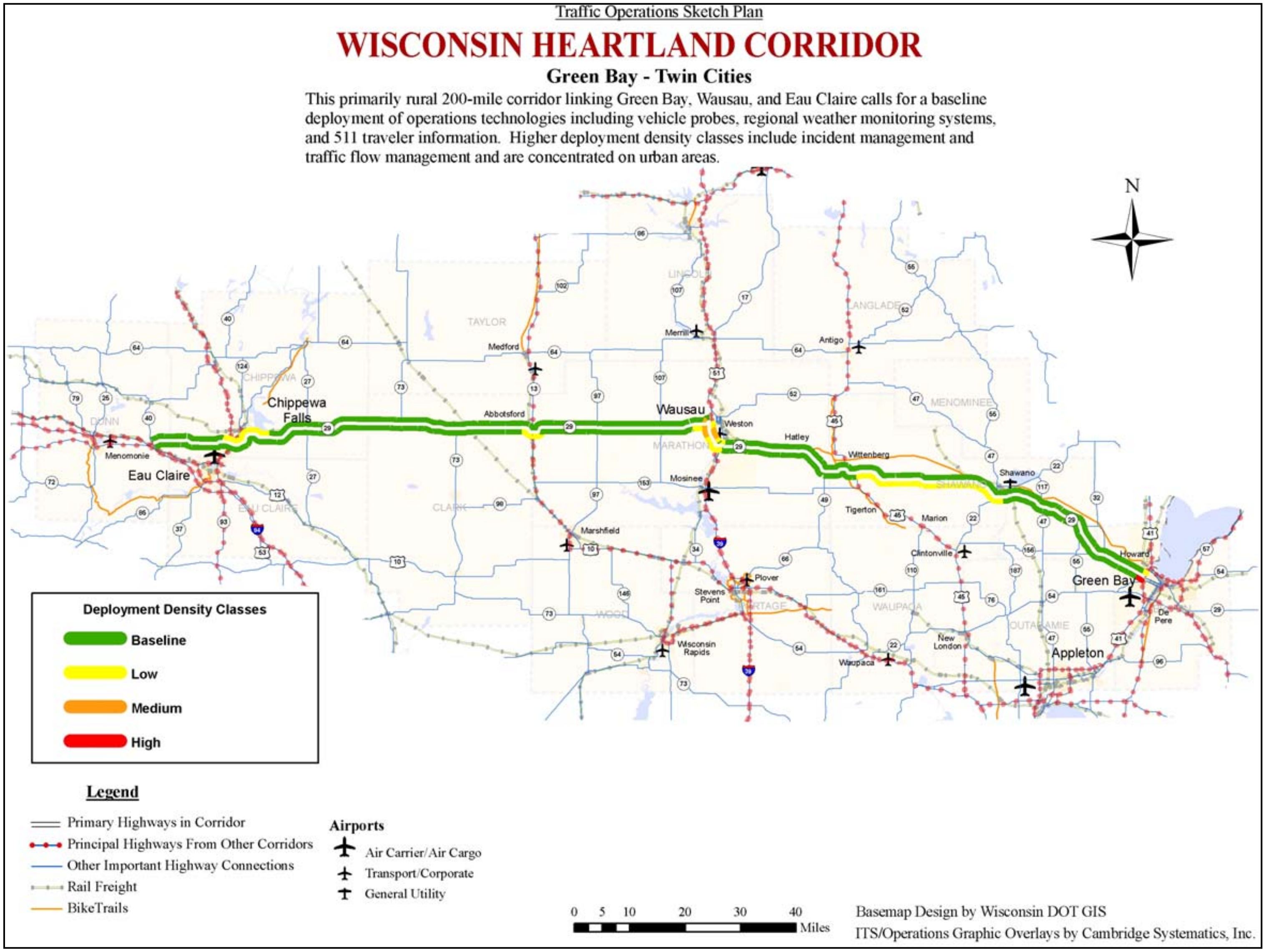
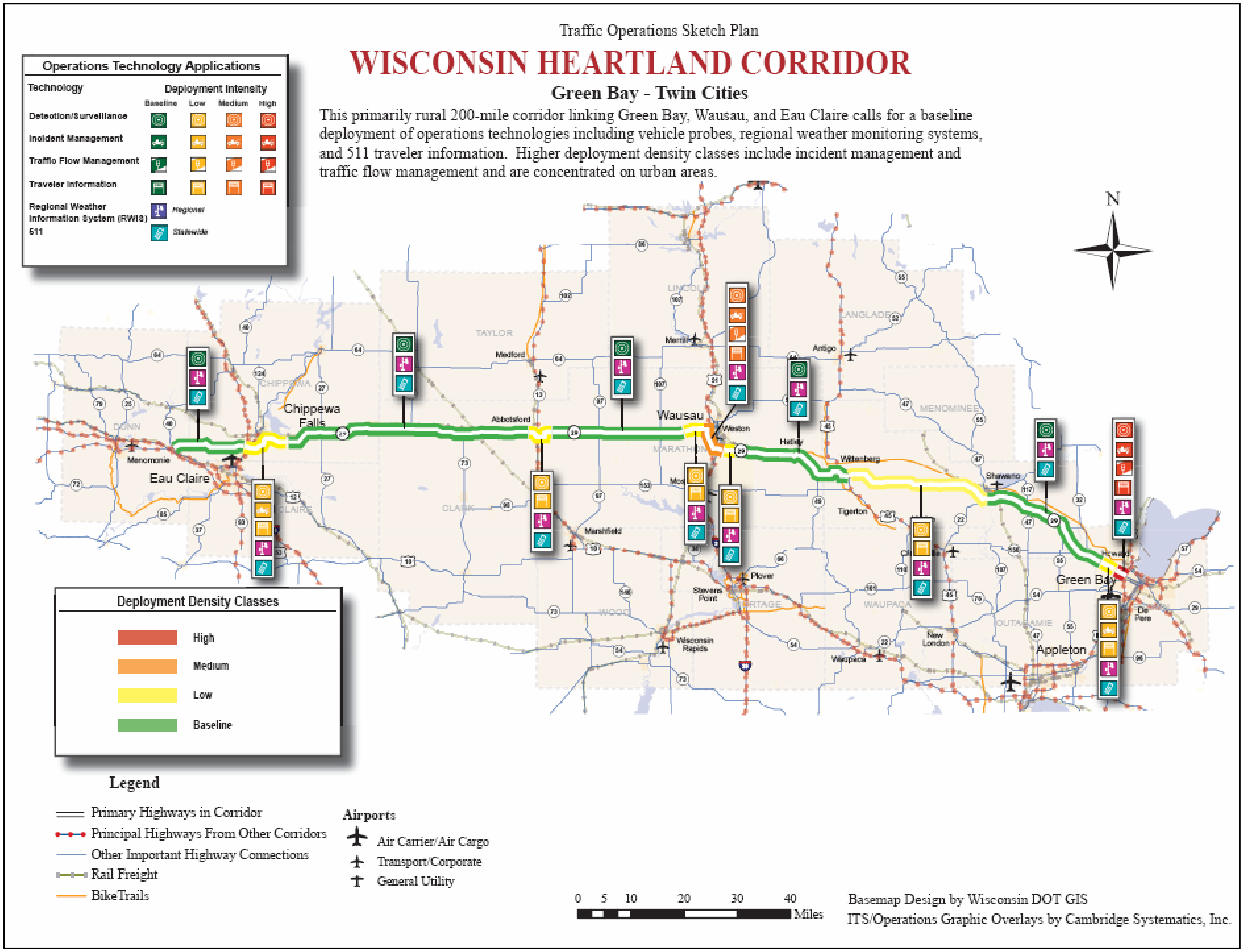


Figure 4.4 Sketch Planning Corridor Map - Final



Appendix A

DETAILED PROCESS FOR INITIAL DEVELOPMENT OF SKETCH PLANNING LINK DATA FILES

In order to facilitate the ordering of the data in the rollup process, the Meta-Manager links are first passed through an ordering process and then inserted into a MySQL database in the order from which they are retrieved.

The route and direction values for each link are obtained from the HWYADIR field in the Meta-Manager data. This field contains three characters of route information and 1 character of direction information. It was noted that this data is very clean, and that there were no missing directions and no inconsistently provided route numbers (29 vs. 029, etc).

The physical location of each link was obtained via the GIS shape file which accompanies the Meta-Manager data. The order of the shapes within the shape file is the same order of the data in the Meta-Manager data . Thus, by traversing the shape file and the Meta-Manager data file at the same time, the location of every link was known.

Many of the shapes for a given link are represented with more than two points in the shape file. However, only the first and last point for each link shape were saved with the links.

Because these link end-points are represented with real numbers, when comparisons are done to determine any proximity to a point, it is done by checking that the comparison of two numbers are within a certain tolerance. This guards against errors in comparisons when one value may be a number such as 25.99999, and the other 26 – which is a situation often occurring with real numbers. Several different values were tried for this tolerance number, however, the Study Team found that one foot works fine.

Appendix B

DETAILED PROCESS FOR INITIAL DEVELOPMENT OF SKETCH PLANNING LINK DATA FILES

Special adjustment must be made when there is a short link parallel to longer links in the other direction.

Most of the Meta-Manager data (for non-divided facilities) is provided in one "direction" only. Here, direction means East or West, or North or South, but not that the facility supports one or two way travel. The exception to this is, of course, Freeway or Expressway system (in most, if not all cases).

In some cases, when a short, two or three mile, section becomes divided, there appear two links in the Meta-Manager data at that physical location. This is, of course, as expected. However, because it is necessary to traverse the links in route and direction order – the system doesn't encounter this part that has become divided out, until a later in the process. Thus, causing that short link (or set of MM links) to become it's own rolled up link.

This was considered at great length and ultimately it was agreed that the fact that the division was made in the Meta-Manager data already points up that the performance characteristics of the two sides are each important in their own right. Indeed, we also know that often opposite sides of such divided sections do have distinct characteristics. Therefore, after close inspection of this issue – we decided that it would be best to leave these links in the system.