Chapter 2
Existing Transportation System

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2.1 Introduction

In an effort to clearly understand the existing traffic conditions in the community, it was necessary to gather current information about different aspects of the transportation system. Existing traffic volume data was used to determine weighted annual average daily traffic (AADT) volumes on major roadway segments within the study area. Traffic data other than the AADT was collected during the spring of 2009, during the month of May, while school was in session. The data was used to determine current operational characteristics, and to identify any traffic concerns that may exist or are likely to arise within the foreseeable future. A variety of information was gathered to help evaluate the system including:

- Existing functional classifications & study roadways;
- Existing traffic volume counts (2001 and 2009);
- Existing roadway corridor size;
- Intersection turning movement counts;
- Current traffic signal operation information;
- Intersection data required to conduct level of service analyses;
- Signing information (intersection control only); and
- Traffic crash records.

2.2 Roadway Functional Classification System

One of the initial steps in trying to understand a community's existing transportation system is to first identify what roadways will be evaluated as part of the larger planning process. A community's transportation system is made up of a hierarchy of roadways, with each roadway being classified according to certain criteria. Some of these criteria are geometric configuration, traffic volumes, spacing in the community transportation grid, speeds, etc. It is standard practice to examine roadways that are functionally classified as a collector, minor arterial, or principal arterial in a regional transportation plan project. These functional classifications can be encountered in both the "urban" and "rural" setting. The reasoning for examining the collector, minor arterial and principal arterial roadways, and not local roadways, is that when the major roadway system (i.e. collectors or above) is functioning to an acceptable level, then the local roadways are not used beyond their intended function. When problems begin to occur on the major roadway system, then vehicles and resulting issues begin to infiltrate neighborhood routes (i.e. local routes). As such, the overall health of a regional transportation system can be typically characterized by the health of the major roadway network. The roadways being studied under this Transportation Plan update, along with the appropriate functional classifications, are shown on **Figure 2-1** and **Figure 2-2**. It should be noted that the functional classifications shown on these figures are a mixture of "Federally Approved" classifications, locally defined "City" collector roadways, and locally defined "County" collector roadways. For the "Federally Approved Functional Classification" system, only four routes are defined: U.S. Highway 93, Secondary 269 (Eastside Highway), Secondary 531 (Main Street), and Municipal 53-32 (Hope Avenue).

Roadway functional classifications are typically defined as principal arterials; minor arterials; collector routes; and local streets. These definitions can apply to both an **urban** and a **rural** area, with some slight modifications. It is important to recognize that although volumes may differ on developed and rural sections of a street, it is important to maintain coordinated right-of-way standards to allow for efficient operation of roadways. A description of the most common functional roadway classifications, broken out by **"urban"** and **"rural"** classifications, is provided in the following sections.

Urban Principal Arterial System – The purpose of the principal arterial is to serve the major centers of activity, the highest traffic volume corridors, and the longest trip distances in an area. This group of roads carries a high proportion of the total traffic within the developed area. Most of the vehicles entering and leaving the area, as well as most of the through traffic bypassing the central business district, utilize principal arterials. Significant intra-area travel, such as between central business districts and outlying residential areas, and between major suburban centers, is served by principal arterials.

The spacing between principal arterials may vary from less than one mile in highly developed areas (e.g., the central business district), to five miles or more on the urban fringes. Principal arterials connect only to other principal arterials or to the interstate system.

The major purpose of the principal arterial is to provide for the expedient movement of traffic. Service to abutting land is a secondary concern. It is desirable to restrict on-street parking along principal arterial corridors. The speed limit on a principal arterial could range from 25 to 70 mph depending on the area setting.

Urban Minor Arterial Street System – The minor arterial street system interconnects with and augments the urban principal arterial system. It accommodates trips of moderate length at a somewhat lower level of travel mobility than principal arterials, and it distributes travel to smaller geographic areas. With an emphasis on traffic mobility, this street network includes all arterials not classified as principal arterials while providing access to adjacent lands.

The spacing of minor arterial streets may vary from several blocks to a half-mile in the highly developed areas of town, to several miles in the suburban fringes. They are not normally spaced more than one mile apart in fully developed areas.

On-street parking may be allowed on minor arterials if space is available. In many areas on-street parking along minor arterials is prohibited during peak travel periods. Posted speed limits on minor arterials would typically range between 25 and 55 mph, depending on the setting.

<u>Urban Collector Street System</u> – The urban collector street network serves a joint purpose. It provides equal priority to the movement of traffic, and to the access of residential, business, and industrial areas. This type of roadway differs from those of the arterial system in that collector roadways may traverse residential neighborhoods. The collector system distributes trips from the arterials to ultimate destinations. The collector streets also collect traffic from local streets in the residential neighborhoods, channeling it into the arterial system. On-street parking is usually allowed on most collector streets if space is available. Posted speed limits on collectors typically range between 25 and 45 mph.

<u>Urban Local Street System</u> – The local street network comprises all facilities not included in the higher systems. Its primary purpose is to permit direct access to abutting lands and connections to higher systems. Usually service to through-traffic movements is intentionally discouraged. On-street parking is usually allowed on the local street system. The speed limit on local streets is usually 25 mph.

<u>Rural Principal Arterial System</u> – The rural principal arterial system consists of a network of routes with the following service characteristics:

1. Corridor movement with trip length and density suitable for substantial statewide or interstate travel.

2. Movements between all, or virtually all, urban areas with populations over 50,000 and a large majority of those with populations over 25,000.

3. Integrated movement without stub connections except where unusual geographic or traffic flow conditions dictate otherwise (e.g., international boundary connections or connections to coastal cities).

In the more densely populated states, this class of highway includes most (but not all) heavily traveled routes that might warrant multilane improvements in the majority of states; the principal arterial system includes most (if not all) existing rural freeways.

The rural principal arterial system is stratified into the following two design types: (1) freeways and (2) other principal arterials.

<u>Rural Minor Arterial System</u> – The rural minor arterial road system, in conjunction with the rural principal arterial system, forms a network with the following service characteristics:

1. Linkage of cities, larger towns, and other traffic generators (such as major resort areas) that are capable of attracting travel over similarly long distances.

2. Integrated interstate and intercounty service.

3. Internal spacing consistent with population density, so that all developed areas of the state are within reasonable distances of arterial highways.

4. Corridor movements consistent with items (1) through (3) with trip lengths and travel densities greater than those predominantly served by rural collector or local systems.

Minor arterials therefore constitute routes, the design of which should be expected to provide for relatively high travel speeds and minimum interference to through movement.

Rural Collector System – The rural collector routes generally serve travel of primarily intracounty rather than statewide importance and constitute those routes on which (regardless of traffic volume) predominant travel distances are shorter than on arterial routes. Consequently, more moderate speeds may be typical. To define rural collectors more clearly, this system is subclassified according to the following criteria:

- Major Collector Roads. These routes (1) serve county seats not on arterial routes, larger towns not directly served by the higher systems, and other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, and important mining and agricultural areas; (2) link these places with nearby larger towns or cities, or with routes of higher classifications; and (3) serve the more important intracounty travel corridors.

- Minor Collector Roads. These routes should (1) be spaced at intervals consistent with population density to accumulate traffic from local roads and bring all developed areas within reasonable distances of collector roads; (2) provide service to the remaining smaller communities; and (3) link the locally important traffic generators with their rural hinterland.

Rural Local Road System – The rural local road system, in comparison to collectors and arterial systems, primarily provides access to land adjacent to the collector network and serves travel over relatively short distances. The local road system constitutes all rural roads not classified as principal arterials, minor arterials, or collector roads. A very low-volume rural local road is a road that has a design ADT of 400 vehicles per day or less. The *AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT < 400).*

Table 2-1 on the following page contains a summary of the major street network in and around the City of Hamilton proper with associated functional classifications and route purpose.

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Table 2-1
Functional Street Classifications for Hamilton

Classification	Primary Function
FHWA Classified Routes	
Principal Arterials ➢ US Highway 93	Mobility
Major Collectors ➢ S-269 (Eastside Highway) ➢ S-531 (Main Street)	Land Access / Mobility
Minor Collectors ➢ M-53-32 (Hope Avenue)	Land Access / Mobility
City of Hamilton Classified Routes	
Minor Collectors ➢ Adirondac Avenue ➢ Pine Avenue ➢ Pickney Street ➢ State Street ➢ Marcus Street ➢ Fairgrounds Road ➢ Golf Course Road ➢ Ravalli Street ➢ 7th Street ➢ 4th Street ➢ Daly Avenue ➢ Kurtz Lane ➢ Freeze Lane ➢ Big Corral Road ➢ Grantsdale Road	Land Access / Mobility
Ravalli County Classified Routes (see note 1)	
Major Collectors ➢ Bowman Road (Ricketts Road to US Highway 93) ➢ Hamilton Heights Road (S-269 to Harvey Lane) ➢ Fairgrounds Road (Freeze Lane to S-269) ➢ Golf Course Road (US Highway 93 to Big Corral Road) ➢ Grantsdale Road (S-38 to Golf Course Road)	Land Access / Mobility
Minor Collectors ➢ West Bridge Road ➢ Old Corvallis Road ➢ Ricketts Road ➢ Riverside Cut-off ➢ Black Lane ➢ Bass Lane ➢ Blood Lane ➢ Hamilton Heights Road (Harvey Lane to Study Area Boundary) ➢ Bowman Road (Dutch Hill Road to Study Area Boundary) ➢ Golf Course Road (Big Corral Road to Tammany Lane)	Land Access / Mobility

Note 1: Ravalli County roadway classifications follow the AASHTO standards for rural roadways.

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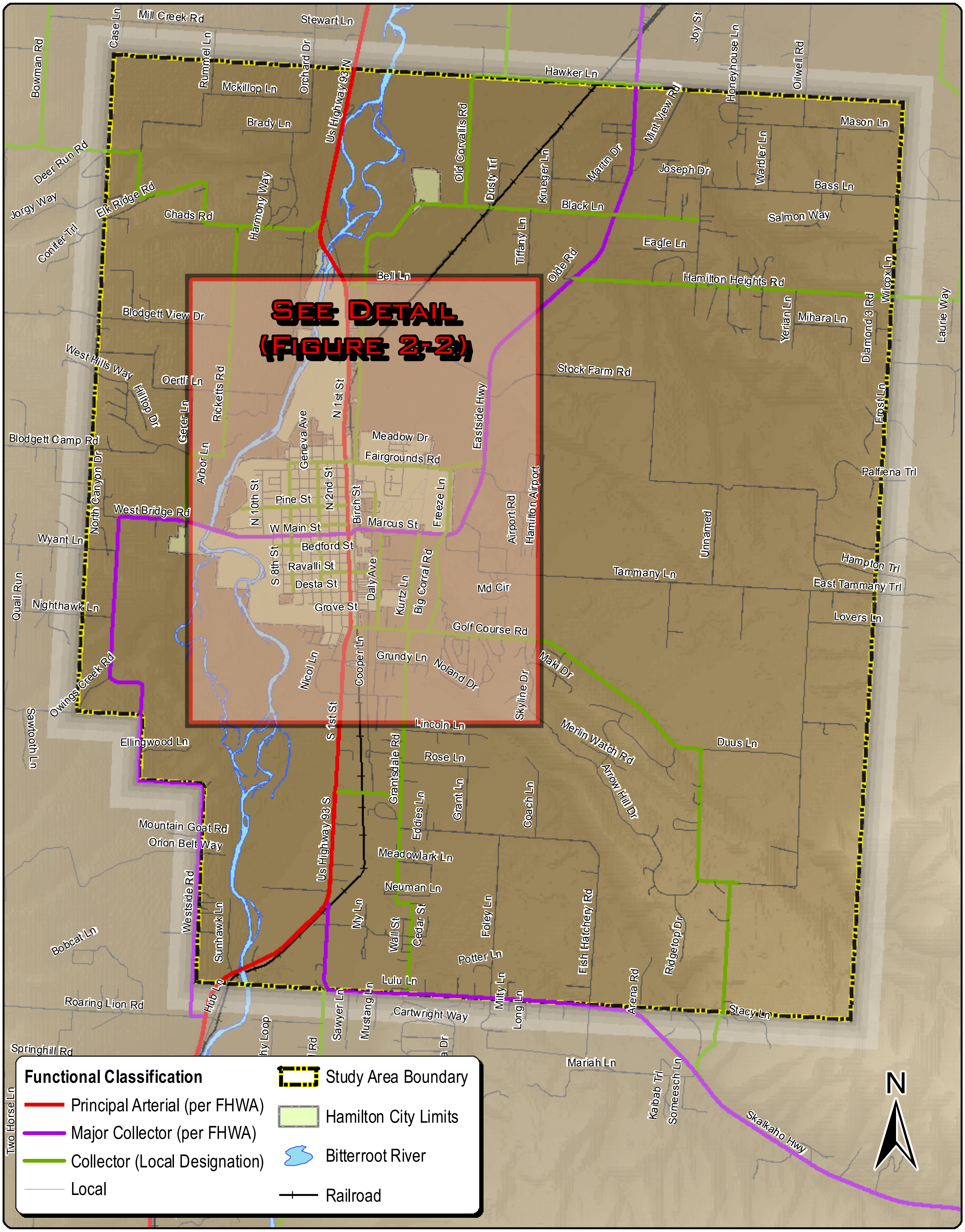

Figure 2-1
Roadway Functional Classification

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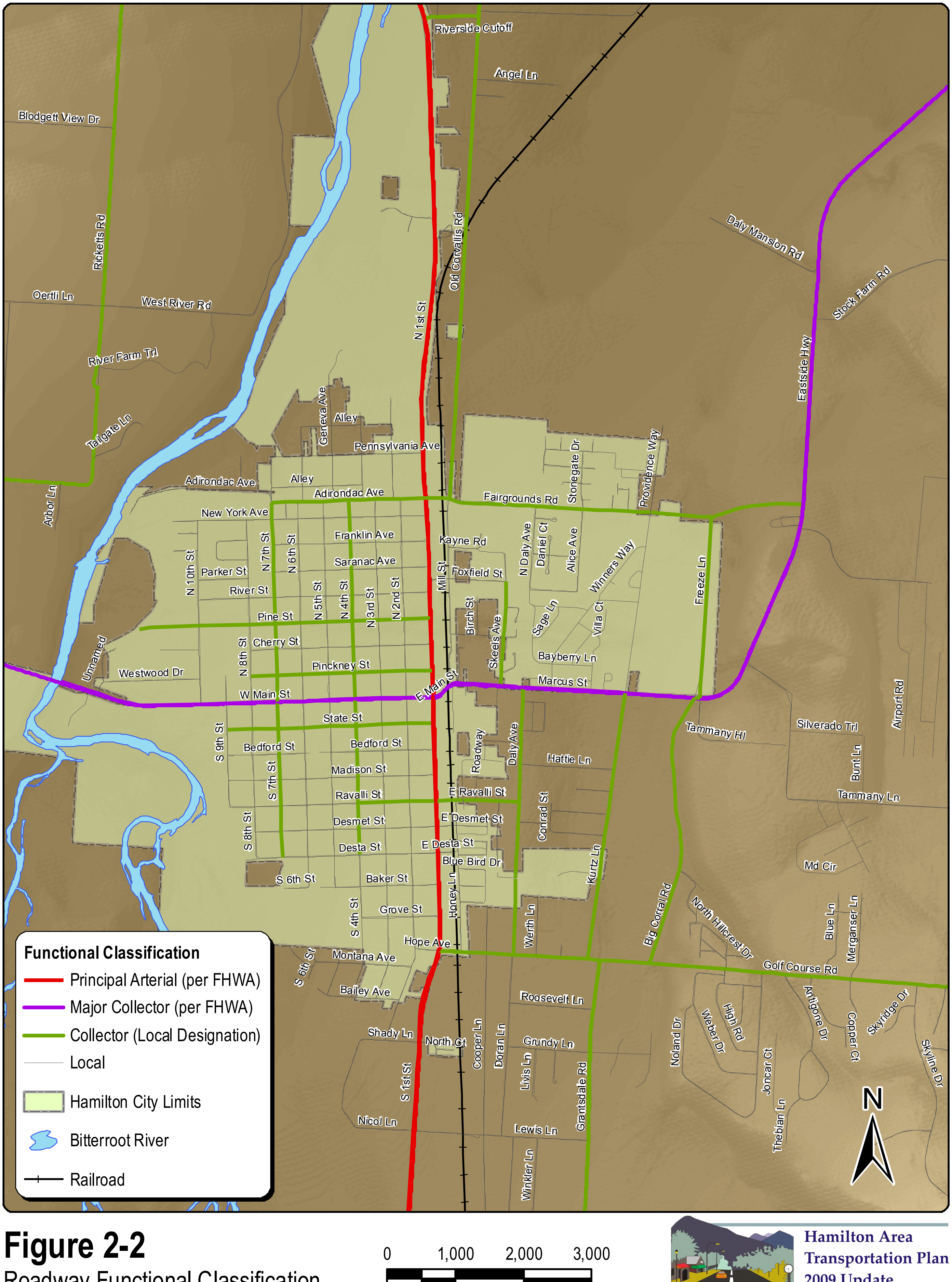

Figure 2-2

Roadway Functional Classification
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2.3 Existing Traffic Volumes and Corridor Facility Size

When evaluating a roadway system it is generally good practice to compare the traffic average annual daily traffic (AADT) volumes to the approximate capacity of each roadway facility. US Highway 93 traffic data is collected by the Montana Department of Transportation. This is also true for some of the secondary roads in the study area. In addition, the Ravalli County Road and Bridge Department collects AADT volumes on many of the rural roadways in the study area.

Estimated AADT volumes were calculated based on the PM Peak Hour turning movement counts performed at eighteen of the intersections in the study area boundary. This is an acceptable methodology for planning level documents, as summarized in the Highway Capacity Manual 2000 and stated below:

> *Capacity and other traffic analyses frequently focus on the peak hour of traffic for the peak direction because it represents high capacity requirements. Because planning applications frequently deal with annual average daily traffic (AADT), the K factor is needed to provide a means to convert between daily and hourly volumes.*
>
> *For vehicle traffic, the proportion of AADT occurring in the analysis hour is referred to as the K-factor. The K-factor is highly dependent on the analysis hour selected, the specific characteristics of the roadway, and the location of the roadway. In converting hourly volumes to daily volumes, the hourly volume is divided by the K-factor.*

The Highway Capacity Manual 2000 offers default values to be used in the conversion of peak hourly volumes to AADT volumes for planning purposes. In this case, a default K factor of 0.10 was identified, which in practice means that the PM peak hour traffic volumes are 10 percent of the estimated AADT volumes. Thus, AADT volumes were estimated for the year 2009 based on turning movement counts, and are shown on **Figure 2-3** and **Figure 2-4**. In areas where estimated 2009 volumes are not available due to a lack of turning movement counts, AADT's are shown as originally represented in the 2002 Hamilton Transportation Plan.

All roadways within the study area boundary are predominately two-lane roadways, with the exception of US Highway 93, which has both five-lane and four-lane segments.

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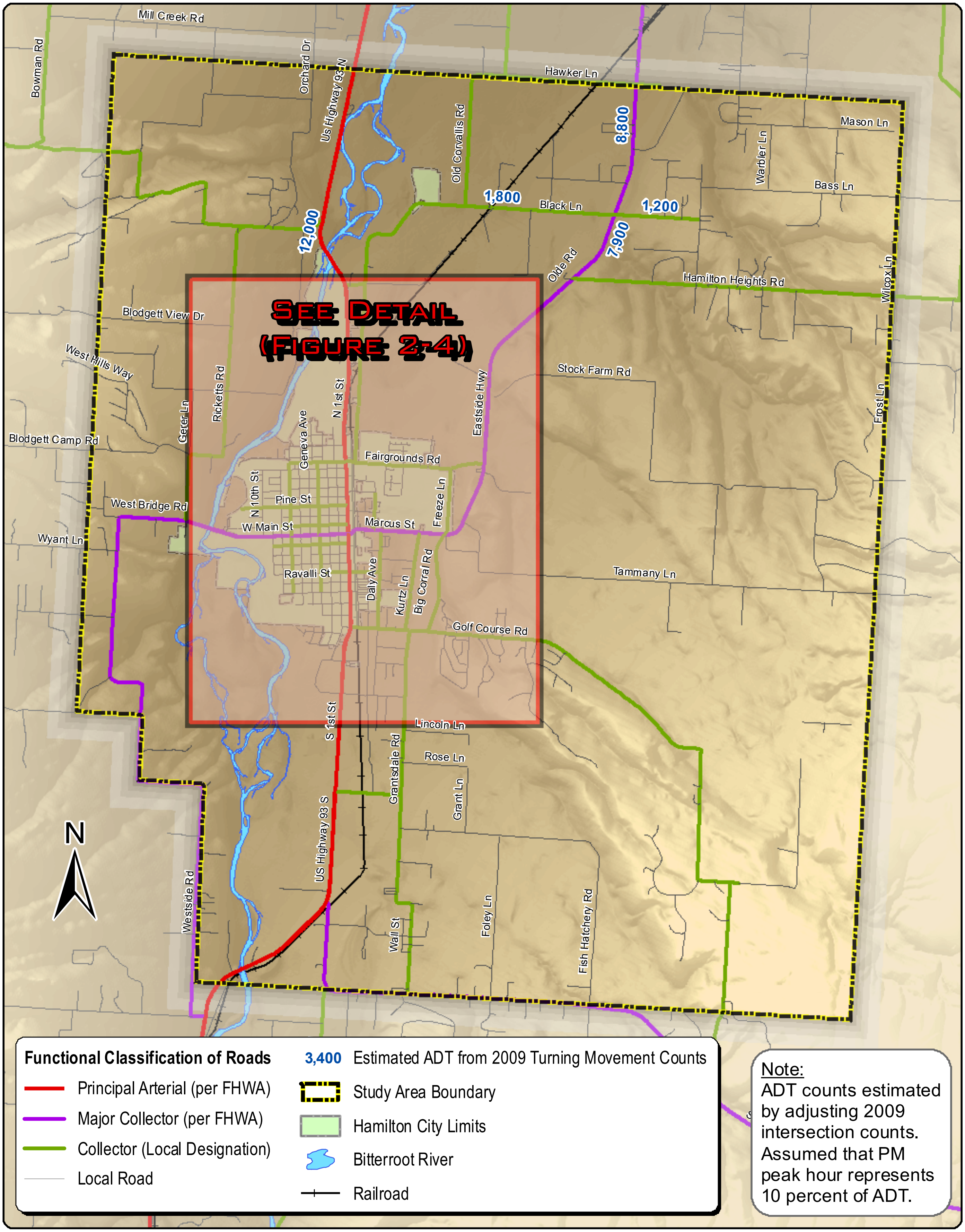

Figure 2-3

Estimated Average Daily Traffic (ADT) Volumes

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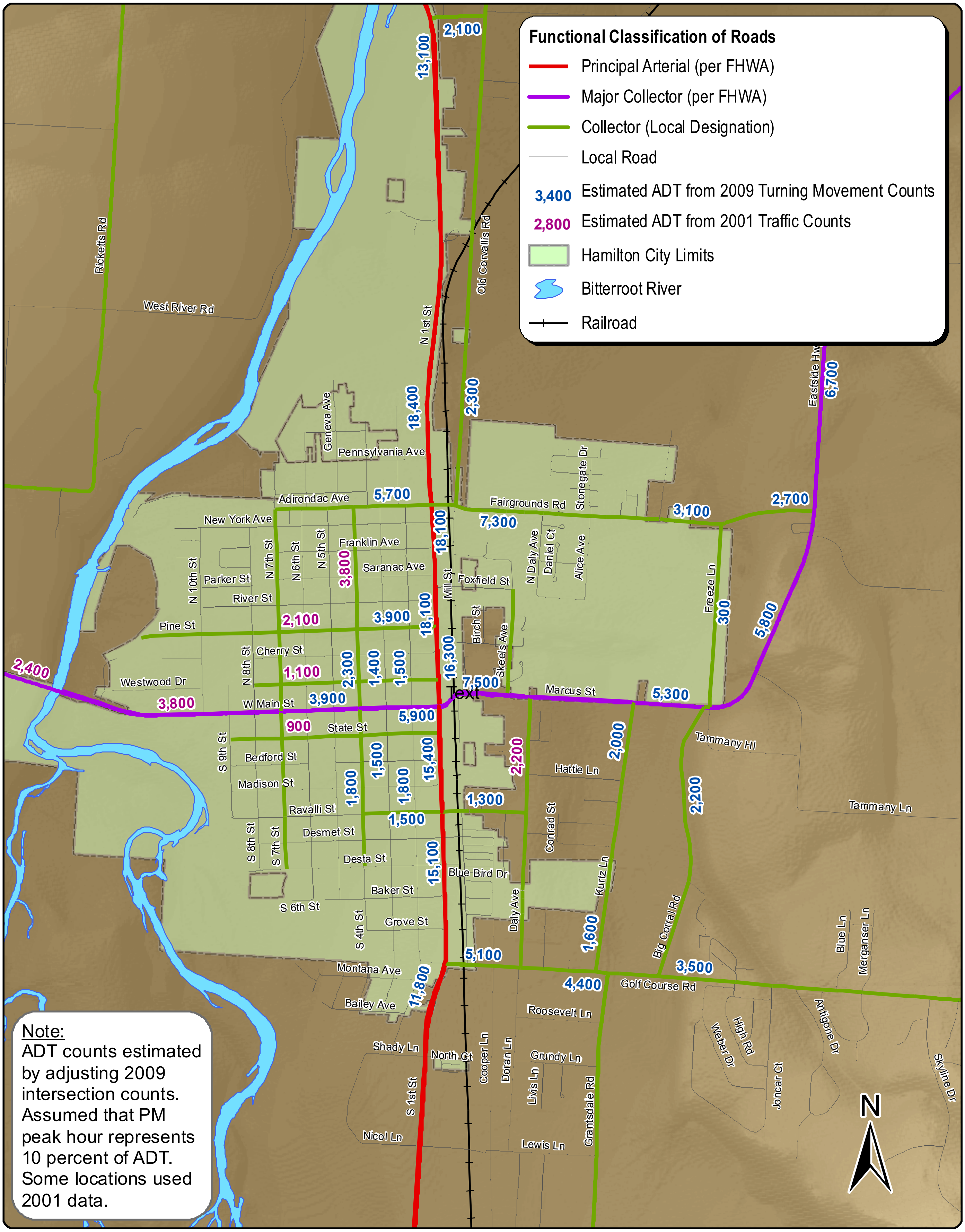

Figure 2-4

Estimated Average Daily Traffic (ADT) Volumes
Inset Area

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2.4 Existing Levels of Service

Roadway systems are ultimately controlled by the function of major intersections. Intersection failure directly reduces the number of vehicles that can be accommodated during the peak hours that have the highest demand and the total daily capacity of a corridor. As a result of this strong impact on corridor function, intersection improvements can be a very cost-effective means of increasing a corridor's traffic volume capacity. In some circumstances, corridor expansion projects may be able to be delayed with correct intersection improvements. Due to the significant portion of total expense for roadway construction projects used for project design, construction, mobilization, and adjacent area rehabilitation, a careful analysis must be made of the expected service life from intersection-only improvements. If adequate design life can be achieved with only improvements to the intersection, then a corridor expansion may not be the most efficient solution. With that in mind, it is important to determine how well the major intersections are functioning by determining their Level of Service (LOS).

Level of Service (LOS) is a qualitative measure developed by the transportation profession to quantify driver perception for such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles. It provides a scale that is intended to match the perception by motorists of the operation of the intersection. Level of Service provides a means for identifying intersections that are experiencing operational difficulties, as well as providing a scale to compare intersections with each other. The level of service scale represents the full range of operating conditions. The scale is based on the ability of an intersection or roadway segment to accommodate the amount of traffic using it. The scale ranges from "A" which indicates little, if any, vehicle delay, to "F" which indicates significant vehicle delay and traffic congestion. The LOS analysis was conducted according to the procedures outlined in the Transportation Research Board's Highway Capacity Manual – Special Report 209 using the Highway Capacity Software, version 4.1f.

In order to calculate the LOS, 18 intersections on the Major Street Network were counted during the spring of 2009. These intersections included 6 signalized intersections and 12 high-volume unsignalized intersections in the Hamilton area. Each intersection was counted between 7:00 a.m. to 9:00 a.m. and 4:00 p.m. and 6:00 p.m., to ensure that the intersection's peak volumes were represented. Based upon this data, the operational characteristics of each intersection were obtained.

2.4.1 Signalized Intersections

For signalized intersections, recent research has determined that average control delay per vehicle is the best available measure of level of service. Control delay takes into account uniform delay, incremental delay, and initial queue delay. The amount of control delay that a vehicle experiences is approximately equal to the time elapsed from when a vehicle joins a queue at the intersection (or arrives at the stop line when there is no queue) until the vehicle departs from the stopped position at the head of the queue. The control delay is primarily a function of volume, capacity, cycle length, green ratio, and the pattern of vehicle arrivals.

The following table identifies the relationship between level of service and average control delay per vehicle. The procedures used to evaluate signalized intersections use detailed information on geometry, lane use, signal timing, peak hour volumes, arrival types and other parameters. This information is then used to calculate delays and determine the capacity of each intersection. Generally, an intersection is determined to be functioning adequately if operating at LOS C or better. **Table 2-2** shows the LOS by control delay for signalized intersections.

Table 2-2
Level of Service Criteria (Signalized Intersections)

	Control Delay per Vehicle (sec)
A	< 10
B	10 to 20
C	20 to 35
D	35 to 50
E	50 to 80
F	> 80

Source: The Transportation Research Board's *Highway Capacity Manual*

Using these techniques and the data collected in the spring of 2009, the LOS for the signalized intersections was calculated. **Table 2-3** shows the AM and PM peak hour LOS for each individual leg of the intersections, as well as the intersections as a whole. The intersection LOS is shown graphically in **Figure 2-5** and **Figure 2-6**.

Table 2-3
Existing (2009) Level of Service for Signalized Intersections

Intersection	AM Peak Hour					PM Peak Hour				
	EB	WB	NB	SB	INT	EB	WB	NB	SB	INT
US 93 & Adirondac Avenue/Fairgrounds Road	F	E	B	B	C	D	C	C	B	C
US 93 & Pine Street	F	-	A	A	B	F	-	A	A	D
US 93 & Main Street/Marcus Street	B	B	B	B	B	B	B	B	B	B
US 93 & Ravalli Street	D	D	A	A	A	E	C	A	A	B
US 93 & Golf Course Road/Hope Avenue	D	F	A	A	E	C	F	A	A	C
2nd Street & Main Street	B	B	B	B	B	B	A	B	B	B

(Abbreviations used in the table are as follows: EB = eastbound; WB = westbound; NB = northbound; SB = southbound; INT = intersections as a whole)

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2.4.2 Unsignalized Intersections

Level of service for unsignalized intersections is based on the delay experienced by each movement within the intersection, rather than on the overall stopped delay per vehicle at the intersection. This difference from the method used for signalized intersections is necessary since the operating characteristics of a stop-controlled intersection are substantially different. Driver expectations and perceptions are also entirely different. For two-way stop controlled intersections, the through traffic on the major (uncontrolled) roadway experiences no delay at intersection. Conversely, vehicles turning left from the minor roadway experience more delay than other movements and at times can experience significant delay. Vehicles on the minor roadway, which are turning right or going across the major roadway, experience less delay than those turning left from the same approach. Due to this situation, the level of service assigned to a two-way stop controlled intersection is based on the average delay for vehicles on the minor roadway approach.

Levels of service for all-way stop controlled intersections are also based on delay experienced by the vehicles at the intersection. Since there is no major roadway, the highest delay could be experienced by any of the approaching roadways. Therefore, the level of service is based on the approach with the highest delay as shown in **Table 2-4**. This table shows the LOS criteria for both the all-way and two-way stop controlled intersections.

Table 2-4
Level of Service Criteria (Stop Controlled Intersections)

Level of Service	Delay (seconds/vehicle)
A	< 10
B	10 to 15
C	15 to 25
D	25 to 35
E	35 to 50
F	> 50

Source: The Transportation Research Board's *Highway Capacity Manual*

Using the above guidelines, the data collected in the spring of 2009 and calculation techniques for two-way stop controls and all-way stop controls, the LOS was calculated for 12 intersections. **Table 2-5** and **Table 2-6** show the detailed results of the performance level turning movement breakout for each unsignalized intersection. The intersection LOS is shown graphically in **Figure 2-5** and **Figure 2-6**.

Table 2-5
Existing (2009) Level of Service for Unsignalized Intersections

Unsignalized Intersection	AM Peak Hour			PM Peak Hour		
	Delay	LOS	V/C	Delay	LOS	V/C
US 93 & Riverside Cutoff	-	-	-	-	-	-
Westbound Left	22.7	C	0.30	38.1	E	0.39
Westbound Right	9.9	A	0.02	11.6	B	0.09
Southbound Left	8.5	A	0.05	10.1	B	0.03
Old Corvallis Road/Mill Street & Fairgrounds Road	-	-	-	-	-	-
Eastbound Left/Thru/Right	8.1	A	0.06	8.0	A	0.05
Westbound Left/Thru/Right	7.8	A	0.01	8.1	A	0.01
Northbound Left/Thru/Right	15.4	C	0.07	16.5	C	0.13
Southbound Left/Thru/Right	13.9	B	0.18	19.5	C	0.38
Freeze Lane & Fairgrounds Road	-	-	-	-	-	-
Westbound Left/Thru	7.4	A	0.01	7.8	A	0.00
Northbound Left	10.4	B	0.04	11.1	B	0.02
Northbound Right	8.7	A	0.01	9.5	A	0.00
Eastside Highway & Fairgrounds Road	-	-	-	-	-	-
Eastbound Left/Right	13.9	B	0.20	20.8	C	0.47
Northbound Left/Thru	8.3	A	0.02	7.9	A	0.03
Eastside Highway & Kurtz Road	-	-	-	-	-	-
Eastbound Left/Thru/Right	8.5	A	0.20	7.6	A	0.01
Westbound Left/Thru/Right	7.7	A	0.02	8.2	A	0.02
Northbound Left/Thru/Right	61.5	F	0.68	25.2	D	0.48
Southbound Left	41.4	E	0.04	17.9	C	0.01
Southbound Thru/Right	26.5	D	0.42	16.3	C	0.26
Eastside Highway & Black Lane/Bass Lane	-	-	-	-	-	-
Eastbound Left/Thru/Right	23.1	C	0.25	44.9	E	0.66
Westbound Left/Thru/Right	22.1	C	0.37	23.6	C	0.23
Northbound Left/Thru/Right	8.6	A	0.02	8.1	A	0.01
Southbound Left/Thru/Right	7.9	A	0.02	8.6	A	0.03
3rd Street & Main Street	-	-	-	-	-	-
Eastbound Left/Thru/Right	8.86	A		10.75	B	
Westbound Left/Thru/Right	8.70	A		9.34	A	
Northbound Left/Thru/Right	8.00	A		8.90	A	
Southbound Left/Thru/Right	8.03	A		9.07	A	
4th Street & Main Street	-	-	-	-	-	-
Eastbound Left/Thru/Right	9.45	A		10.79	B	
Westbound Left/Thru/Right	8.95	A		9.16	A	
Northbound Left/Thru/Right	8.78	A		9.12	A	

Southbound Left/Thru/Right	8.41	A		8.92	A	

Table 2-6
Existing (2009) Level of Service for Unsignalized Intersections

Unsignalized Intersection	AM Peak Hour			PM Peak Hour		
	Delay	LOS	V/C	Delay	LOS	V/C
Golf Course Road & Big Corral Road	-	-	-	-	-	-
Eastbound Left/Thru	8	A	0.29	7.7	A	0.06
Southbound Left/Right	11.2	B	0.14	11.9	B	0.22
Golf Course Road & Kurtz Lane	-	-	-	-	-	-
Eastbound Left/Thru	8.3	A	0.07	7.8	A	0.02
Southbound Left/Right	13.8	B	0.18	12.9	B	0.23
Eastside Highway & Tammany Lane	-	-	-	-	-	-
Westbound Left/Right	12.1	B	0.12	16.3	C	0.27
Southbound Left/Thru	7.7	A	0.03	8.4	A	0.05
Eastside Highway & Airport Road	-	-	-	-	-	-
Westbound Left/Right	10.1	B	0.02	12.9	B	0.07
Southbound Left/Thru	7.7	A	0.01	8.4	A	0.02

The existing conditions LOS study in the Hamilton area shows that two signalized and three unsignalized intersections are currently functioning at LOS D or lower. These five intersections indicate potential opportunities for closer examination and further intersection improvement measures to mitigate "operational" conditions. These are shown in **Table 2-7**.

Table 2-7
Existing Intersections Functioning at a LOS D or Lower

Intersection		AM Peak	PM Peak
US 93 & Pine Street	S	F	D
US 93 & Golf Course Road/Hope Avenue	S	E	C
US 93 & Riverside Cutoff	U	C	E
Kurtz Lane & Marcus Street/Eastside Highway	U	F	D
Eastside Highway & Black Lane/Bass Lane	U	C	E

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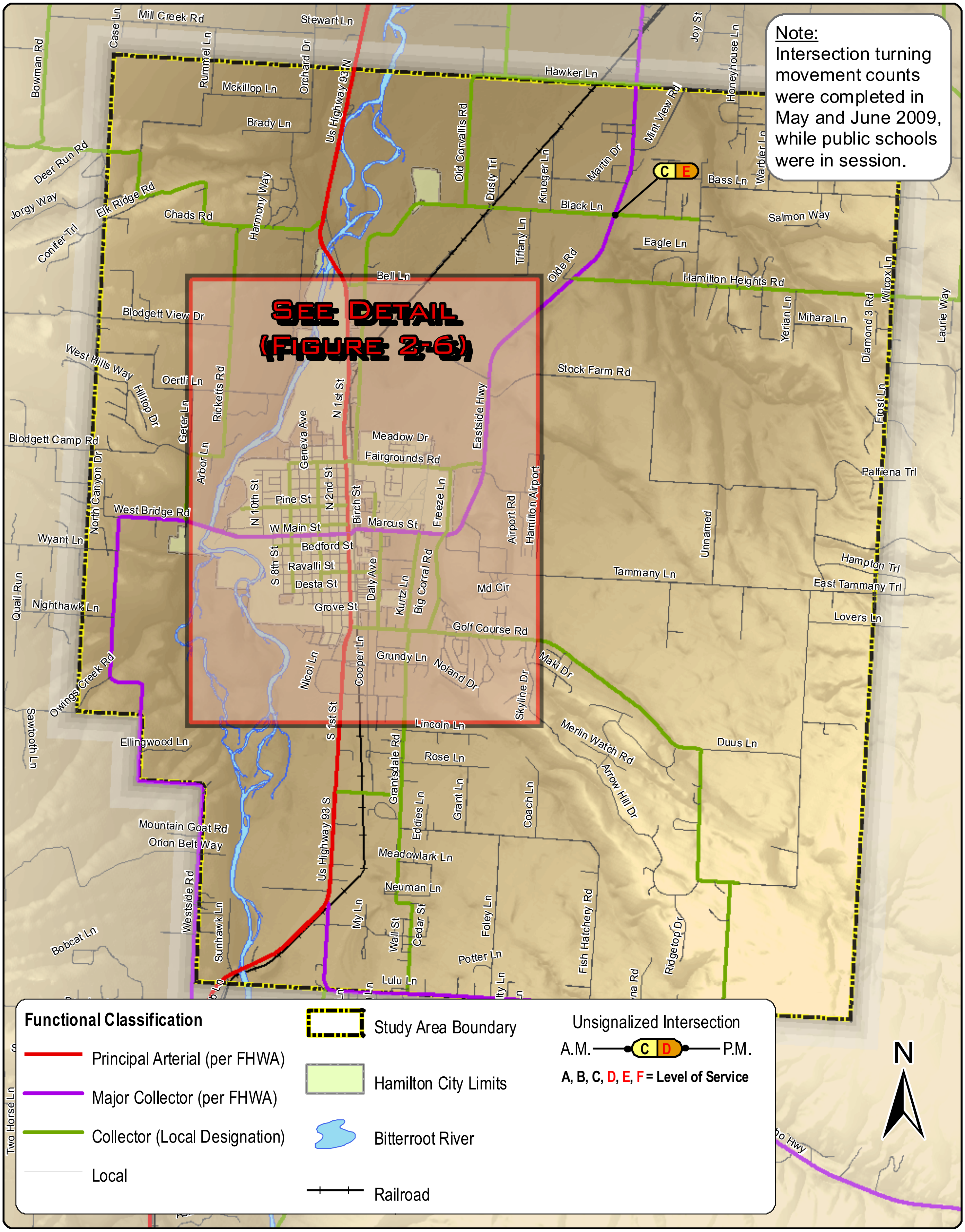

Figure 2-5

Intersection Level of Service

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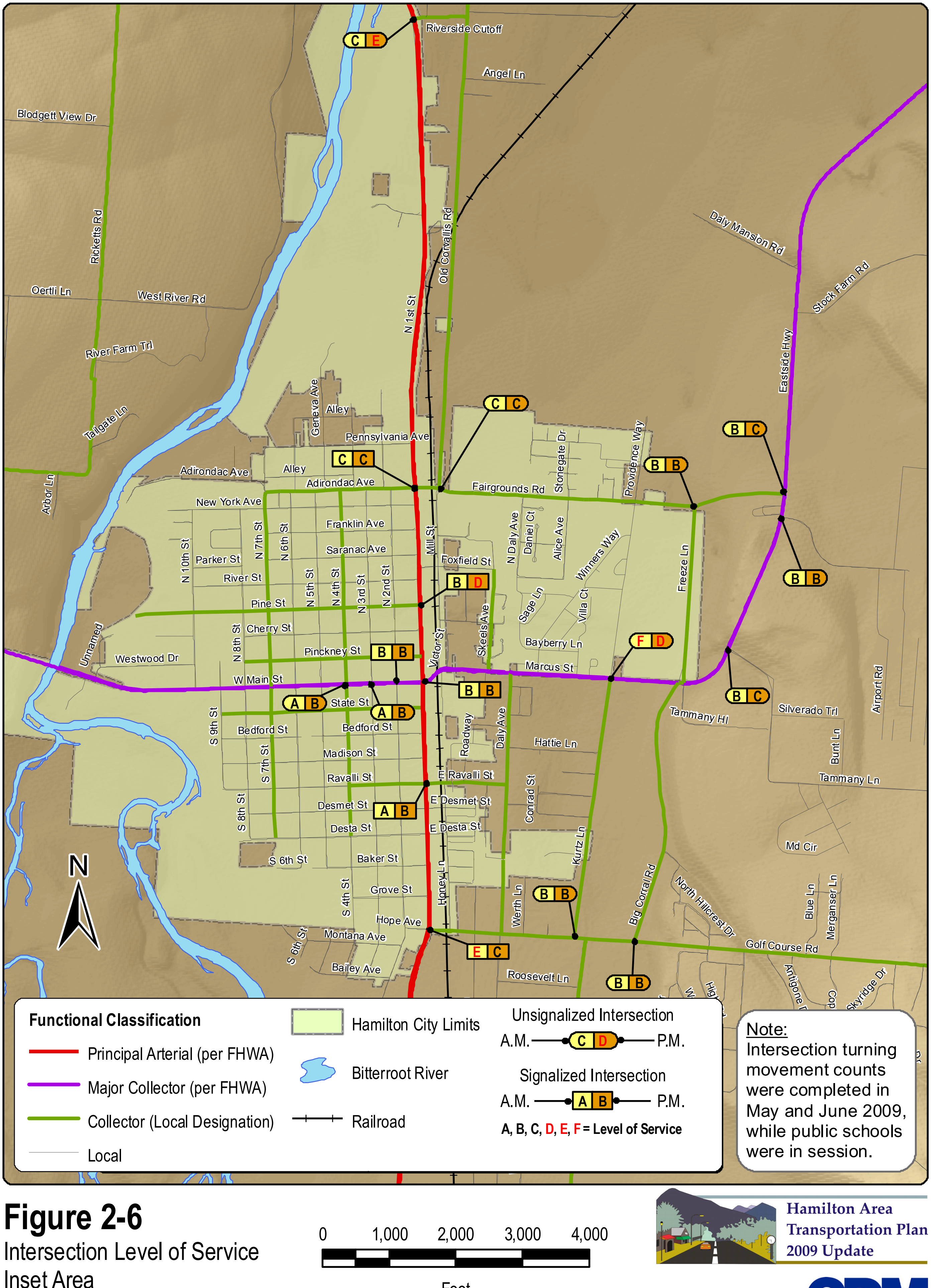

Figure 2-6

Intersection Level of Service
Inset Area

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2.5 Existing City Signing Inventory (Intersection Control)

A cursory review and data collection effort was made of the traffic control signs within the City of Hamilton. Signs were not inventoried along the numerous County roadways and/or State of Montana maintained facilities. The inventory was conducted to provide a record of stop sign locations throughout the residential areas of the City of Hamilton.

Hamilton has a varied use of stop signs for intersection traffic control. During the project development activities there were quite a few public comments on the perceived inconsistent use of stop signs in the community. From a technical perspective, stop signs should only be used in accordance with engineering judgment and as specified in the Manual on Uniform Traffic Control Devices (MUTCD) guidance. Use of signs in situations other than as specified in the MUTCD are typically not warranted and should be avoided.

For completeness, the relevant sections of the MUTCD that address this matter are included below:

Section 2B.05 STOP Sign Applications

Guidance:

STOP signs should be used if engineering judgment indicates that one or more of the following conditions exist:

A. Intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;

B. Street entering a through highway or street;

C. Unsignalized intersection in a signalized area; and/or

D. High speeds, restricted view, or crash records indicate a need for control by the STOP sign.

Standard:

Because the potential for conflicting commands could create driver confusion, STOP signs shall not be installed at intersections where traffic control signals are installed and operating.

Portable or part-time STOP signs shall not be used except for emergency and temporary traffic control zone purposes.

Guidance:

STOP signs should not be used for speed control.

STOP signs should be installed in a manner that minimizes the numbers of vehicles having to stop. At intersections where a full stop is not necessary at all times, consideration should be given to using less restrictive measures such as YIELD signs.

Once the decision has been made to install two-way stop control, the decision regarding the appropriate street to stop should be based on engineering judgment. In most cases, the street carrying the lowest volume of traffic should be stopped.

A STOP sign should not be installed on the major street unless justified by a traffic engineering study.

Support:

The following are considerations that might influence the decision regarding the appropriate street upon which to install a STOP sign where two streets with relatively equal volumes and/or characteristics intersect:

A. Stopping the direction that conflicts the most with established pedestrian crossing activity or school walking routes;

B. Stopping the direction that has obscured vision, dips, or bumps that already require drivers to use lower operating speeds;

C. Stopping the direction that has the longest distance of uninterrupted flow approaching the intersection; and

D. Stopping the direction that has the best sight distance to conflicting traffic.

Section 2B.07 Multiway Stop Applications

Support:

Multiway stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multiway stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multiway stop control is used where the volume of traffic on the intersecting roads is approximately equal. The restrictions on the use of STOP signs described in Section 2B.05 also apply to multiway stop applications.

Guidance:

The decision to install multiway stop control should be based on an engineering study.

The following criteria should be considered in the engineering study for a multiway STOP sign installation:

A. Where traffic control signals are justified, the multiway stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

B. A crash problem, as indicated by 5 or more reported crashes in a 12-month period that are susceptible to correction by a multiway stop installation.

C. Minimum volumes:

   1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and

   2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour, but

   3. If the 85th-percentile approach speed of the major-street traffic exceeds 65 km/h or exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above values.

D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

<u>Option:</u>

Other criteria that may be considered in an engineering study include:

A. The need to control left-turn conflicts;

B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;

C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to reasonably safely negotiate the intersection unless conflicting cross traffic is also required to stop; and

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multiway stop control would improve traffic operational characteristics of the intersection.

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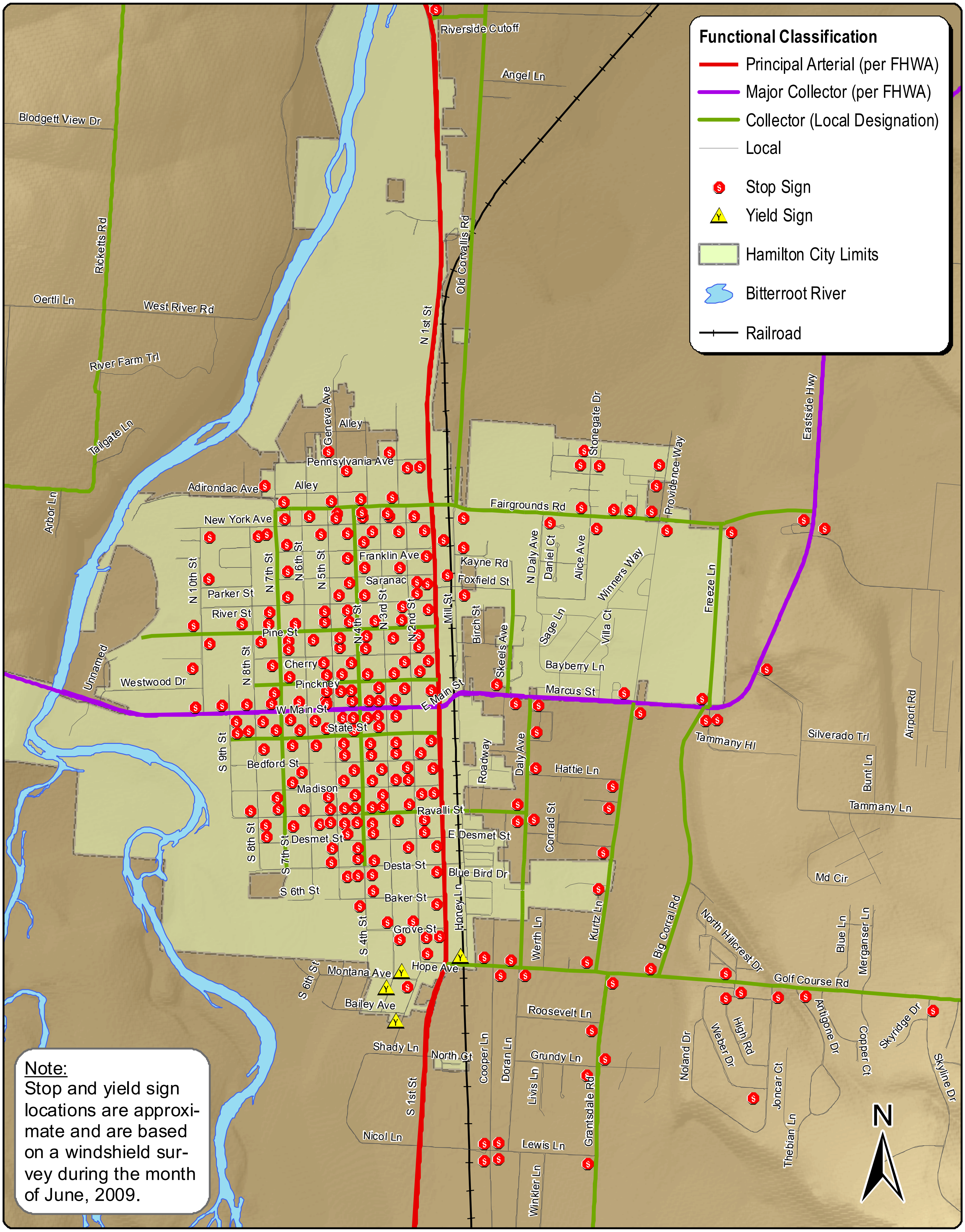

Figure 2-7

Intersection Control Signs
Inset Area

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2.6 Existing Crash Analysis

The purpose of this section is to document the number of crashes, severity of crashes, and overall intersection crash rates at the eighteen intersections being studied as part of this plan effort. The MDT Traffic and Safety Bureau provided crash information and data for use in the Hamilton Area Transportation Plan (2009 Update). The crash information was analyzed to identify intersections with crash characteristics that may warrant further study. General crash characteristics were evaluated along with potential causes. The crash information covers the three-year time period from January 1st, 2006 to December 31st, 2008. For this analysis eighteen intersections constituting the major signalized and un-signalized intersections were included (see **Table 2-8**). These intersections were defined for this analysis within the project scope of work. These eighteen intersections are considered to be the major, more important intersections within the planning study area boundary. They generally also include the higher volume intersections found within the study area boundary as well.

Using crash information provided by the MDT Traffic and Safety Bureau, an initial step at defining crash locations and types were made for the subject intersections being studied as part of the transportation planning effort. Subsequent to this initial review, CDM personnel researched the various crash number, crash types, and specific crash locations via analysis of the *Crash Investigators Reports* provided by the MDT at the MDT Headquarters. Three analyses were performed to rank the intersections based on different crash characteristics. First, the intersections were ranked by number of crashes. A summary of these intersections, along with the number of crashes at each intersection, is shown in **Table 2-8**.

Table 2-8
Intersection Crashes in the Three-Year Period
(January 1, 2006 thru December 31, 2008)

INTERSECTION		# CRASHES
Intersections with 16-21 crashes		
US 93 & Main Street/Marcus Street	S	16
Intersections with 11-15 crashes		
US 93 & Adirondac Avenue/Fairgrounds Road	S	13
Eastside Highway & Black Lane/Bass Lane	U-2W	13
US 93 & Golf Course Road/Hope Avenue	S	11
Eastside Highway & Fairgrounds Road	U-1W	11
Intersections with 6-10 crashes		
US 93 & Ravalli Street	S	10
US 93 & Pine Street	S	6
Intersections with 0-5 crashes		
Kurtz Lane & Marcus Street/Eastside Highway	U-2W	4
Old Corvallis Road/Mill Street & Fairgrounds Road	U-2W	3
Kurtz Lane & Golf Course Road	U-1W	3
2nd Street & Main Street	S	3
4th Street & Main Street	U-4W	3
US 93 & Riverside Cutoff	U-1W	2
Big Corral Road & Golf Course Road	U-1W	2
Eastside Highway & Tammany Lane	U-1W	1
Eastside Highway & Airport Road	U-1W	1
Freeze Lane & Fairgrounds Road	U-1W	1
3rd & Main Street	U-4W	0

S=Signalized intersection; U-1W=Unsignalized one-way stop controlled;
U-2W=Unsignalized two-way stop controlled; U-3W=Unsignalized three-way stop controlled;
U-4W=Unsignalized four-way stop controlled.

It should be noted that only eighteen intersections identified for analysis for the transportation plan were included in this analysis. The intersection shown in **Table 2-8** as having zero crashes is included for completeness only.

The second analysis involved a more detailed look at the crashes to determine the MDT "severity index rating". The severity index is a ratio that allows the analyst to see where the most severe types of crashes occur. Crashes were broken into three categories of severity: property damage only (PDO), non-incapacitating and possible injury crash, and fatality or incapacitating injury. Each of these three types is given a different rating: one (1) for a property damage only crash; three (3) for an injury crash; and eight (8) for a crash that resulted in a fatality. The MDT severity index for the intersections in the analysis is shown in **Table 2-9**. The calculation used to figure the severity index rating is as follows:

$$\boldsymbol{MDT\ Severity\ Index} = \frac{1(\#\ PDO)+3(\#\ Non-Incapacitating\ or\ Possible\ Injury)+8(\#\ Fatality\ or\ Incapacitating\ Injury)}{Total\ Number\ of\ Crashes\ in\ a\ Three-Year\ Period}$$

The third analysis ranked the number of crashes against the annual average daily traffic (AADT) entering each intersection, expressed in crashes per million entering vehicles (MEV). A summary of the intersections in the analysis is shown in **Table 2-10**. The formula used to determine the intersection crash rate, expressed in crashes per million entering vehicles (MEV), as shown in **Table 2-10**, is as follows:

$$\boldsymbol{Intersection\ Crash\ Rate} = \frac{Total\ number\ of\ crashes\ in\ three-year\ period}{(AADT\ Entering\ the\ Intersection) \times (3\ years) \times (365\,\frac{days}{year}) \Big/ 1{,}000{,}000\ vehicles}$$

Note that the Average Annual Daily Traffic (AADT) utilized for each of the eighteen intersections was calculated by adding up all of the intersection leg entering volumes collected during the PM peak hour period, and multiplying that number by 10. This is based on an assumption that the PM peak hour volumes are approximately 10 percent of the AADT for any given location under consideration. In actuality, data obtained from MDT Traffic Count Station A-056 suggests the PM peak hour may be approximately 11.76 percent of the AADT, however for purposes of this planning level analysis the 10 percent “rule-of-thumb” was considered to be adequate. Of note is that the 11.76 percent value is an average number based on yearly data collected between the time period of 1986 thru 2007. During that time frame the actual percentage ranged from a low value of 10.90 percent (years 2000 and 2001) to a high value of 13.30 percent (year 1991). MDT Traffic Count Station A-056 is located 2.5 miles north of Hamilton, near reference post 9RP) 51, on route N-7 (US Highway 93).

Table 2-9
Intersection Crash Analysis – MDT Severity Index

INTERSECTION	PDO	Possible/Non-Incapacitating Injury	Fatality/ Incapacitating Injury	Severity Index
Intersections with 3.25 - 3.50 Severity Index				
Kurtz Lane & Golf Course Road	2	0	1	3.33
Eastside Highway & Tammany Lane	2	1	1	3.25
Intersections with 3.00 – 3.24 Severity Index				
Eastside Highway & Airport Road	0	1	0	3.00
Intersections with 2.75 - 2.99 Severity Index				
-				
Intersections with 2.50 - 2.74 Severity Index				
US 93 & Adirondac Avenue/Fairgrounds Road	8	3	2	2.54
Intersections with 2.25 - 2.49 Severity Index				
Eastside Highway & Black Lane/Bass Lane	6	6	1	2.46
Old Corvallis Road/Mill Street & Fairgrounds Road	1	2	0	2.33
4th Street & Main Street	1	2	0	2.33
Intersections with 2.00 - 2.49 Severity Index				
Big Corral Road & Golf Course Road	1	1	0	2.00
Intersections with 1.75 - 1.99 Severity Index				
-				
Intersections with 1.50 - 1.74 Severity Index				
US 93 & Pine Street	4	2	0	1.67
Intersections with 1.00 - 1.49 Severity Index				
Eastside Highway & Fairgrounds Road	8	3	0	1.55
US 93 & Golf Course Road/Hope Avenue	8	3	0	1.55
Kurtz Lane & Marcus Street/Eastside Highway	3	1	0	1.50
US 93 & Main Street/Marcus Street	14	2	0	1.25
US 93 & Ravalli Street	9	1	0	1.20
US 93 & Riverside Cutoff	2	0	0	1.00
Freeze Lane & Fairgrounds Road	1	0	0	1.00
2nd Street & Main Street	3	0	0	1.00
3rd Street & Main Street	0	0	0	-

Table 2-10
Intersection Crash Rate

Intersection		Number of Crashes	Volume	Rate
Intersections with 1.00 – 1.50 Intersection Crash Rate				
Eastside Highway & Fairgrounds Road	U-1W	11	7,120	1.41
Eastside Highway & Black Lane/Bass Lane	U-2W	13	9,820	1.21
Intersections with 0.5 - 0.99 Intersection Crash Rate				
US 93 & Main Street/Marcus Street	S	16	22,190	0.66
US 93 & Golf Course Road/Hope Avenue	S	11	15,860	0.63
Kurtz Lane & Marcus Street/Eastside Highway	U-2W	4	6,570	0.56
Eastside Highway & Tammany Lane	U-1W	4	6,590	0.55
US 93 & Ravalli Street	S	10	16,770	0.54
US 93 & Adirondac Avenue/Fairgrounds Road	S	13	23,340	0.51
Kurtz Lane & Golf Course Road	U-1W	3	5,360	0.51
Intersections with 0.00 - 0.49 Intersection Crash Rate				
4th Street & Main Street	U-4W	3	5,970	0.46
Big Corral Road & Golf Course Road	U-1W	2	4,750	0.38
Old Corvallis Road/Mill Street & Fairgrounds Road	U-2W	3	7,860	0.35
Freeze Lane & Fairgrounds Road	U-1W	1	3,140	0.29
US 93 & Pine Street	S	6	19,150	0.29
2nd Street & Main Street	S	3	11,660	0.23
Eastside Highway & Airport Road	U-1W	1	5,710	0.16
US 93 & Riverside Cutoff	U-1W	2	13,620	0.13
3rd Street & Main Street	U-4W	0	5,650	0.00

S=Signalized intersection; U-1W=Unsignalized one-way stop controlled; U-2W=Unsignalized two-way stop controlled; U-3W=Unsignalized three-way stop controlled; U-4W=Unsignalized four-way stop controlled.

**AADT was calculated by adding the entering peak PM volumes of all legs of the intersection and multiplying by 10.*

(Assumes peak hour PM volumes are 10% of AADT.)

In order to give the intersections included in the crash analysis an even rating, a composite rating score was developed based on the three analyses presented above. The intersections were rated based on their position on each of the three previous tables, giving each equal weight. For example, the intersection of Eastside Highway and Fairgrounds Road was given a ranking of 4 for its position in **Table 2-8**, another ranking of 10 for its position in **Table 2-9**, and a ranking of 1 for its location in **Table 2-10**. Thus its composite rating is 15. Refer to **Table 2-11** for the composite rating of each intersection.

Table 2-11
Intersection Crash Analysis – Composite Rating

Intersection	Crash No.	Severity No.	Rate No.	Composite Ranking
Eastside Highway & Black Lane/Bass Lane	2	5	2	9
US 93 & Adirondac Avenue/Fairgrounds Road	2	4	8	14
Eastside Highway & Fairgrounds Road	4	10	1	15
US 93 & Main Street/Marcus Street	1	13	3	17
US 93 & Golf Course Road/Hope Avenue	4	10	4	18
Kurtz Lane & Golf Course Road	9	1	8	18
Eastside Highway & Tammany Lane	15	2	6	23
Kurtz Lane & Marcus Street/Eastside Highway	8	12	5	25
4th Street & Main Street	9	6	10	25
Old Corvallis Road/Mill Street & Fairgrounds Road	9	6	12	27
US 93 & Ravalli Street	6	14	8	28
US 93 & Pine Street	7	9	13	29
Big Corral Road & Golf Course Road	13	8	12	33
Eastside Highway & Airport Road	15	3	16	34
2nd Street & Main Street	9	15	15	39
Freeze Lane & Fairgrounds Road	15	15	13	43
US 93 & Riverside Cutoff	13	15	17	45
3rd Street & Main Street	18	18	18	54

Intersections that were identified through the composite rating score method, as described previously, which warrant further study and may be in need of mitigation to specifically address crash trends are listed below. The locations of these intersections are shown on **Figure 2-8** and **Figure 2-9**.

- Eastside Highway & Black Lane/Bass Lane
- Eastside Highway & Fairgrounds Road
- Eastside Highway & Tammany Lane
- Kurtz Lane & Golf Course Road
- US 93 & Golf Course Road/Hope Avenue
- US 93 & Main Street/Marcus Street
- US 93 & Adirondac Avenue/Fairgrounds Road

The identified intersections will be evaluated further to determine what type of mitigation measures may be possible to reduce specific crash trends (if any) and/or severity. Some intersections noted above have already been studied in greater detail and have had mitigation plans developed. An example is the intersection of Eastside Highway & Black Lane/Bass Lane. An intersection improvement project is currently in development that will improve operational characteristics at the intersection, and likely result in lower observed crashes in the future. This intersection is currently projected for construction in fiscal year 2012.

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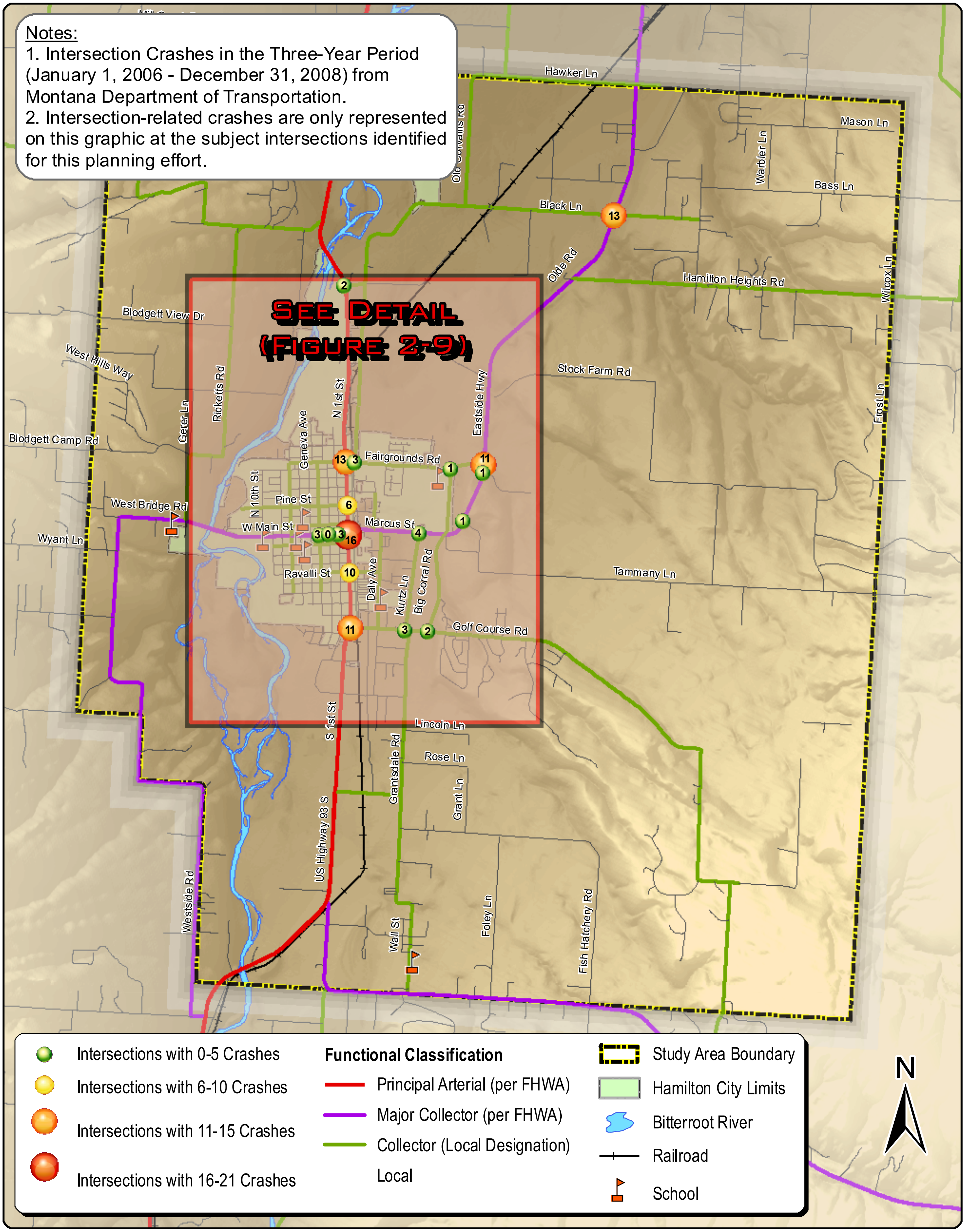

Figure 2-8
Crash Analysis

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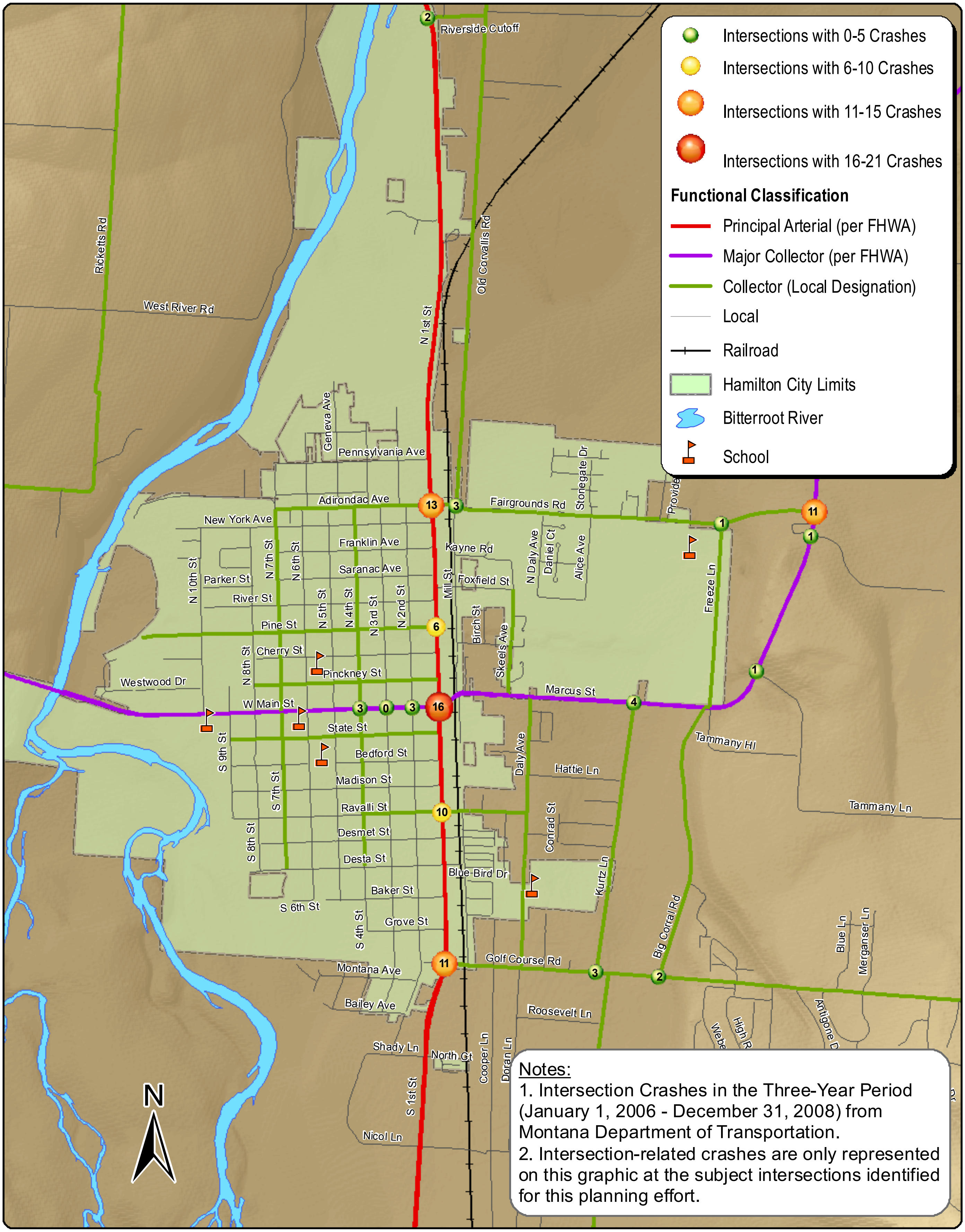

Figure 2-9

Crash Analysis
Inset Area

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