Appendix A

Previous Studies

Appendix A.1 – *Wye Road Urban Design Guidelines (van der Zalm & Associates)*

Appendix A.2 – *Wye Road, Ordze Road to Highway 21, Functional Planning Study (Al-Terra Engineering) – 2011*

Appendix A.3 – *Wye Road and Brentwood Boulevard Supplemental Intersection Analysis (Al-Terra Engineering) – 2011*

Appendix A.1

Wye Road Urban Design Guidelines
(van der Zalm & Associates)

Al-Terra

Building A Better Place To Live

WYE ROAD AREA URBAN DESIGN GUIDELINES

Strathcona County

SHERWOOD PARK/ STRATHCONA COUNTY ALBERTA







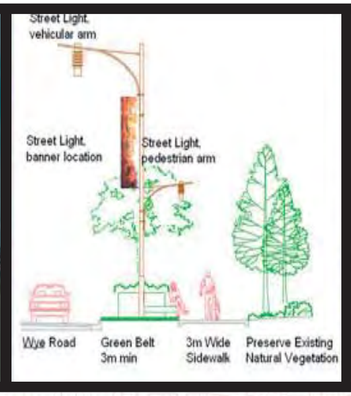








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ACKNOWLEDGEMENTS

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INTRODUCTION

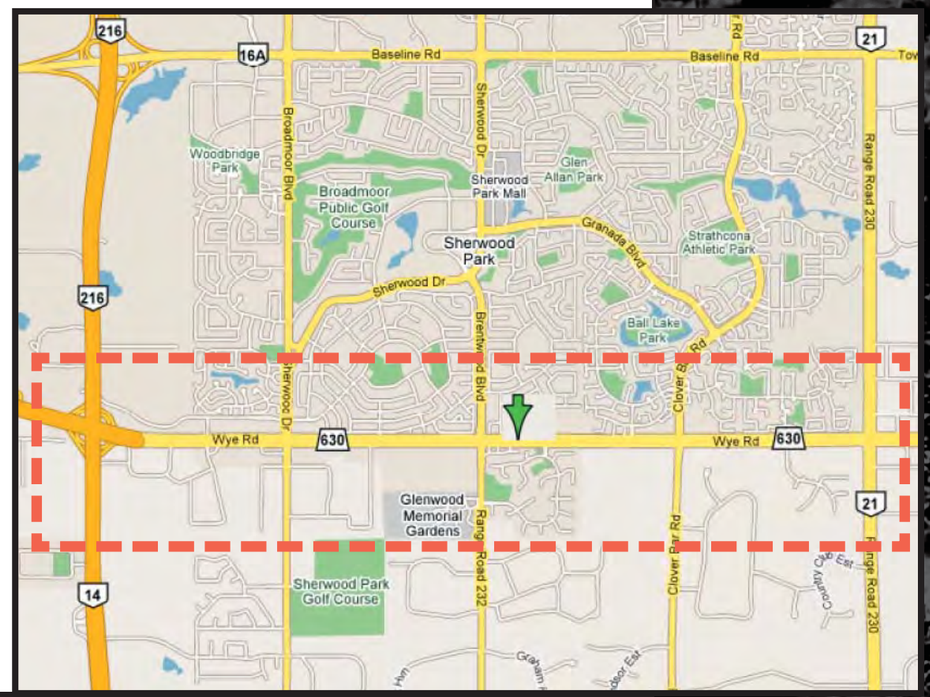
Wye Road between Hwy 14 and Hwy 21 is typical of many high volume thoroughfares running through most North American suburbs. These streets are often critical mainstreets but typically have more in common with freeway rights of way - utilitarian and unattractive with little consideration to the experiential quality offered to either vehicles or pedestrians. Wye Road currently offers pedestrians little in the way of comfort or safety. In some places, the existing sidewalk is located directly adjacent to the roadway making it both uncomfortable and noisy. In many situations traffic passes at more than 70km/hr. Clearly there are significant opportunities for improvement that will be explored in this document.

The Design Guidelines and concepts presented in this document represent an examination of the existing conditions of Wye Road between Hwy 14 and Hwy 21. The intent of the consulting team to understand the existing conditions, opportunities and constraints of the current roadway alignment and to provide alternatives for landscape improvements, place-making and building of a stronger identity throughout.

This study suggests stronger themed development of Wye Road and provides concrete examples, precedents, and design solutions in a conceptual format for both pedestrian and vehicular interests.

Whether specific for master planning of particular areas or broad in terms of principles, this document should be used as a reference for ongoing design and development on Wye Road.

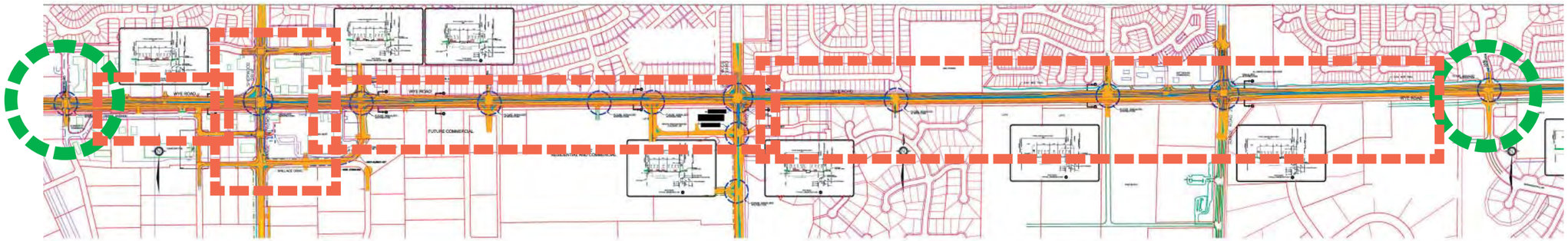
context map of WYE ROAD AND SURROUNDING AREA



PROJECT AREA

The project area is Wye Road right of way from Hwy 216 to Hwy 21. This study area is divided into following zones:

1. Ordze Road Area
2. Historic Museum Area
3. Hawthorn Road Area (Typical Streetscape)
4. Nottingham Way Area
5. The two Gateway Areas at the east/west end of the study area



GATEWAY | ORDZE RD. AREA | HISTORIC MUSEUM AREA | HAWTHORN ROAD AREA (TYPICAL STREETSCAPE) | NOTTINGHAM WAY AREA | GATEWAY

GENERAL OPPORTUNITIES

The wide expanse of the Wye Road corridor will visually enhance any sequenced design features such as street trees, signage, and seating amenities.

GENERAL CONSTRAINTS

Large intersections require additional signage, paving details, and pedestrian-oriented design to ensure that streetscapes are visually readable and thus safer

DES MOINES, IOWA & CHICAGO, ILLINOIS

Opportunities to reduce the broad expanse of paving by adding planted medians should be explored. The addition of green space helps to reduce the visual impact of the road, enhances the aesthetic quality of the driving experience and define Sherwood Park as a distinctive place.

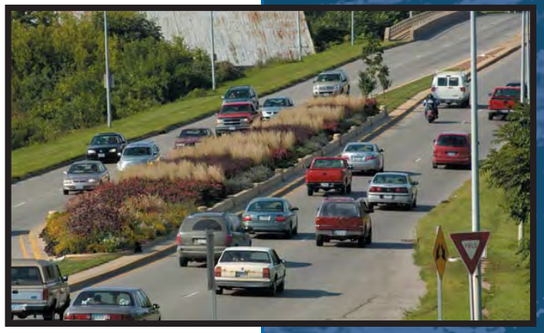
In Des Moines, Iowa, a street of similar character was transformed when turning lanes were consolidated and the center lane was replaced with planted medians. A decorative planter wall and splash strip were added in order to reduce the negative impact of snow clearing and salt spray on plants. In addition to supporting plant growth, these features also add character and distinctiveness to the street. These features also serve to Plants were chosen for their ability to provide a substantial visual impact in all seasons of the year. As the main arterial between the airport and downtown, this enhancement project has had a tremendous impact on people's first impressions of Des Moines as well as the civic pride that residents share.

A similar reduction in paving was created when planted medians were added to the turning lane on Michigan Avenue in Chicago. As a premier shopping street, the sheer number of people that experience this streetscape has had an enormous impact on the way people perceive the City. Seasonal flower displays are now as much of a draw to the area as the store that flank both sides of the street. In addition, these displays make the street unique in Chicago and a model for other cities.

As a major arterial, Wye Road supports a substantial amount of vehicular traffic. For many drivers and passengers, the scenery will be a familiar experience. For other people, the only impression they have of Sherwood Park may be drawn from what they experience looking from a vehicle window. Given these facts, it is essential that streetscape improvements consider the aesthetic experience of those passing in vehicles at moderately high speeds.









JASPER, ALBERTA

Connaught Drive in Jasper, Alberta is a great example of a successfully themed streetscape. Connaught Drive is the main through-way in this resort town that has been themed with a northern cabin appeal. The area has bylaws associated with it encouraging all commercial developments to follow architectural guidelines to have cabin-like forms and detailings. All signs and awnings also have a raw timber-form aesthetic and rustic quality. Lights also blend well with the northern themed design and are provided at varying heights; which transition from sidewalk poles to dual-lit median poles. Hardscape transitions range from stone paved sidewalks, to brick themed crosswalks and asphalt paving. Pedestrian oriented areas are clearly defined from vehicular areas making the streetscape feel safe to walk across. Street trees are used where possible and provide shade and additional texture to the streetscape. Key views and access to pathways and plazas remain open and easy to migrate to from the streetscape. These spaces are also themed in their materials and detailing which adds to the overall sense of place. Artwork such as murals or sculpture pieces can be found throughout the area which depicts the overall community character of Jasper. Finally, an adequate amount of streetscape furnishings such as benches, receptacles, and planters has been provided to ensure visitors find it easy to linger within the streetscape and enjoy the surrounding area.

Images provided by webshots.com

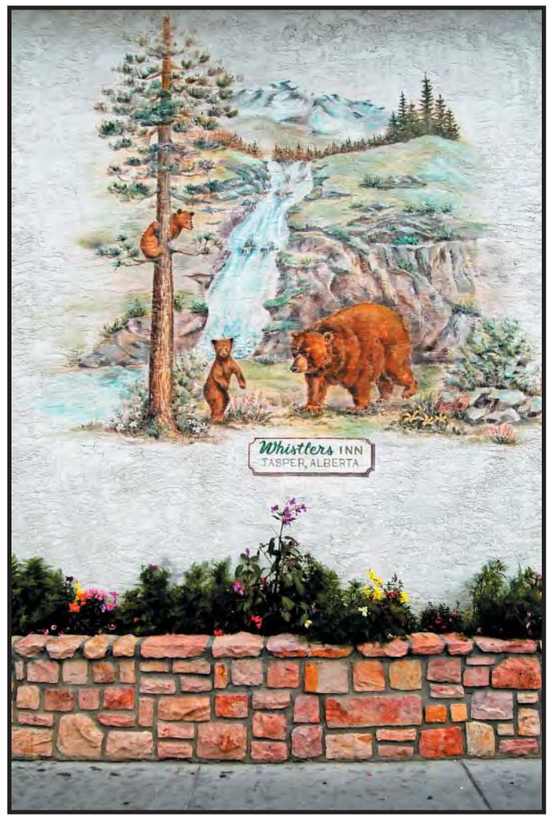






JASPER, ALBERTA

Below is a street mural found in Jasper, Alberta, which is associated with the areas Northern theme and contributes greatly to its surrounding streetscape aesthetic.



1. Street lights are provided at varying levels depending on use. Here they are approximately 14' high; a comfortable height for a large volume of pedestrian use

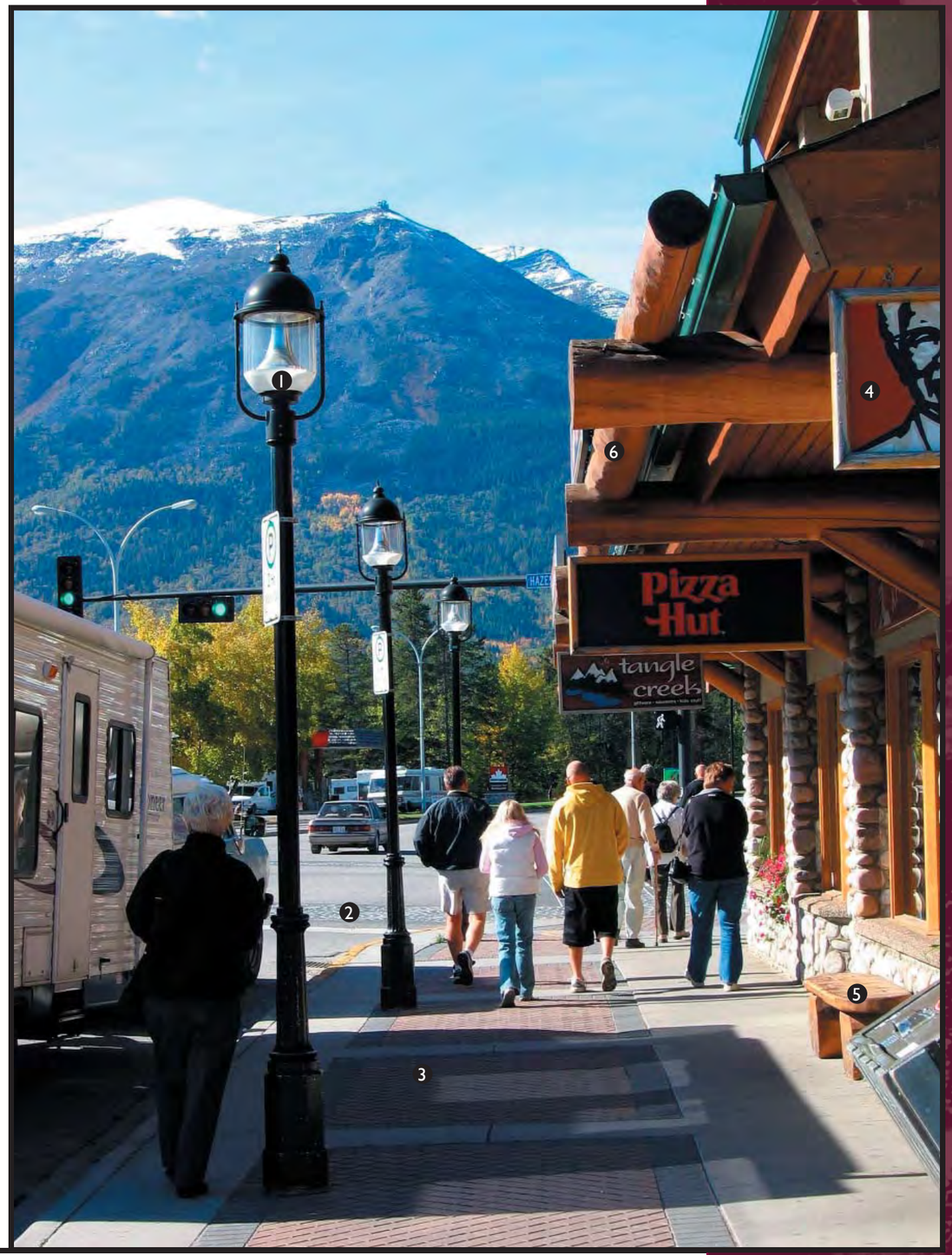
2. A material (Duratherm by Integrated Paving Concepts) is used along crosswalks to identify areas of pedestrian traffic to drivers

3. Various materials and used along the sidewalk to identify areas of walking vs. areas of relaxation or transition

4. Siganage is adequately provided and theme oriented

5. Site furnishing are theme oriented and placed wherever possible

6. Architectural details are theme oriented, contributing to streetscape character



GUIDELINE 1.0
CREATE A THEME FOR WYE ROAD -- "CONTEMPORARY WESTERN STYLE WITH A TOUCH OF HISTORIC CHARM"

Having a theme can help guide development of each zone. It is important that the theme be specific but also general enough to allow flexibility in design alternatives. The contemporary Western theme is also consistent with Sherwood Park's identity and provides an authentic guide to future improvements. Providing an underlying theme that reflects on local history helps to develop a strong local identity rooted in shared traditions and memories.

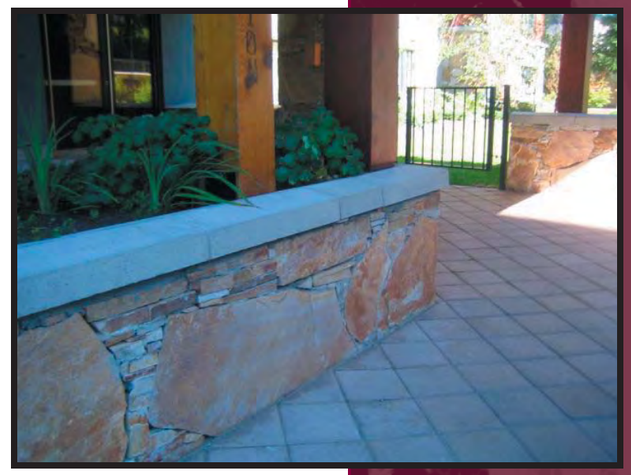
Example of a plaza 'sequence of spaces' where pedestrians can flow from walkable zones to areas of leisurely enjoyment



Example of character signage



Example of a detail design that reinforces the theme



Example of how canopied spaces and hierarchies of the pedestrian environment create interest



Example of detail design that reinforces the theme



GUIDELINE 1.1
EXPAND AND IMPROVE MEDIANS TO REDUCE IMPACT OF WIDE EXPANSES OF PAVING

OPPORTUNITIES

- Incorporate planted medians to reduce impact of wide expanses of paving

- ATCO pipeline constraints on street tree planting dictate possible placement in the median.

- Medians can be developed with graphic, 4-season plantings to create a strong visual statement.

- Ornamental or native grasses, low-maintenance shrubs should be considered as a means of being more "earth friendly" and to reduce maintenance requirements. Cultured "blue" grasses are not suggested in medians due to mowing works.

Trees planted in median reduce the scale of the road.



Example of native grass in road median



Example of existing use of native grass along Wye Road

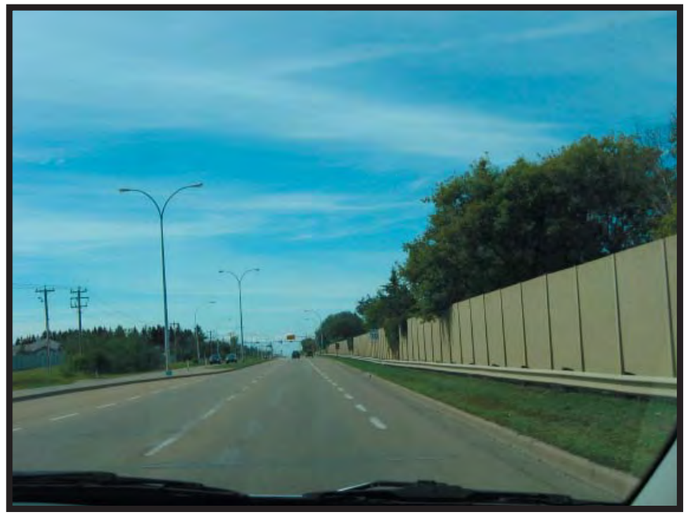


Example of mature trees in road median



GUIDELINE 1.2
REDUCE THE VISUAL IMPACT OF SOUND BARRIERS

EXISTING CONDITIONS/ CONSTRAINTS
Relentless wall elevation exposed to street.

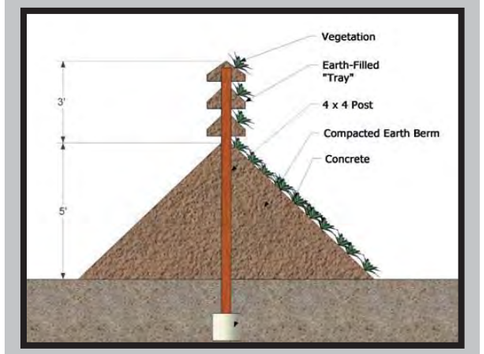


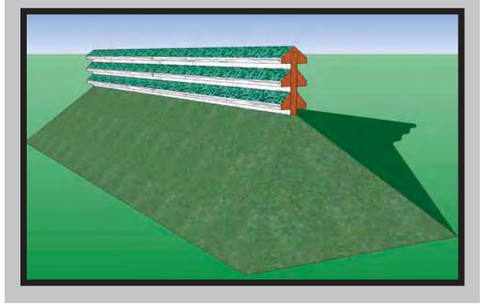
OPPORTUNITIES
Use planting material to soften sound walls. Examples of ways in which the visual impact of bare sound abatement walls can be designed as a more attractive element in the streetscape.

Example 1:

A patented sand, pumice or planting mix filled sound wall that is wind, weather and graffiti proof. It blocks sound and absorbs sound.

http://www.acoustic sciences.com/sound-fence/earthwall.htm





Example 2:
Using Green Screen: provide vertical climbing support for vines.
www.greenscreen.com



Example 3:
By providing texture and divisions on the wall



Example 4:
By staggering wall modules, you develop spaces to plant vines and create shadow on the wall.



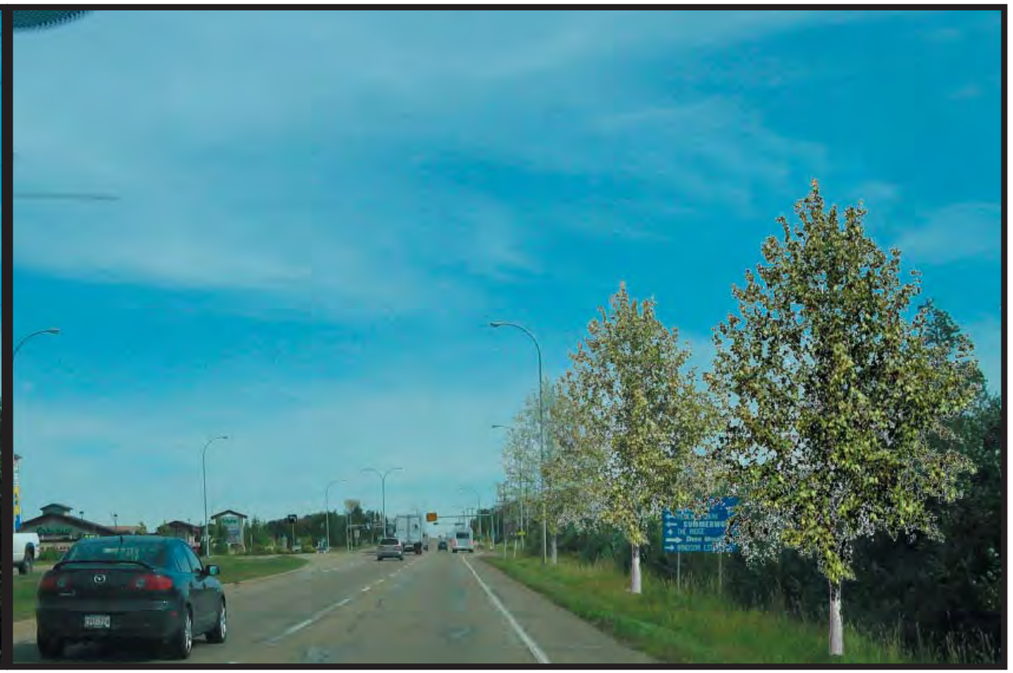
GUIDELINE 1.3
REDUCE VISUAL CLUTTER AND BURY EXISTING OVERHEAD UTILITIES WHERE POSSIBLE

Below is an example of how reduced visual clutter along streetscapes can create calmed beauty through driving corridors with the addition of vegetation

CURRENT (BEFORE)



PROPOSED (AFTER)



GUIDELINE 14
SELECT AND PLACE LIGHT POLES TO ENHANCE THE VISUAL COHESION OF THE STREETSCAPE

Well designed and placed street lights help to make the streetscape more pedestrian friendly and promote safer night use. Specifiers should look beyond mere functional capacity and consider street lights in terms of their potential sculptural quality and as an animator of the public space.

EXISTING CONDITIONS/ CONSTRAINTS

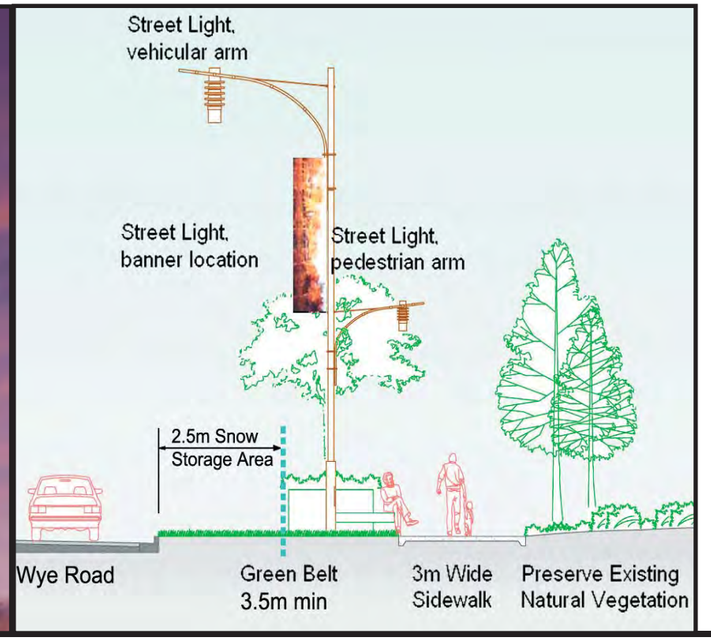
Existing street lights are not attractive; they do not address pedestrian needs, and location varies from both sides of road to center of median.

OPPORTUNITIES

A. Layout street lights in a consistent way;
B. Choose a street light which has two arms: one vehicular arm and one pedestrian arm.
C. Select and locate street lights in a manner which provide both night safety and aesthetic value.
D. Add bollard lights wherever needed for pedestrian safety.
E. Along Wye Road, suggest to paint all light poles and traffic light poles dark gray.







ADDITIONAL STREETLIGHT OPTION:
(Selected from www.stresscrete.com)
We suggest to lower one light to 3-4m high to provide better pedestrian illumination

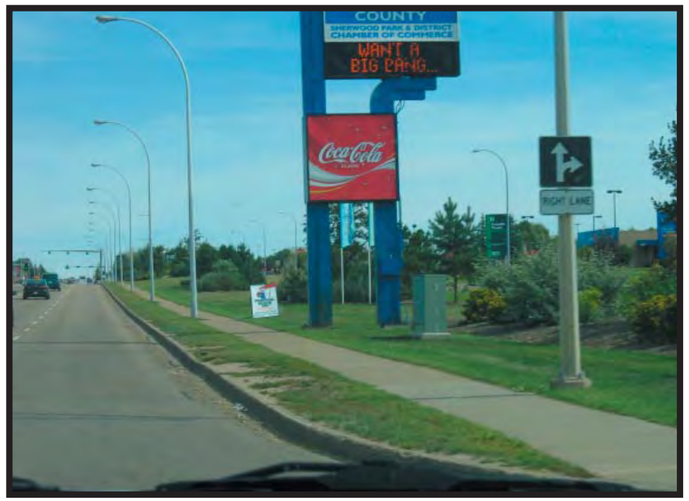


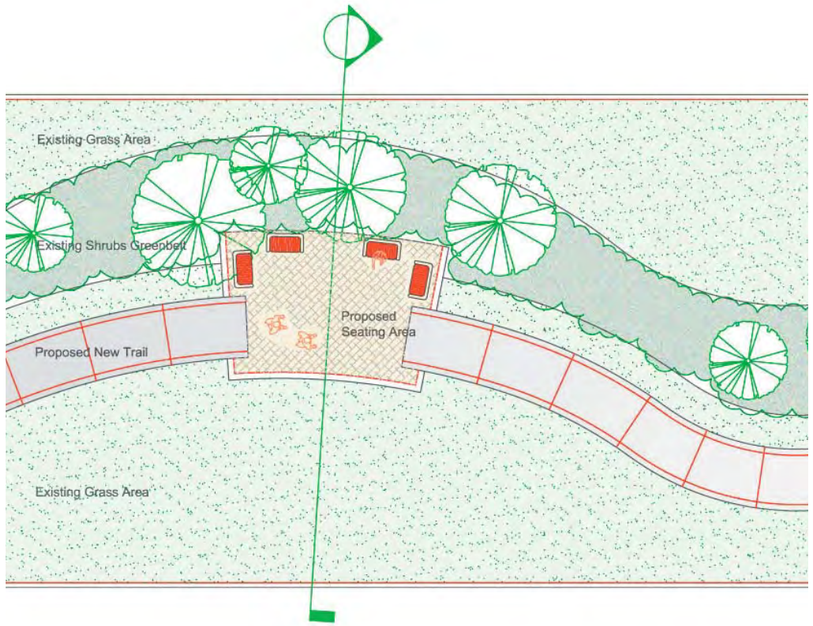


GUIDELINE 2.0
AVOID EXCESSIVELY LONG SEGMENTS OF STRAIGHT SIDEWALKS

EXISTING CONDITIONS/ CONSTRAINTS

The lack of texture along the Wye Road corridor creates a long and bleak appearance





OPPORTUNITIES

1. Pedestrian nodes should be added on the route to provide destination and social opportunities.
2. Small plazas and seating areas should be incorporated on the trail system to provide seating and rest areas.
3. Combine with roadside commercial to create outdoor dining areas and seating areas.
4. Create more curvaceous trail shape to make the walk more interesting.



Example of how multiple materials create textural interest



Example of how the repetition of various materials create a defined and desirable space



Example of how street trees can canopy a space and create interest through the contrast of

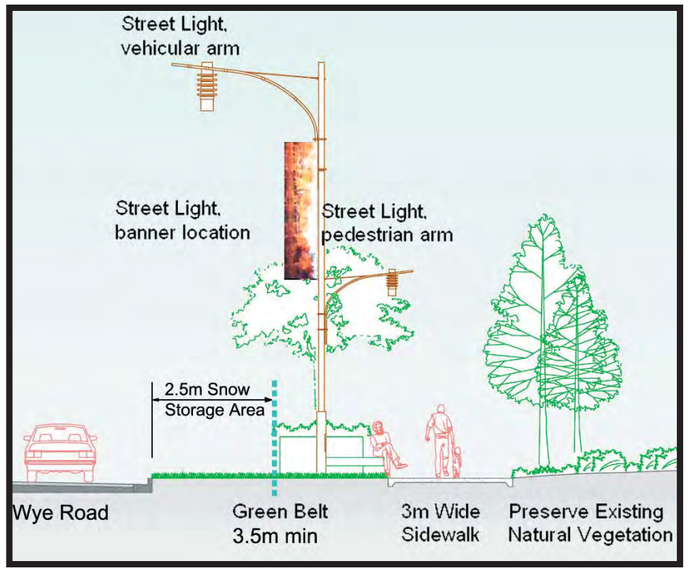
GUIDELINE 2.1
INCORPORATE LIGHTING IN PEDESTRIAN WAY TO IMPROVE SECURITY AND FUNCTION

OPPORTUNITIES

Sample of using a street light which has two arms: one vehicular arm and one pedestrian arm. Pedestrian arm would be 3-4m high to provide enough illumination for pedestrian safety. Select and locate street lights in a manner which provides both night safety and aesthetic value.

- Provide enough light to promote pedestrian safety for night times.

- Bollard lights function well in a non-intrusive way to enhance pedestrian safety and visibility.





(Right) are three examples of how adequate lighting along streets and pedestrian areas promote safety, interest, and aesthetic quality







GUIDELINE 2.2
CREATE A LANDSCAPE BUFFER BETWEEN PEDESTRIANS AND VEHICLES

EXISTING CONDITIONS/ CONSTRAINTS

Between Ordze Road and Sherwood Drive, an existing sidewalk on the south side of Wye Road offers pedestrians little in the way of comfort or safety. The existing sidewalk is located directly adjacent to the roadway making it both dangerous and noisy. In the area where Ordze Road parallels Wye Road, an existing 16m wide greenway has the potential to offer a more pleasant pedestrian experience.

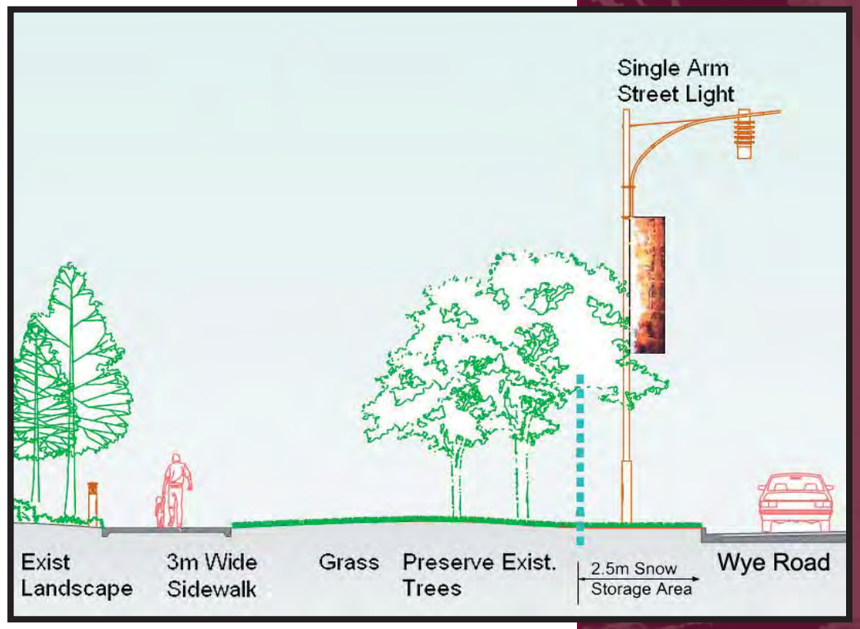
EXISTING: Unsafe, noise and unpleasant experience



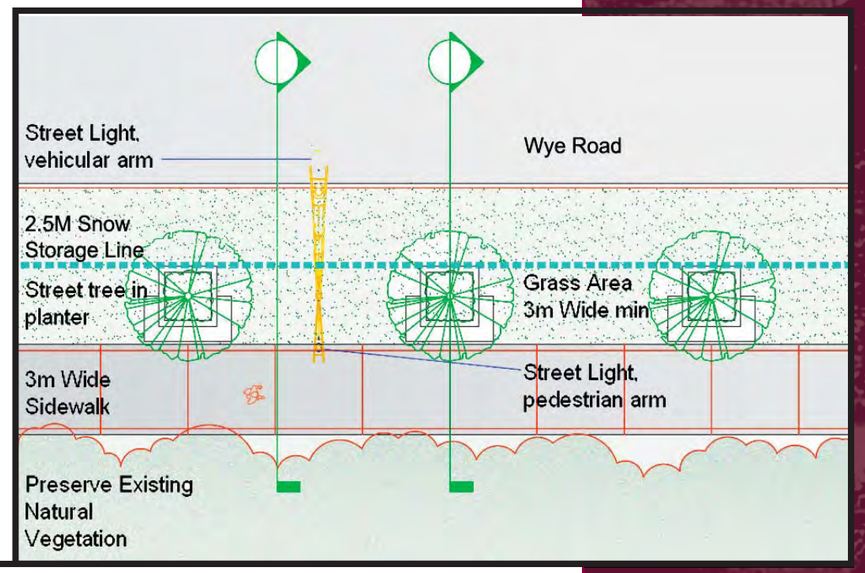
PROPOSED SOLUTION: Safe and pleasant experience



PROPOSED SOLUTION EXAMPLE 1:
Example of vehicular and pedestrian separation

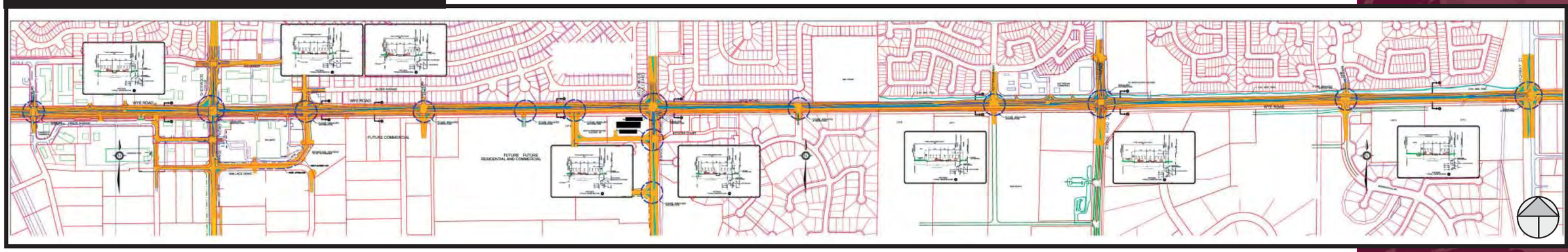


PROPOSED SOLUTION EXAMPLE 2:
Trees may be planted in raised planters where Atco Pipeline provides depth limitations



GUIDELINE 2.3

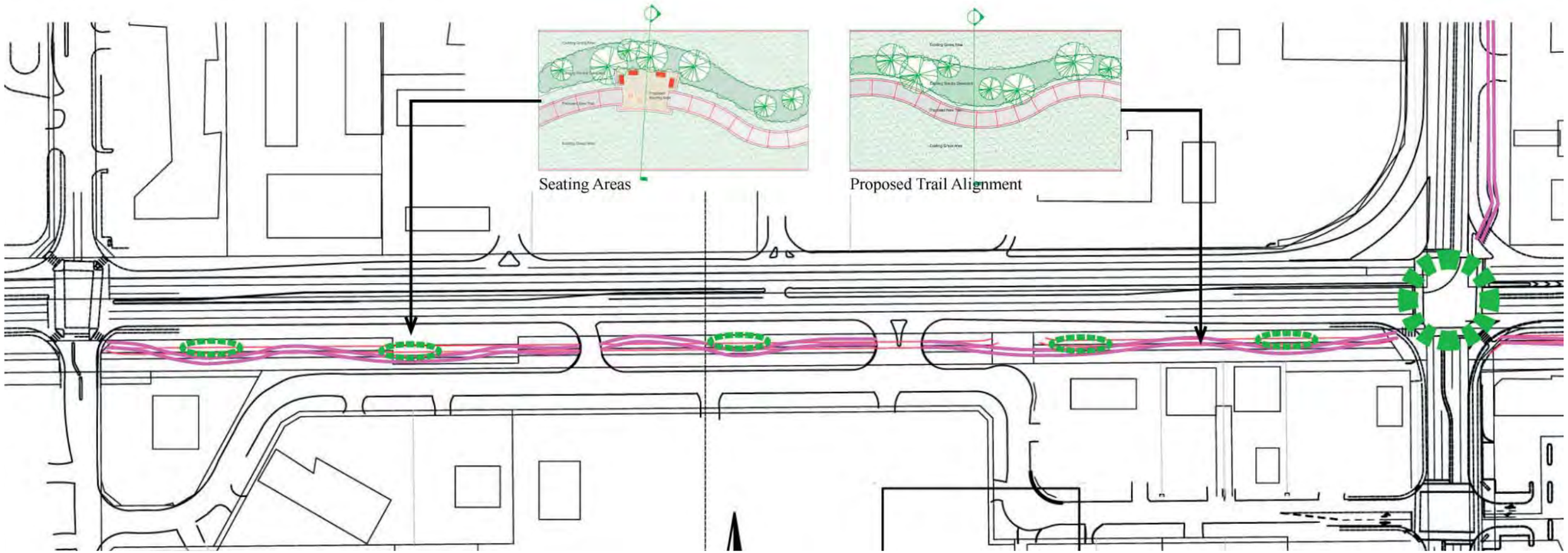
PROVIDE A CONTINUOUS PEDESTRIAN RIGHT OF WAY WHERE POSSIBLE



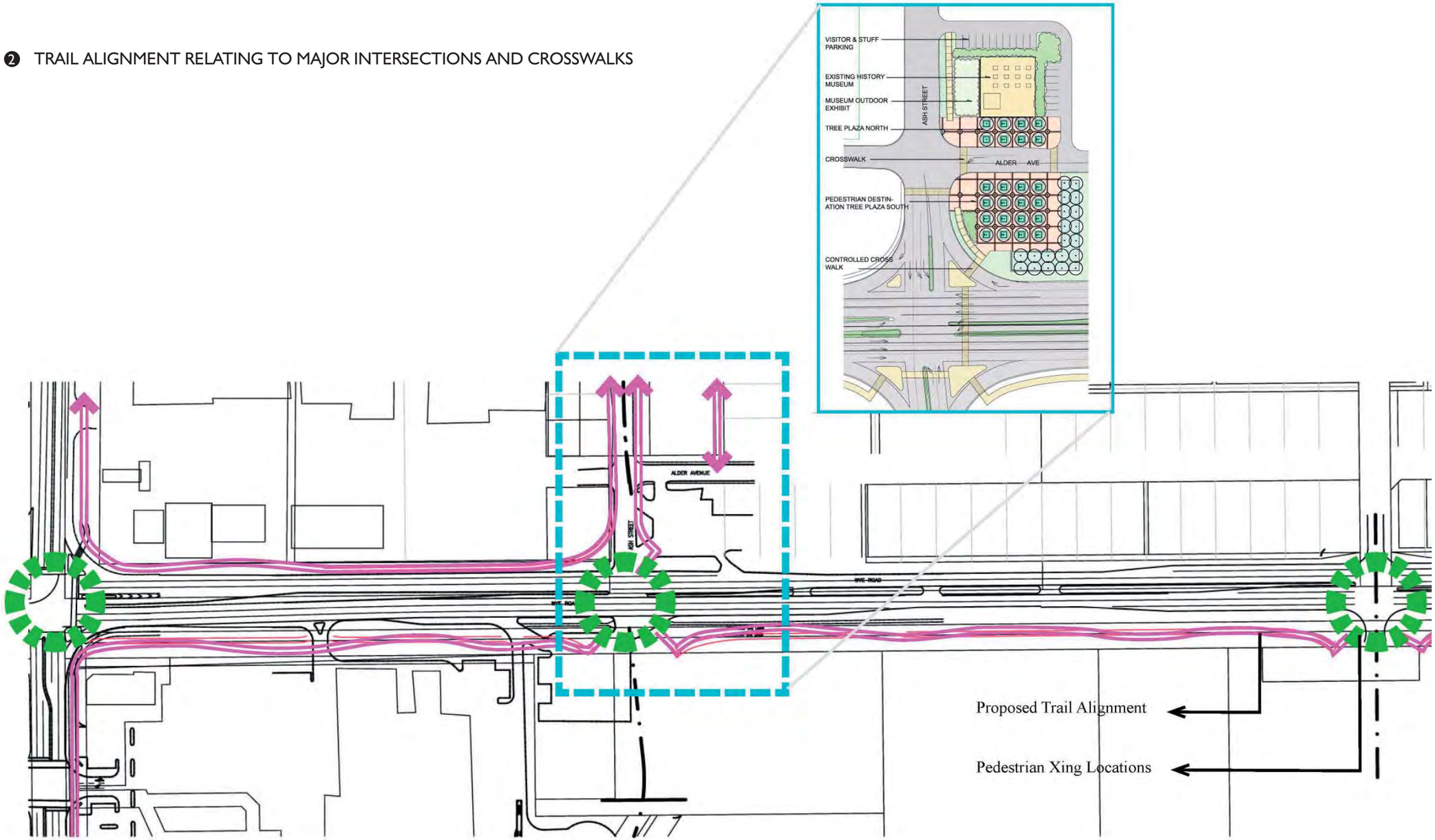
THE FOLLOWING PAGES SHOW ENLARGEMENTS OF THE TRAIL SEGMENTS IN THE FOLLOWING ORDER:

1. Overall trial alignment and proposed seating areas
2. Trail alignment relating to major intersections and crosswalks
3. Relationship to road R.O.W.
4. Buffer areas

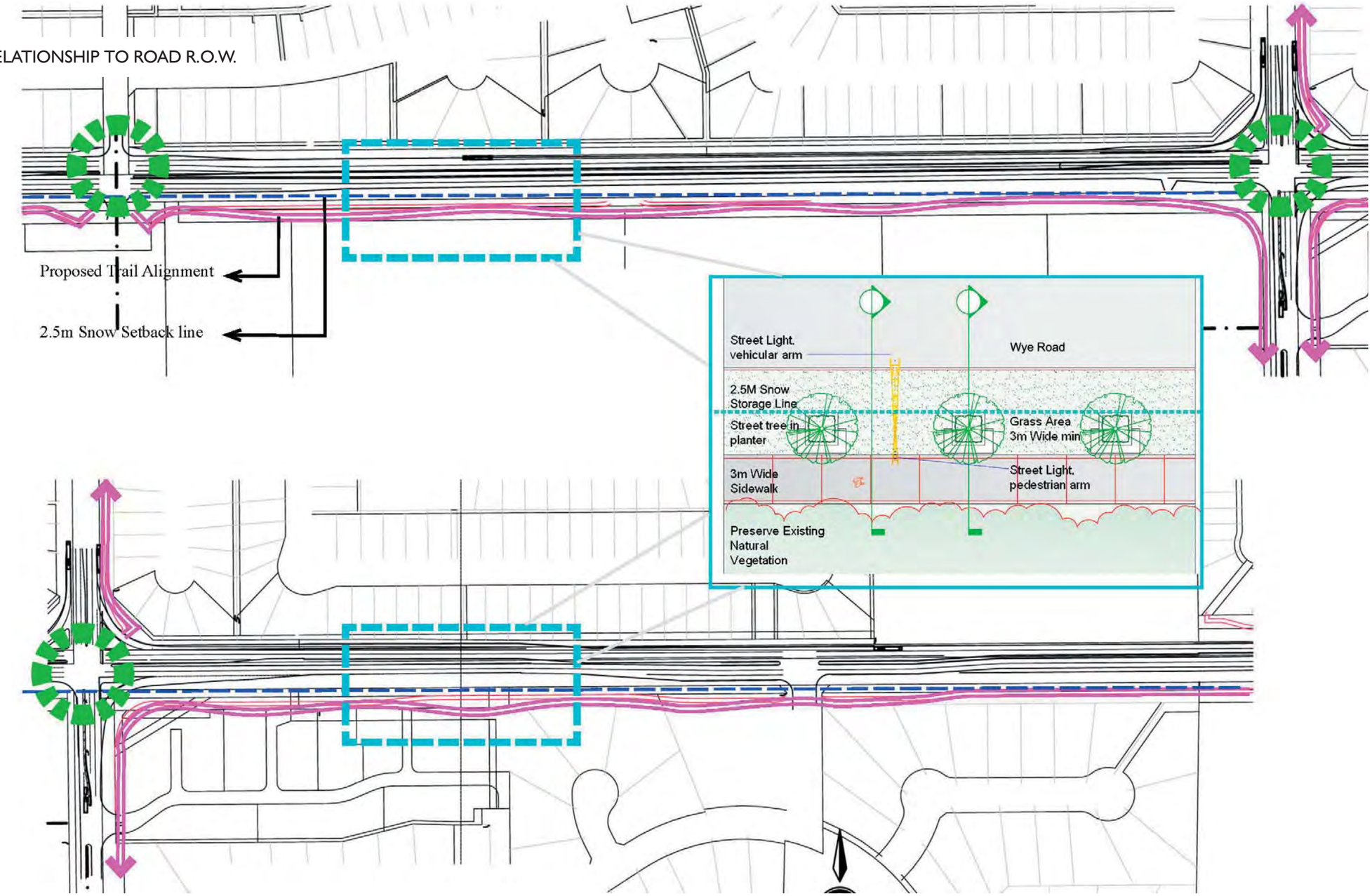
❶ OVERALL TRIAL ALIGNMENT AND PROPOSED SEATING AREAS



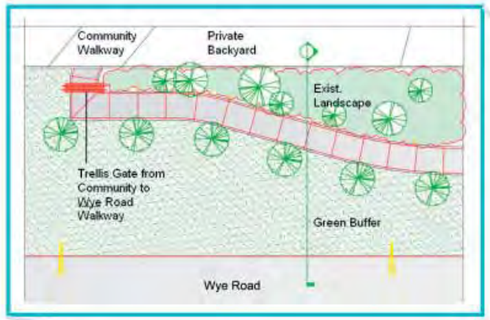
❷ TRAIL ALIGNMENT RELATING TO MAJOR INTERSECTIONS AND CROSSWALKS



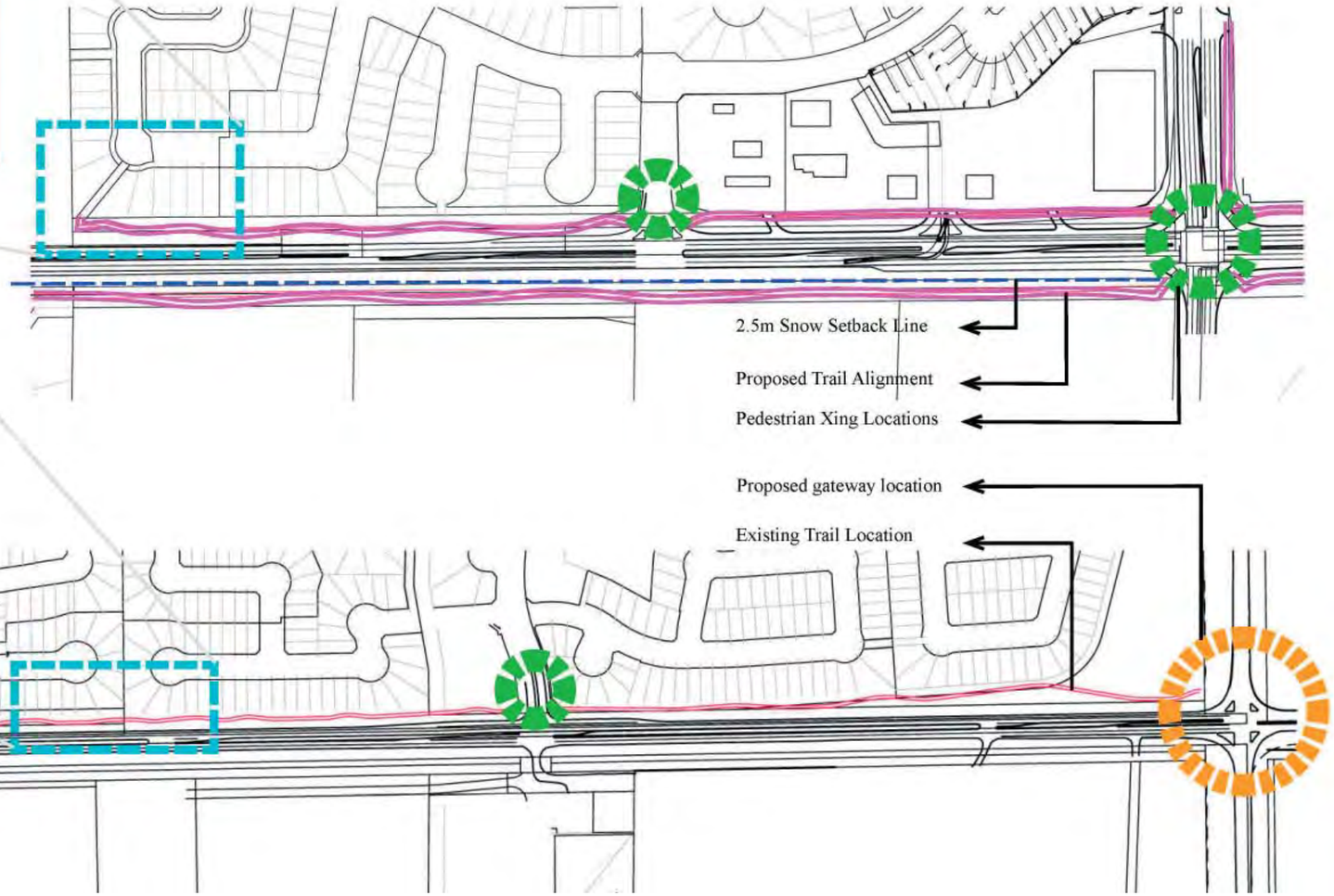
❸ RELATIONSHIP TO ROAD R.O.W.



❹ BUFFER AREAS







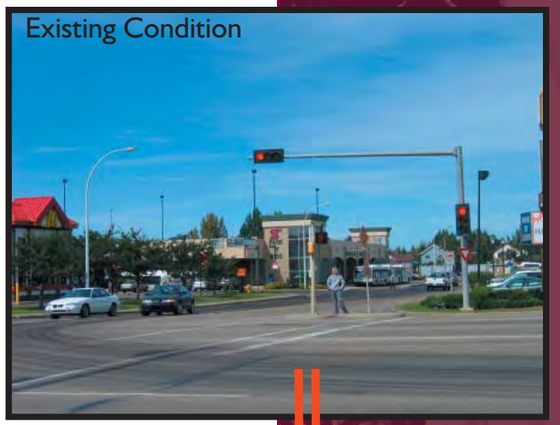
GUIDELINE 24:
ENHANCE THE VISIBILITY AND AESTHETIC QUALITY OF PEDESTRIAN CROSSWALK

EXISTING CONDITIONS/ CONSTRAINTS

(Shown right) is a photograph that illustrates that the pedestrian sidewalks along Wye Road could use aesthetic upgrades and interactive features.

OPPORTUNITIES

Defined pedestrian crossing with special paving; controlled signs. The trail on the south side of Wye Road is the only access to the trail system. Therefore, crosswalks are essential and must be safe and visible with appropriate signage directing pedestrian traffic.





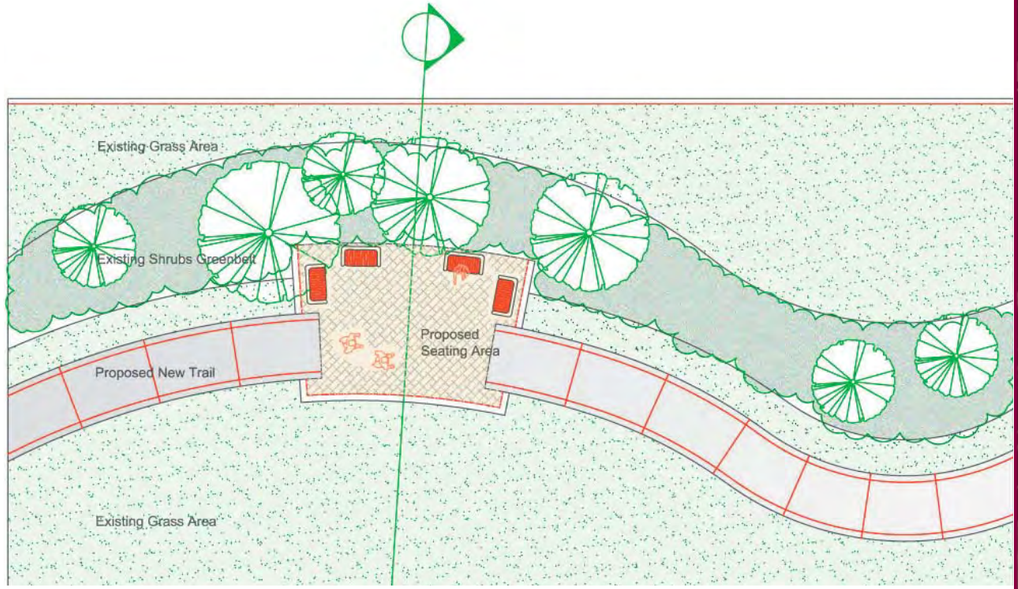


GUIDELINE 3.0
PROVIDE SEATING OPPORTUNITIES

Seating opportunities should be provided where appropriate. In some locations the sidewalk may be widened to create an opportunity for seating.

Seating would be suggested in:
- the museum area
- close to fast food
- trees of distinction and along the trail

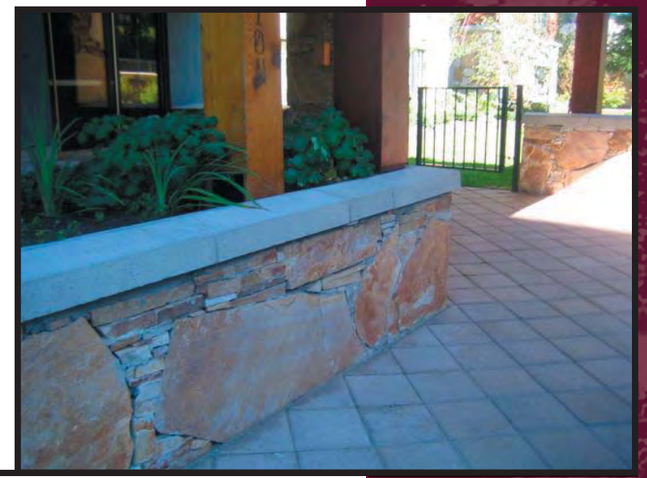
Refer to next sheet for information about site furnishings that would aide the design with seating opportunities





(Right) are examples of how a variety of seating options can define spaces and create site variability





GUIDELINE 3.1
USE SITE FURNITURE CREATE CHARACTER IN STREETSCAPE

OPPORTUNITIES

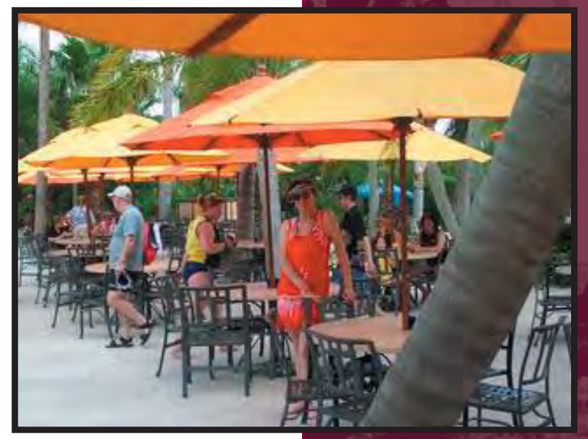
Site furnishings such as benches, lighting, bus shelters, bike racks and trash receptacles should be used to offer comfort amenities to pedestrians. In addition, careful consideration of their design and color provide a tremendous opportunity for defining place and enhancing attractiveness of each zone.

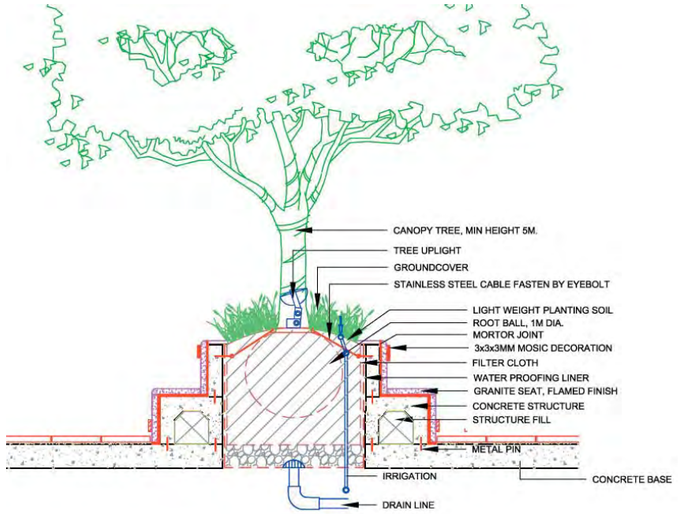
Design should create seating opportunities within each zone's specific and unique condition by using planter seating walls and plaza seating areas. Choose benches, trash cans and all other street furnishings to match street light poles in colour and character.

(Below/ Right) are examples of how changes in seating patterns can transition one space to the next in an open pedestrian environment.

The addition of site accessories such as canopies and garbage cans can also aide in pedestrian flows and the transition of spaces.













GUIDELINE 3.2
CREATE A FOUR SEASON LANDSCAPE THAT IS LOW MAINTENANCE AND SUSTAINABLE

Careful consideration should be given to the selection of plant material to be used in the project area. Minimally, plant selection must consider the visual interest of any plant in all seasons of the year so that their natural beauty can be featured in four seasons.

Plants should also be selected on the basis of the ability to tolerate harsh conditions associated with road rights of way and budget limitations on maintenance funds.

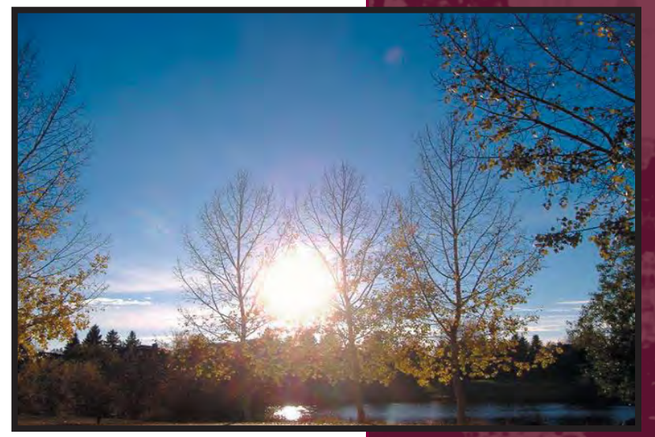
Native species are highly recommended for use along Wye Road for higher survival rate, lower maintenance and sustainability.





Examples shown here illustrate how seasonal vegetation can create changing visual interest year-round

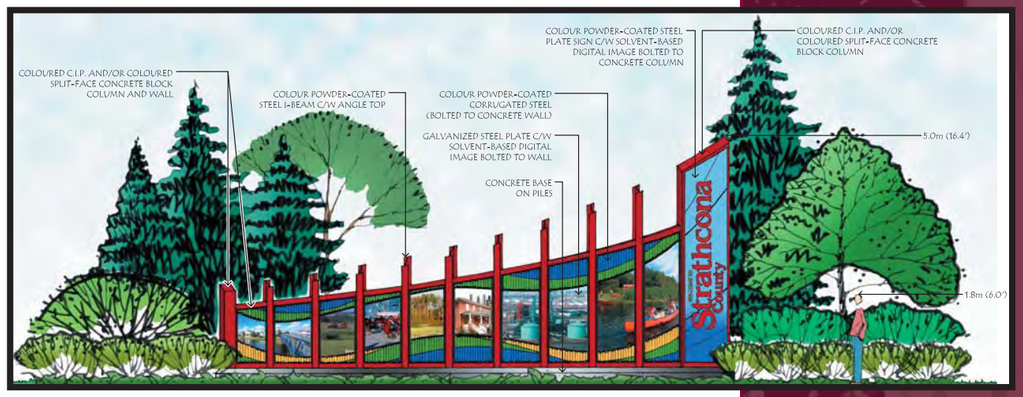






GUIDELINE 4.0
CREATE VISUAL GATEWAYS TO IDENTIFY ENHANCED STREETSCAPE AREA

Council approved gateway feature for Hwy 14



Context map showing gateways





OPPORTUNITY 1
Green Gateway: possible to use on intersection of Hwy 21



OPPORTUNITY 2
Create a sculptural looking vertical element as a gateway feature



OPPORTUNITY 3
Combine with road signs to create gateway

GUIDELINE 4.1
USE SIGNAGE TO HELP DEFINE PLACE AND TO IMPROVE VEHICULAR AND PEDESTRIAN WAYFINDING

Well designed and integrated signage can be instrumental in helping to define the street as a place and for helping people navigate. Traffic signals, utility poles and signage may be combined or featured in their own right to make these necessary elements helpful and place defining elements. Traffic lights may serve two functions by incorporating street signage into the overall framework of the structure. Poles and signage can be coordinated for a more unified look (dark gray is recommended). Graphic signage and ornamental banners can be used to help define place, promote cultural events and improve vehicular and pedestrian wayfinding.

EXISTING CONDITIONS/ CONSTRAINTS

Many existing intersections have no street sign to indicate street names, which may cause way-finding problems for residences as well as visitors.

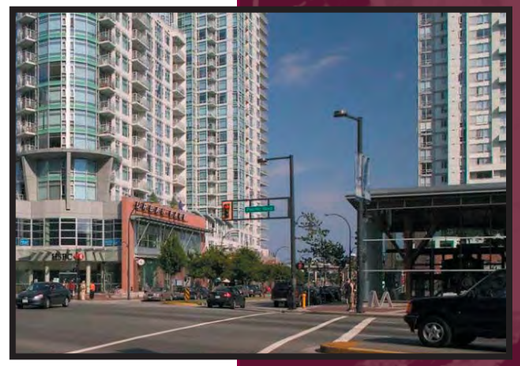


OPPORTUNITIES

Street signs may be free-standing or combine with traffic lights and street lights

Street signs of sculptural interest can also become landmarks in the pedestrian realm









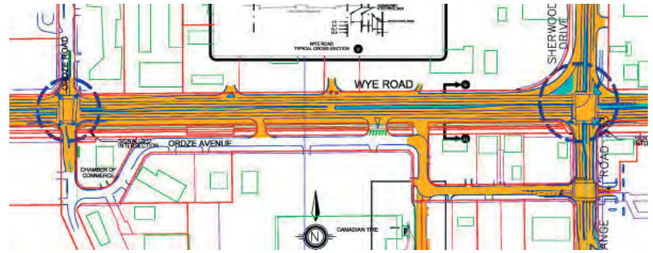
GUIDELINE 4.2
REDUCE VISUAL CLUTTER OF COMMERCIAL SIGNAGE

OPPORTUNITY 1
The example (right) shows a before and after streetscape condition. It is clear that removal, reduction, or better design of commercial signage can have a tremendous impact on the overall desirability of a street. The city may consider signage bylaws that dictate placement, size, and character of any new sign.



OPPORTUNITY 2
Well designed banners and other commercial signs can promote the street's urban feeling and make the road visually more pedestrian friendly. Banners can also promote heritage.





STREETSCAPE

EXISTING CONDITIONS/ CONSTRAINTS

- Between Ordze Road and Sherwood Drive, an existing sidewalk on the south side of Wye Road offers pedestrians little in the way of comfort or safety. The existing sidewalk is located directly adjacent to the roadway making it both dangerous and noisy.
- Existing street signs are not organized.
- Straight sidewalk without any seating.





BUFFER AREA

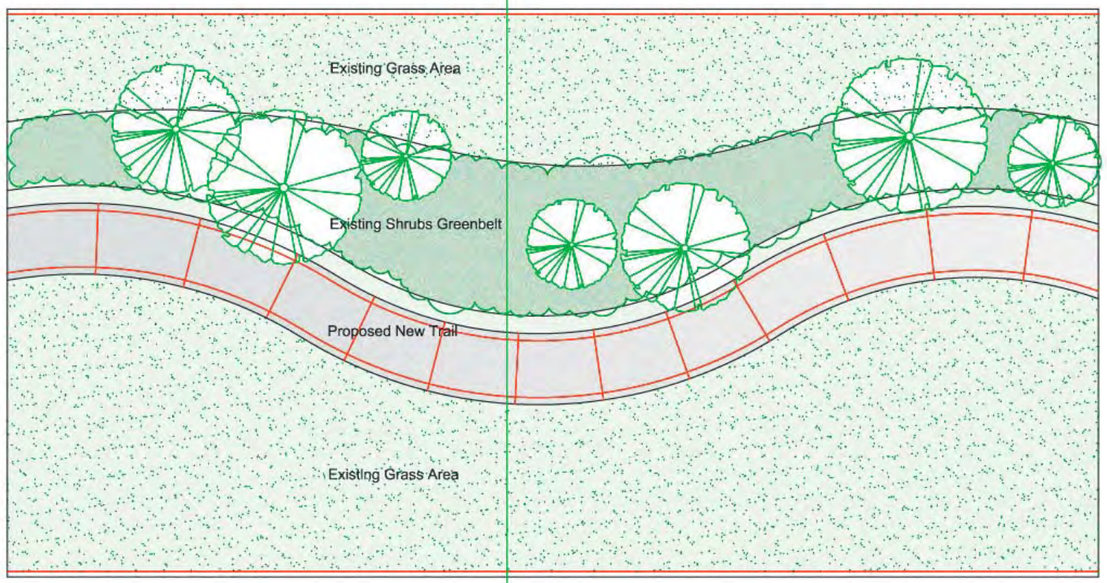
OPPORTUNITIES (EXAMPLE 1)

In the area where Ordze Road parallels Wye Road, an existing 16m wide greenway has the potential to offer a more pleasant pedestrian experience.



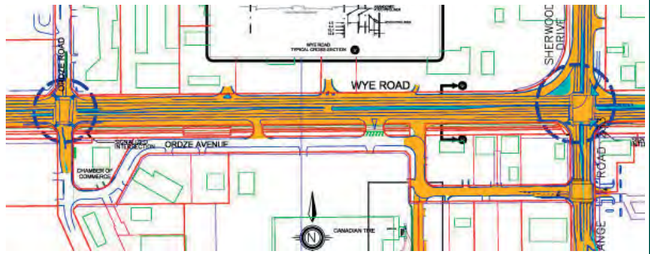


BUFFER AREA



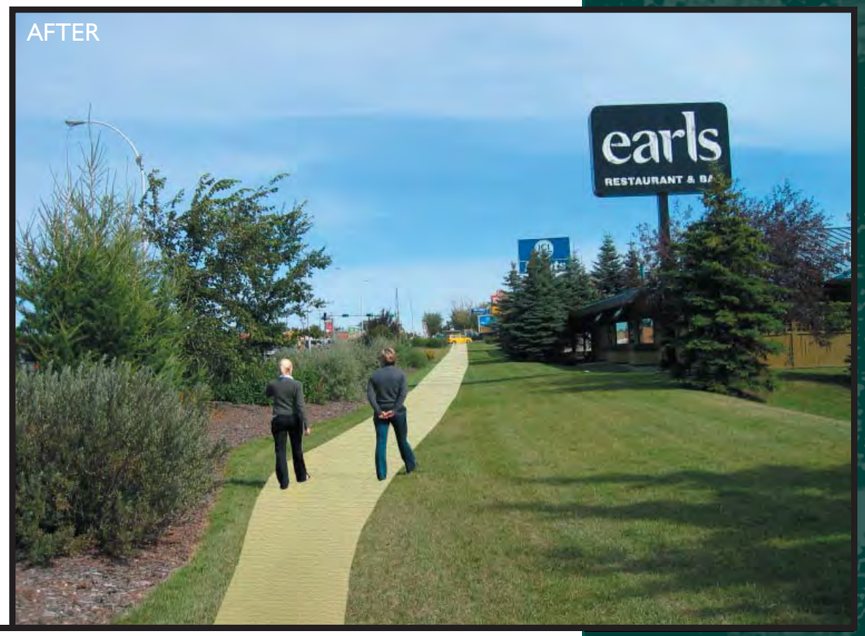


CONTEXT MAP

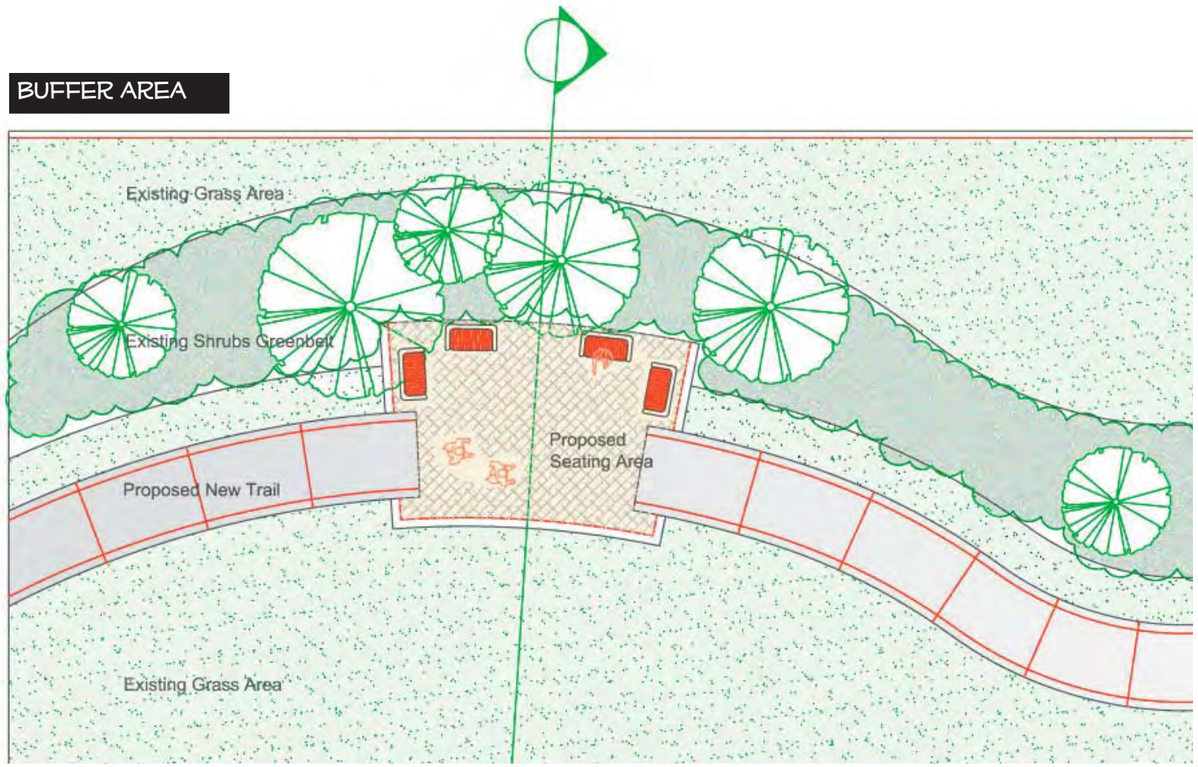


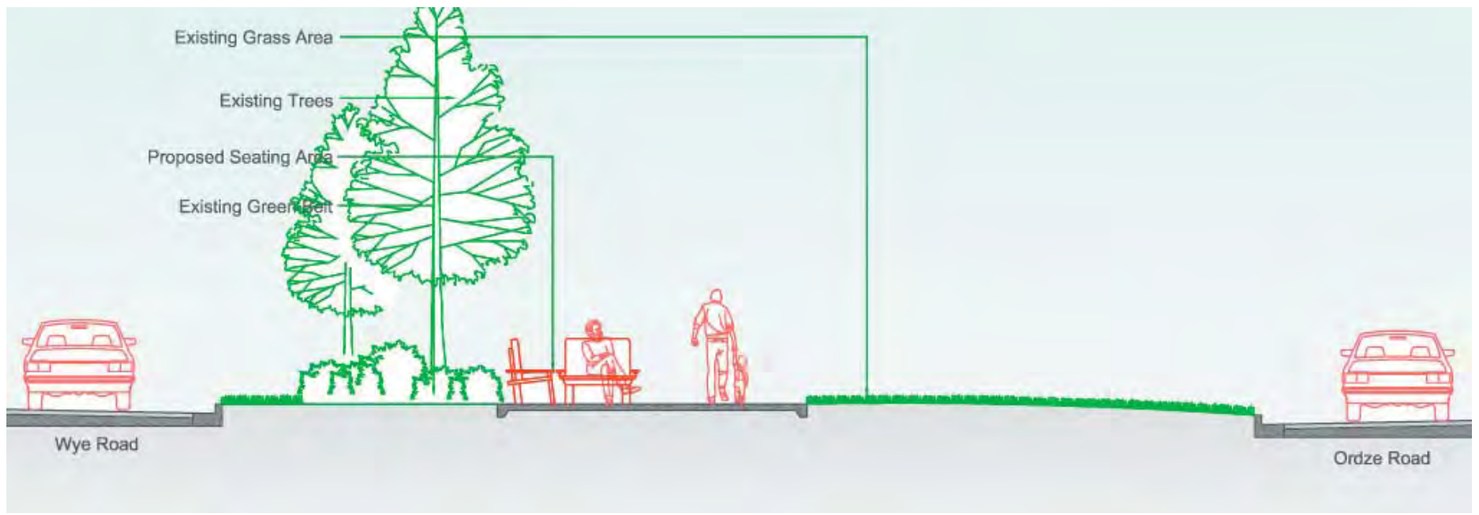
OPPORTUNITIES (EXAMPLE 2)
Shows how planting buffers can define pedestrian and vehicular zones and promote safety

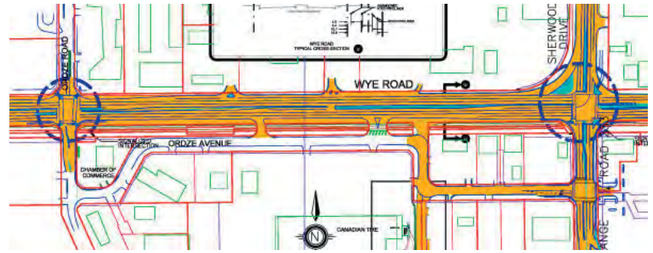
OPPORTUNITIES (EXAMPLE 3)
Shows how moving the pedestrian trail within the green buffer can enhance its function and user enjoyment



ZONE 1: WYE ROAD ORDZE AREA







CONTEXT MAP

OPPORTUNITIES (EXAMPLE 4)
Shows that it is possible to provide opportunity for seating plazas where space is available.

MUSEUM AREA INTRODUCTION

The Museum is an important place defining landmark on Wye Road. Its visibility should be enhanced to be a prominent feature of the street. Development of a plaza in front of the museum would help to create an important node and place for people to meet.

The following pages describe possible opportunities for creating a unique landmark place on Wye Road.

EXISTING CONDITIONS/ CONSTRAINTS

1. Museum is not “highlighted” from the road;
2. Nothing is happening in front of plaza to create a “space” or a “destination”
3. Difficult pedestrian access

CONTEXT MAP



OPPORTUNITIES (EXAMPLE 1)
Museum could be a potential destination on Wye Road

OPPORTUNITIES (EXAMPLE 2)
There is enough vacant land between Wye Road and the Museum to make a plaza to attract people to socialize in this area.



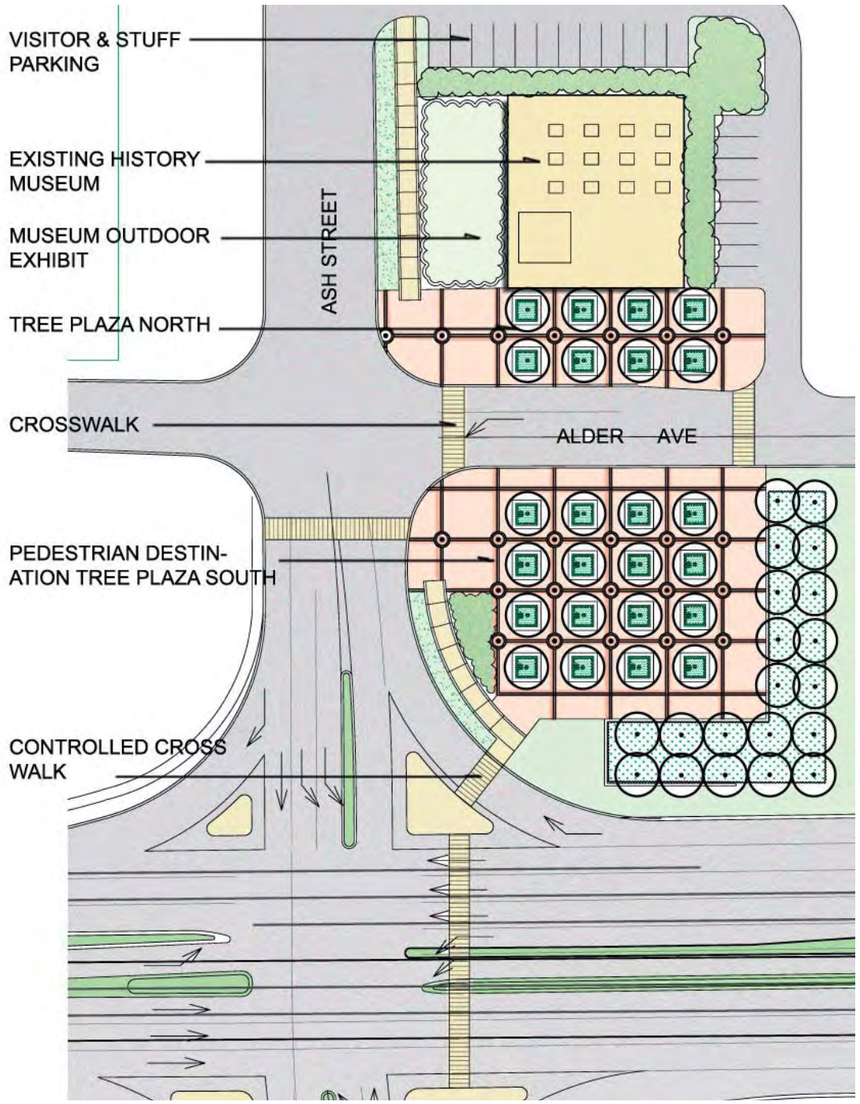




PLAZA CONCEPT

POSSIBLE DESIGN CONCEPT

The graphic shown here illustrates how a patterned geometric design can create a visually simple and readable space; where areas of relaxation and movement can easily be understood by users.

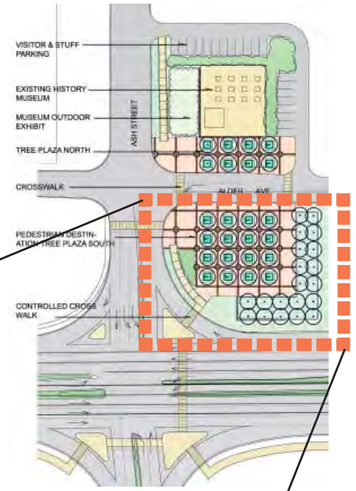


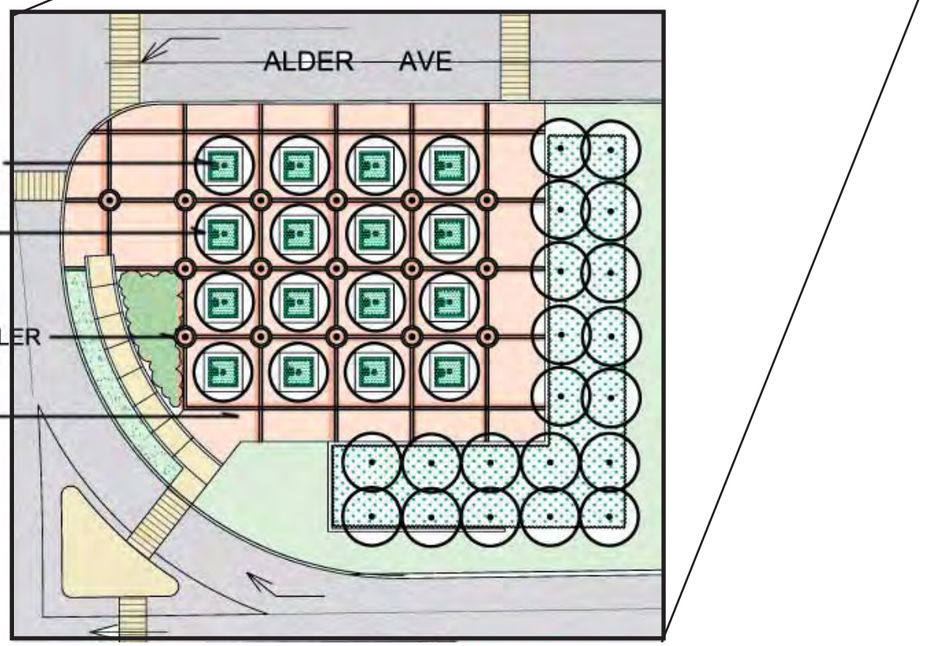


CONTEXT MAP

PLAZA CONCEPT

A tree and fountain plaza would create a destination for people to linger and enjoy themselves in the museum district. This concept provides seating opportunities, fountain bubblers for children to play within, canopy trees to provide shade in summer time and allow winter sun to shine through the branches. A well designed lighting plan can also make this area a spectacular place to view at night.







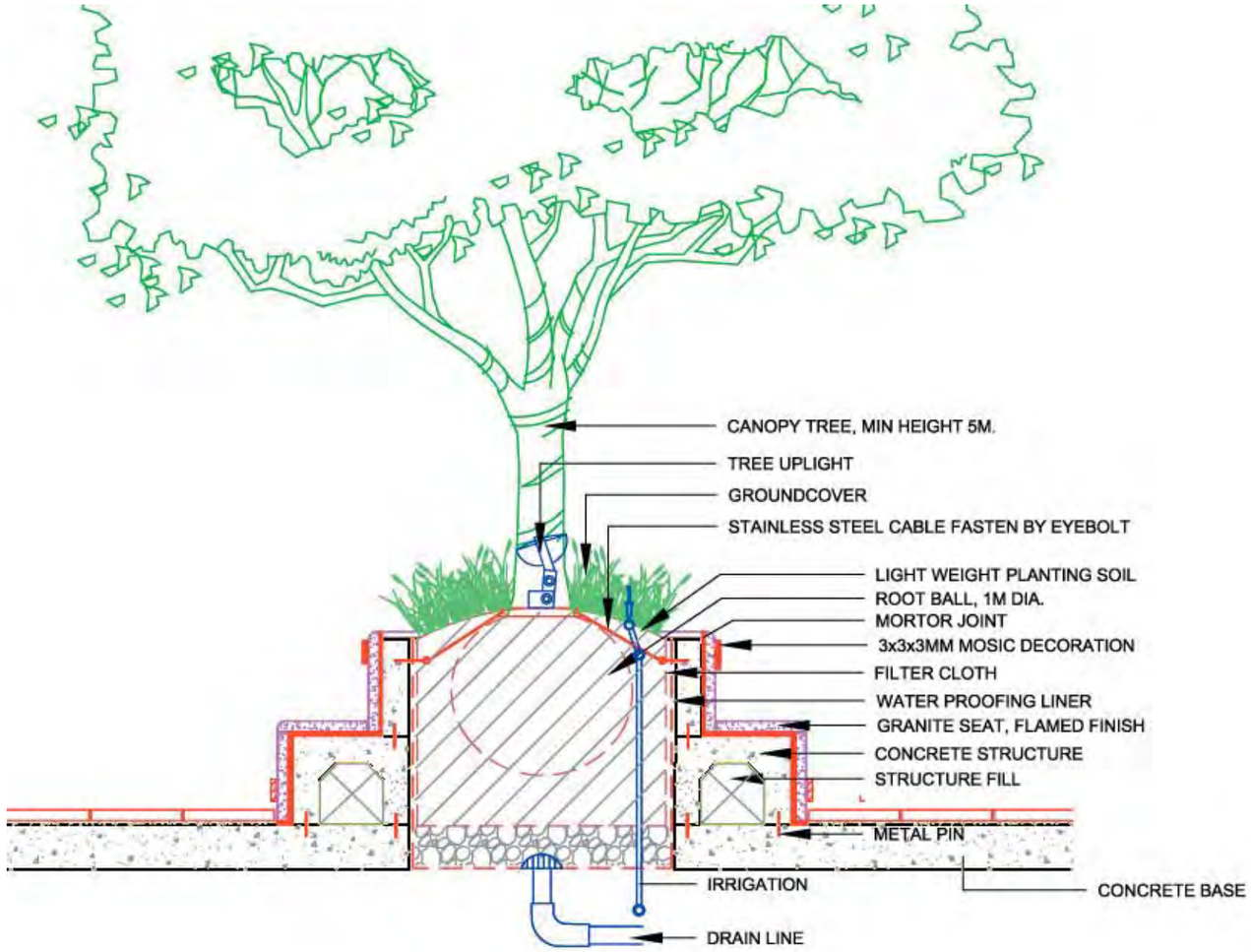
CONTEXT MAP

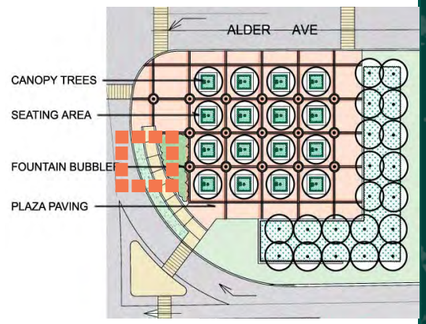
The images (below) corresponds with the concept (shown left) and illustrates that the plaza designed for the museum area can be a visual foci for the community; with changing beauty and function in every season.





PLAZA CONCEPT SEATING





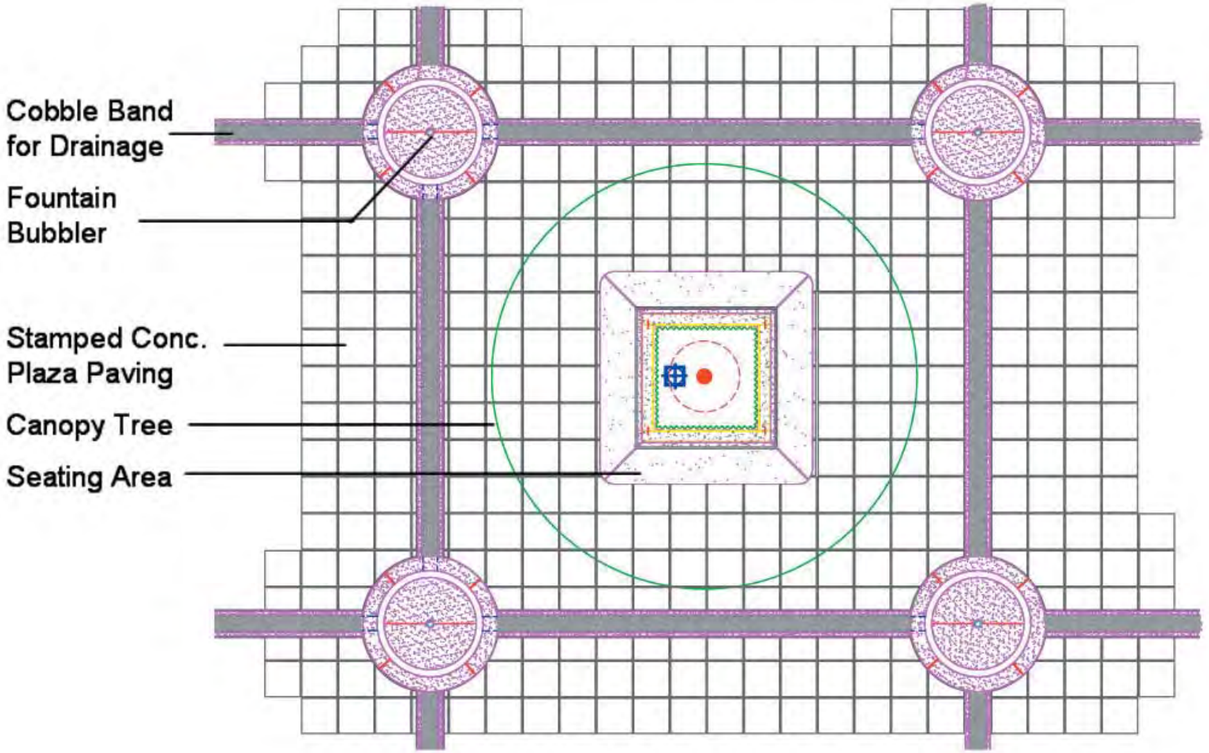
CONTEXT MAP

The design shows a tree planter with a seat wall detail not only for the tree and fountain plaza in front of Historic Museum, but also for use in the typical sections along Wye Road where ATCO pipelines set limitations on planting street trees. The continuity of details along Wye Road and the Museum plaza would make the plaza part of the streetscape design through unity of material, form and function.

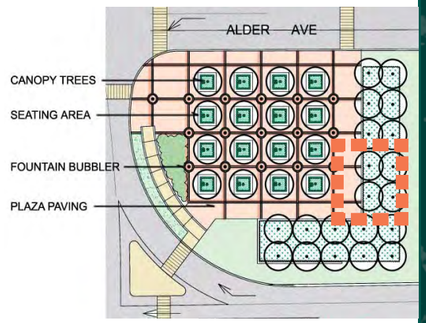


PLAZA CONCEPT ENLARGED LAYOUT

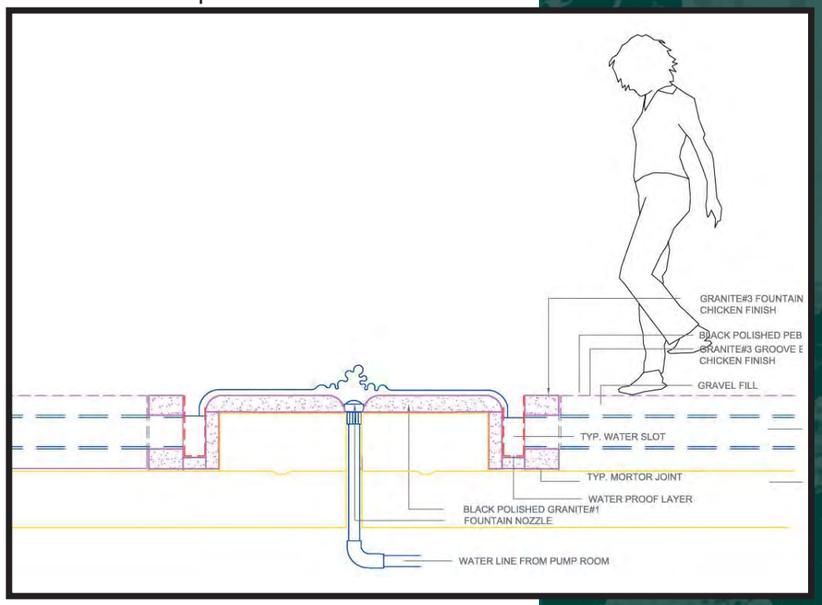
Detail plan showing possible plaza elements and materials.



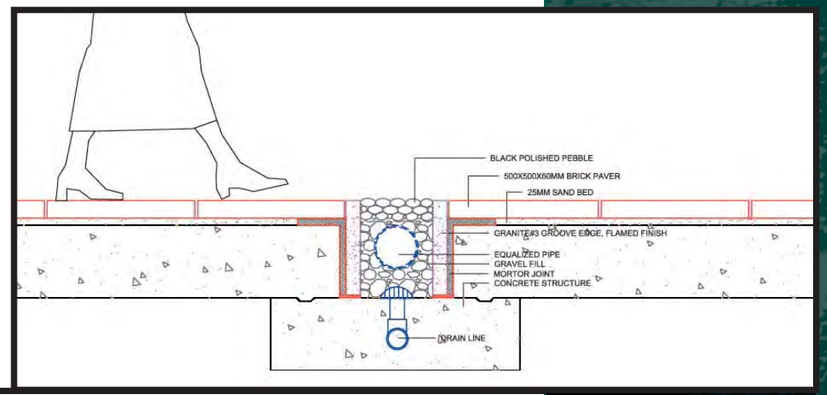
CONTEXT MAP



Section showing possible character of water feature element in plaza.

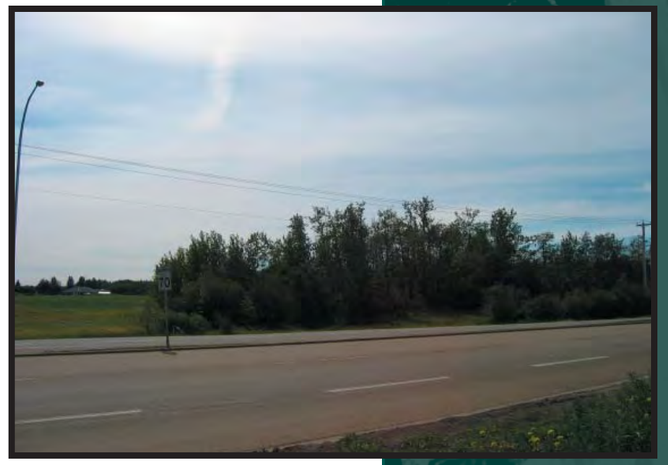


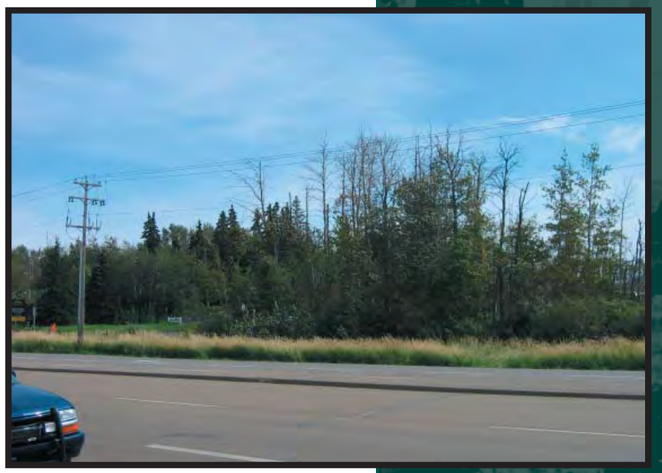
Detail section showing possible plaza elements and materials

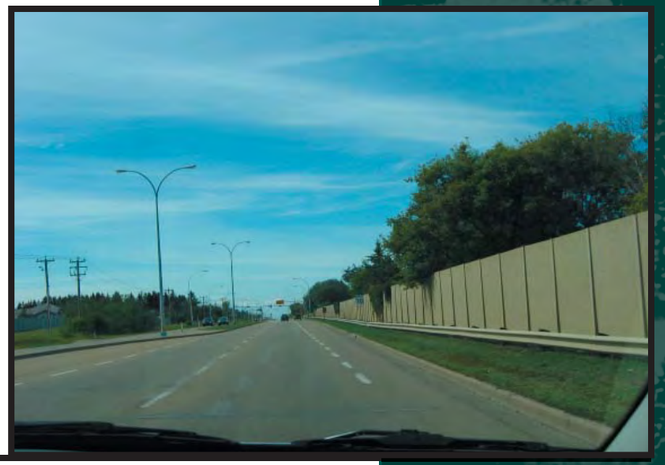


ZONE 3: HAWTHORN STREET AREA (TYPICAL STREETSCAPE)

INTRODUCTION







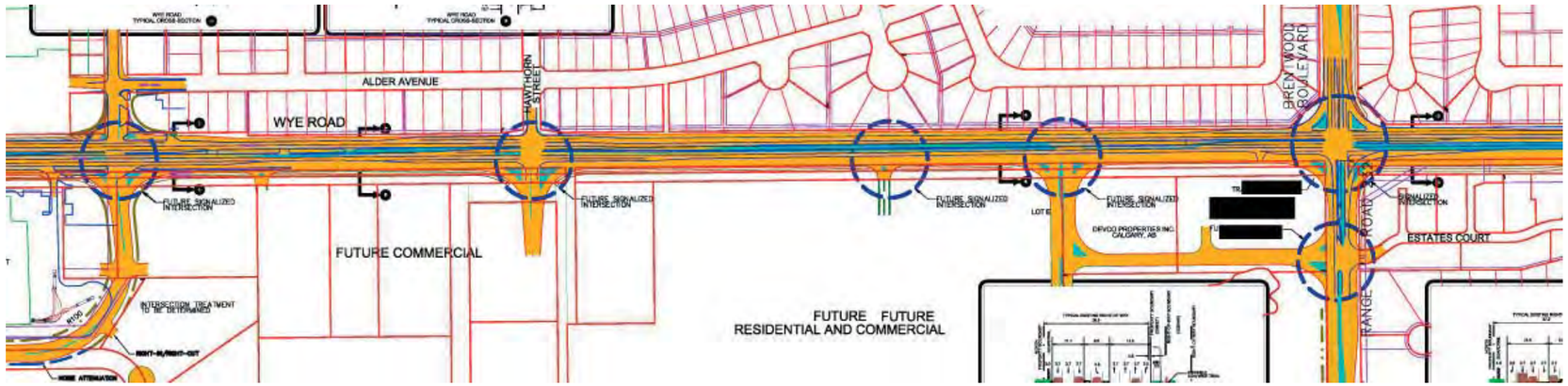
EXISTING CONDITIONS/ CONSTRAINTS

1. Limited space between private properties and Wye Road curb line.
2. ATCO pipeline right-of-way makes it difficult to plant big trees;
3. Existing street lights not attractive; they do not address pedestrian needs and location varies from both sides of road to center of median.
4. Existing sound wall looks very harsh.

OPPORTUNITIES

1. Enough space to create at least 3m buffer between trail and Wye Road
2. Good natural landscape exists within some private properties

CONTEXT MAP

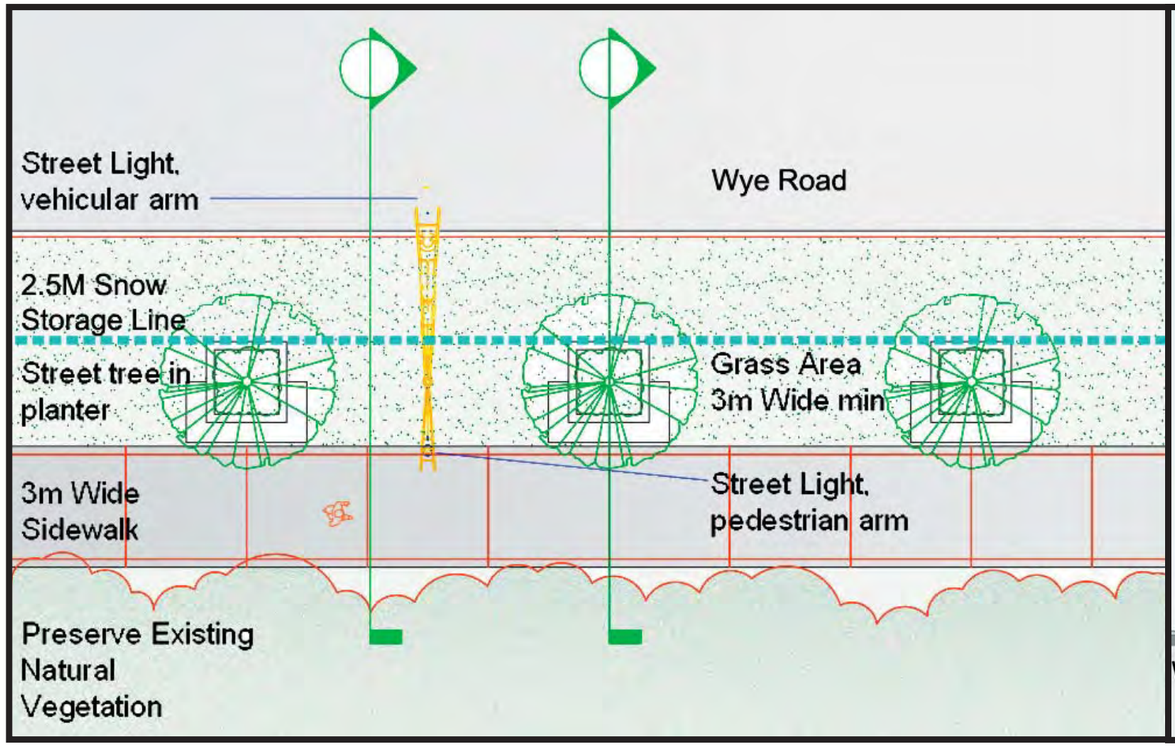


STREETSCAPE PROFILE

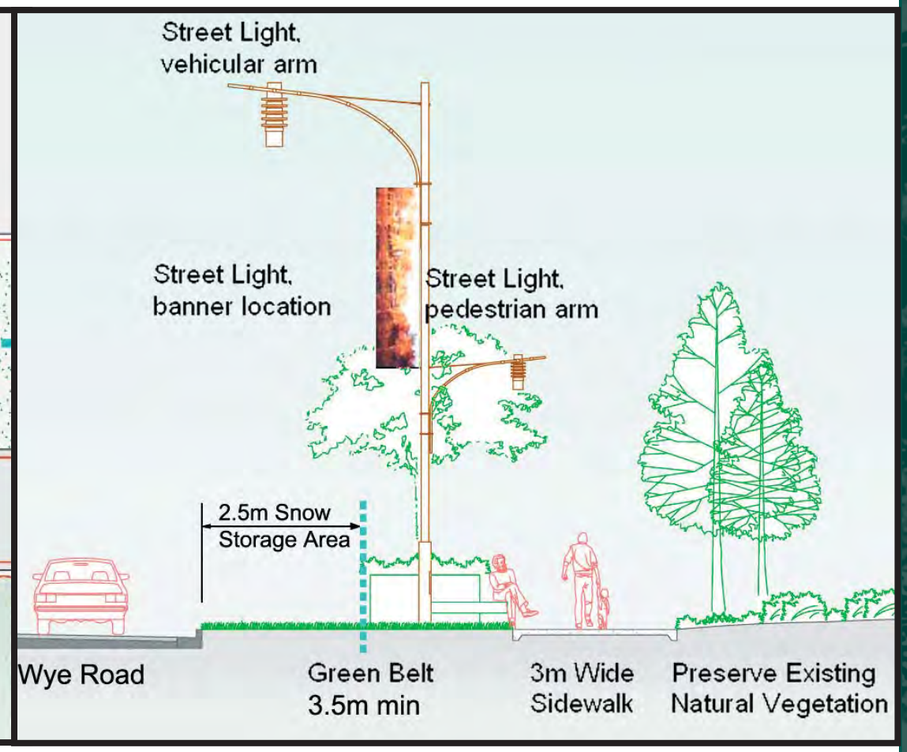
OPPORTUNITIES

1. Provide minimum 3 meter green buffer between trail and Wye Road curb line;
2. Plant trees in planters which could combine with seat wall (provide both street tree and seating);
3. Choose a street light which has two arms: one vehicular arm and one pedestrian arm. Select and locate street lights in a manner which provide both night safety and aesthetic value.
4. Street light poles also provide opportunities to organize banners.
5. Sound Wall solutions see Design Guidelines -- Aesthetic Quality

Below is an overview of the clean transition from pedestrian to vehicular zones using street trees and landscape buffers

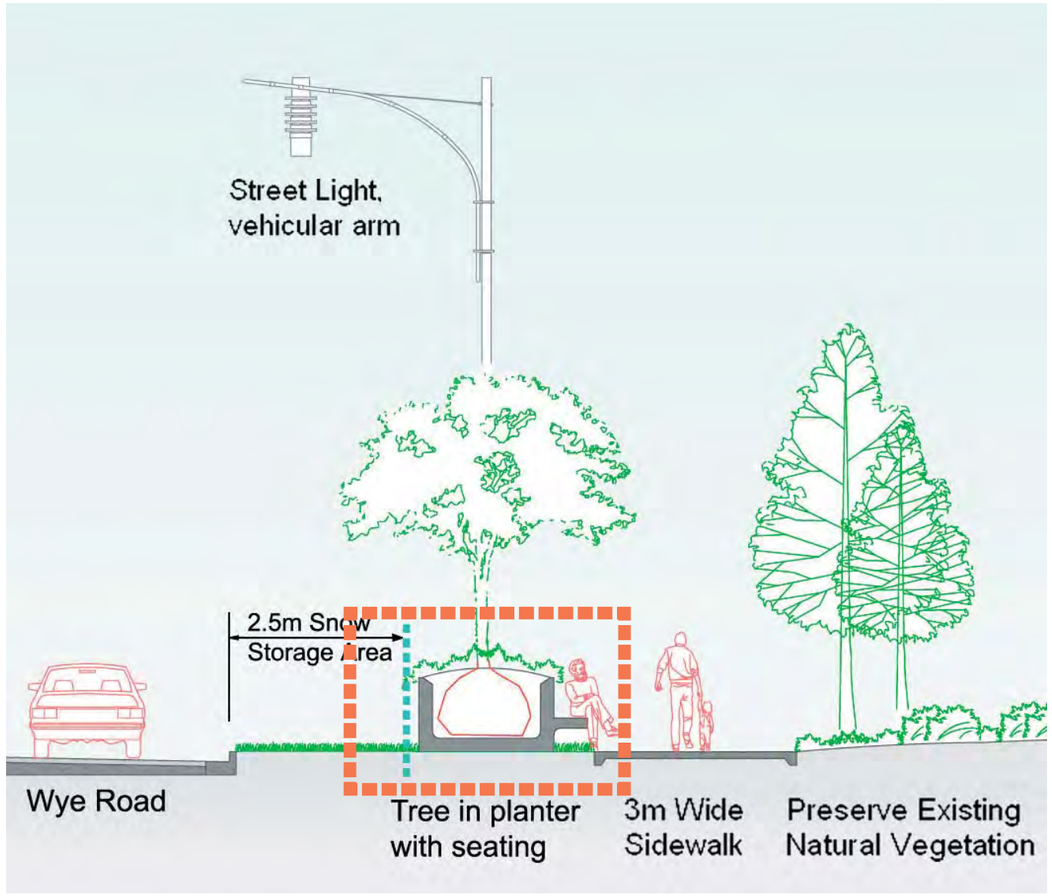


Below shows how lights, seating, and signage can aide in the transition of spaces



STREETSCAPE PROFILE

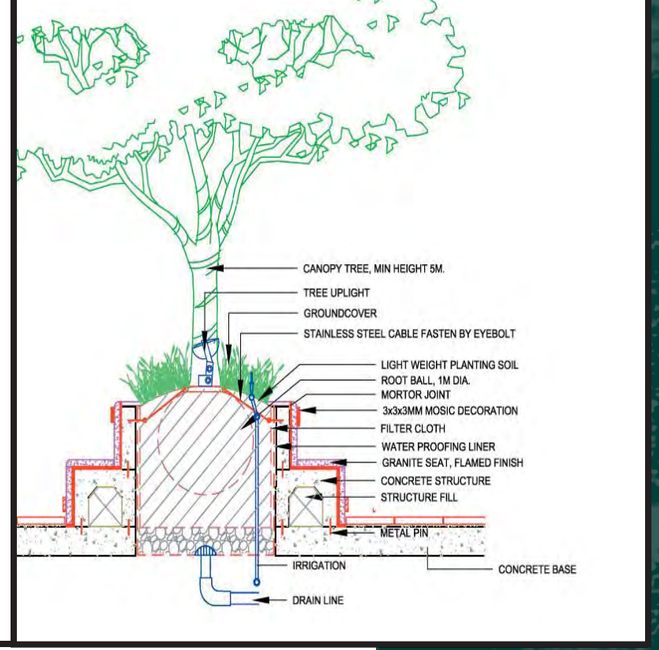
An enlarged detail shown below illustrates how raised planters can provide plant protection and additional seating options



The image shown right shows how dual-armed lights can function in both pedestrian/ vehicular settings



The detail shown right shows how a planter seat wall can be built consistent with the museum zone



MANAGEMENT OF EXISTING VEGETATION

Conservation of natural vegetation is very important to Wye Road Streetscape, especially the south side of the road. Existing condition of natural vegetation on the south side the roadway is very good, which provides the green background for the built concrete road system.

The green buffer makes the experience for both pedestrians and drivers more pleasant. The variety of natural plantings maintains a connection between the growing urbanization of Sherwood Park and the surrounding native landscapes

Natural vegetation conservation will also assist in making Wye Road distinguished from all the other roads in Sherwood Park.

The images shown right are examples of how the preservation of vegetation can maintain the natural beauty and scenic quality of a corridor









INTRODUCTION

EXISTING CONDITIONS/ CONSTRAINTS

A. No pedestrian lights for night use
B. Not connected to existing community trail

OPPORTUNITIES
A. Existing landscape area uses native grasses and other local species, which is very effective;
B. Some existing trees could be preserved;
C. Could connect to community and bring residents easy access to Wye Road trail from neighborhoods.

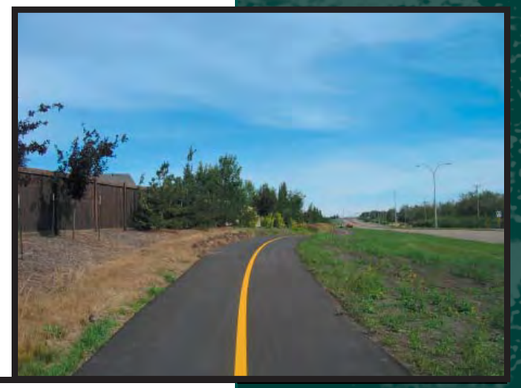
CONTEXT MAP



Images shown right depict existing areas of landscape development







OPPORTUNITIES

A. Provide access to community with a small gateway sign
B. Preserve existing trees and existing green area along the trail
C. Provide bollard lights for pedestrian and single arm vehicular light to match typical.
D. Could provide seating plaza with spacious seating
E. Consider a seating area around two Bur Oaks (Trees of Distinction)

Planters in plaza settings provide spaces for possible signs of "Trees of Distinctions" and emphasize visual nodes

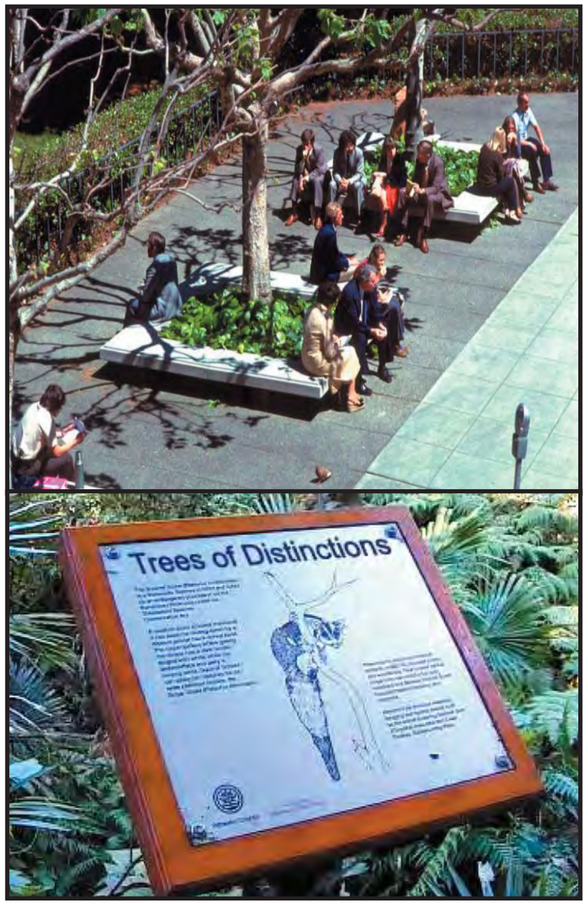
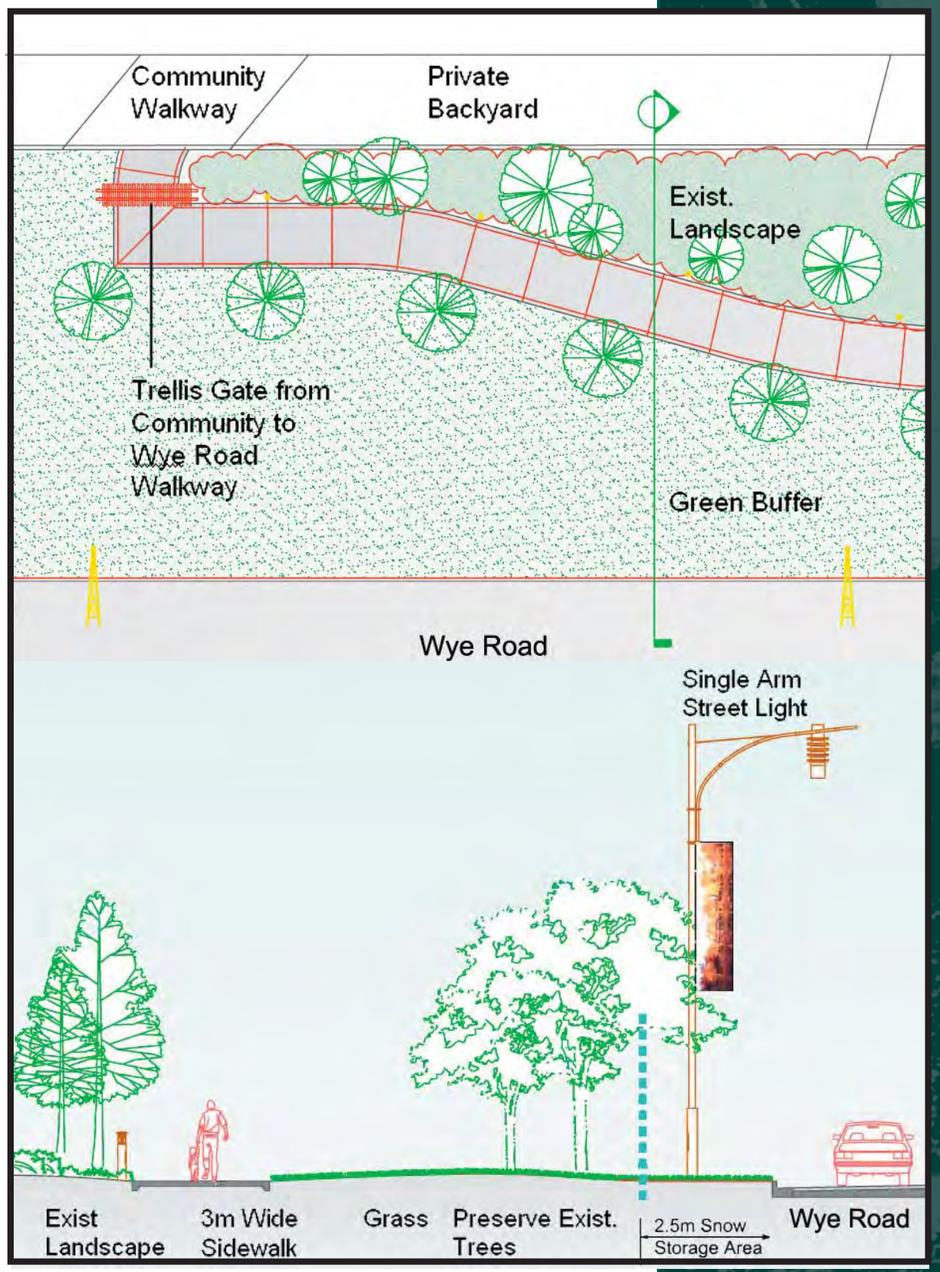
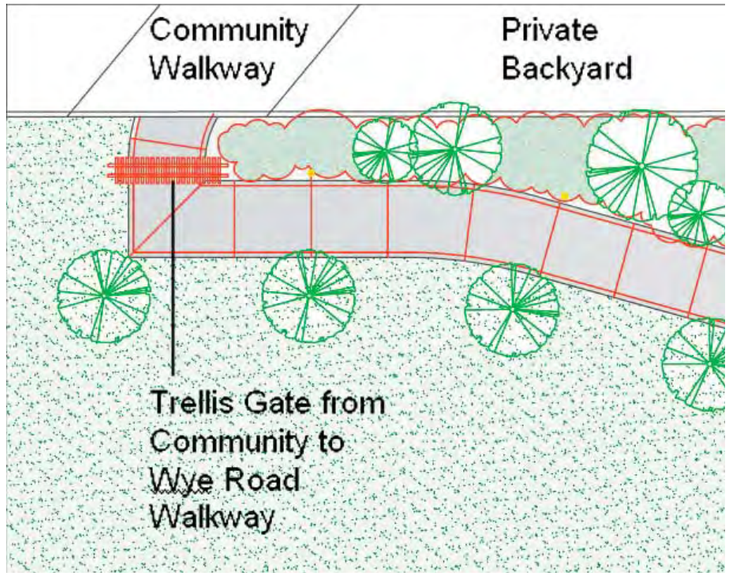


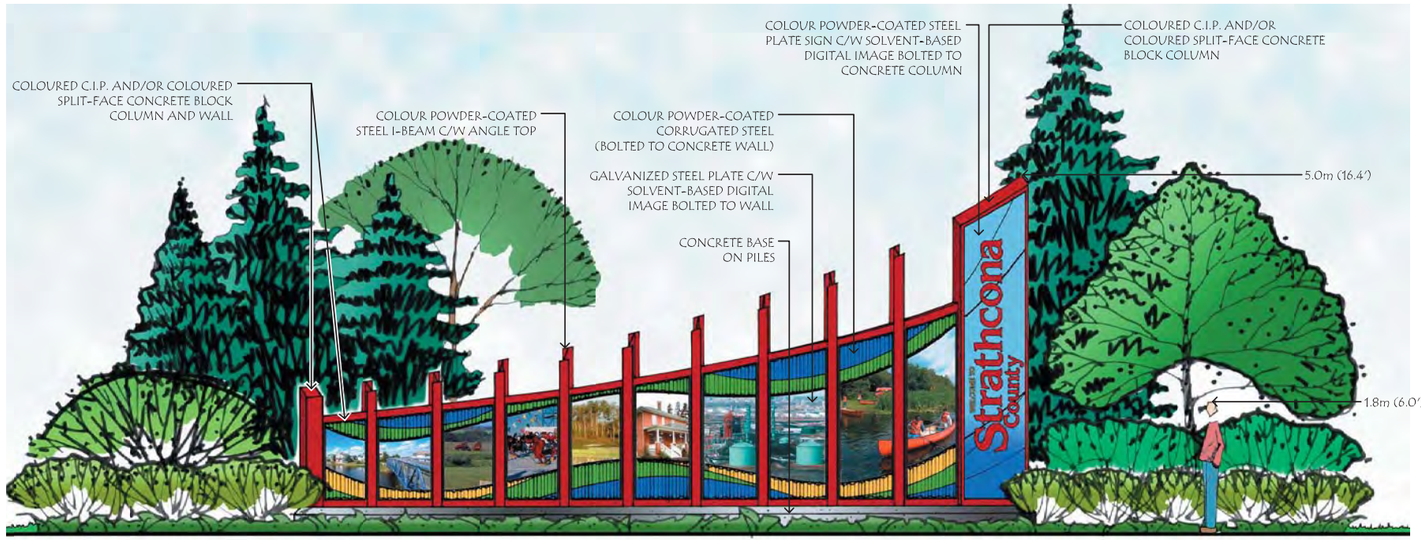
Diagram showing trellis gate from community to Wye Road Walkway



TRELLIS & GATEWAY OPPORTUNITIES



Council approved gateway feature for Hwy 14



Possible trellis gate style



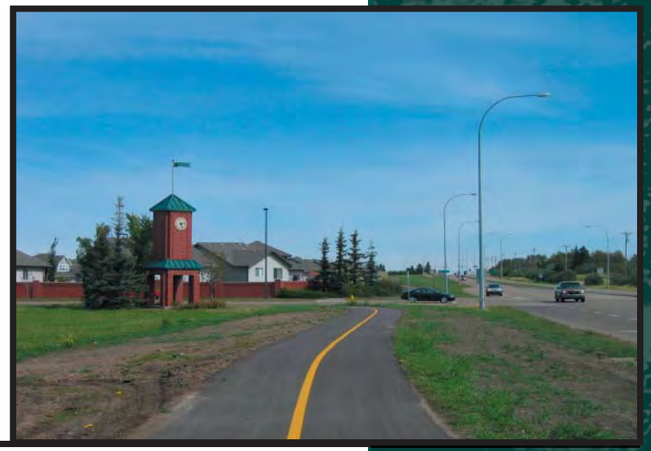
Possible community archway entry style



Below are examples of architectural features used in gateways







INTRODUCTION

The lighting of Wye Road and its surrounding secondary roads is critical in creating atmosphere for both pedestrian and vehicular traffic.

Streetscape lighting should be selected on the following criteria:

- Light fixtures can illuminate both sidewalks and roads which aide in street safety
- If selected properly, lights can have attachments such as signs, banners, or hanging baskets - all which are items that denote streetscape character and wayfinding
- If selected properly, lights can have detailing that emphasize a 'contemporary western with a touch of historic charm' theme

The following section shows four lighting options that exemplify the characteristics described. The first two options are suggested for a primary road (Wye Road) environment, and the following two options are suggested for a secondary road (Ordze, Nottingham, Hawthorn) environment.



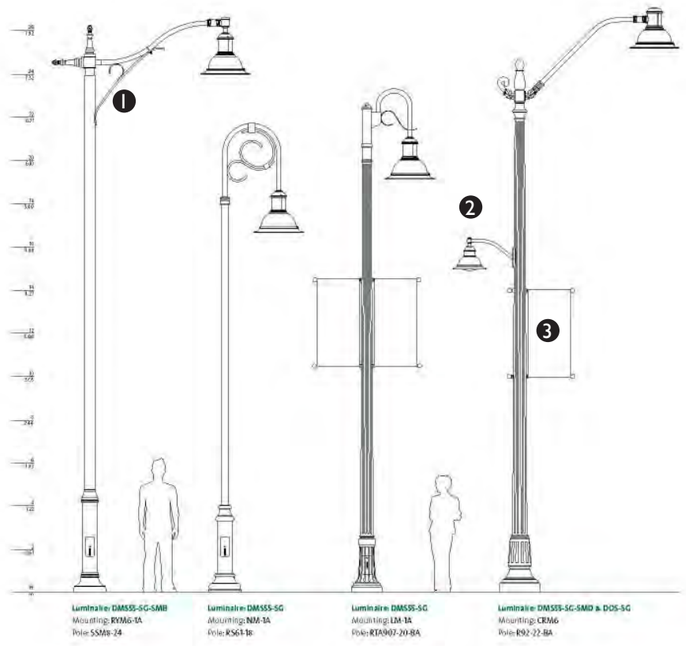


Images
by Lumec
Lighting

SUGGESTED PRIMARY ROAD LIGHTING (WYE ROAD)

OPTION 1: DOMUS SERIES
BY LUMEC LIGHTING

This series was selected as an option because its silhouette appears clean, yet rustic through an antiqued approach to edging and detailing the heads and bases of the poles. The streetlights are reminiscent of old western lamps and could set the tone for the streetscape.



1. The light features have a rustic aesthetic quality
2. The light features have arms suitable to illuminate both pedestrian and vehicular areas
3. The light features have options for signage attachments that could aide in creating a defined streetscape





Note: Images are sourced from Lumec Lighting (www.lumec.com) and illustrate lamp features and past installations.



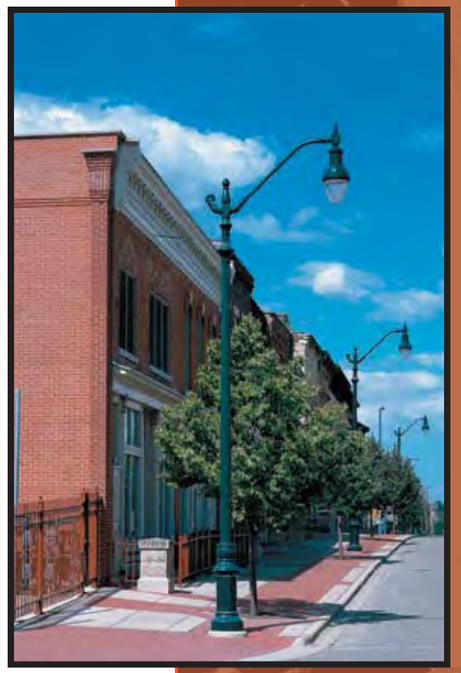
Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

SUGGESTED PRIMARY ROAD LIGHTING (WYE ROAD)

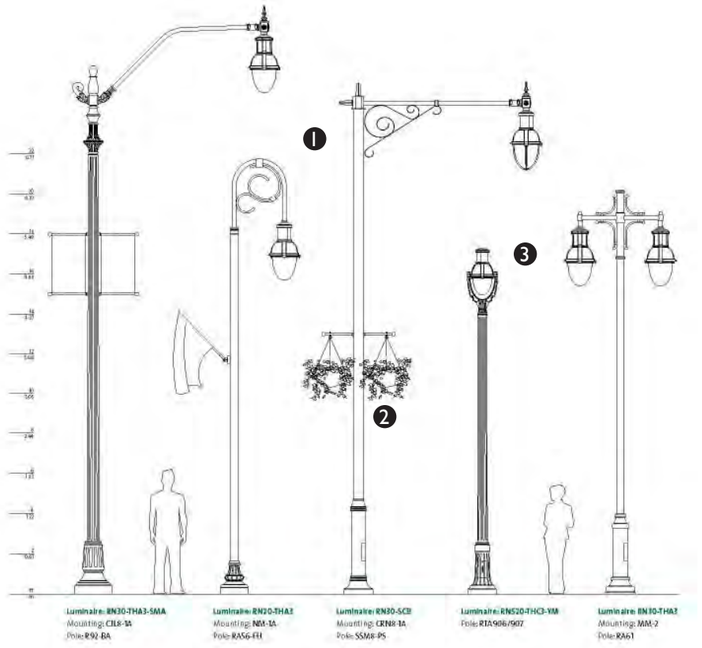
OPTION 2: RENAISSANCE SERIES
BY LUMEC LIGHTING

Like the Domus series, the Renaissance series offers a rustic antiqued look that would work well within the theme. Additional opportunities offered by the Renaissance series are listed below.





Note: Images are sourced from Lumec Lighting (www.lumec.com) and illustrate lamp features and past installations.



1. The Renaissance lights show more of an antiqued character than the Domus series and offer more variability in choice (i.e. fixtures can extend from long arms, can be top mounted, hang at varying levels, or be dual-lit)

2. There is a variety of choice for mounted features ranging in hanging baskets, flagged signs, or banner signs. Hanging baskets would be optimal for the contemporary western theme in the summer months. They would provide an opportunity to introduce colourful perennial or annual plants to the streetscape which would accentuate the colours of mass plantings in medians or areas of distinction. They denote a classic streetscape character. However, a banner or flagged sign could contribute to streetscape character through the colder months of the year.

3. The wide range in height options is great for providing transitions through spaces because all the lights could maintain the same aesthetic look but be of varying heights depending on the need for light intensity (i.e. moving from the pathway to the road you could use top mounted short poles and transition them into tall arched streetscape poles)



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

SUGGESTED SECONDARY ROAD LIGHTING (ORDZE, NOTTINGHAM, HAWTHORN)





Note: Images are sourced from Lumec Lighting (www.lumec.com)
and illustrate lamp features and past installations.

OPTION 1: NEW-WESTMINSTER SERIES
BY LUMEC LIGHTING

The following options were selected because they represent common contemporary light fixtures yet could contribute to a western theme through their subtle touches of rustic detail. Such level of detail is recommended for transitioning from a primary road (Wye Road) to a secondary road (Ordze, Nottingham, Hawthorn)

The fixtures shown here would emit a soft, round light. Areas requiring more light intensity (i.e. trellis gates or the pathway) could have wall-mounted or bollard lights.





Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

SUGGESTED SECONDARY ROAD LIGHTING (ORDZE, NOTTINGHAM, HAWTHORN)

OPTION 2: CALLISTO SERIES
BY LUMEC LIGHTING



The fixtures shown here would emit a more focused light compared to the New-Westminster series.

Their form and detailing also yield an aesthetic quality more appropriate to the theme.

Like the New-Westminster series, this series of lighting offers wall mounts and bollard-light options which is suitable for areas needing light intensification.









Note: Images are sourced from Lumec Lighting (www.lumec.com) and illustrate lamp features and past installations.

Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

INTRODUCTION

Providing residents and visitors with various seating opportunities can contribute largely to extending people's length of stay when walking along Wye Road and surrounding streets.

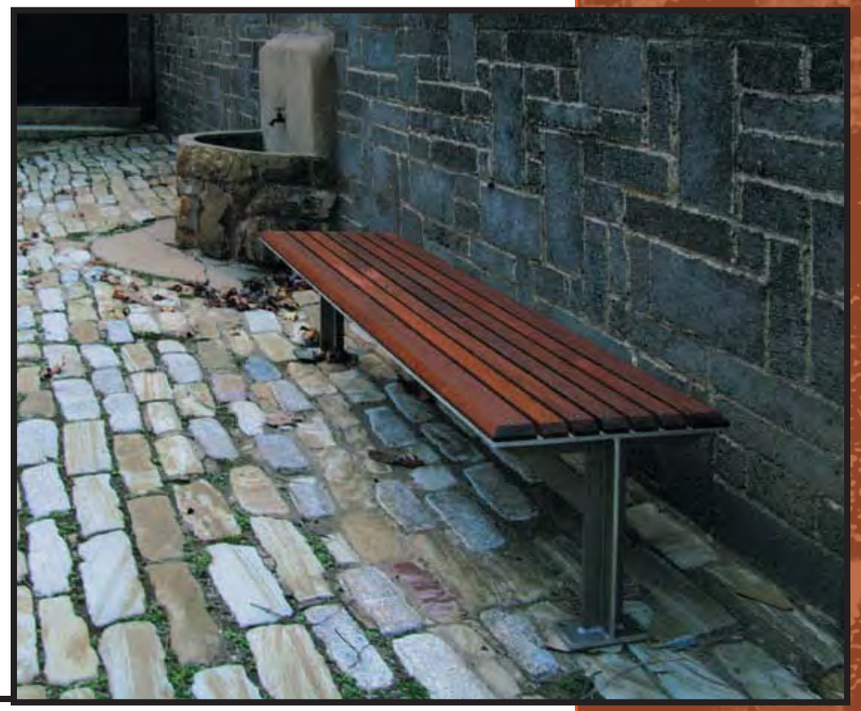
Increased pedestrian usage of the streetscape will aide in traffic calming, as drivers will be more prone to slow down. Seeing more people out on the street will also encourage drivers to stop and investigate the surroundings.

The following options discuss the material options for seating accessories and suggest detailing options available that would correspond with the theme.

It is important to note that whatever preferred material combination is used (be it wood/metal, metal, metal/stone); that subsequent site accessories follow a similar material combination to create a cohesive streetscape appearance.



Bench by Timberform showing rustic quality through a wood/metal combination and antique detailing.



'Knight' backless bench by Forms and Surfaces

BENCHES

OPTION 1: RUSTIC SEATS WITH A CONTEMPORARY FRAME

The use of wood is reflective of historic benches and a western theme. Using a metal frame in contrast to a wood base is suggestive of an 'edgy' contemporary element- something worth considering for site furnishings in respect to the theme.



Right (Top): The 'Knight' bench by Forms and Surfaces.

Right (Middle/Bottom): Examples of backless benches offered by Maglin. Refer to www.maglin.com for further information.





Below are various examples of wooden benches by Maglin.
Refer to www.maglin.com for further information.



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

BENCHES





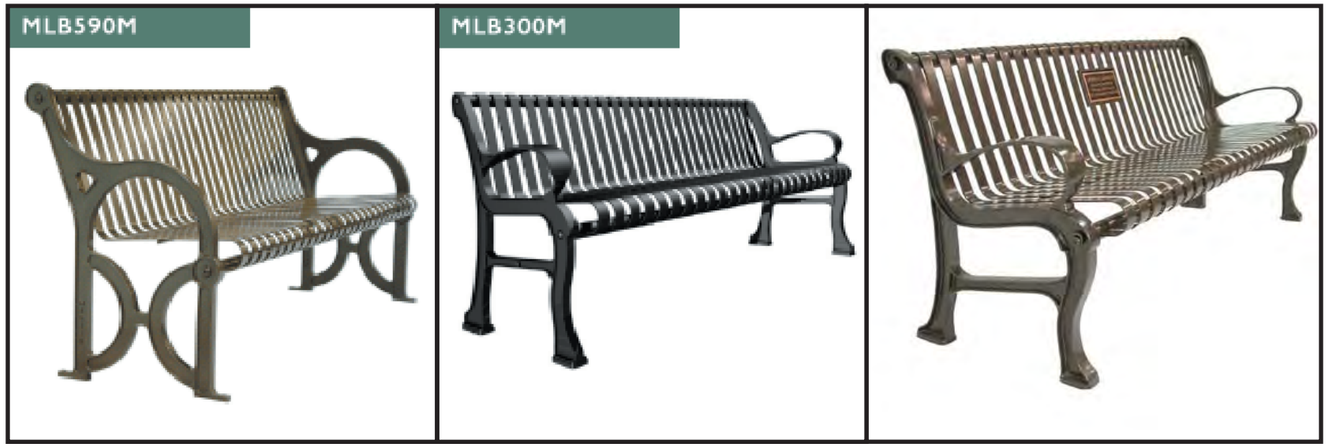
Above: Examples of bench customization through using a logo (shown top left) or a dedication plaque (shown right) which signifies a donation made from or in honour of a community member.

OPTION 2: A HARD FRAME WITH RUSTIC DETAILING

Metal benches are often an optimal choice for their reputation in withstanding weathering. If a metal bench is preferential, then it is recommended that one is selected with a rustic/antique character. Examples of curved and details edges that present such rustic quality are provided below.

Additional: Page 72 discusses the creation of custom planters which would serve the dual purpose of seating walls. It is possible that the stone base suggested for the planters could also be used for the base of benches. Wood or metal could then be used to top off the bench base for a complete and custom made appearance.

Below are three examples of benches by Maglin that suit the theme. Refer to www.maglin.com for further information.



Below: An example of circular bench customized to a site.



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

TABLES & CHAIRS

The following are options for areas where grouped seating may occur. It is recommended that tables and chairs selected be of the same material combination and colour as the benches.



Left: An example of a chess table by Dumor Inc.

Left: An example of a metal table and chair arrangement by Dumor Inc. Refer to www.dumor.com for further information.



Above: An example of an umbrella used in a table setting by Forms and Surfaces. Umbrellas may be great accessories for seating areas in full sunlight.





Right: Are three options of wood/ metal seating arrangements offered by Maglin.



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

INTRODUCTION

Streetscape accessories largely contribute to a sites ‘sense of place’ and overall character.

Accessories can include anything from manhole covers to bikeracks and should always be selected with the theme in mind. The following accessory options provided are intended to coordinate with the preferred seating and lighting options.

Streetscape accessory options include:

- Bikeracks
- Drainage covers
- Bollards
- Garbage, Ash, Recycling Receptacles
- Moveable Planters
- Tree guards
- Themed detailing



A contemporary planter arrangement by Ironworks Ltd.

BIKE RACKS

Bikeracks should be provided along streetscapes near the Museum, the pathway, and near existing commercial developments.

The bike racks shown right are alternatives to the circular recommendations. The top two are from Urban Accessories and the bottom rack is from Maglin.

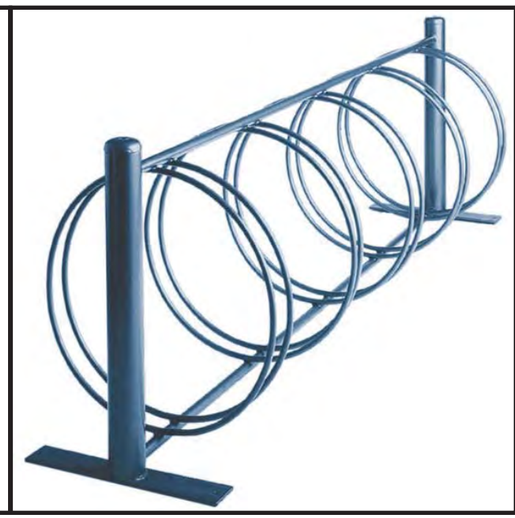


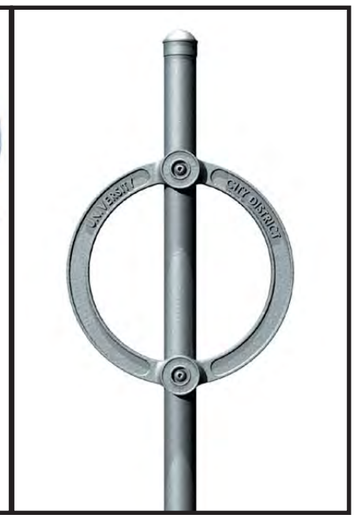


Below: Examples of recommended bikeracks of a 'woven' and classic appearance that work well with the theme. The left and center bike rack examples are from Maglin. The bike rack shown right is from Urban Accessories. Refer to www.maglin.com and www.urbanaccessories.com for further information.

MBR300







MBR400



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

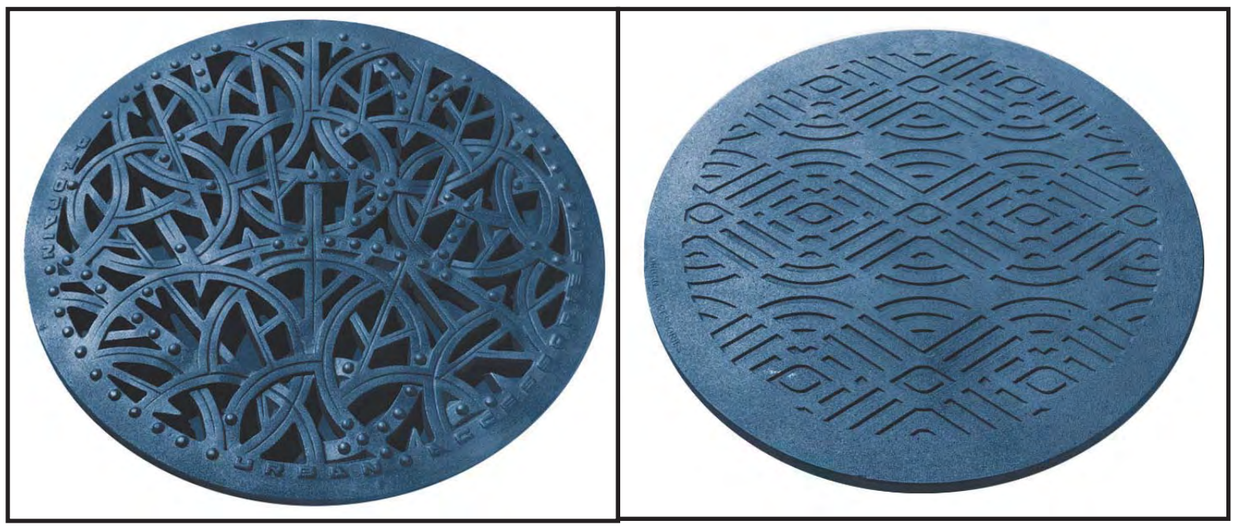
DRAINAGE COVERS

Drainage covers are often overlooked accessories that can be incorporated into a streetscapes theme. To 'theme' these accessories is a concept that has gained recognition through successful streetscape improvement projects in recent years. Covers can be given logos or patterns that coordinate with the overall theme.

Right are drainage covers from Urban Accessories of a clean contemporary appearance that could also work within the theme.



Below are examples of textural covers from Urban Accessories which are suggestive of a western appearance. Refer to ww.urbanaccessories.com for further information.





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BOLLARDS

Bollards may be desired for the pathway or plaza area. Options of bollard lights were previously shown in the lighting section, however, additional options of typical bollards have been provided here for consideration.

Below are examples of bollards from Maglin which are of an antique character that would correspond with the level of detail shown in lighting and bench options. Refer to www.maglin.com for further information.





Right are additional examples of bollards given a pattern detail or in a simple contemporary shape. Refer to ww.dumor.com for further information.





Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

TRASH RECEPTACLES

Trash receptacles should be provided in areas where benches are located, along the pathway, and near commercial developments. Wood and metal options have been provided that correspond with seating options previously shown.



Above are two examples of metal receptacles offered by Urban Accessories.





Right (top/center) are metal receptacles offered by Dumor.

Right (bottom) is a metal receptacle offered by Maglin.



Below are examples of wooden and mutli-material based trash receptacles.



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

RECEPTACLE ACCESSORIES

It is encouraged that lids and top accessories be purchased for trash receptacles to detract pests, rodents, and control odour. Most models of trash cans come with lid options. Below are two examples from Forms and Surfaces that show lid attachments.







RECYCLING RECEPTACLES

It is recommended that recycling receptacles be purchased to provide people with the option to recycle. The placement of such receptacles should be in open visible places.

Right are two examples of recycling receptacles. The top receptacle is from Maglin and the bottom receptacle is from Dumor.

MRC200-3

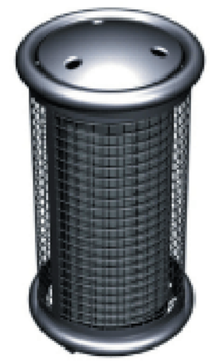




ASH RECEPTACLES

Ash receptacles should be considered for public areas such as the plaza or near existing commercial developments or bus stops to encourage smokers to not pollute. Below are two metal options created by Maglin.

MLAU800M



MLAU550



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

MOVEABLE PLANTERS

Moveable planters could be provided along the street, near the plaza, or at major intersections. They could be planted with native grass arrangements which would be low maintenance, or with annual or perennial plantings to provide extra colour to the streetscape. Wood and metal options have been provided that correspond with seating options previously shown.



Above are examples of metal planters that coordinate with previous seating and streetscape accessory options. Both are from Maglin.





Below are examples of wooden planters that coordinate with the contemporary western theme and previous examples of seating options. The center planter could especially unify materials together as it has both wood and metal elements. The planters on the left and center are from Dumor and the planter on the right is from Landscape Forms. Refer to www.dumor.com or www.landscapeforms.com for further information.



Right are examples of metal planters that coordinate with previous seating and streetscape accessory options. All three options are from Dumor.



Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

TREE GAURDS

If tree guards are required for specimen street trees, then it is recommended that they are of a level of detail and colour that coordinate with the theme. Below are two examples from Urban Accessories that coordinate with the detail shown on other metal accessory options.



THEMED DETAILING

Planters, benches, receptacles and other streetscape accessories could be visually unified in ways other than colour and material. There is the option of providing logos (as displayed by Dumor below) or through etching a custom theme related pattern into features (as displayed right on planters by Maglin).







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FURNISHING OPTIONS - LANDMARK FEATURES & WAYFINDING AMENITIES

INTRODUCTION

Landmark features are often used by the public as common meeting places or destinations to relax. These features are usually designed with clusters of streetscape accessories such as benches, planters, and lighting - which signal to the public that relaxing in the area is welcomed. Landmark features also aide in wayfinding as it is common for people to refer to landmarks when giving descriptive directions. Therefore, landmarks often contribute largely to a streets overall 'readability' and should be a carefully planned part of any streetscape improvement. The following pages explore opportunities to create landmark features and discuss additional wayfinding amenities such as signage.

A view of a landmark feature: Sculptural Art in Olympic Plaza in Calgary, Alberta



THEMED PLAYGROUNDS

Currently there are no proposals for playgrounds areas near Wye Road.

However, in the event that public parks near the Wye Road streetscape improvement area are 1) being designed or 2) being refurbished, it is recommended that the theme be carried over into the park area to improve overall connectivity and 'sense of place'.

Three examples of themed playground areas designed by Timberform (www.timberform.com) shown here display western motifs.







FURNISHING OPTIONS - LANDMARK FEATURES & WAYFINDING AMENITIES

TRELLIS FEATURE

As previously discussed in the Zone 5 section, it is recommended that trellis gateways aesthetically work within the theme. Examples of wood frame trellis features are provided below. It is possible that the trellis features custom designed for Wye Road could have stone bases or metal accents in the frame to intensify the visual unity between the features and the proposed streetscape furnishings. In addition; graphic details, logos, or dedication plaques are all items that could be considered in detailing trellis features.



PUBLIC AMENITY LANDMARKS

Clocks or sundials are public amenities that often serve a dual purpose in towns as visual landmarks.

Clocks such as the ones shown right by Canterbury International are common amenities found on streetscapes with a 'historic' or western detailing. It is strongly suggested that such an item be considered for Wye Road. Refer to www.canterburyintl.com for further information.





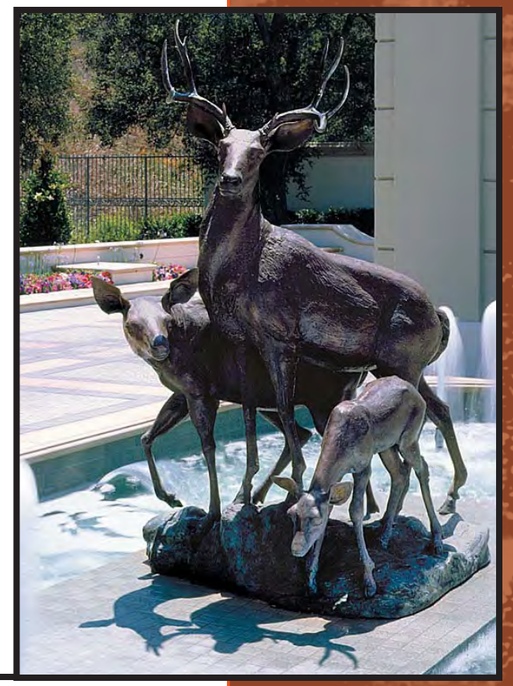
SCULPTURAL LANDMARKS

Public art can significantly contribute to the character of any particular street.

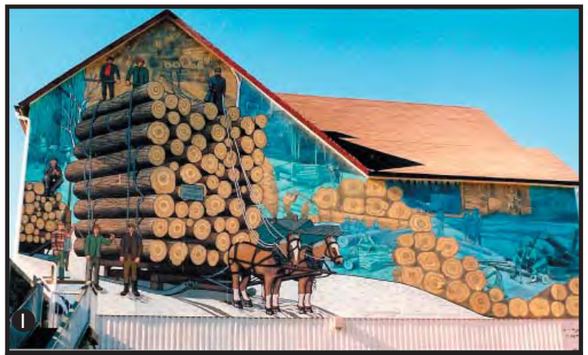
Sculptural art is especially impactive when incorporated into streetscape furnishings. An example of such is below showing a boy fastened to a bench. Incorporating such artwork into site furnishings would give greater depth and dimension to any space that the furnishing would be located in. It is recommended that any sculptural art selected would coordinate with the theme and be placed with a dedication plaque describing how the art relates to a historical fact about the area.

Public art can also be a landmark feature in the landscape when placed in a central location. The wildlife shown right is located in the center of a waterfeature and is the visual focus the surrounding space. A 'centralized' approach to placing art could be considered for the plaza area, seating nodes along the pathway, or bordering major intersections along Wye Road. Refer to www.canterburyintl.com for further information on the sculptural art shown.

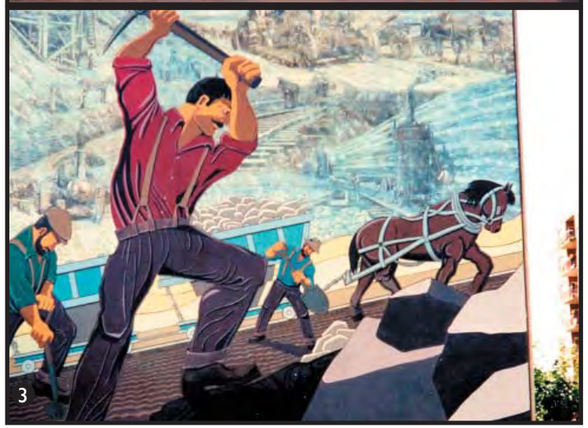




Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance







MURAL LANDMARKS

Painting murals is a wonderful way to incorporate artwork into a streetscape. Mural projects are usually commissioned to local artists who understand the history of an area and can visually portray significant events or features about an area into the painted form.

Examples of towns famous for their streetscapes 'historic charm' through mural artwork are listed in coordination with photos shown left (going top to bottom).

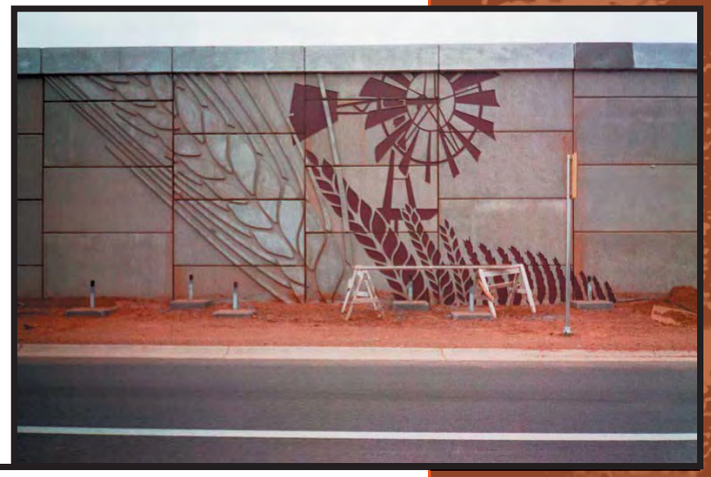
1. 'The Brag Load' - Parry Sound, Ontario
2. 'The Dundalk Mural' - Welland, Ontario
3. 'Digging of the Canal' - Welland, Ontario

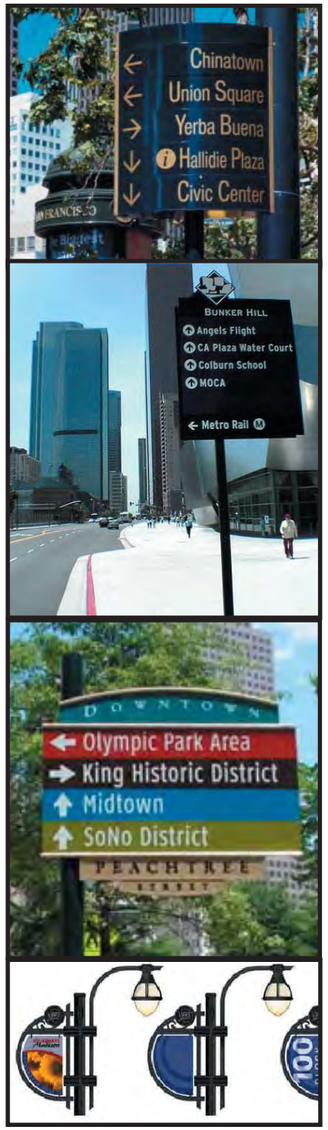




SOUND-WALL RELIEF SCULPTURES

Sound wall relief sculpture is on the forefront of road improvements in North America and is one of the most popular solutions to handling visual blight from sound walls. These sculptures are created by taking a stencil (drawn by an artist or a design professional) and translating it onto sound wall panels by carving the stencil at an even depth. The images shown right illustrate how relief sculptures can depict the visual character of a community.





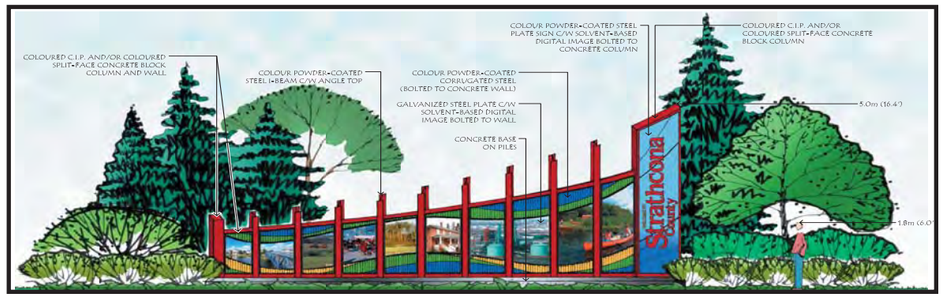
STREET SIGNAGE

The colour and text on street signage should relate to the overall theme of the streetscape. Key words, such as "downtown" or "city centre" could be used to convey to visitors where they are (see example in the third image down on the left). It is recommended that if a common graphic or logo is used throughout the streetscape, that it should also appear on central signage (see example in the second image down on the left).

Signs should be provided in open and obvious locations for people to notice them. Signs providing direction to the Museum and other local attractions should also be provided in multiple locations as a reminder to visitors that they are welcome to stop and experience the area.

GATEWAY SIGNAGE

Below is the approved graphic illustrating the gateway design of Wye Road as designed by Gibbs & Brown. Refer to the Zone 5 section for further information.

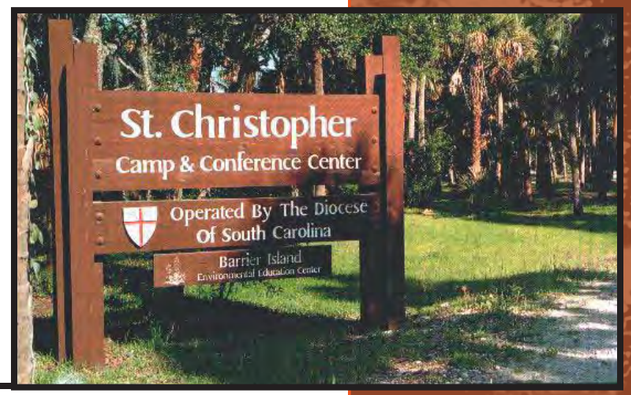




PLAZA & PATHWAY SIGNAGE

The images shown right are examples of how to incorporate additional forms of signage into a site that would signify an important feature. It is recommended that alternatives of signage be considered for areas such as the pathway or the plaza area. Custom detailing and design of such signage would be created to relate to the theme of the streetscape.





Reminder: A colour relating to the theme (i.e. dark grey) should be selected and applied to all metallic surfaces of streetscape furnishings (i.e. lights, trash receptacles, benches) to create a cohesive overall appearance

INTRODUCTION

The hardscape materials selected and used along Wye Road will have the greatest impact on how pedestrians and drivers will move through the area. The more transitional materials used; the more people are likely to 'read' the streetscape and move through it with ease. An increase in transitional materials will also signify to drivers that this is a special place and they should slow down.

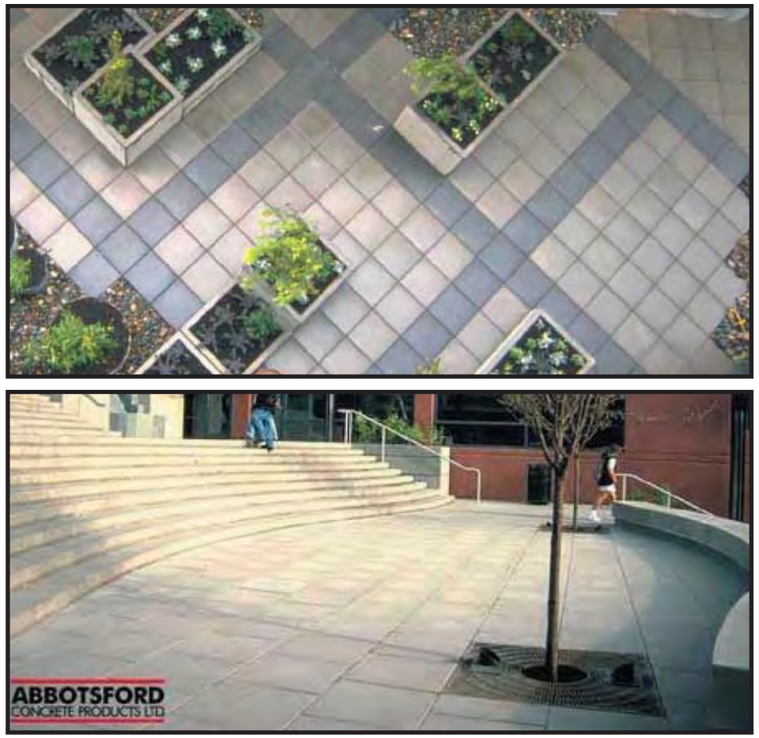
The following options reveal opportunities of how to hardscape transitional spaces such as cross walks, plaza or storefront entries, or border sidewalks and medians.







PLAZA PAVING OPTIONS



OPTION 1: HYDRAPRESSED SLABS BY ABBOTSFORD CONCRETE

These slabs could be suitable for the plaza areas because they are hydraulically pressed to be durable and dense, which would guarantee long term wear. In addition, the finish on these slabs are non-slip, making them a great choice for an area of high public activity. The images shown left are examples of hydrapressed slabs.

Refer to www.pavingstones.com for further information.



OPTION 2: INTERLOCKING PAVERS BY ABBOTSFORD CONCRETE

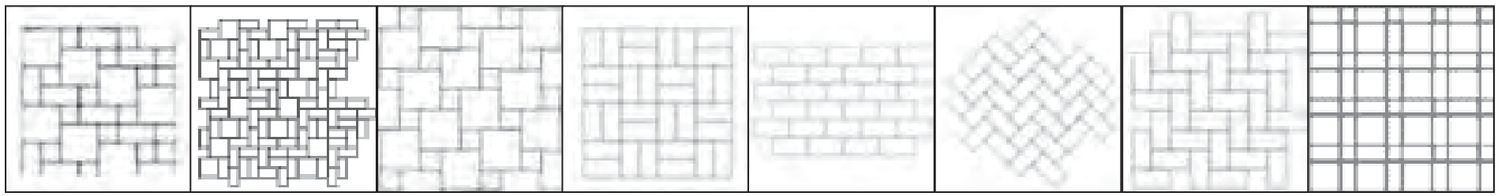
Interlocking pavers are a great option for the plaza area as they are easy to install, low maintenance, and do not weather easily. They are well suited for areas of high activity and come with a variety of colour and pattern choices that would work well within context with the theme. The images shown right are examples of interlocking pavers.

Refer to www.pavingstones.com for further information.





Below are common paving pattern options provided by Abbotsford Concrete



Ashlar | Full & Half Slab | Full & Quarter Slab | Half Slab Parsquet | Half Slab Running Bond | Herringbone | Herringbone | Lattice

CROSSWALK & DETAILING OPTIONS

OPTION 1: PATTERNED PAVERS
BY PERMA PAVING STONE COMPANY

A unique 'fishtail' formed way to placing pavers is a specialty of the company described here. Examples of work by the Perma Paving Stone Company (right) demonstrate how the fanned appearance on the brickwork in the photographs emphasize the placement of key features in the landscape. Such an option should be considered for unique crosswalk designs or areas of interest along the streetscape requiring different hardscape treatments.

Refer to www.permapavingstone.com for further information.





CROSSWALK & DETAILING OPTIONS

OPTION 2: STREETPRINT PAVING BY INTEGRATED PAVING CONCEPTS

Streetprint paving is a patented product created by Integrated Paving Concepts in Surrey, BC. This product is applied through heating up asphalt, applying a texture, and finishing it with a high-performance bond coating.

Products such as streetprint or duratherm (shown on the next two pages) is highly recommended for consideration as they are extremely cost effective in comparison to actual pavers. These products are proven to tolerate Northern conditions as they have been used for primary streetscaping projects in cities such as Jasper, Alberta and Whistler, British Columbia.

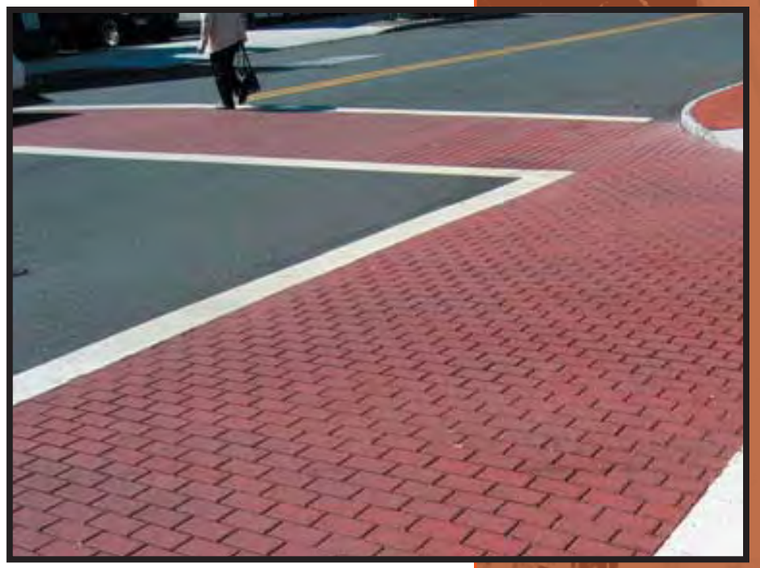
Refer to www.integratedpaving.com for further information.

Below are images depicting the installation of the streetprint product









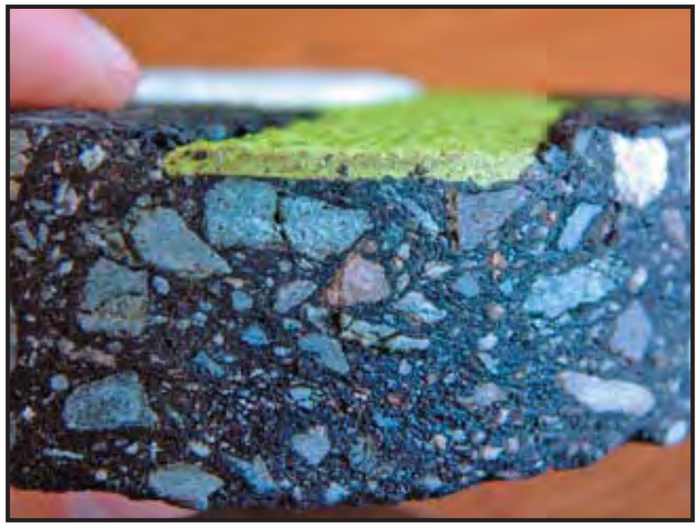
Right are images of the steetprint product after installation.





CROSSWALK & DETAILING OPTIONS

OPTION 3: DURATHERM
BY INTEGRATED PAVING CONCEPTS



Left is a cut section showing the fusion between the duratherm material and asphalt.

Below are images depicting the typical installation process for the duratherm product.









The duratherm product is a high-performance thermoplastic that can be installed through fusing it with heated asphalt.

Like streetprint, duratherm can handle the weathering effects from northern conditions and is extremely cost effective.

Duratherm is recommended for consideration because it can offer a unique decorative element to any streetscape. The thermoplastic used in this product can be stenciled into any shape. It has provided numerous cities with the opportunity to incorporate community crests or theme related logos into their streets; greatly contributing to the overall aesthetic quality their surrounding area.

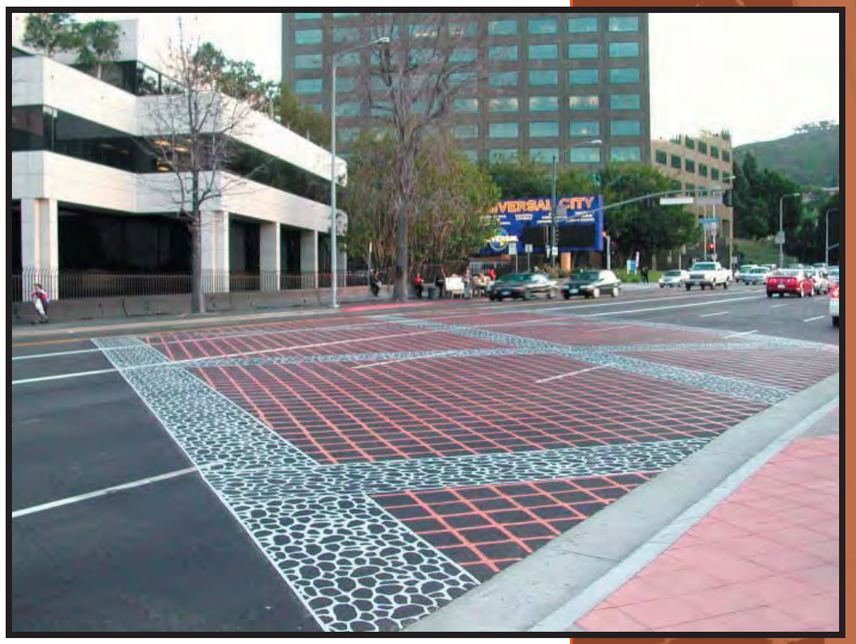
Refer to www.integratedpaving.com



The images shown (above and below) here are close-ups of the duratherm product embedded into an asphalt street.



Right is an example of the duratherm product used at Campo de Cahuenga in Los Angeles.



CROSSWALK & DETAILING OPTIONS

OPTION 3: DURATHEM BY INTEGRATED PAVING CONCEPTS (CONTINUED)



The images bordering the bottom of this page show the duratherm product as installed in Jasper, Alberta. The town of Jasper is a northern destination revered for its amazing views of the mountains. Connaught Drive in Jasper is the central primary road passing through the town, which manages a high volume of traffic and an even higher volume of pedestrians.

A northern theme was carried throughout Connaught Drive and its surrounding area. The theme was translated into the hardscape by placing a logo along all pedestrian crosswalks, accompanied with additional transition materials. Refer to the images below and the website www.integratedpaving.com for further information.





FORMED PLANTER / SEATING WALL





The images on this page depict various materials used to create seating walls. It is recommended that blocks of rough-cut granite or a similar material be used to create seating wall planters along Wye road. Such a material would have a raw aesthetic quality and would tie in well with the overall theme.

The material used for the planters could also be considered for forming the raised roadway median.

Note: Images provided by webshots.com or google.com These images are intended to only show what a formed planter/seating wall looks like. Granite is not shown in any of these images.







MEDIAN PLANTINGS



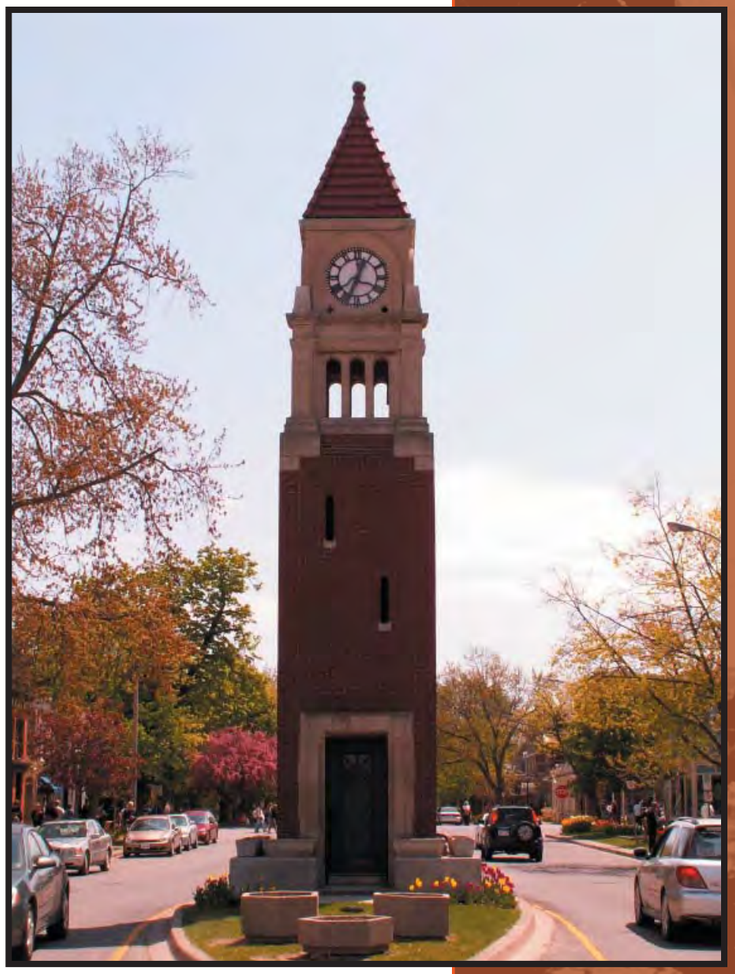
It is recommended that median plantings for Wye Road consist of native grasses and low maintenance hardy shrubs. Plantings should be placed in mass formations which would appear beautiful from both the pedestrian and vehicular perspective.

The images shown here are from google.com and webshots.com and illustrate how mass plantings can be beautiful accents to any streetscape.

The image of the clock tower is from Niagara on the Lake, Ontario. It depicts that placing a landmark feature in a median is also something to be considered for a large streetscape.









STREET PLANTINGS



The trees used along Wye Road should be native and salt tolerant. A variety of medium to fast growing trees should be used along the roadway and should be of varying form and colour. The images shown to the right are of a trembling aspen and a bur oak tree - two great candidates for street trees.

The trees used in planters or in the plaza area should be specialty trees of distinction. Trees in key locations should have unique textural features on places such as their bark, bloom, or leaf colour. The images shown to the left are of a birch and plum tree - two examples of candidates that fit this description.







Native grasses used along Wye Road should have various forms and textural qualities. The images shown left depict how colour combinations should also be considered for mass plantings.



SUMMARY AND NEXT STEPS

The Design Guidelines and concepts presented in this document provide a review of existing conditions and offer tangible solutions for improving the Wye Road corridor and in essence *'creating a better place to live'*.

Some of these guidelines, such as undergrounding of utilities, have already been adopted by Sherwood Park and will be implemented over time. Other proposed guidelines are new responses to the Wye streetscape environment. In either case, these guidelines have been created in direct response to those conditions of the current streetscape that could be improved in terms of safety and experiential quality for both vehicles and pedestrians. Each of these user groups are unique in their use and perception of the streetscape. These guidelines address this fact both generally and specifically.

Throughout this document, specific solutions are provided in response to perceived opportunities. One example is the desirability of establishing greater visibility and connectedness within Wye Road alignment. The document also proposes broad guidelines to improve the aesthetic and experiential quality of this important road. Environmental sustainability and pedestrian safety are two examples of this approach.

Whether specific for master planning of particular areas or broad in terms of principles, this document should be used as a reference for ongoing design and development on Wye Road. It is assumed that future design development of distinct districts along to roadway alignment will afford a greater opportunity for design development and more in-depth solutions tied to specific zones within the Wye Road alignment.



Appendix A.2

Wye Road, Ordze Road to Highway 21, Functional Planning Study
(Al-Terra Engineering) – 2011

Al-Terra

AL-TERRA ENGINEERING

Strathcona County

FINAL REPORT

Wye Road – Sherwood Park
Ordze Road to Highway 21

Functional Planning Study



December 2008
Finalized October 2011

WYE ROAD – SHERWOOD PARK
ORDZE ROAD TO HIGHWAY 21
FUNCTIONAL PLANNING STUDY

EXECUTIVE SUMMARY

The Functional Planning Study for Wye Road between Highway 216 and Highway 21 was initiated by Strathcona County to develop plans to meet the long-term traffic demand for this important transportation corridor, including intersection requirements and access management for both existing and proposed developments. The primary objective was to determine a configuration for the roadway and intersections that will maintain an acceptable level of operating service for the foreseeable future.

SECONDARY OBJECTIVES INCLUDE

- Address the needs of pedestrians in the corridor, including trails, sidewalks, benches, lighting and cross-walks (addressed in detail in a separate report entitled “Wye Road Urban Design Guidelines”).
- Condition assessment and capacity analysis of storm sewers (Ordze Avenue to east of Brentwood Boulevard).
- Noise assessment to determine additional noise attenuation requirements along Wye Road.
- Condition assessment of the existing concrete noise wall (addressed in a separate report).

RECOMMENDATIONS

The recommended plans are illustrated on **Exhibits ES-1** through **ES-3**, and generally include widening Wye Road to a six (6) lane divided arterial roadway, plus auxiliary lanes and double left turn lanes, where required, to meet traffic demand. Additional findings and recommendations of the study include:

- **Sherwood Drive / Wye Road Intersection:** To maintain satisfactory operations and Level of Service, all left turn movements will require relocation, except eastbound to northbound. A jughandle roadway behind Walmart, as shown, would accommodate the displaced left turn movements and would provide a target Level of Service for the projected 2015 traffic. Other roadway improvements on Fir Street / Sherwood Drive and Ash Street / Wye Road, as well as an alternate road connection to the Canadian Tire commercial area would be required to fully implement the relocation of left turn movements. A staged approach is recommended, as described in **Section 11.0** of the report.

- **Brentwood Boulevard / Wye Road Intersection:** Traffic analysis at the intersection indicates that the implementation of select double left turns will result in reasonably acceptable function, but beyond 2015, a jughandle provides superior operation. In addition, the long term requirement for six (6) through lanes on Brentwood Boulevard / Range Road 232 cannot be provided in conjunction with southbound double left turn lanes, unless right-of-way is

acquired from the residential lots that back onto Brentwood Boulevard. As the acquisition of the additional right-of-way would be very difficult, we recommend that all left turns, except eastbound to northbound, be relocated to a jughandle, as illustrated. It would be desirable to implement the jughandle in conjunction with the Wye Road widening, provided right-of-way in the undeveloped southwest quadrant can be obtained.

- **Clover Bar Road / Wye Road Intersection:** Conventional intersection treatment, with double left turn lanes eastbound and northbound appears to meet the long-term traffic demand for this intersection. It is suggested that right-of-way in the southwest quadrant (publically owned) be protected to allow jughandle implementation in the long-term.

- **Traffic Calming** measures (roundabout) on Alder Avenue, between Hawthorne Street and Brentwood Boulevard should be considered to discourage short cutting (and speeding) that may occur as a result of the Sherwood Drive intersection modifications.

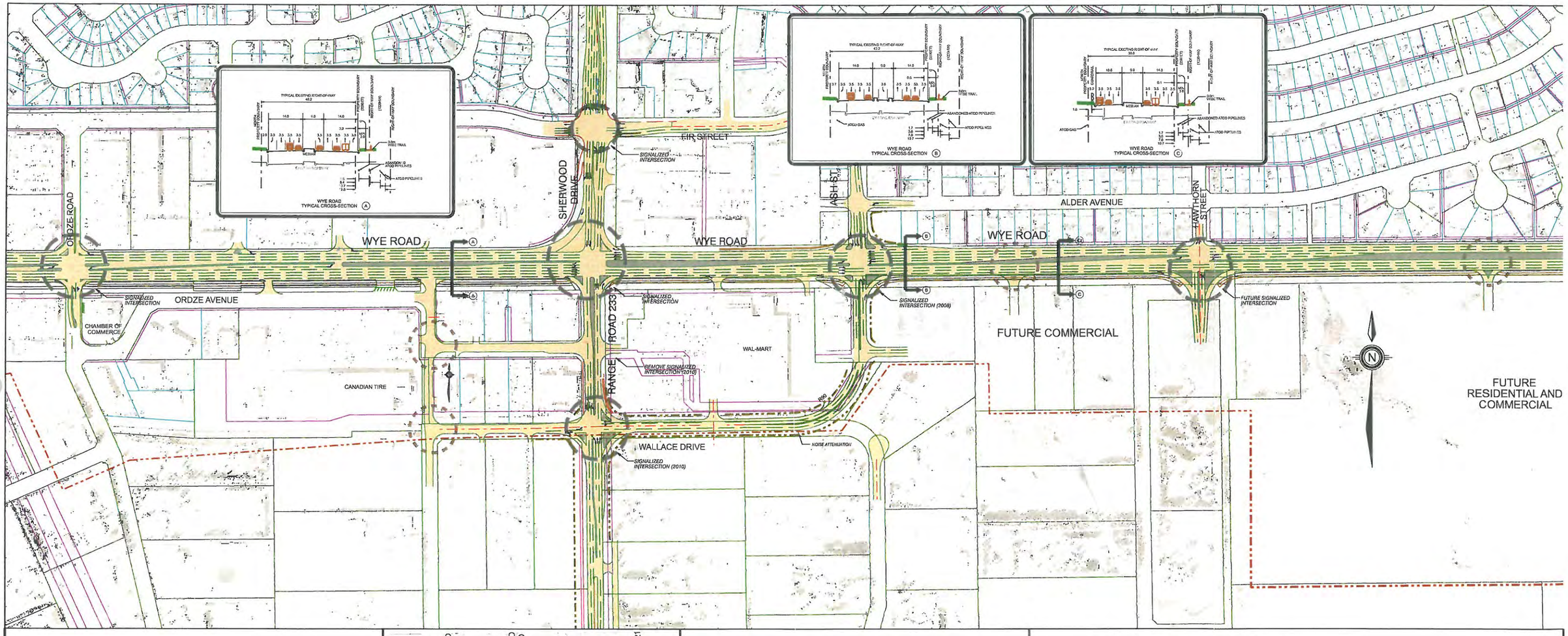
- **Access Management** for the new development south of Wye Road between Ash Street and Range Road 232 was completed as part of this Functional Planning Study, and the fixed access locations are shown on the Exhibits. It should be noted that the study assumed future development of the acreage parcels west of Range Road 231 would be low density residential, and as such the only access provided is at Nottingham Way. Development of this area into high density residential or commercial property would require further review, but it should be noted that any additional accesses along Wye Road will detrimentally affect network performance. It is strongly recommended that additional accesses are not permitted along this corridor.

- **Storm Sewer Review** of the existing storm infrastructure should be undertaken in advance of roadway improvements so that any capacity or condition concerns can be addressed in advance of the roadway construction.

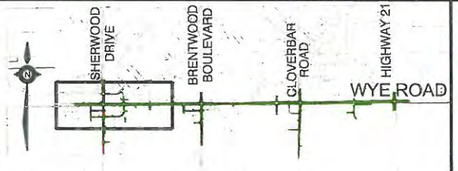
COST ESTIMATE AND IMPLEMENTATION STRATEGY

The estimated total cost of this project, based on 2008 typical construction costs, is **$60 Million**, which does not include right-of-way acquisition, but does include pipeline and power relocations, extensive trail and landscape construction, new street lights and signals, as well as pavement rehabilitation of the existing roadway.

It is anticipated that the project will be staged over a number of years, and it would be prudent to use this study as the guiding document for staged implementation of the project. Feedback from the public communication sessions already held has indicated that the unconventional intersection improvements (recommended) are somewhat controversial, but we strongly believe that jughandles for the Sherwood Drive and Brentwood Boulevard intersections will provide the best operations for the long-term traffic demand at these locations.



FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:5,000

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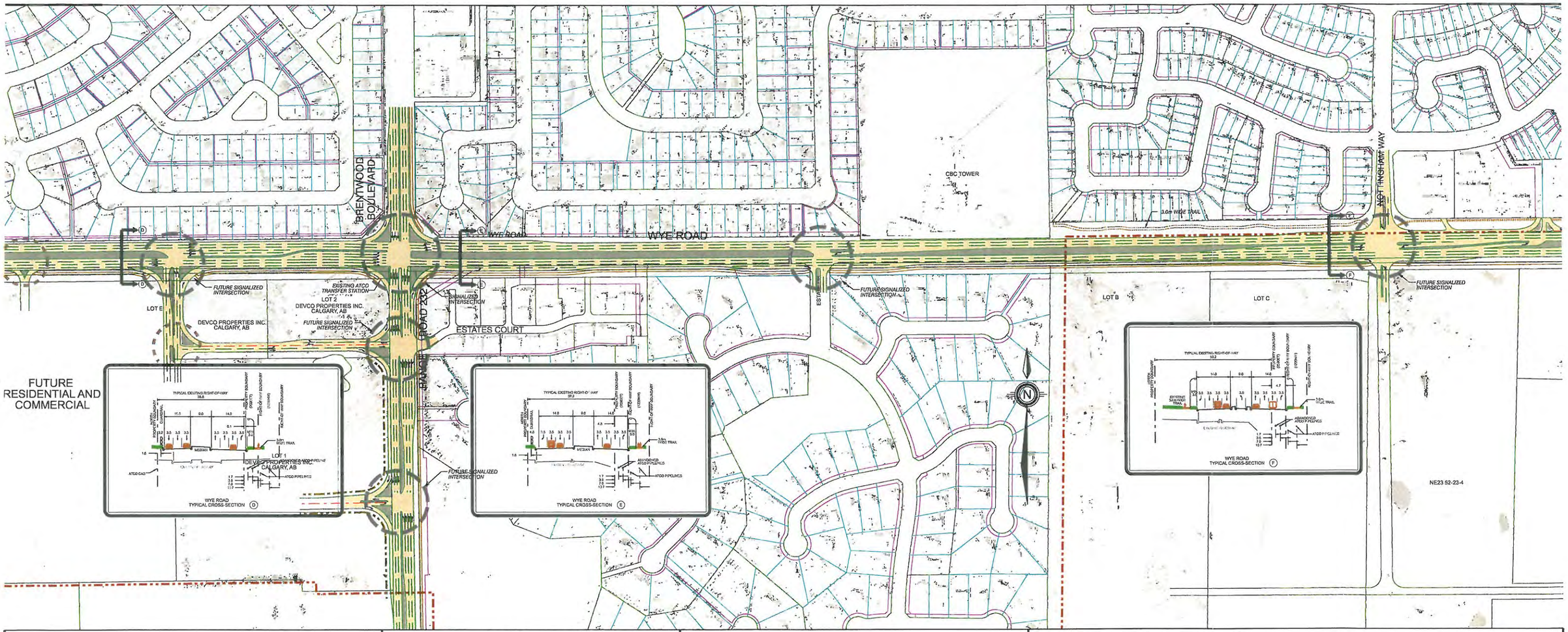
HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

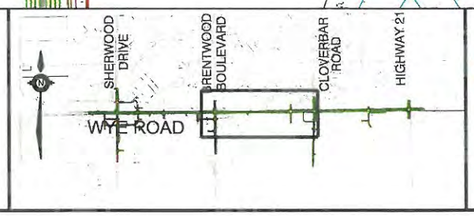
RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT ES-1



FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:5,000

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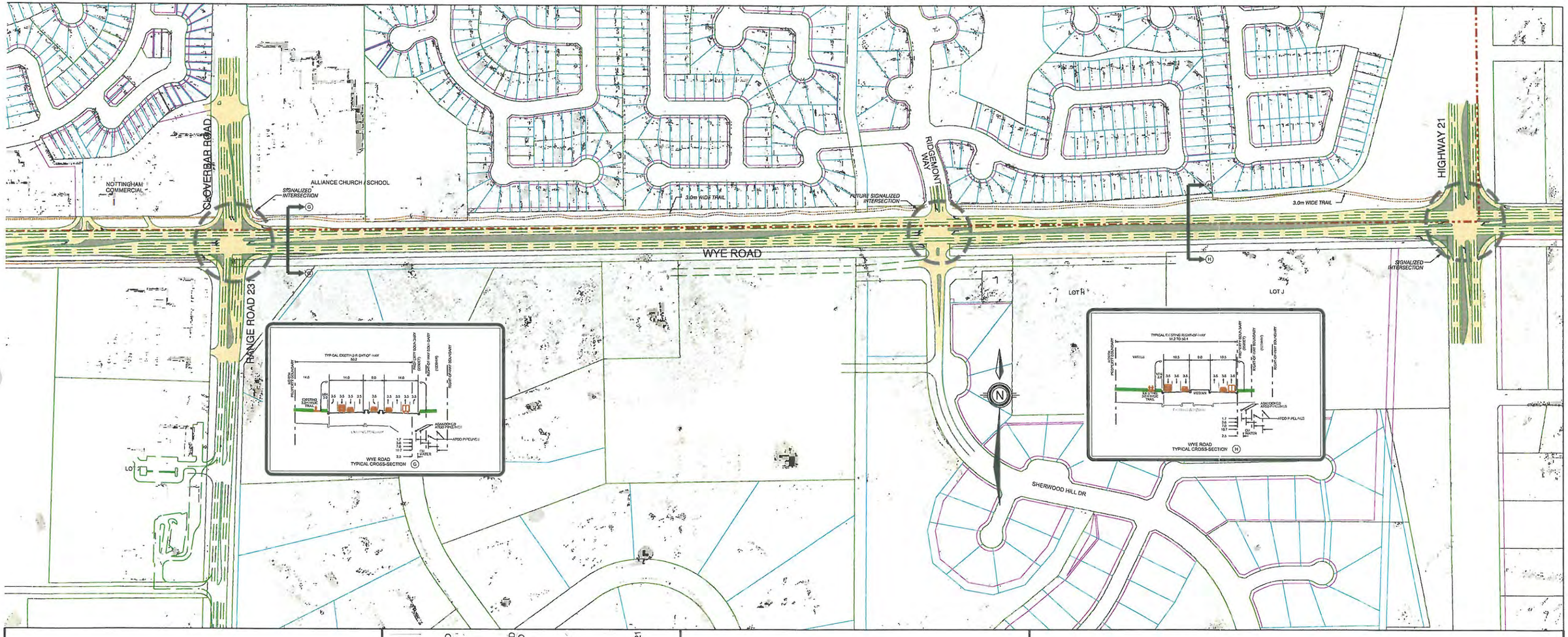
HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT ES-2



FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:5,000

50m 0 100m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT ES-3

CORPORATE AUTHORIZATION

This report entitled **"Wye Road Sherwood Park – Ordze Road to Highway 21 Functional Planning Study"** was prepared by **Al-Terra Engineering Ltd.**, under the authorization of Strathcona County.

The designs and recommendations put forward reflect Al-Terra's best judgment with the information available. Any use of this information in a manner not intended, or with the knowledge that situations have changed, shall not be the responsibility of Al-Terra Engineering Ltd.

PERMIT TO PRACTICE
AL-TERRA ENGINEERING LTD.
Signature
Date Oct 21 2011
PERMIT NUMBER: P 2104
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Corporate Permit

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Bogusia Stapor, M.Eng., P.Eng., PTOE

PROFESSIONAL ENGINEER ALBERTA DANA M. LEITHEAD

Dana Leithead, P.Eng.

ACKNOWLEDGMENT

Al-Terra Engineering Ltd. was fortunate to have worked with a highly-qualified and dedicated Project Team to complete the **Wye Road Sherwood Park – Ordze Road to Highway 21 Functional Planning Study**. In-house experience in the areas of functional planning and traffic engineering was supplemented by the services of a number of subconsultants. We would like to acknowledge the high quality of assistance that they brought to the project in meeting the expectations of the Client.

Subconsultants associated with the project were:

IMI Strategies Inc. – Dr. Ian Montogomerie
Public Consultation

J. R. Paine & Associates Ltd. – Mr. John Rakievich, P.Eng.
Pavement Evaluation and Design

BPTEC-DNW Engineering Ltd. – Mr. Stuart Smith, P.Eng., M.Eng.
Noise Wall Condition Assessment

ACI Acoustical Consultants Ltd. – Mr. S. Bilwachuk, M.Sc., P.Eng.
Noise Assessment / Modeling

In addition we would like to acknowledge, with gratitude and appreciation, the assistance of the Technical Review Committee for their input, assistance and cooperation during the study.

Technical Review Committee members include:

Strathcona County	Mr. Ross Etches, M.Eng., P.Eng., P.T.O.E.
	Mr. Chris Batty, M.Eng., P.Eng., R.T.O.E.
	Mr. Richard Dekker, R.E.T.
	Mr. Jim McNeill, C.E.T.

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1.0 INTRODUCTION

1.1 GENERAL

Strathcona County retained Al-Terra Engineering Ltd. (Al-Terra) to undertake a Functional Planning Study for Wye Road to develop a plan to address the long term traffic demands (both pedestrian and vehicular), make recommendations regarding congestion and operational concerns at major intersections, and develop an access management plan between Highway 216 and Highway 21 as illustrated on **Exhibit 1.1 Study Area**.

Long term plans from Alberta Transportation for improving Highway 216, Highway 628, and Highway 14, as well as the impending adjacent commercial development between Sherwood Drive and Hawthorne Street provide an opportunity for partnership in the redevelopment of this important arterial road network.

Some guiding design themes for the Wye Road Functional Planning Study were outlined in a concurrent study entitled "Wye Road Urban Design Guidelines," which was prepared to address pedestrian needs such as trails, sidewalks, benches, lighting, and crosswalks. Wye Road is envisioned as a "Gateway to Sherwood Park," and although it functions as a major commuter route to Edmonton from outlying areas, it is intended to have increased "walkability" upon completion, providing access from the rural areas south of Wye Road to the urban services and heritage sites to the north. In accordance with Strathcona County Guidelines, the Transportation Association of Canada (TAC) three themes with twelve guiding principles for Sustainable Transportation Planning were considered in the design.

In addition, a condition assessment of the concrete noise fence along the north side of Wye Road between Ash Street and Estates Drive was completed and reported under a separate cover. This study identified a number of immediate repairs required for this twenty-five year old fence and also provided suggestions for a long term maintenance program.

1.2 BACKGROUND

The 6.5 km section of Wye Road within the Urban Services Area (Sherwood Park) is experiencing congestion, particularly at major intersections. In addition, planned developments south of Wye Road will further increase the traffic demand on this roadway.

Guidelines for permissible access locations and configurations were required to address these and other roadway related issues. The study objective was to develop functional plans to identify the required roadway upgrading and enhancements for both the immediate and long-term demands of this facility.

Wye Road is a six (6) lane divided urban roadway with auxiliary lanes between Highway 216 (interchange) and Sherwood Drive; a four (4) lane divided urban roadway

with auxiliary lanes between Sherwood Drive and Brentwood Boulevard; and a four (4) lane divided semi-urban roadway (rural eastbound) between Brentwood Boulevard and Highway 21. The roadway functions at a good level of service (LOS) during off peak hours, but experiences congestion, particularly during the PM Peak, when eastbound (commuter) and left turn volumes are very high.

Long-term plans for Wye Road envisioned a six (6) lane urban cross-section; however, recent traffic modeling (2002 Transportation Study Update) suggests that a lower standard might be appropriate, provided the intersection capacity could be enhanced. The validity of this traffic modeling had come into question, particularly because it was based on the Edmonton Regional Model. As a result, the County commissioned a concurrent study to develop an updated traffic model based on a higher employment rate assumption. The results of the concurrent study were intended to provide background traffic for the analysis required for this functional planning, but it was not available at the time. To date, all projected traffic models for Strathcona County have included / envisioned two mile interchange spacing along Highway 14, (Sherwood Park can only be accessed off Highway 14 at Highway 21 and Range Road 232), and four (4) laning, with the signalization of Highway 628, per the long range plans from Alberta Transportation.

As input to the Wye Road Functional Planning Study, Strathcona County completed a traffic counting program for the commercial area south of Wye Road, between Range Road 233 and Ordze Crescent. This information was used to generate traffic for proposed developments and confirm outputs from the Traffic Impact Analysis (TIA) available for the area.

1.3 OBJECTIVES AND SCOPE OF STUDY

The primary objective of the Functional Planning Study was to develop plans for Wye Road that would meet the long-term traffic demand for the roadway, including intersection requirements and access management for both the existing and proposed developments. The plans developed would include a trail linkage between Highway 21 and Sherwood Drive to also address pedestrian / cyclist uses in the corridor.

A secondary objective was to complete an assessment of the Wye Road noise attenuation wall, to address immediate repair requirements and to develop a long-term maintenance strategy for this facility. This was completed and dealt with in a separate, stand-alone report.

Specific issues addressed in the study included:

- Assemble and review available background data, including plans and profiles, intersection plans, legal base, development access, etc. to develop comprehensive base plans for the study area.
- Review the available traffic data, TIA's, County Model, Regional Model, and traffic counts required to develop a base year traffic plan and future traffic plans

for all intersections and potential accesses, including Sherwood Drive (Range Rd 233) between Fir Street and Wallace Drive.

- Develop a base year traffic model / simulation using Synchro / Sim Traffic and complete an analysis to identify (reconfirm) operational issues and/or deficiencies in the existing infrastructure. Quantify the issues and deficiencies in order that a "targeted approach" can be used to develop options and alternatives.
- Prepare alternatives to address the operational and safety concerns, which were further evaluated.
- Complete a traffic analysis on Wye Road between Ordze Crescent and Brentwood Boulevard to provide guidance for the appropriate access locations for both the existing and proposed developments.
- Review the projected traffic volumes on each segment of Wye Road to confirm the long-term lane requirements and lane balance.
- Review the requirements for six (6) laning and analyze how the widening and improvements could be accommodated within the right-of-way, particularly between the CBC Tower and Sherwood Drive.
- Identify issues such as right-of-way requirements and pipeline constraints.
- Other issues addressed in the study:
  - Condition assessment and capacity analysis of storm sewers (Ordze Avenue to east of Brentwood Boulevard).
  - Pavement design for widening, and structural overlay.
  - Noise assessment.

SHERWOOD PARK

STRATHCONA COUNTY

HIGHWAY 216

SHERWOOD PARK FREEWAY

LIMIT OF STUDY

ORDZE RD

FIR ST

SHERWOOD DR

ASH ST

HAWTHORNE ST

BRENTWOOD BLVD

WYE ROAD

WALLACE DR

ESTATE DR

NOTTINGHAM WAY

CLOVER BAR RD

RIDGEMONT WAY

SHERWOOD PARK HAMLET BOUNDARY

HIGHWAY 21

LIMIT OF STUDY

TWP. RD 524
WYE ROAD

Rge Rd 233

Rge Rd 232

Rge Rd 231

HIGHWAY 21

Strathcona County

AL-TERRA ENGINEERING

METRIC SCALE 0 500 1 000 metres

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

STUDY AREA

Date: NOVEMBER 2008

EXHIBIT 1.1

2.0 EXISTING CONDITIONS

2.1 LAND USE AND ACCESS MANAGEMENT

Existing and proposed land use within the study area is shown on **Exhibit 2.1**.

Existing lands north of Wye Road are essentially fully developed and consist primarily of commercial uses near the Sherwood Drive intersection (west portion) and relatively low density residential uses throughout the remaining area to Highway 21.

South of Wye Road, adjacent lands are only partially developed and a number of new developments along the roadway are currently in the planning or development stage. It has been assumed that these developments will be completed by 2015, which is expected to coincide generally with build out of Sherwood Park.

The proposed developments are addressed in the following Traffic Impact Assessments (TIA's) and include:

- South Wye Area Structure Plan (ASP) Amendment by Bunt and Associates – May 2007 prepared for The Royop Corporation for the areas between Range Road 233 and Range Road 232, within existing Sherwood Park boundary.
- Strathcona Christian Academy Elementary School Range Road 231 Sherwood Park – TIA Report by Bunt and Associates – June 2006.
- Sherwood Hill Estates ASP – TIA by Stantec Consulting – April 2004 for ½ section NE 24-52-23.
- The lands where the TIA's were not available were assumed to be future low density country residential (discussed with County staff).

The South Wye Area is envisioned as a sustainable mixed use development with approximately 41,000 m^2 (440,000 ft^2) of commercial space and 1,950 residential units. A Traffic Impact Assessment completed (by others) suggests the development will generate approximately 30,000 new vehicle trips/day (3,000 trips/hour in PM Peak Hour), and therefore, will have a significant impact on the vicinity road network, particularly on Wye Road. As a result of the potential impact, it was necessary to develop an access management strategy to ensure that the integrity of Wye Road was protected, while providing reasonable opportunity for access. This initial access management plan was subjected to significant discussion and debate, and the compromised final version is felt to provide a reasonable balance between providing access and maintaining the integrity of the arterial roadway.

An underdeveloped area of approximately 56 hectares (140 acres) south of Wye Road and west of Clover Bar Road has been assumed as future low density residential, based on the current zoning. An alternate, more intense type of development could generate significantly higher traffic volumes on Wye Road.

The long term access management plan developed is shown on **Exhibit 2.2**.

2.2 EXISTING FEATURES (CONSTRAINTS)

The ability to upgrade (widen) Wye Road is limited by two very significant constraints, as noted on **Exhibit 2.3**.

2.2.1 Concrete Noise Attenuation Fence

This fence built in 1983 along the north side of Wye Road, between Ash Street and Estates Drive, is a significant feature located 6.8 m north of the north through curb line. Alberta Weak Post W-beam guard rail is located at approximately 1.5 m from the wall. As part of this study, the effectiveness of the guardrail in protecting the concrete fence was evaluated. According to Alberta Infrastructure and Transportation's Roadside Design Guide of November 2007, a Weak Post W-Beam guardrail has a design deflection of 2.5m, and therefore, was determined to be largely ineffective in protecting the fence from vehicles (full analysis is included in **Appendix "E"**). The analysis concluded that the guard rail could be removed, but relocation of the noise fence would not be practical due to property and other constraints. To accommodate a six (6) lane configuration next to the concrete noise wall, the north curb line was located along the current alignment of the existing acceleration / deceleration lanes; approximately 3.2 m from the noise fence. This alignment solution precludes the development of acceleration and deceleration lanes at intersections westbound from Ash Street to Estates Drive within the limits of the noise wall.

2.2.2 Atco Right-of-Way

The width of the existing Wye Road right-of-way between Ordze Avenue and Estates Drive varies somewhat, but is generally less than 40 m wide and not sufficient for a six (6) lane roadway with double left turn lanes. Available right-of-way is constrained on the south side by two (2) Atco Pipeline right-of-ways (6.0 m and 9.0 m), both of which are owned (fee simple) by Atco. As the ability to widen Wye Road to the north was not considered feasible, investigation for encroachment into the Atco right-of-way was required.

Investigation into the current right-of-way status indicates there are two (2) 323 mm (12 inch) diameter pipelines located in the northerly 6.0 m Atco right-of-way, immediately south of Wye Road that have been abandoned, and therefore, no active pipelines exist within the right-of-way. However, between Range Road 232 and Hawthorne Street, one (1) of the 323 mm diameter pipelines (nearest Wye Road) has been converted to a gas distribution main.

The current active pipelines (406 mm and 508 mm diameter high pressure) are located in the 9.0 m right-of-way, further removed from Wye Road, and would therefore be minimally impacted by any Wye Road widening to the south.

In addition to the pipeline right-of-way, Atco Group operates Gate Stations in the southeast quadrant of the Wye Road/Sherwood Drive intersection and in the southwest quadrant of the Wye Road/Brentwood Boulevard intersection. The Gate Station at the Sherwood Drive intersection could be accommodated by roadway design, but would

require collision protection, whereas the Brentwood Gate Station definitely requires relocation for the Wye Road/Brentwood Boulevard intersection improvements. In discussions with Atco Group, it was determined that the relocation of both Gate Stations, with appropriate cost sharing, would be in the best interests of both Atco Group and Strathcona County.

Atco (CU Water) also operates a 350 mm diameter water main within the 6.0 m right-of-way south of Wye Road between Clover Bar Road and Highway 21. Widening of Wye Road will result in portions of this water main being within the carriageway of the roadway (auxiliary lanes). However, this configuration is not atypical and construction would be considered conventional. Appropriate cover for frost protection should be considered at detailed design.

Discussions and negotiations with Atco Group have been ongoing throughout the study and a Memorandum of Understanding (MOU) was developed; however, not formally signed by the parties due to potential legalities. Generally the following consensus has been achieved:

- Atco will transfer (sell or other appropriate mechanism) 5.1 m of the northerly 6.0 m Atco right-of-way to the County to facilitate the Wye Road improvements. The transfer for each stage of Wye Road is to be negotiated, but generally the preferred approach will be for Atco to receive the right-of-way in kind, adjacent to the southerly 9.0 m Atco right-of-way. Strathcona County will, where lands adjacent to Wye Road are currently undeveloped, require the right-of-way in kind to be dedicated, as a condition of development.
- The County will provide a site (≈ 30 m x 30 m) between Hawthorne Street and Brentwood Boulevard to relocated the Gate Station (Gate #1). The cost share for the Gate Station relocation is to be negotiated.
- Atco will relocate the Sherwood Drive Gate Station (Gate #2) to a site south of Wye Road and near the Transportation and Utility Corridor (TUC).
- Strathcona County will work with Atco for the removal of abandoned pipelines from within the right-of-way transferred from Atco to Strathcona County.
- Atco Gas will provide an alignment within the Wye Road right-of-way, or other right-of-way, to install a gas distribution main between new Gate Stations 1 and 2.
- Atco will consider, on a case-by-case basis, for Strathcona County to construct landscaping, trails, etc. on Atco right-of-way to enhance the function and aesthetics of the Wye Road corridor.

2.2.3 Existing Utilities

Various underground and overhead utilities are located within the Wye Road right-of-way. Existing overhead power is located along the south boundary of the existing Wye Road, and will require relocation to facilitate road widening. The overhead power should be relocated underground where feasible and where the budget permits.

Other utilities, including Telus duct lines, gas distribution, and deep utilities exist within the right-of-way but are not expected to be a major constraint to the Wye Road improvements. Utilities should be researched and modification and/or relocation determined during design of each stage. **Exhibit 2.3** through **2.11** show, in plan view and cross-sections, the existing features along the Wye Road corridor.

2.3 EXISTING TRAFFIC OPERATIONS

Operations of the existing Wye Road traffic were modeled using Synchro / Sim V7 software for modeling, optimizing, and simulating traffic operations.

Operations of the existing AM and PM Peak traffic analysis indicate that AM peak traffic operates at good level of service with 30-40% spare capacity. The majority of traffic during AM peak is directed westbound toward the City of Edmonton. However, the PM Peak show higher than AM peak traffic demand (commuter and commercial traffic), with some Wye Road major intersections reaching near capacity condition with congestion, high delays, and long queues.

The existing PM Peak traffic analysis shows significant congestion at the Wye Road/ Sherwood Drive intersection, with LOS D (intersection average delay 50 seconds) some movements operate at LOS E and F. The queues at all approaches affect the operations of adjacent intersections on Wye Road and Sherwood Drive.

Although not modeled, observation of the Saturday Peak Hour traffic at the Wye Road/ Sherwood Drive intersection indicates regular congestion and operational concerns during this period.

Based on the above it was determined that the PM Peak would represent the design hour for which the proposed improvements would be modeled and tested.

2.4 EXISTING COLLISION STATISTICS

Collision statistics were obtained from Strathcona County for the five year period from 2003-2007 to determine the collision rate at intersections along the Wye Road corridor. The collision rate is expressed as a ratio of the number of collisions per million entering vehicles, and is shown on **Exhibit 2.12** for intersections along Wye Road. Collision rates generally increase as congestion and operational problems increase, as is the case on Wye Road.

To provide a comparison of collision rates on Wye Road, collision statistics were also obtained for major intersections on Baseline Road as shown on **Exhibit 2.13**. The higher collision rates at the Broadmoor Boulevard and Sherwood Drive intersections on Baseline Road can be attributed to the amount of congestion and the expanse of pavement at these intersections.



Strathcona County

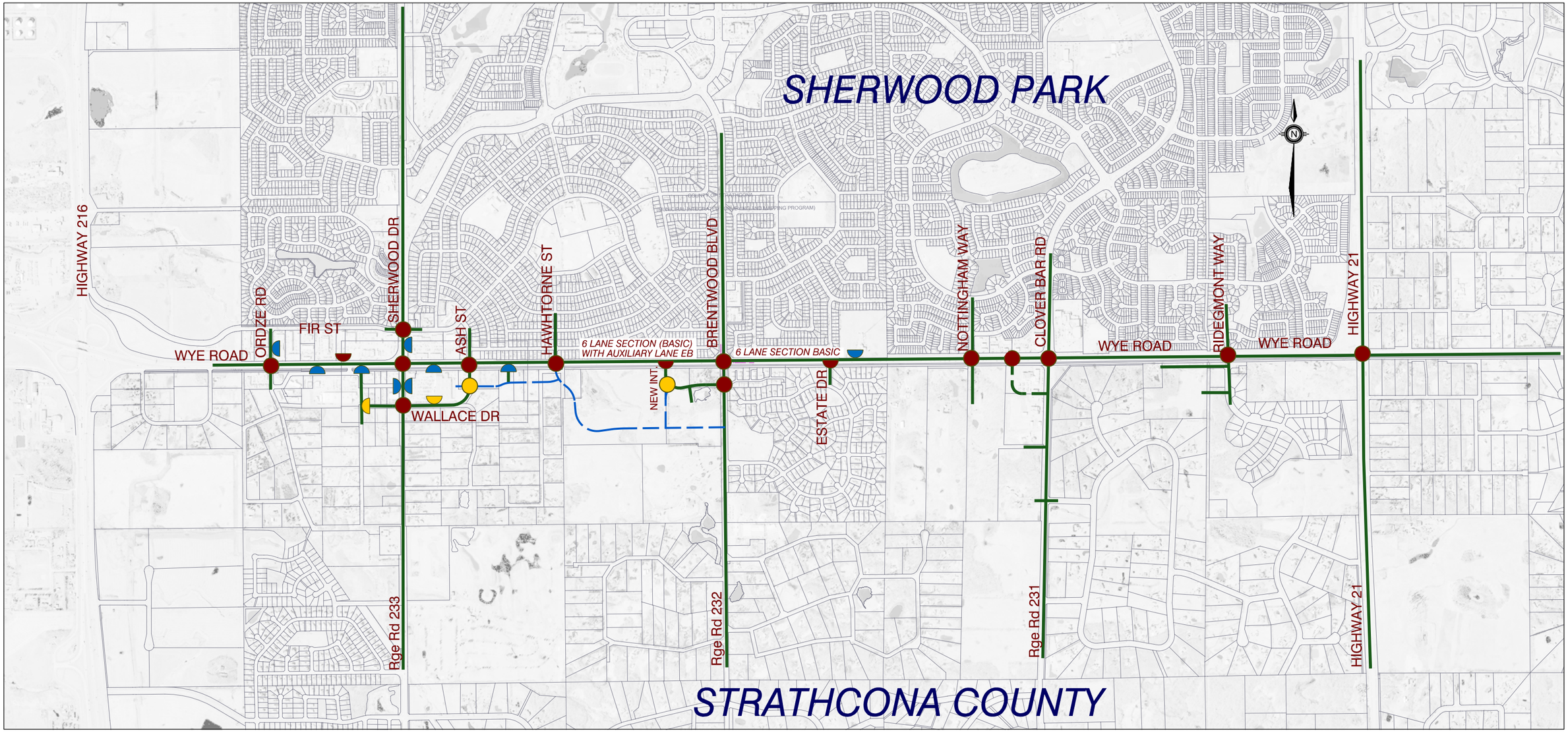
AL-TERRA ENGINEERING

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

LAND USE MAP

Date: NOVEMBER 2008

EXHIBIT 2.1



LEGEND:

- *ALL DIRECTIONAL INTERSECTION SIGNALIZED*
- *T- INTERSECTION SIGNALIZED (MAY BE PARTIAL)*
- *ALL DIRECTIONAL INTERSECTION NOT SIGNALIZED*
- *T- INTERSECTION NOT SIGNALIZED*
- *RIGHT-IN/RIGHT-OUT*
- *PROPOSED DEVELOPMENT ROADS*

Strathcona County

AL-TERRA ENGINEERING

METRIC SCALE 0 500 1 000 *metres*

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

LONG TERM ACCESS MANAGEMENT MAJOR INTERSECTIONS

Date: NOVEMBER 2008

EXHIBIT 2.2

SHERWOOD PARK

HIGHWAY 216

ORDZE RD

FIR ST

SHERWOOD DR

ASH ST

HAWTHORNE ST

BRENTWOOD BLVD

NOTTINGHAM WAY

CLOVER BAR RD

RIDGEMONT WAY

SHERWOOD PARK HAMLET BOUNDARY

HIGHWAY 21

SHERWOOD PARK FREEWAY

WYE ROAD

3.00m CONCRETE NOISE FENCE

TWP. RD 524

WYE ROAD

ATCO GATE STATION #2

WALLACE DR

ATCO PIPELINES

ATCO GATE STATION #1

ESTATE DR

ATCO PIPELINES

Rge Rd 233

Rge Rd 232

Rge Rd 231

HIGHWAY 21

STRATHCONA COUNTY

Strathcona County

AL-TERRA ENGINEERING

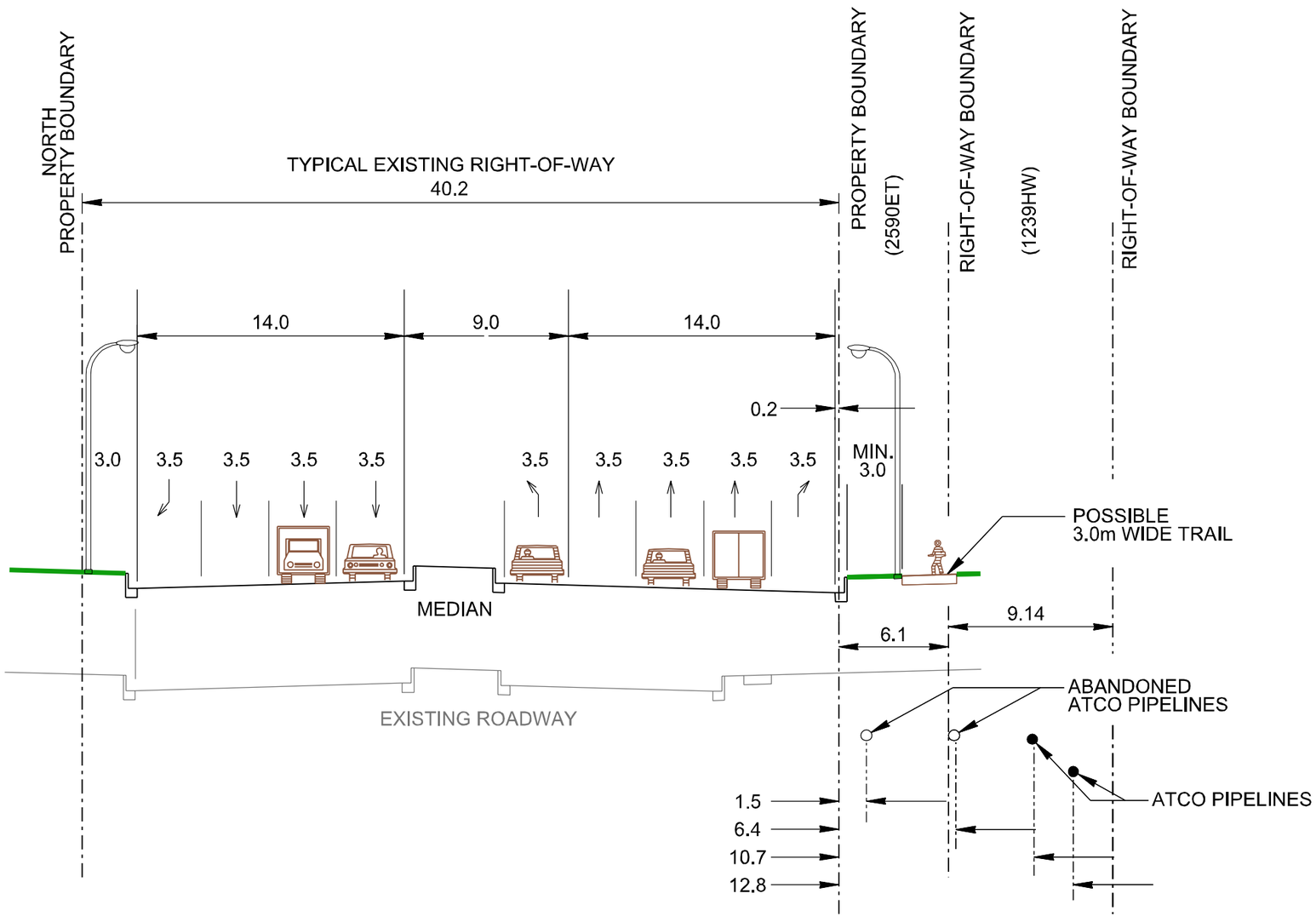
METRIC SCALE 0 500 1 000 metres

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

FEATURES

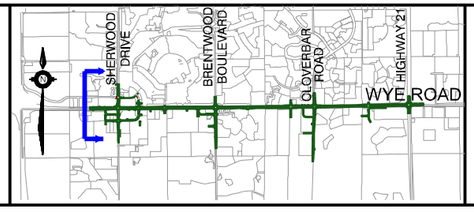
Date: NOVEMBER 2008

EXHIBIT 2.3



WYE ROAD
CROSS-SECTION - WEST OF SHERWOOD DRIVE

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

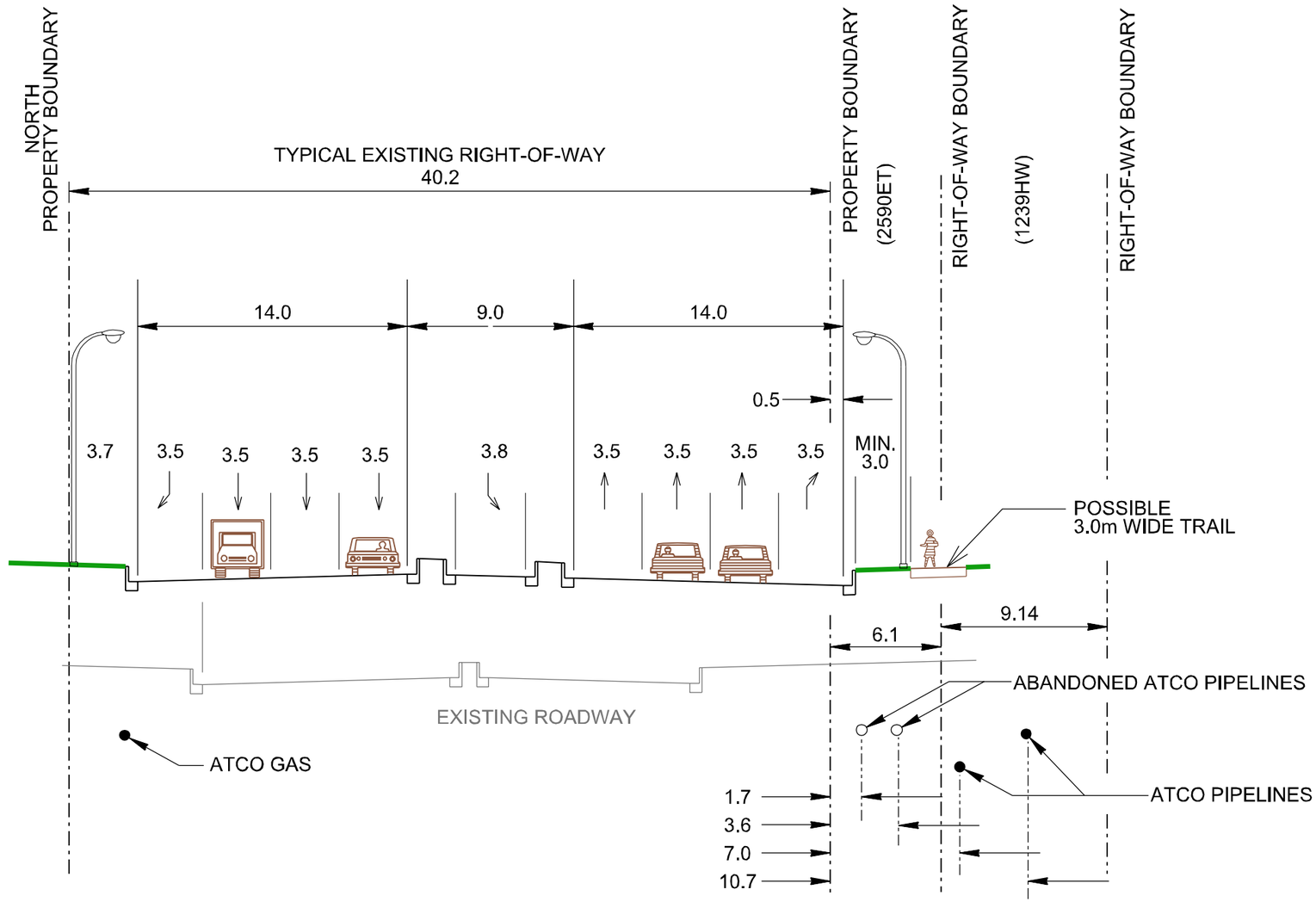
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

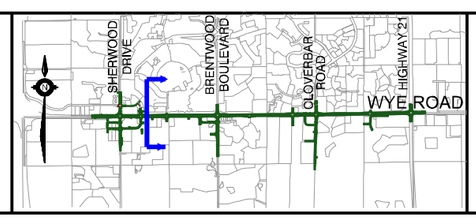
Date: NOVEMBER 2008

EXHIBIT 2.4



WYE ROAD
CROSS-SECTION - EAST OF ASH STREET

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

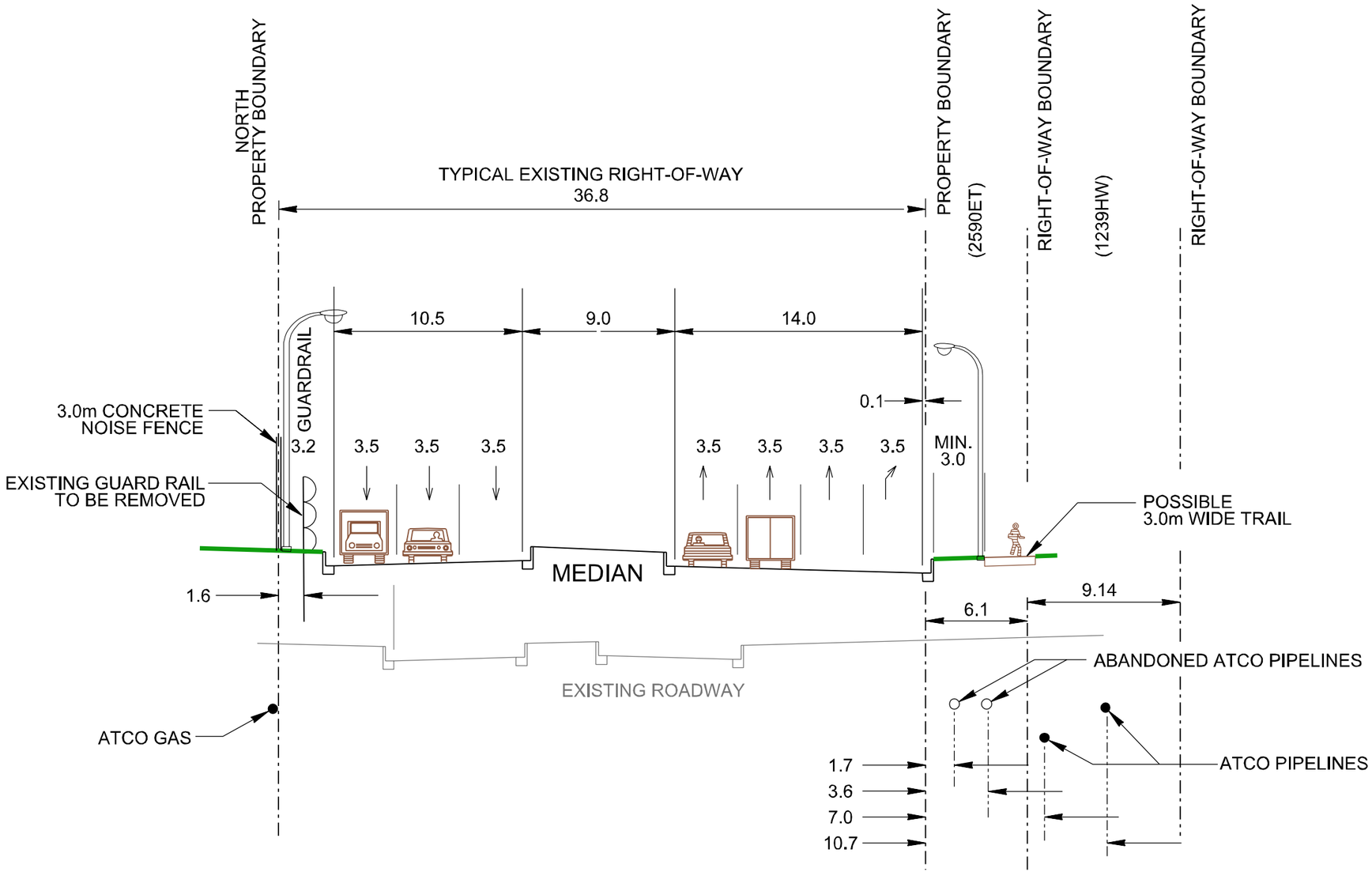
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

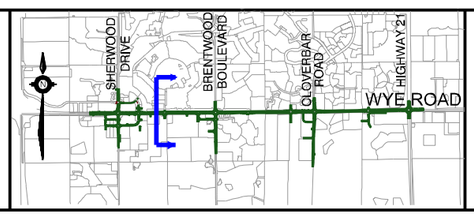
Date: NOVEMBER 2008

EXHIBIT 2.5



WYE ROAD
CROSS-SECTION - WEST OF HAWTHORNE STREET

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

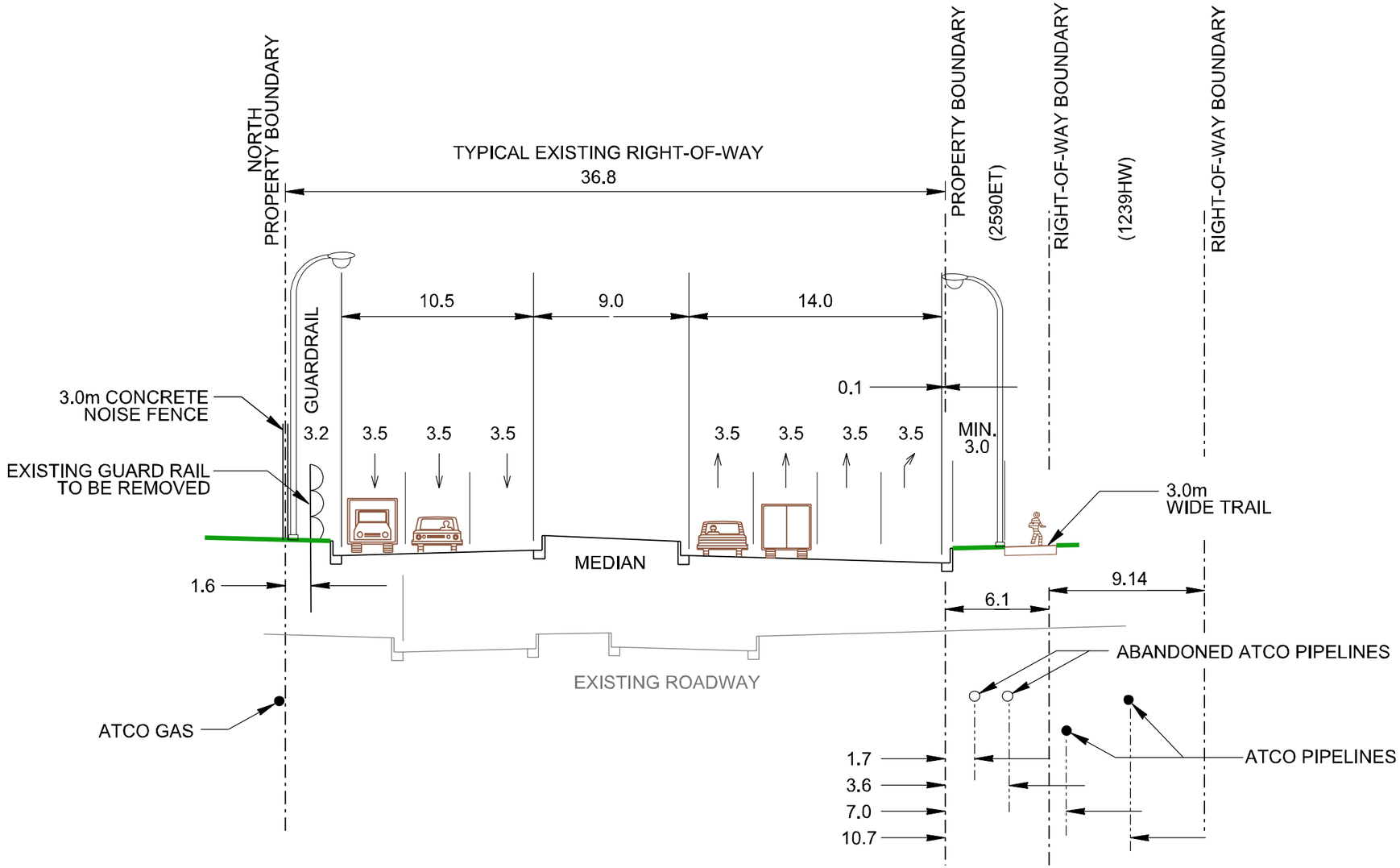
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

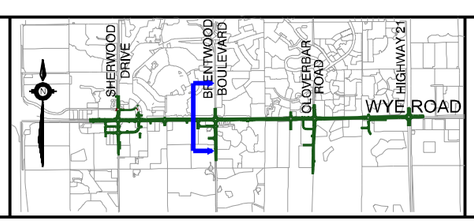
Date: NOVEMBER 2008

EXHIBIT 2.6



WYE ROAD
CROSS-SECTION - WEST OF BRENTWOOD BLVD

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

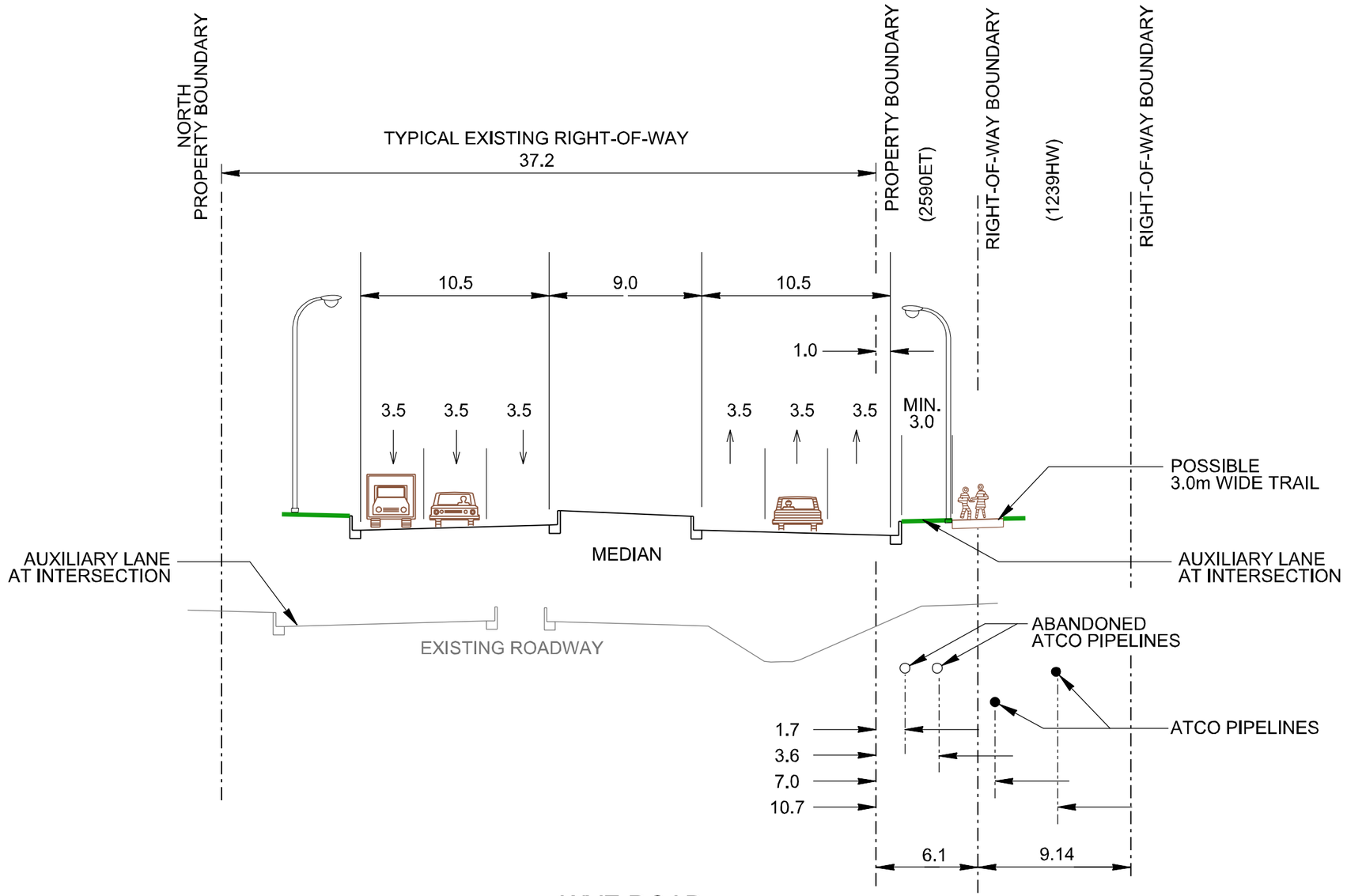
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

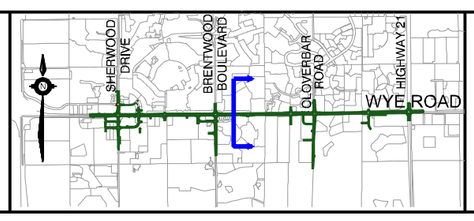
Date: NOVEMBER 2008

EXHIBIT 2.7



WYE ROAD
CROSS-SECTION - EAST OF BRENTWOOD BLVD

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

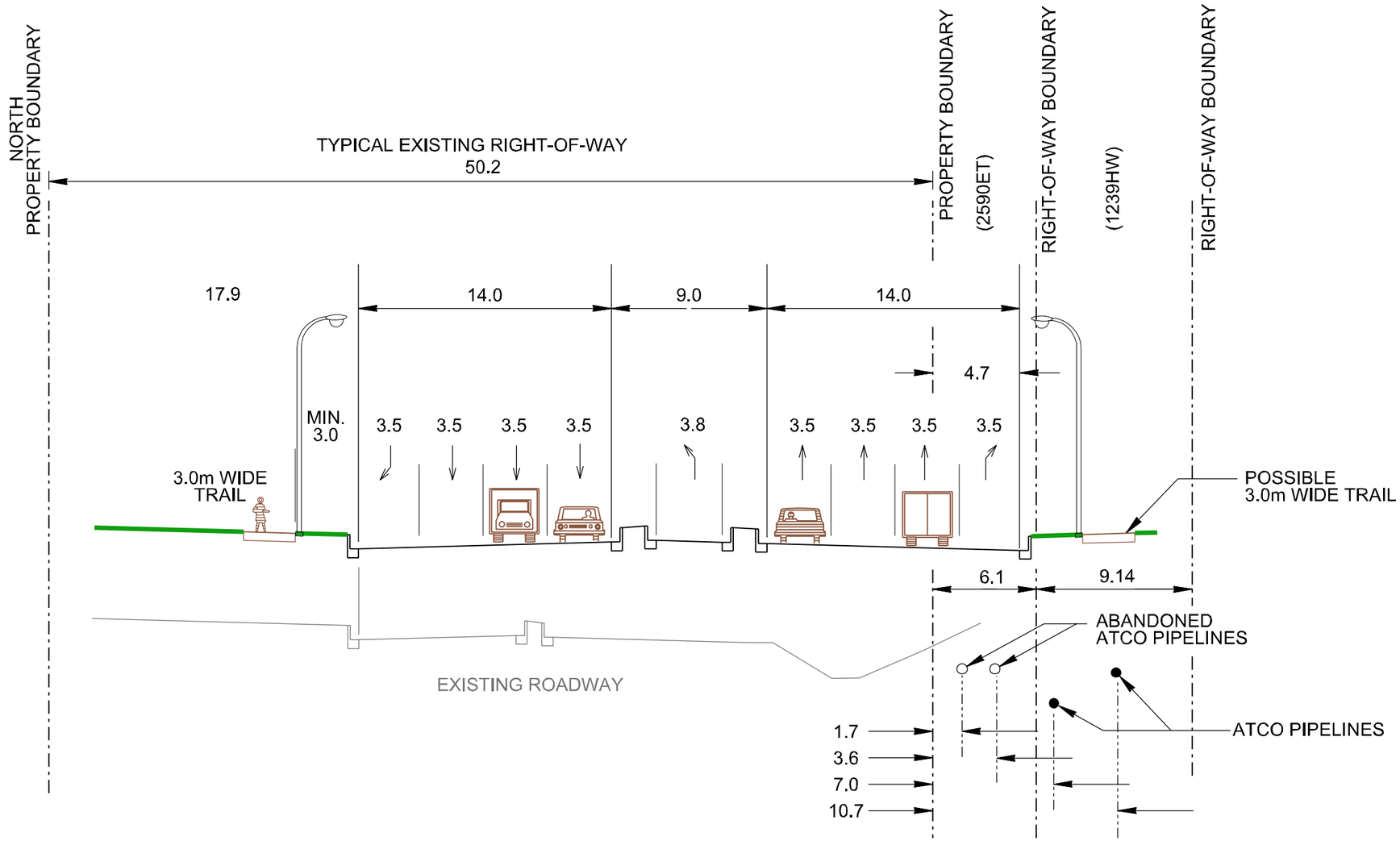
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

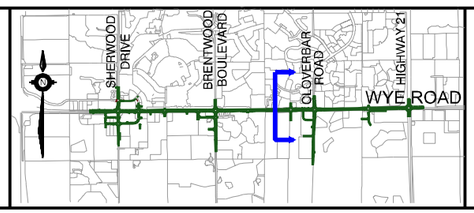
Date: NOVEMBER 2008

EXHIBIT 2.8



WYE ROAD
CROSS-SECTION - WEST OF NOTTINGAM WAY

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

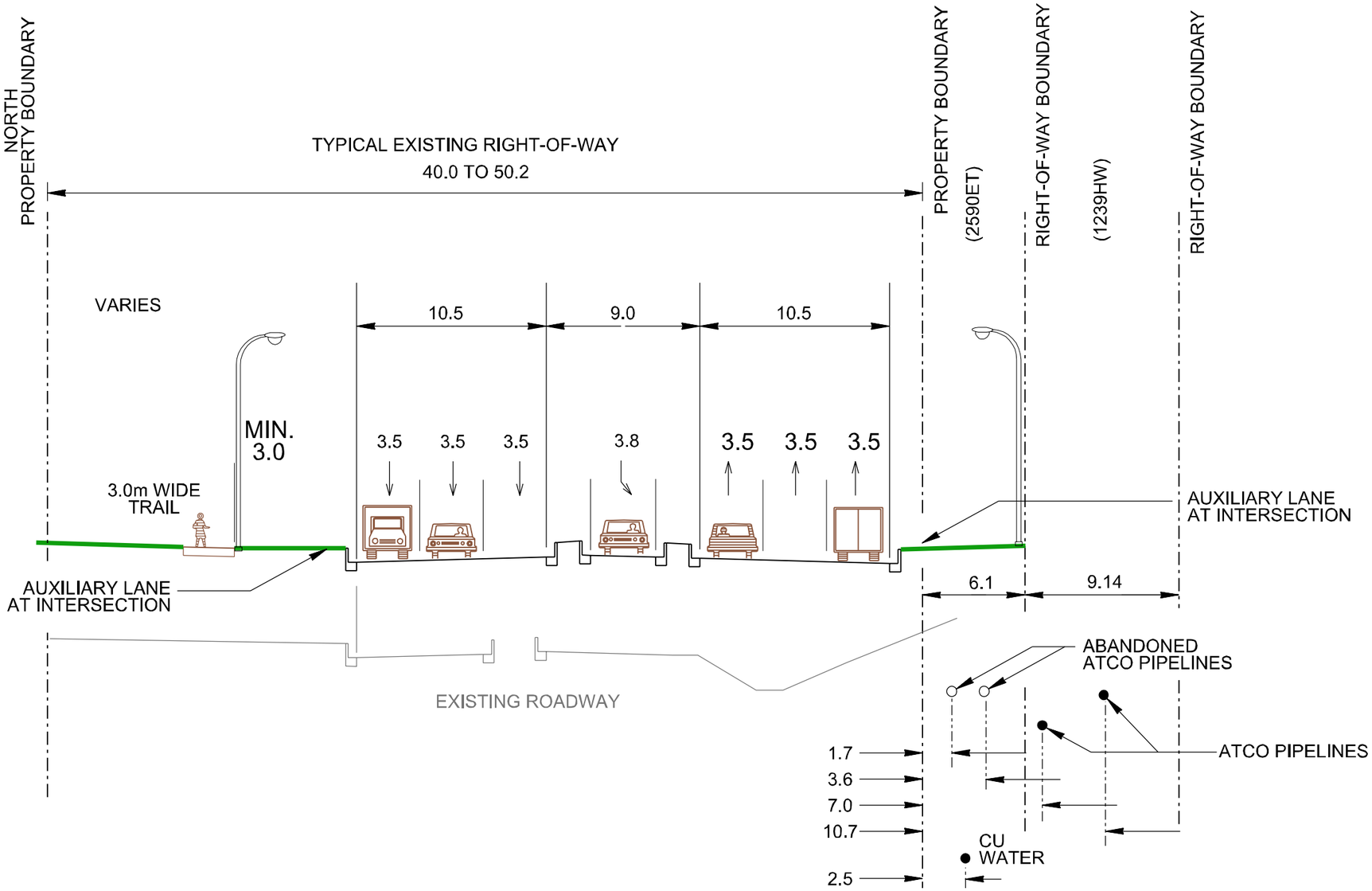
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

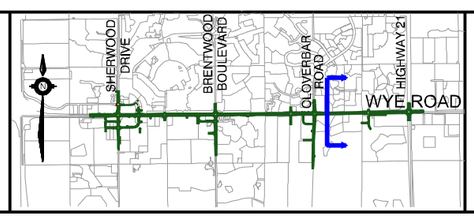
Date: NOVEMBER 2008

EXHIBIT 2.9



WYE ROAD
CROSS-SECTION - EAST OF CLOVERBAR ROAD

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

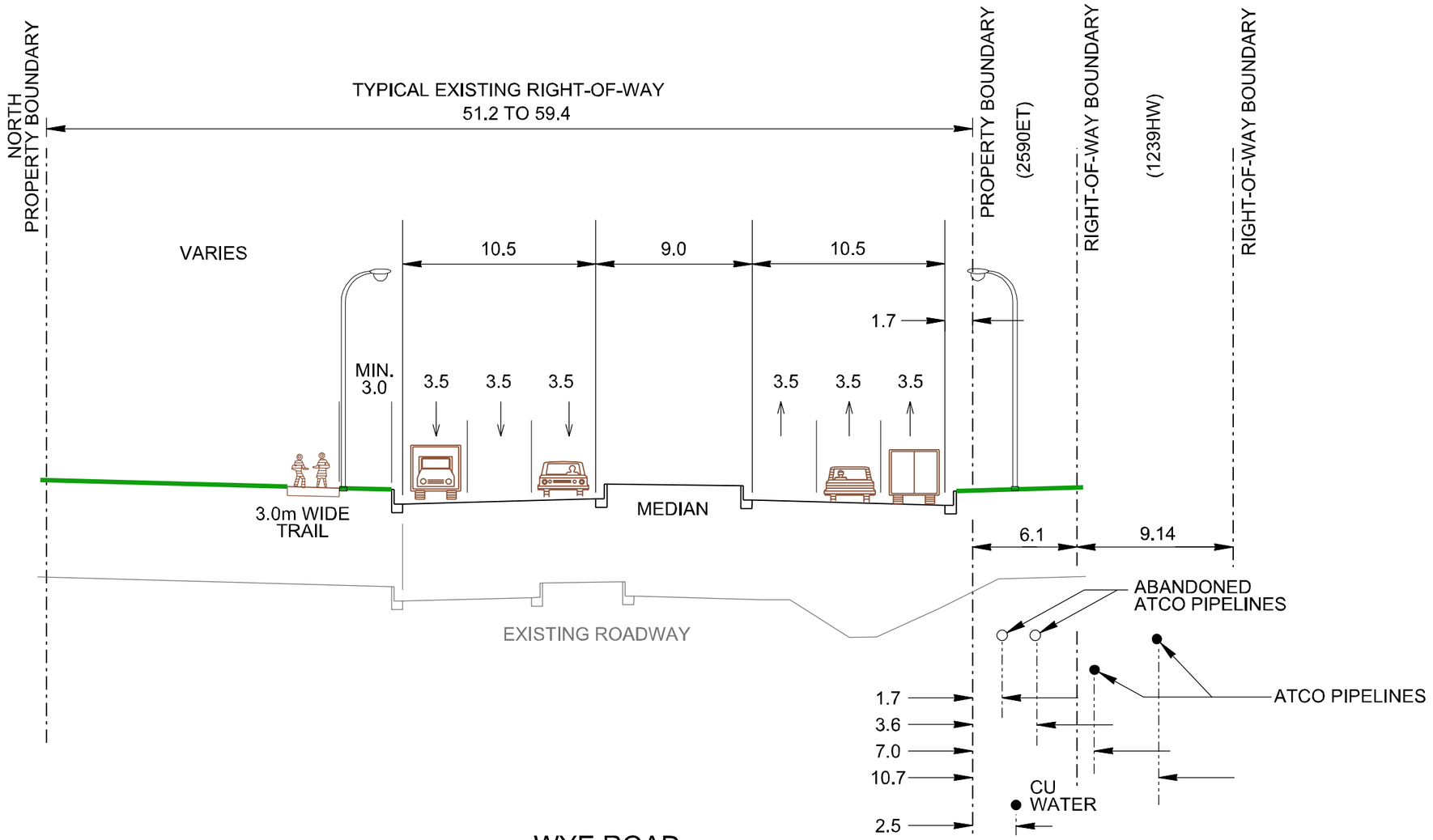
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WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

TYPICAL CROSS - SECTION

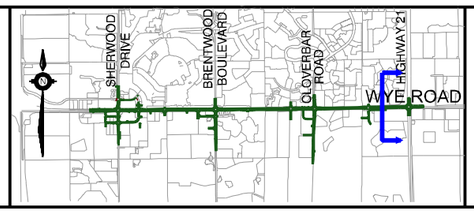
Date: NOVEMBER 2008

EXHIBIT 2.10



WYE ROAD
CROSS-SECTION - WEST OF HIGHWAY 21

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

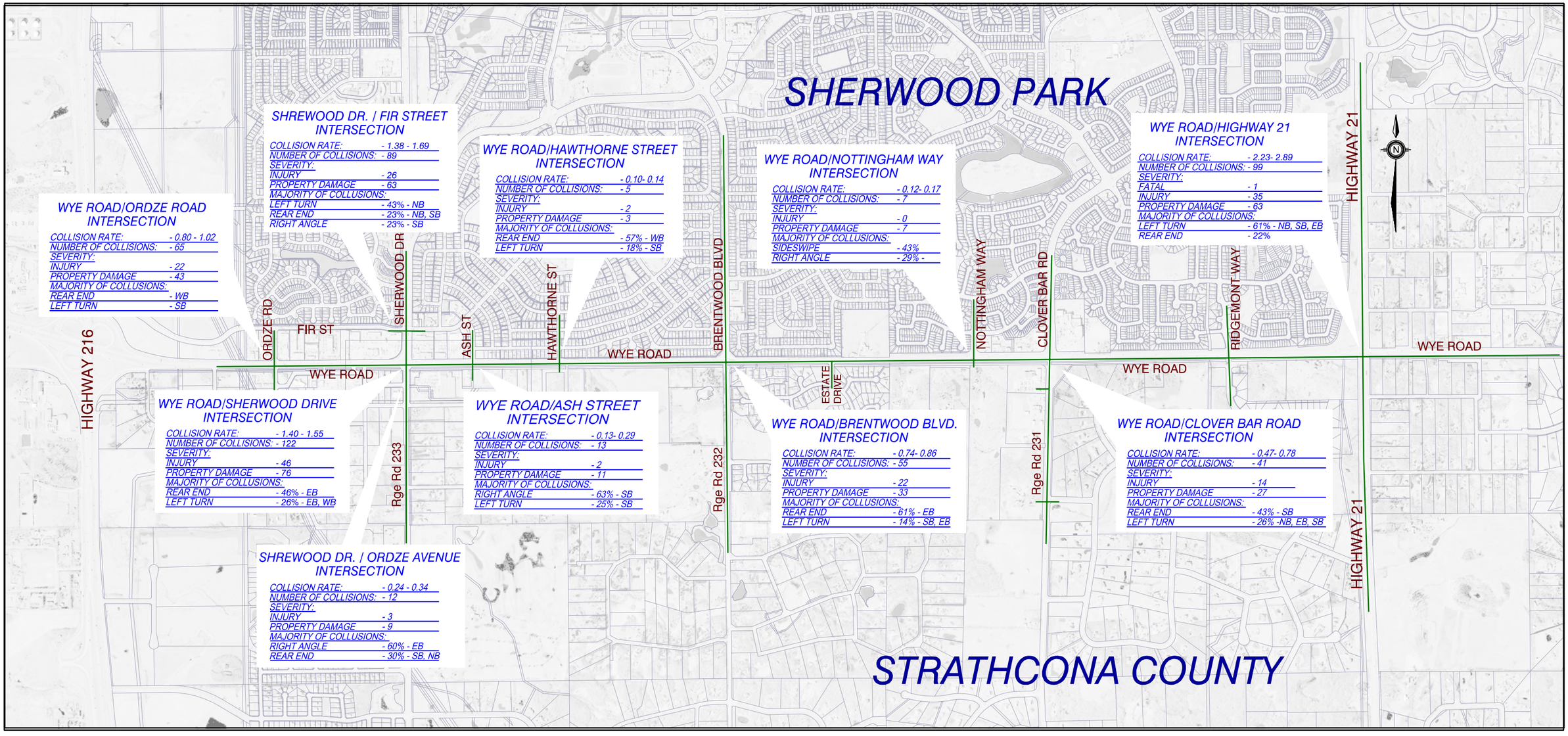
AL-TERRA ENGINEERING

Scale: N.T.S.

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY
TYPICAL CROSS - SECTION

Date: NOVEMBER 2008

EXHIBIT 2.11



NOTE:

COLLISION RATE = NUMBER OF CRASHES PER MILLION ENTERING VEHICLES PER YEAR

Strathcona County

AL-TERRA ENGINEERING

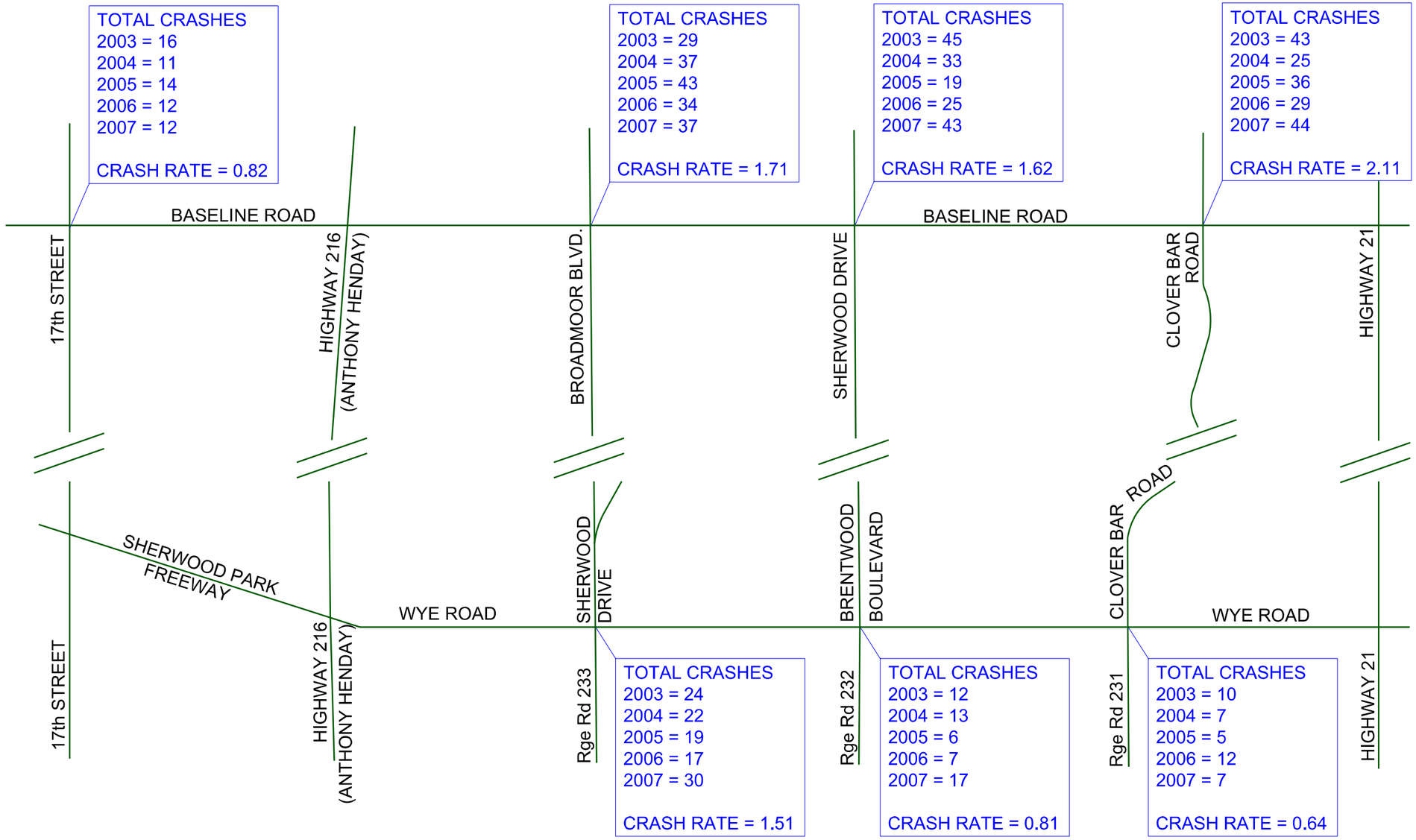
METRIC SCALE 0 500 1 000 metres

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

COLLISIONS STATISTICS
WYE ROAD CRASH HISTORY
YEARS 2003-2007

Date: NOVEMBER 2008

EXHIBIT 2.12



NOTES:

COLLISION STATISTICS 2003 - 2007
TOTAL CRASHES INCLUDE INJURY AND PROPERTY COLLISIONS
CRASH RATE IS 5 YEAR AVERAGE PER MILLION ENTERING VEHICLES

Strathcona County

AL-TERRA ENGINEERING

METRIC SCALE 0 500 1 000 metres

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

COLLISIONS STATISTICS CRASH HISTORY - YEARS 2003-2007 AT WYE AND BASELINE ROADS

Date: NOVEMBER 2008

EXHIBIT 2.13

3.0 DESIGN CRITERIA

The general approach to the study was to develop a long-term plan that maintains the integrity and function of Wye Road as a major arterial roadway in Sherwood Park and Strathcona County.

The desired (targeted) level of service at the time of full build out of Sherwood Park, expected to be achieved in about year 2015, would be LOS D, with 10% spare capacity, and a volume to capacity ratio (v/c) less than 0.8 for all movements. Level of service is defined in Step Five, Traffic Analysis, in the Traditional Traffic Model in **Section 4.0**.

Although 2015 represents the build out of Sherwood Park, it should be noted that further growth will occur in Strathcona County after that time. Further growth may include additional growth nodes (Colchester Area), business and commercial development, and increased truck traffic, all which could result in significant additional traffic demand on Wye Road. Even in the absence of new growth nodes, traffic volumes on Wye Road will continue to increase with normal growth, and therefore, it is prudent to plan for Wye Road improvements to have some spare capacity based on the 2015 traffic projections.

The design criteria used for the preparation of the Wye Road Functional Plans, as shown in **Table 3.1**, was developed by the design team in consultation with County staff. These design criteria are considered appropriate for the standard and classification of this roadway.

Table 3.1
Design Criteria

Criteria	Wye Road
Road Classification	UAD
Design Speed	80 km/h
No. of Lanes	Six (6) Lanes, and Auxiliary Lanes as Required
Design Vehicle	WB 21
Minimum Radius	R 250 m (80 km/h)
Minimum K Factor	Crest 35, Sag 35 (80 km/h)
Minimum Grade	Desired >0.6%
Superelevation	Typical Cross-slope 2.5%, Max Superelevation 6%
Minimum Stopping Sight Distance (SSD)	140 m (80 km/h)
Minimum Decision Sight Distance (DSD)	230 – 310 m (80 km/h)
Lane Width	3.5 m min (Basic and Auxiliary Lanes)
C/G Width	0.25 m Gutter (min)
Median Width	9.0 m – allowance for double left turn lane

4.0 INTERSECTION EVALUATION / TRAFFIC MODELING & ANALYSIS

As noted, the traffic projections and analyses were performed for year 2015 horizon, which represents the build out Sherwood Park and for which the Strathcona County traffic model was prepared for the recent Transportation Study Update.

The model volumes for future developments south of Wye Road were subtracted from the Strathcona model in order to estimate Wye Road background traffic. Background traffic represents area wide traffic growth in Sherwood Park and Strathcona County, as well as existing traffic. Based on new inputs related to land uses and trip generation rates, development traffic was added to this background traffic to estimate the year 2015 total traffic along Wye Road.

A five step Traditional Traffic Model was used to determine traffic demand along Wye Road.

1. Trip Generation

   Recently conducted by Strathcona County the Trip Generation Study for commercial areas along Wye Road is summarized in **Table 4.1**.

   Local, Sherwood Park trip generation rates for residential areas were used.

   Trip generation rates for mixed retail and service areas utilized average rates from the Strathcona County Trip Generation Study. For all other specific land uses, ITE (Report Volume 7) rates were used.

   Summary of trip generation rates, trip generation, and trip distribution assumptions are shown in **Table 4.2**.

   It was assumed that all trips generated from the residential area are primary (new) trips between an origin and a destination.

   For a variety of commercial areas it was assumed that some of trips generated would be primary trips and the remaining trips are created by traffic already on the road network. These trips are called pass-by or diverted trips. Vehicles traveling in a direction, passing-by the development turn into it, and then go back to the road and continue the trip in the same direction.

   The assumption of the proportions of primary and pass-by trips are based on ITE recommended practices.

2. Trip Distribution

   Trip Distribution assumptions (travel direction) were based on the City of Edmonton Origin-Destination Regional Model. Trip Distribution for the new development areas along Wye Road are shown in **Table 4.2**.

3. Modal Split

   No significant transit change on the Sherwood Park traffic is anticipated, so no modal split was analyzed.

4. Traffic Assignment

   In traffic assignment the new traffic was allocated to the road network based on the shortest path (shortest time of travel) using above origin-destination assumption.

   The total traffic for year 2015 represents a sum of background traffic, new primary trips and pass-by traffic.

   Exhibits 4.1 through **4.3** show the existing, year 2015 background, and year 2015 total traffic estimates for the PM Peak in the study area, and at intersections. These were the volumes used in the traffic analysis. The details of all traffic components including existing, new and pass-by, and traffic growth is included in **Appendix "A."**

   In addition, daily traffic volumes were estimated to gauge the magnitude of impact of the proposed developments, south of Wye Road on the Wye Road corridor. Daily volumes are shown on **Exhibits 4.1(a)**, **4.2(a)**, and **4.3(a)** for the existing, year 2015 background, and year 2015 total traffic, respectively.

   The traffic generation, distribution and assignment yield turning volumes at Wye Road and Brentwood Boulevard presented in this report somewhat differently than the volumes generated by South Wye Area Structure Plan Amendment (TIA). This was considered acceptable because the assignment of traffic is somewhat subjective and actual roadway conditions will determine which access to the development drivers would use: access from Wye Road versus access from Range Road 232.

5. Traffic Analysis

   Traffic analysis was conducted using Synchro and Sim Traffic modeling software, which utilizes two methods for evaluating traffic operations.

   The first method is compatible with Highway Capacity Manual 2000 (HCM) methodology and is based on estimating average vehicle delays at intersections. The software is capable of finding the optimum cycle and coordination

parameters based on a traffic demand. HCM gives an output average delay and volume to capacity ratio (v/c) for the particular movements, as well as estimates the queues.

The second method is an evaluation procedure, which uses Intersection Capacity Utilization (ICU). The ICU is compatible with HCM and uses the same inputs, but it is not cycle length dependant. The procedure uses saturation flows for all movements and estimates the capacity (% spare or % over) of the intersection. ICU level of service (LOS) provides capacity information applicable to the whole intersection.

The HCM measure of effectiveness for signalized intersection uses the average delay for the intersection (dependent on cycle length), and is described as follows:

LOS	Delay per Vehicle (sec./veh)
A	≤10
B	10-20
C	20-35
D	35-55
E	55-80
F	> 80

The ICU measure of effectiveness, volume to capacity ratio indicates a reserve or deficiency of the capacity for the intersection (independent of cycle length) and is described in the table below.

ICU LOS	Capacity Used	
A	≤55%	
B	55-64%	
C	64-73%	
D	73-82%	Normally no congestion, most of the traffic is served on one cycle.
E	82-91%	On the verge of congestion condition, incidents may create severe congestion.
F	91-100%	Over capacity, - congestion periods 15 to 60 minutes per day, some residual queues.
G	100-109%	Over capacity, - congestion periods up to 2 hours per day, long queues.
H	> 109%	Over capacity - congestion periods over 2 hours per day, drivers will choose different routes, long queues .

Wye Road intersectional analyses were conducted for the system from Ordze Road to Highway 21 using estimated year 2015 PM Peak traffic volumes. Considering that this is a planning application, default Synchro inputs used in the analyses include a saturation

flow of 1900 veh/h, peak hour factor PHF=1.0, lane utilization factors, and 0% heavy vehicles – all input in pcu's (car equivalences).

Initially, Wye Road was analyzed with a "do nothing" option in order to evaluate the magnitude of the impacts. The analyses indicated unsatisfactory traffic conditions at the major intersections, including Sherwood Drive and Brentwood Boulevard, and Clover Bar Road to a lesser extent.

After initial evaluation, traditional and non-traditional improvement options were developed for each major intersection and evaluated to determine operations based on 2015 projected traffic. Analysis and option illustrations are included in **Appendix "B."**

4.1 WYE ROAD AND SHERWOOD DRIVE INTERSECTION (SUMMARY TABLE 4.3)

Prior to the analyses, some access management modifications were required for the existing road network. These modifications were proposed to address existing safety and operational issues. The functional areas of the Wye Road and Sherwood Drive, and Ordze Avenue (access to Wal-Mart) and Sherwood Drive intersections overlap, resulting in queues from the main intersection spilling onto the adjacent accesses and vice versa for the minor intersection traffic affecting the operations of the main intersection.

Frequently, it is observed (particularly on weekends) that intersections are being blocked due to long queues from inadequate storage space. This situation affects the performance of the main intersection and all adjacent accesses, including development sites.

The close proximity of the Ordze Avenue/Range Road 233 intersection and the Sherwood Centre access intersection to the Wye Road/Sherwood Drive intersection, in combination with very high traffic volumes, creates a high collision location, as is indicated in **Section 2.4**. There is also a significant number of unreported and "near miss" incidents, which are not included in the collision statistics.

To address the operational and safety concerns, it is proposed to modify the existing accesses at Ordze Avenue/Range Road 233 and Sherwood Center/Sherwood Drive by closing the medians and converting the accesses to right-in/right-out operation only. This would modify the traffic patterns for the Sherwood Center, Wal-Mart site, and the businesses along Ordze Avenue. The Wallace Drive Jughandle was proposed to provide alternate access from the Wal-Mart site to the adjacent road network.

The traffic analyses conducted for the year 2015 included the access modifications, and the traffic affected by the median closure was redistributed onto the Wallace Drive and the adjacent road network, as required.

The following is a description of the options considered for the improvements at the Wye Road/Sherwood Drive intersection. Eleven options were developed and evaluated.

A summary of the analyses results for all options, including the proposed improvements, and LOS parameters for HCM and ICU methodology are presented in **Table 4.3**.

4.1.1 "Do Nothing" Option

The option assumes that no improvements would be implemented until 2015 except for the access management modifications at the Ordze Avenue and Sherwood Centre accesses, and the implementation of a jughandle road for alternative access. The analyses indicates that the Wye Road/Sherwood Drive intersection is over capacity and will experience long periods of congestion with long queues; drivers would likely find alternative routes during peak hours, if available, or would not travel at peak hours.

4.1.2 Option 1

Option 1 represents conventional intersection treatment improvements. The traditional approach includes adding lanes for the through movements as well as turning lanes. Two alternatives were considered.

4.1.2.1 Option 1a

The first alternative involved increasing the number of through lanes on Wye Road to three (3) lanes westbound, four (4) lanes eastbound and two (2) westbound left turn lanes, with no improvements on Sherwood Drive. The existing right-of-way restrictions limit the widening possibilities on Sherwood Drive. Intersectional analyses indicate intersection operations over capacity, and traffic will likely experience congestion periods from 15 to 60 minutes. Minor traffic fluctuations and/or incidents will cause significant congestion. Volume to capacity ratios for some movements show unacceptable values.

4.1.2.2 Option 1b

In addition to an increased number of lanes, this alternative considered the provision of a double southbound to eastbound left turn lane. Due to close spacing between Wye Road and Fir Street, no deceleration taper can be provided between the two reversed left turning lanes, which makes the operation of turning vehicles abrupt, and inconsistent with the design parameter objectives. Capacity will improve, comparing with Option 1a, but the intersection will operate on the verge of congestion. Minor traffic fluctuations or incidents will cause significant congestion.

4.1.3 Option 2

Option 2 intersection improvements include the combination of traditional and unconventional treatments. The unconventional treatment removes one of the turning movements and accommodates it via an alternate network connection.

4.1.3.1 Option 2a

In this option the westbound left turn lane is removed from the Wye Road/Sherwood Drive intersection and is accommodated at Ash Street on the jughandle roadway. The intersection at Wye Road/Ash Street would be signalized in addition to the widening of

Wye Road to six (6) basic lanes. The analyses indicate intersection operation over capacity, which would not be acceptable.

4.1.3.2 Option 2b

In addition to the improvements and modifications of Option 2a, double southbound to eastbound left turning lanes would be provided in this option. The intersection operations would be on the verge of congestion, with marginally acceptable intersection capacity ICU 90.3%: LOS C (31.3 sec./veh.), but critical movement v/c ratios are worse than the 0.8 objective. Similar to Option 1a, the double left turn lane taper would not be provided to accommodate deceleration for the two reversed turning lanes at Wye Road and Fir Street.

4.1.4 Option 3

Option 3 includes the widening Wye Road to six lanes (6), and two left turn movements removed from the intersection and accommodated by other network connections.

4.1.4.1 Option 3a

With the two left turn movements relocated, the westbound left turn is to be accommodated at Ash Street, and eastbound left turn movement is to be accommodated via Ordze Avenue and Wallace Drive. The configuration includes a jughandle, in which the left turn, eastbound to northbound, would be accommodated via a right turn in advance of the Sherwood Drive intersection and then traffic would proceed to Wallace Drive, making a left turn northbound followed by through movement at Wye Road. The left turn westbound to southbound would be relocated to Ash Street and Wallace Drive. The analyses indicate that the intersection at Wye Road and Sherwood Drive would be over capacity, which is not acceptable.

4.1.4.2 Option 3b

This option is similar to Option 3a, with the provision of a double left turn lane southbound to eastbound. The Intersection capacity reached an ICU of 100%, which would not be acceptable.

4.1.5 Option 4

Option 4 includes the removal of southbound and northbound left turns. The southbound movement was assigned to Fir Street and Wallace Drive. The northbound left turn would use the Wallace Drive and Ash Street.

The Wye Road widening includes widening to six (6) lanes.

4.1.5.1 Option 4a

In this option the southbound left turn is relocated to two intersections. The southbound traffic would have two options of reaching the desired destination. It was assumed that one third of the traffic would use Fir Street and Ash Street to continue to travel on Wye Road eastbound; drivers would be required to execute two left turns instead of one. The

remaining two thirds of traffic would travel through the Wye Road intersection via Wallace Drive and Ash Street, which would require one left at Wallace Drive and then a right turn at Wye Road to continue eastbound on Wye Road.

The intersection at Wye Road and Sherwood Drive operates at 92% ICU, and southbound and eastbound through movements would be operating at a v/c ratio of 0.88, and 0.91 respectively. These operations are not acceptable.

4.1.5.2 Option 4b

Similar to Option 4a, with a double left turn lane southbound to eastbound at Fir Street, both intersections operate at the same level of congestion and therefore, it is not acceptable based on project targets.

4.1.6 Option 5

In this option all but eastbound to northbound left turns are relocated and accommodated via adjacent road connectors similar to previous options. Southbound to eastbound left turns are relocated to Fir Street and Wallace Drive. The westbound to southbound movement is accommodated via Ash Street and Wallace Drive. The northbound to westbound movement would be accommodated by the Wallace Drive and Ash Street jughandle.

4.1.6.1 Option 5a

Operations of Wye Road/Sherwood Drive intersection for Option 5a would be at an ICU of 80% and would perform acceptably. The Sherwood Drive/Fir Street intersection would be at 110% capacity. Southbound to eastbound turn movements would be at v/c 1.15, which would create long queues southbound and likely would block southbound through movement, operations would not be acceptable.

4.1.6.2 Option 5b

To improve the operations at Sherwood Drive and Fir Street double southbound to eastbound left turn movement is proposed in this option. The operations of the intersections in the vicinity of Wye Road and Sherwood Drive improve to a level unsurpassed by any other options.

It is recommended to implement Option 5b, with a possible initial stage of Option 2b.

4.2 WYE ROAD AND BRENTWOOD BOULEVARD INTERSECTION (SUMMARY TABLE 4.4)

Conventional and unconventional options were considered at the Wye Road/Brentwood Boulevard intersection.

A "do nothing option," traditional and unconventional improvements were considered at the intersection. Brentwood Boulevard to the north is a four (4) lane divided roadway located in restricted right-of-way, so widening would be very difficult without impacting developed residential properties along the road. To the south, the existing roadway is a two (2) lane undivided road (Range Road 232), which will be upgraded to a divided urban arterial in the future. Only the southwest quadrant of the intersection is not yet developed, which allows possible roadway widening to the south and/or implementation of an unconventional intersection configuration, such as a jughandle at that location.

It is assumed that improvements on Brentwood Boulevard to the north of Wye Road would allow only two options of widening: either six (6) lanes without left turn lanes or a four (4) lane cross-section with double left turn lanes southbound.

4.2.1 "Do Nothing" Option

Intersectional analysis demonstrates that the intersection would be over capacity under the year 2015 traffic demand, therefore improvements are necessary.

Further options analyzed assumed that Wye Road would be widened to six (6) basic lanes with auxiliary lanes, as required.

4.2.2 Option A

Option A considers traditional intersection improvements, which include the introduction of double turning lanes for some intersection approaches.

4.2.2.1 Option A-1

This option considers eastbound and westbound double left turn lanes, assuming that Brentwood Boulevard would remain as is and Range Road 232 would be upgraded. The intersection analyses indicated that the intersection will be over capacity (ICU 109%) with some movements at and over capacity, which would not be acceptable.

4.2.2.2 Option A-2

Additional to Option A-1 improvements, the double left turn lane southbound was used. The analyses indicates intersection capacity would be 94% which indicates the intersection is over capacity, with congestion periods of 15-60 minutes, long queues, etc.

Option A does not provide satisfactory operation of the intersection; hence the unconventional options were investigated.

4.2.3 Option B

This option considers a jughandle configuration in the southwest quadrant of the intersection. All options assume the removal of eastbound to northbound and westbound to southbound left turn movements, relocating those movements onto the jughandle. The option assumes that the intersections of Wye Road and Range Road 232 with the Jughandle would be signalized. The option considers both single left turn and double left turn southbound to eastbound options.

4.2.3.1 Option B-1

With this option, the intersection of Wye Road and Brentwood Boulevard is at 99.5% ICU LOS, with southbound and eastbound lanes over capacity, which would not be acceptable.

4.2.3.2 Option B-2

In this option, the implementation of double southbound to eastbound left turn lane improves the operation of the intersection to ICU of 90.7%, which is still not acceptable because it indicates that the intersection is on the verge of congestion. Main demand for the eastbound through lane showed v/c >1.

4.2.3.3 Option B-3

It is assumed that Brentwood Boulevard is widened to six (6) lanes, the right deceleration lane southbound is removed and the right turn is shared with the through movement, with only a single left turn southbound lane provided. The Wye Road/ Brentwood Boulevard intersection would be over capacity, ICU 98.1% or LOS F, which would not be acceptable.

4.2.4 Option C

Option C assumed that only eastbound to northbound left turn movement remains at the Wye Road/Brentwood Boulevard intersection and all other left turns are accommodated via the jughandle. Similar to Option B, signalization would be required at the jughandle intersections.

4.2.4.1 Option C-1

In this option it is assumed that the eastbound to northbound left turn is a single turning lane and that Brentwood Boulevard remains as a four (4) lane roadway. The intersection operates on the verge of congestion, with minor traffic fluctuation, accidents or lane closures may result in significant congestion. In addition, the jughandle and Wye Road intersection operates on the verge of congestion.

4.2.4.2 Option C-2

In this option, Brentwood Boulevard is widened to six (6) lanes. Capacity at Brentwood Boulevard improves, but the intersection at Wye Road and the jughandle is still on the verge of congestion, as was the case in Option C-1.

4.2.5 Option D

This jughandle Option assumes the removal of northbound and westbound left turns. Based on the analysis, the Wye Road/Brentwood Boulevard and Wye Road/jughandle intersections would operate on the verge of congestion. The volume to capacity ratio (v/c) for the eastbound movement indicates values of 0.93-0.94 for some movements, which can be manipulated to improve the performance of desired movements.

4.2.6 Option E

Option E assumes all left turn movements at the Wye Road/Brentwood Boulevard intersection are removed. Brentwood Boulevard is widened to six (6) lanes.

The intersection of Wye Road and Brentwood Boulevard is on the verge of congestion, the intersection Wye Road and the jughandle has some spare capacity. The unsignalized intersection at the jughandle and development access indicated a v/c ratio over 1, which might trigger a need for signalization, which would contribute to additional delays for the relocated traffic movements.

4.2.7 Option F

This option considered the conversion of the traditional intersection to a roundabout. However, the complexity of the roundabout, laning requirements, traffic distribution, and function of the intersecting roadways excludes this option as viable.

None of the options fully respond to the traffic demand or achieve the target set for the project, but considering the constraints and traffic demand created by developments in the area, some level of congestion may have to be tolerated.

It is recommended to implement **Option C-2**, as it provides the best intersection operation. Although the traffic operation is adequate with a single eastbound to northbound left turn movement, the construction of a double left turn would provide geometric benefits, and therefore, a double left is shown on the functional plans.

4.3 WYE ROAD AND CLOVER BAR ROAD INTERSECTION (SUMMARY TABLE 4.5)

As with other Wye Road intersections, conventional and unconventional improvement options were considered at the intersection of Wye Road and Clover Bar Road.

Consistent with Wye Road improvements, it is assumed that Wye Road would be upgraded to six (6) lanes with all required auxiliary lanes. The intersection at Wye Road and Nottingham Way would be signalized, and possible signalization of intersection at the Christian Academy access would be considered, if required.

4.3.1 "Do Nothing" Option

Intersectional analysis shows that the intersection would operate over capacity, with the eastbound lane and southbound lane critical movements with a v/c = 1.06. This indicates that the intersection would have to be upgraded to respond to year 2015 traffic

4.3.2 Option I

For Option I the improvements, other than the six (6) laning of Wye Road, would include the implementation of a double left turn lane eastbound. Clover Bar Road would remain as is, and Range Road 231 would be upgraded to four (4) lanes, at least through the intersection area. Intersection capacity indicates that the intersection is on the verge of congestion (ICU 89.2%) with critical movement in the southbound lane, which at optimum intersection performance would result in average delays of 66 sec/veh for that movement (LOS E).

4.3.3 Option II

In this option, the additional improvements include the implementation of double left turn lanes for northbound and southbound movements. The Clover Bar Road intersection would operate on the verge of congestion (ICU 83.4%), with average delays of 26.4 sec/veh. (LOS C)

4.3.4 Option III

This jughandle Option assumes that the eastbound to northbound left turn would be retained and all other left turn movements would be accommodated via the jughandle. This option provides the best traffic conditions, with the Clover Bar Road intersection operating without congestion.

All options indicate possible operational problems at the Christian Academy access, for which signals would likely be required.

It is recommended to protect the right-of-way for the possible jughandle implementation (Option III), even though the performance of the intersection in Options I or II would be marginally acceptable.

4.4 CONCLUSION

Traffic modeling and analysis confirmed that Wye Road between Highway 216 and Highway 21 should be upgraded to a six (6) lane divided roadway to meet the projected traffic demand and equipped with a 9.0 m wide median to accommodate double left turn lanes at the intersections. The removal of all left turns except eastbound to northbound, at both Sherwood Drive and Brentwood Boulevard, with jughandles to accommodate other left turn movements, provide the best alternative for intersection operations. At Clover Bar Road, conventional intersection treatment, with select double left turn lanes, marginally achieves the target intersection operations; however, removing all left turns except eastbound to northbound, with a jughandle, provides the best alternative.

Strathcona County Trip Generation Study

Table 4.1

Nottingham Centre Commercial — IGA, Commercial Strip, Gas Station - 6 pumps, 2 Liquor Stores, Car Wash, Tim Horton's, Medical Services

Total Site Area	34,100 m^2		367,100 ft^2			
Buildings Area	7,250 m^2		78,000 ft^2			
Number of Employees	Full Time	89	Part Time	184		
Site Coverage	21%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	263	275	538	449	531	980
Rate per 1,000 sq. ft	3.37	3.53	**6.90**	5.76	6.81	**12.56**
Rate per Employee	0.96	1.01	**1.97**	1.64	1.95	**3.59**
Directional Split	49%	51%		46%	54%	

Ordze Ave. Canadian Tire — Auto Service, Car Wash, 2 Banks, Gas Station, Tire Store, Restaurant, 2 Fast Food Restaurants, Canadian Tire , Home Hardware, Paint Store and other small business

Total Site Area	115,223 m^2		1,240,300 ft^2		28.46	acres
Buildings Area	15,680 m^2		168,800 ft^2			
Number of Employees	Full Time	188	Part Time	271		
Site Coverage	14%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	352	329	681	329	355	684
Rate per 1,000 sq. ft	2.09	1.95	**4.03**	1.95	2.10	**4.05**
Rate per Employee	0.77	0.72	**1.48**	0.72	0.77	**1.49**
Directional Split	52%	48%		48%	52%	

Caffrey's at Ordze, South of Wye Rd. — Gas Station, 2 Restuarants, Shop, Fast Food Restaurant

Total Site Area	13,036 m^2		140,300 ft^2		3.22	acres
Buildings Area	2,550 m^2		27,400 ft^2			
Number of Employees	Full Time	188	Part Time	271		
Site Coverage	20%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	41	22	63	178	181	359
Rate per 1,000 sq. ft	1.50	0.80	**2.30**	2.28	2.32	**13.10**
Rate per Employee	0.09	0.05	**0.14**	0.39	0.39	**0.78**
Directional Split	65%	35%		50%	50%	

Wal-Mart Area — Walmart, Bank, Shoe Store, Gas Station

Total Site Area	54,251 m^2		584,000 ft^2		13.4	acres
Buildings Area	10,420 m^2		112,200 ft^2			
Number of Employees	Full Time	89	Part Time	126		
Site Coverage	19%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	53	44	97	420	453	873
Rate per 1,000 sq. ft	0.47	0.39	**0.86**	2.49	5.81	**7.78**
Rate per Employee	0.25	0.20	**0.45**	1.95	2.11	**4.06**
Directional Split	55%	45%		48%	52%	

Strathcona County Trip Generation Study

Table 4.1

Mazda Dealer

Total Site Area	50,202 m^2		540,400 ft^2		12.4	acres
Buildings Area	13,170 m^2		141,800 ft^2			
Number of Employees	Full Time	220	Part Time	147		
Site Coverage	26%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	134	96	230	266	279	545
Rate per 1,000 sq. ft	0.94	0.68	**1.62**	9.71	3.58	**3.84**
Rate per Employee	0.37	0.26	**0.63**	0.72	0.76	**1.49**
Directional Split	58%	42%		49%	51%	

Village Market Safeway, Bank, London Drugs, Restaurants incl. Tim Hortons, Pizza, Vet Clinic, Gas Station

Total Site Area	47,004 m^2		506,000 ft^2		11.61	acres
Buildings Area	10,410 m^2		112,100 ft^2			
Number of Employees	Full Time	126	Part Time	172		
Site Coverage	22%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	193	185	378	489	506	995
Rate per 1,000 sq. ft	1.72	1.65	**3.37**	4.36	6.49	**8.88**
Rate per Employee	0.65	0.62	**1.27**	1.64	1.70	**3.34**
Directional Split	51%	49%		49%	51%	

Sherwood Centre Save-on-Foods, Restairants, Commercial

Total Site Area	43,806 m^2		471,500 ft^2		10.82	acres
Buildings Area	11,600 m^2		124,900 ft^2			
Number of Employees	Full Time	148	Part Time	209		
Site Coverage	26%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	115	99	214	462	425	887
Rate per 1,000 sq. ft	0.92	0.79	**1.71**	3.26	5.45	**7.10**
Rate per Employee	0.32	0.28	**0.60**	1.29	1.19	**2.48**
Directional Split	54%	46%		52%	48%	

Average of all sites

Site Coverage	21%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Rate per 1,000 sq. ft	1.38	1.22	**2.61**	4.08	4.46	**7.82**
Rate per Employee	0.45	0.41	**0.84**	1.16	1.23	**2.62**
Directional Split	55%	45%		49%	51%	

Total Area of All Sites 765,200 sq. ft.

All Trips	2201	5323
	2.88 Trips/1000sq.ft.	**6.96** Trips/1000sq.ft.

Description	ITE Land Use Code	Trips Generation Rates						
		Weekday Rate	AM Peak	% In	% Out	PM Peak	% In	% Out
Residential	Local Info	12	0.92	26%	74%	1.01	65%	35%
Convenience Store (in trips/ 1000 sq.ft. GFA)	ITE (852)		31.02	50%	50%	34.57	49%	51%
Convenience Store/Gas Bar (in trips/ 1000 sq.ft. GFA)	ITE (853)		45.58	50%	50%	60.61	50%	50%
Hotel/Motel (trips/room)	ITE (320)		0.64	36%	64%	0.58	53%	47%
Fast Food (in trips/ 1000 sq.ft. GFA)	ITE (933)		53.11	51%	49%	34.64	52%	48%
Office (in trips/ 1000 sq.ft. GFA)	ITE(710)		1.55	88%	12%	1.49	17%	83%
General Office Building (in trips/ employee)	ITE(710)		0.48	88%	12%	0.46	17%	83%
Speciality Store (in trips/ 1000 sq.ft. GFA)	ITE(814)		0.84	68%	32%	2.71	44%	56%
Retail Outlet (in trips/ 1000 sq.ft. GFA)	ITE(815)		0.84	68%	32%	5.06	51%	49%
Mixed Retail/Services (in trips/ 1000 sq.ft. GFA)	Local Info		2.61	55%	45%	8.71	48%	52%
Bank (in trips/ 1000 sq.ft. GFA)	ITE (911)		4.07	57%	43%	33.15	50%	50%
Bank (in trips/ 1000 sq.ft. GFA)	ITE (912)		2.85	57%	43%	8.65	48%	52%
Retail Shopping Centre	ITE(820)		1.03	61%	39%	3.75	48%	52%
School (in trips/ 1000 sq.ft.GFA)	ITE(522)		4.69	54%	46%	1.55	54%	46%
Gymnasium (in trips/ 1000 sq.ft.GFA)	ITE(495)		1.62	61%	39%	1.64	29%	71%
Restaurant (trips/ seat)	ITE(931)		0.03	50%	50%	0.26	67%	33%
Office (in trips/ acre)	ITE(750)		25.65	92%	8%	28.28	15%	85%

Areas North of Wye Road

The Ridge - Zone 79

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to/from Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential	740 D.U.	12	408	106	302	448	291	157	100%	0%	40%	60%
Convenience Store (in trips/ 1000 sq.ft. GFA)	10,000 sq. ft.		62	31	31	69	34	35	40%	60%	80%	20%
New Trips Sub-Total			471	137	333	518	325	192				
Pass-by Trips Sub-Total			7	4	4	8	4	4				
Distribution New Trips: East				35%	35%		35%	40%				
West				75%	75%		65%	60%				
East				48	117		114	77				
West				103	250		211	115				
Distribution Pass-by Trips:				WB	EB		WB	EB				
				80%	20%		20%	80%				
				6	1		2	7				

Areas South of Wye Road

Sherwood Hills Estates (TIA) - Zone 265

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to/from Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential	122 D.U.		112	29	83	123	80	43	100%	0%	0%	100%
		Sub-Total	112	29	83	123	80	43				
Distribution:	East			20%	20%		35%	40%				
	West			80%	80%		65%	60%				
	East			6	17		28	17				
	West			23	66		52	26				

Wye Road South of Nottingham - Zone 262

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential (low density)	120 D.U.	12	110	29	82	121	79	42	100%	0%	0%	100%
School	40,000 sq. ft.		188	101	86	62	33	29	100%	0%	0%	100%
Gymnasium	10,000 sq. ft.		0	0	0	3	2	1	100%	0%	0%	100%
Skate Church	16,000 sq. ft.		0	0	0	4	3	1	100%	0%	0%	100%
New Trips Sub-total			298	130	168	190	117	73				
School Distribution:	North to Clover Bar			58%	22%		23%	32%				
	South - 231			17%	12%		12%	9%				
	East - Wye Rd.			17%	14%		18%	34%				
	West - Wye Rd.			8%	52%		47%	25%				
	North to Clover Bar			59	19		9	10				
	South - 231			17	10		5	3				
	East - Wye Rd.			17	12		7	11				
	West - Wye Rd.			8	45		18	8				
Distribution Residential:	East			20%	20%		35%	30%				
	West			60%	60%		45%	50%				
	North to Clover Bar			20%	20%		20%	20%				
	East			6	16		28	13				
	West			17	49		35	21				
	North to Clover Bar			6	16		16	8				

Rge Rd 232, S of Wye Road (26.7 acres) IMC TIA - Devco Properties Inc. (Zone 1 as per TIA by Schaffer Consultants Ltd.) East Part of Zone 71

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Retail Shopping Centre	150,000 sq. ft.		155	92	60	563	270	293	60%	40%	0%	100%
Residential											10%	90%
Total Area	10.6 ha											20%
New Trips Sub-total			93	55	36	338	162	176				
Pass-by Trips Sub-total			62	37	24	225	108	117				
		Sub-Total	155	92	60	563	270	293				

Distribution: New Trips	East Wye Rd.	15%	15%		20%	20%	
	North Brentwood Rd.	20%	20%		25%	25%	
	South Rge Rd 232	25%	25%		25%	25%	
	West Wye Rd.	40%	40%		30%	30%	
	East Wye Rd.	8	5		32	35	
	North Brentwood Rd.	11	7		41	44	
	South Rge Rd 232	14	9		41	44	
	West Wye Rd.	22	14		49	53	

Distribution Pass-by Trips:	WB	EB	NB	SB	WB	EB	NB	SB
	60%	20%	10%	10%	20%	60%	10%	10%
	37	12	6	6	45	135	23	23

South of Wye Road (Zone 2,3 & 4 as per TIA by Schaffer Consultants Ltd.) - Mid Part of Zone 71

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Big Box (ITE Land Use Code 815)	215,000 sq. ft.		181	123	58	1088	555	533	70%	30%	0%	100%
Residential	units		0	0	0	0	0	0	100%	0%	10%	90%
New Trips Sub-total			126	86	40	762	388	373				
Pass-by Trips Sub-total			54	37	17	326	166	160				

Distribution: New Trips	East Wye Rd.	100%	25%	25%	100%	25%	25%
	North Brentwood Rd.		30%	30%		25%	25%
	South Rge Rd 232		25%	25%		30%	30%
	West Wye Rd.		20%	20%		20%	20%
	East Wye Rd.		21	10		97	93
	North Brentwood Rd.		26	12		97	93
	South Rge Rd 232		21	10		117	112
	West Wye Rd.		17	8		78	75

Distribution Pass-by Trips:	WB	EB		WB	EB
	80%	20%		20%	80%
	43	11		65	261

Harbour Park, TIA by Bunt and Associates - West Part of Zone 71 - Intersections at Ash St, Ridgeway St., and Hawthorne St.

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Retail Shopping Centre	91,000 sq. ft.		94	57	37	341	164	177	60%	40%	0%	100%
Speciality Store (in trips/ 1000 sq.ft. GFA)	37,000 sq. ft.		31	21	10	100	44	56	60%	40%	0%	100%
Fast Food (in trips/ 1000 sq.ft. GFA)	4,000 sq. ft.		186	95	91	121	63	58	50%	50%	0%	100%
Bank (in trips/ 1000 sq.ft. GFA)	6,000 sq. ft.		24	14	11	199	99	99	55%	45%	0%	100%
New Trips Sub-total			181	102	79	435	211	224				
Pass-by Trips Sub-total			154	85	69	327	159	167				
	137,000 sq. ft.					761						
Distribution: New Trips	East Wye Rd.			60%	60%		60%	60%				
	West Wye Rd.			40%	40%		40%	25%				
	East Wye Rd.			61	48		126	134				
	West Wye Rd.			41	32		84	56				
Distribution Pass-by Trips:				WB	EB		WB	EB				
				80%	20%		20%	80%				
				123	31		65	261				

Harbour Park, TIA by Bunt and Associates - West Part of Zone 71 - Intersections at Ash St, Ridgeway St., and Hawthorne St. (1600 medium density @0.83 trips/unit for pm peak)

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	Wye Road/Brentwood
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
0	1600 units		1472	383	1089	1328	863	465	100%	0%	10%	90%
New Trips Sub-total			1325	344	980	1195	777	418				
Distribution: New Trips	West Through Commercial			25%	25%		25%	25%				
	Through Rge Rd 232			75%	75%		75%	75%				
	Through Commercial West			86	245		194	105				
	Through Rge Rd 232											
	Through Rge Rd 232 East		20%	69	196	20%	155	84				
	Through Rge Rd 232 South		30%	103	294	30%	233	125				
	Through Rge Rd 232 Brentwo		25%	86	245	25%	194	105				
				344	980		777	418	1195			

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Do Nothing No improvements to existing intersection Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 125.9% - ICU LOS H** SBL v/c = 1.36 EBT v/c = 1.41 WBL v/c = 1.0.5 **LOS F** Intersection Average Delay = 137 s/veh	▪ Intersection over capacity, congestion periods over 120 min, long queues ▪ Motorists will avoid the area – find alternate route or travel in off peak time
Option 1 a – Conventional Treatment Increased Number of Lanes WBT – 3 Lanes EBT – 4 lanes WBL – 2 lanes SBL – existing 1 lane Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 106.1% - ICU LOS G** WBT v/c = 0.95 SBL v/c = 1.01 **LOS E** Intersection Average Delay = 62.4 s/veh Critical Movement - WBL Average Delay = 100 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min ▪ Long queues are common ▪ Motorists will avoid the area – find alternate route or travel in off peak time 95th % queue: EB ~230m; SB~250m
Option 1 b Increased Number of Lanes WBT – 3 Lanes EBT – 4 lanes WBL – 2 lanes SBL – 2 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 92.0% - ICU LOS F** EBT v/c = 0.90 EBL v/c = 0.88 **LOS D** Intersection Average Delay = 42.0 s/veh Critical Movement - WBL Average Delay = 62.1 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min. ▪ Residual queues at the end of green cycle. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~230m, SB~100m Impact related to widening of Sherwood Drive. Deceleration for double SBL not provided due to existing intersection spacing - geometry
Option 2 a WBL left movement removed and accommodated at Ash Street/Wallace Drive Single SBL Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes	**ICU 103.8% - ICU LOS G** EBL v/c = 1.08 SBL v/c = 1.11 **LOS C** Intersection Average Delay = 50.3 s/veh Critical Movement - SBL 106s/veh. (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min ▪ Residual queues at the end of green cycle. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EBL ~170m, SBL~225m

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option 2 b – Recommended First Stage WBL left movement removed and accommodated at Ash Street/Wallace Drive Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes	**ICU 90.3% - ICU LOS E** NBT v/c = 0.86 EBT v/c = 0.83 **LOS C** Intersection Average Delay = 31.3 s/veh Critical Movement SBL = 53.6 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion ▪ Deceleration for double SBL not provided due to existing intersection spacing - geometry 95th % queue: EBL ~150m, Impact related to widening of Sherwood Drive. Deceleration for double SBL not provided due to existing intersection spacing - geometry
Option 3 a WBL left movement removed and accommodated at Ash Street EBL – removed, accommodated at Wallace Drive SBL – single left WBT – 3 lanes EBT – 3 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 110% - ICU LOS H** SBL v/c = 1.20 NBT v/c = 1.30 **LOS E** Intersection Average Delay = 56.9 s/veh Critical Movement - SBL Average Delay = 95 s/veh (LOS F)	▪ Intersection over 10% over capacity and likely will experience congestion periods over 120 min at this time of day ▪ Motorists would use alternate routes if available or travel in different time Signalized intersection at Ordze Avenue 95th % queue: EB ~230m, SBL ~ 185m
Option 3 b WBL left movement removed and accommodated at Ash Street EBL – removed, accommodated at Ordze Avenue and Wallace Drive SBL – 2 lanes WBT – 3 lanes EBT – 3 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 100.0% - ICU LOS F** EBT v/c = 0.93 NBT v/c = 0.92 **LOS D** Intersection Average Delay = 36.6 s/veh Critical Movement - SBL Average Delay = 77.6 s/veh (LOS E)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion ▪ Deceleration for double SBL not provided due to existing intersection spacing - geometry Impact related to widening of Sherwood Drive. Signalized intersection at Canadian Tire 95th % queue: EB ~175m, NBT ~ 210m

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option 4 a SBL – removed, accommodated at Fir Street (1/3) Wallace Drive (2/3) Fir Street Single SBL EBT/WBT – 3 lanes Wal-Mart Access Modified, Road Connection Wallace Drive to Ash Street	**ICU 92.0% - ICU LOS F** SBT v/c = 0.88 EBT v/c = 0.91 **LOS D** Intersection Average Delay = 43.0 s/veh Critical Movement - EBL Average Delay = 53 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, lane closure can cause significant congestion 95th % queue: EB ~170m Congestion moved to Fir Street Intersection ICU 104.4% ICU LOS G, SBL v/c = 1.62
Option 4 b SBL removed and accommodated at Wallace Drive, Fir Street Double SBL EBT – 3 lanes Wal-Mart Access Modified, Road Connection Wallace Drive to Ash Street	**ICU 92.0% - ICU LOS F** EBL v/c = 0.88 EBT v/c = 0.91 **LOS D** Intersection Average Delay = 38.4 s/veh Critical Movement - EBL Average Delay = 53.0 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, lane closure can cause significant congestion 95th % queue: EB ~170m. SB ~135m Fir Street Intersection operates at 93.1% ICU, LOS F, SBL v/c = 0.83 – congestion for 15-60 min during pm peak hour
Option 5 a Only EBL remains, other movements accommodated at Fir and Wallace accommodated at Wallace Drive, SBL at Fir St. - Single EBT – 3 lanes Wal-Mart Access Modified	**ICU 80.0% - ICU LOS D** SBT v/c = 0.77 EBL v/c = 0.73 **LOS C** Intersection Average Delay = 26.3 s/veh Critical Movement - EBL Average Delay = 44.6 s/veh (LOS D)	▪ Intersection normally has no congestion. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~130m, ~SB 110m Congestion moved to Fir Street Intersection ICU 110.9% ICU LOS H, SBL v/c = 1.15 for SBL, NBT v/c=1.05
Option 5 b Recommended Only EBL remains, other movements accommodated at Fir Street Wallace Drive, SBL at Fir St. - Double EBT – 3 lanes Wal-Mart Access Modified	**ICU 80.0% - ICU LOS D** SBT v/c = 0.78 EBL v/c = 0.77 **LOS C** Intersection Average Delay = 22.4 s/veh Critical Movement - EBL Average Delay = 42.2 s/veh (LOS D)	▪ Intersection normally has no congestion. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~140m, SB ~120 All adjacent intersections operated at satisfactory LOS D or better.

Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Do Nothing No improvements to existing intersection	**ICU 141.5% LOS H** SBL v/c = 1.40 EBT v/c = 1.29 **LOS F** Intersection Average Delay = 116.1 s/veh	▪ Intersection over capacity, congestion periods over 120 min, long queues, etc.
Option A - 1 Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes WBL – 2 lanes EBL – 2 lanes	**ICU 110.9% - ICU LOS H** SBL v/c= 1.25 EBT v/c = 1.05 WBL v/c = 1.27 **LOS E** Intersection Average Delay = 56.6 s/veh Critical Movement - WBL Average Delay = 201 s/veh (LOS F)	▪ Intersection over capacity, congestion periods over 120 min, long queues, etc.
Option A - 2 Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes WBL – 2 lanes EBL – 2 lanes SBL – 2 lanes	**ICU 102.1% - ICU LOS G** EBT v/c = 0.98 SBL v/c = 1.07 WBL v/c = 0..95 **LOS D** Intersection Average Delay = 39.7 s/veh Critical Movement - SBL Average Delay = 112 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min, long queues ▪ Motorists would use different routs or time of travel.
Option B-1 Jughandle in SW quadrant Increased Number of Lanes WBT/EBT – 3 lanes SBT/NBT – 2 lanes SBL – 1 lane WB and EB Left Turns removed	**ICU 99.5% - ICU LOS F** SBL v/c = 1.41 EBT v/c = 1.07 **LOS D** Intersection Average Delay = 46.9 s/veh Critical Movement - SBL Average Delay = 230 s/veh (LOS F)	▪ Intersection over capacity and likely experiences 15 to 60 min of congestion, residual queues at the end of the cycle is common ▪ Minor traffic fluctuation, accidents, andlane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required

Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

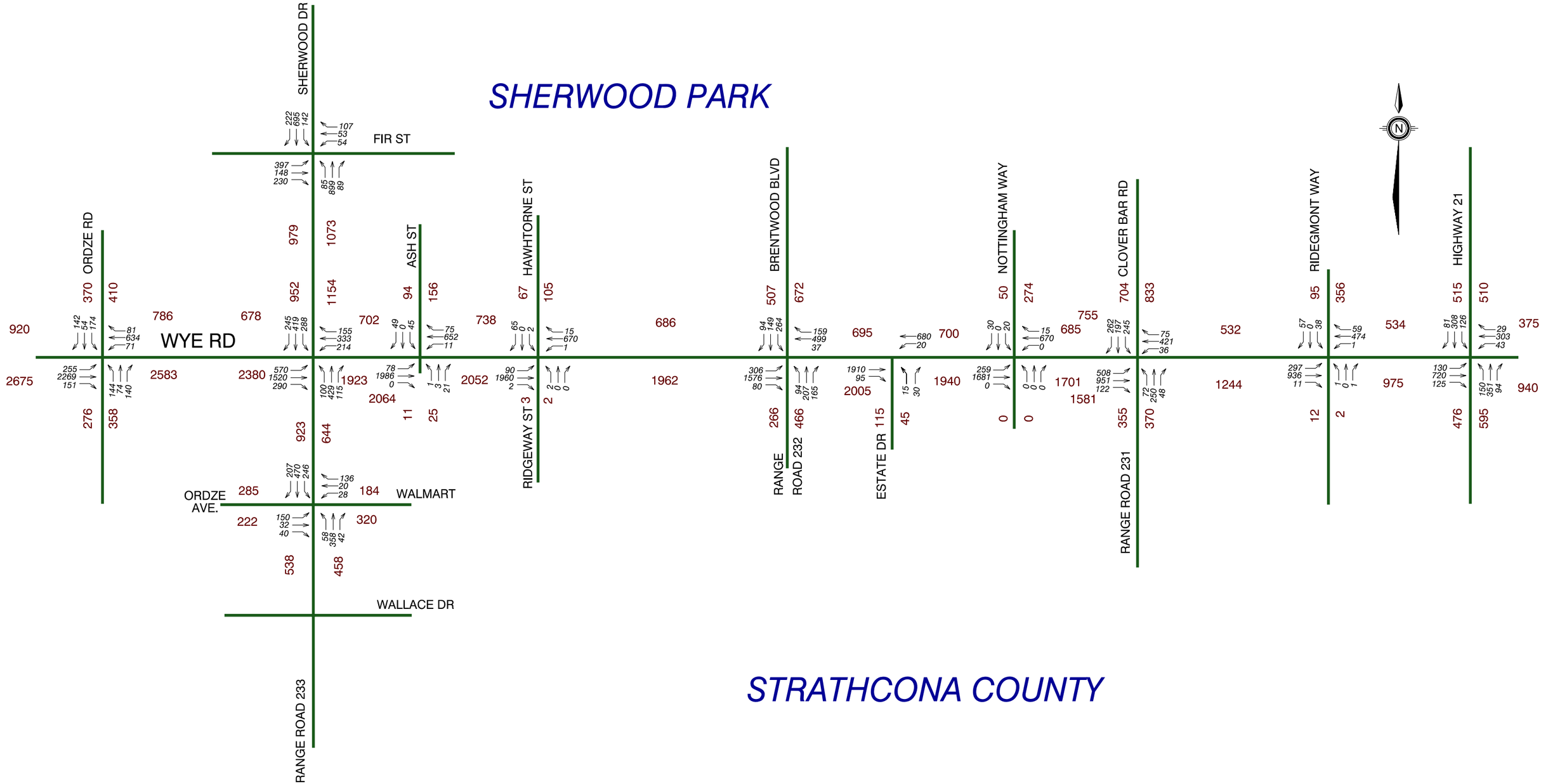
Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option B-2 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes SBL – 2 lanes WB and EB Left Turns removed	**ICU 90.7% - ICU LOS E** EBT v/c = 1.01 **LOS C** Intersection Average Delay = 28.4 s/veh Critical Movement – SBL at Jughandle Average Delay = 53 s/veh (LOS D)	▪ Intersection is right on the verge of congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause increased congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option B-3 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes SBL – 1 lanes WB and EB Left Turns removed	**ICU 98.1% - ICU LOS F** EBT v/c = 1.00 SBL v/c = 1.23 **LOS C** Intersection Average Delay = 34.2 s/veh Critical Movement - SBL Average Delay = 160 s/veh (LOS F)	▪ Intersection over capacity and likely experiences 15 to 60 min of congestion ▪ Residual queues at the end of each cycle ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option C-1 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes Only EBL to NB Retained (single lane) Other movements accommodated through Jughandle	**ICU 86.1% - ICU LOS E** EBT v/c = 0.90 SBT v/c = 0.90 **LOS C** Intersection Average Delay = 24.2 s/veh Critical Movement - SBT Average Delay = 52.7 s/veh (LOS D) Jughandle/Wye Rd Intersection **ICU 89.7%** Single WBL v/c = 0.92, Average Delay 60 s/veh. LOS E, queues 95th % ~ 90 m	▪ Intersection is right on the verge of congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause increased congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required

Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option C-2 - Recommended Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes Only EBL to NB Retained (single lane) Other movements accommodated through Jughandle	**ICU 81.6% - ICU LOS D** EBT v/c = 0.93 **LOS C** Intersection Average Delay = 21.0 s/veh Critical Movement - SBT Average Delay = 39.0 s/veh (LOS D) Jughandle/Wye Rd Intersection ICU 89.78%, NBL v/c 0.95 Double WBL, LOS E	▪ Intersection normally has no congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause some congestion ▪ Spare capacity ~ 10% Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option D NBL and EBL removed SBT/NBT – 2 lanes WBT/EBT – 3 lanes Removed Left Turn Movements accommodated through Jughandle	**ICU 89.7% - ICU LOS E** EBT v/c = 0.93 **LOS C** Intersection Average Delay = 27.7 s/veh Critical Movement - NBT Average Delay = 59.0 s/veh (LOS E) Intersection Wye Rd./Jughandle ICU LOS 89.7%, EBT v/c 0.94, WBL v/c 0.91	▪ Wye Road Intersections on the verge of congestion condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option E All left Turn Removed Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes All Left Turn Movements accommodated through Jughandle	**ICU 84.3% - ICU LOS E** EBT v/c = 0.91 **LOS C** Intersection Average Delay = 20.8 s/veh Critical Movement - NBT Average Delay = 48 s/veh (LOS D)	▪ Wye Road Intersections on the verge of congestion condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required Stop Controlled Intersection at Jughandle over capacity
Option F 4/5 lane Roundabout Approach Lanes – 4&5 Exit Lanes 3&4 In addition to exclusive right turns	NB v/c = 1.02	Very Complex Intersection - not suitable for the road function and traffic distribution

Wye Road/Clover Bar Road Intersection **Table 4.5**
Option Evaluation

Option Year 2015 Traffic Volumes	**Level of Service**	**Operations** **Additional Requirements**
Do Nothing No improvements to existing intersection	**ICU 108.3 LOS G** EBL v/c = 1.06 SBL v/c = 1.06 **LOS D** Intersection Average Delay = 39.1 s/veh Critical Movement - SBL Average Delay = 115 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min, long queues ▪ Motorists would use different routs or time of travel. Unsignalized Intersections at Nottingham/Wye and Clover Bar/Christian Academy Access Fail
Option I Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes EBL – 2 lanes	**ICU 89.2% - ICU LOS E** SBL v/c = 0.89 **LOS C** Intersection Average Delay = 29.4 s/veh Critical Movement - SBL Average Delay = 68 s/veh (LOS E)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access
Option II Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes EBL/SBL/NBL – 2 lanes	**ICU 83.4% - ICU LOS E** EBL v/c = 0.82 **LOS C** Intersection Average Delay = 26.6 s/veh Critical Movement - NBT Average Delay = 52 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access
Option III – Jughandle Option EB to NB Left Turn Remains Remaining Left Turn Movements Accommodated via Jughandle at SW quadrant of intersection	**ICU 76.9% - ICU LOS D** SBT v/c = 0.65 **LOS B** Intersection Average Delay = 14.6 s/veh Critical Movement - NBT Average Delay = 37.0 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access



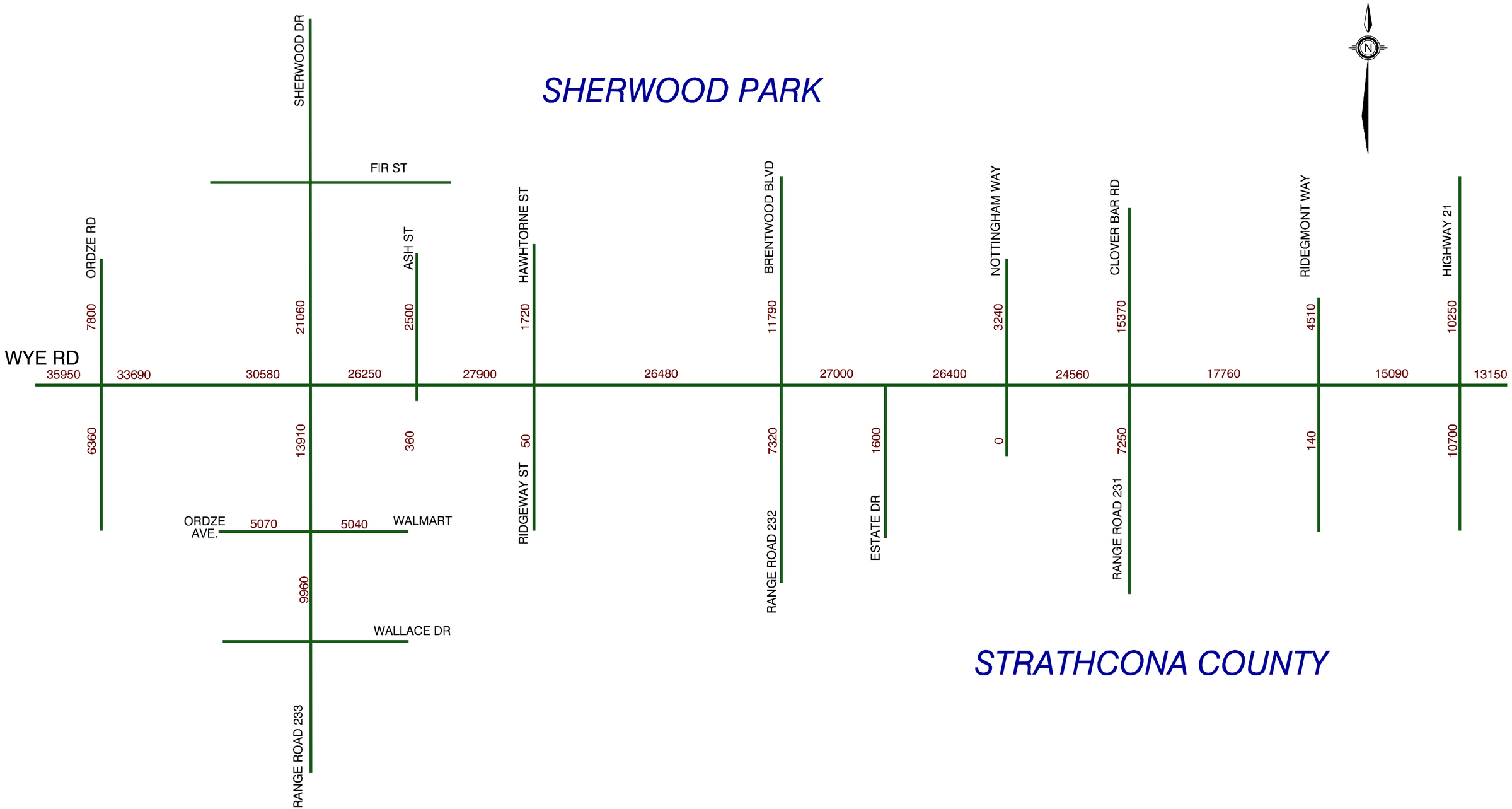
Strathcona County

AL-TERRA ENGINEERING

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY
ESTIMATED EXISTING (YEAR 2006)
TRAFFIC PM PEAK

Date: NOVEMBER 30, 2008

EXHIBIT 4.1



Strathcona County

AL-TERRA ENGINEERING

LEGEND:

33690 - ESTIMATED DAILY TRAFFIC VOLUME

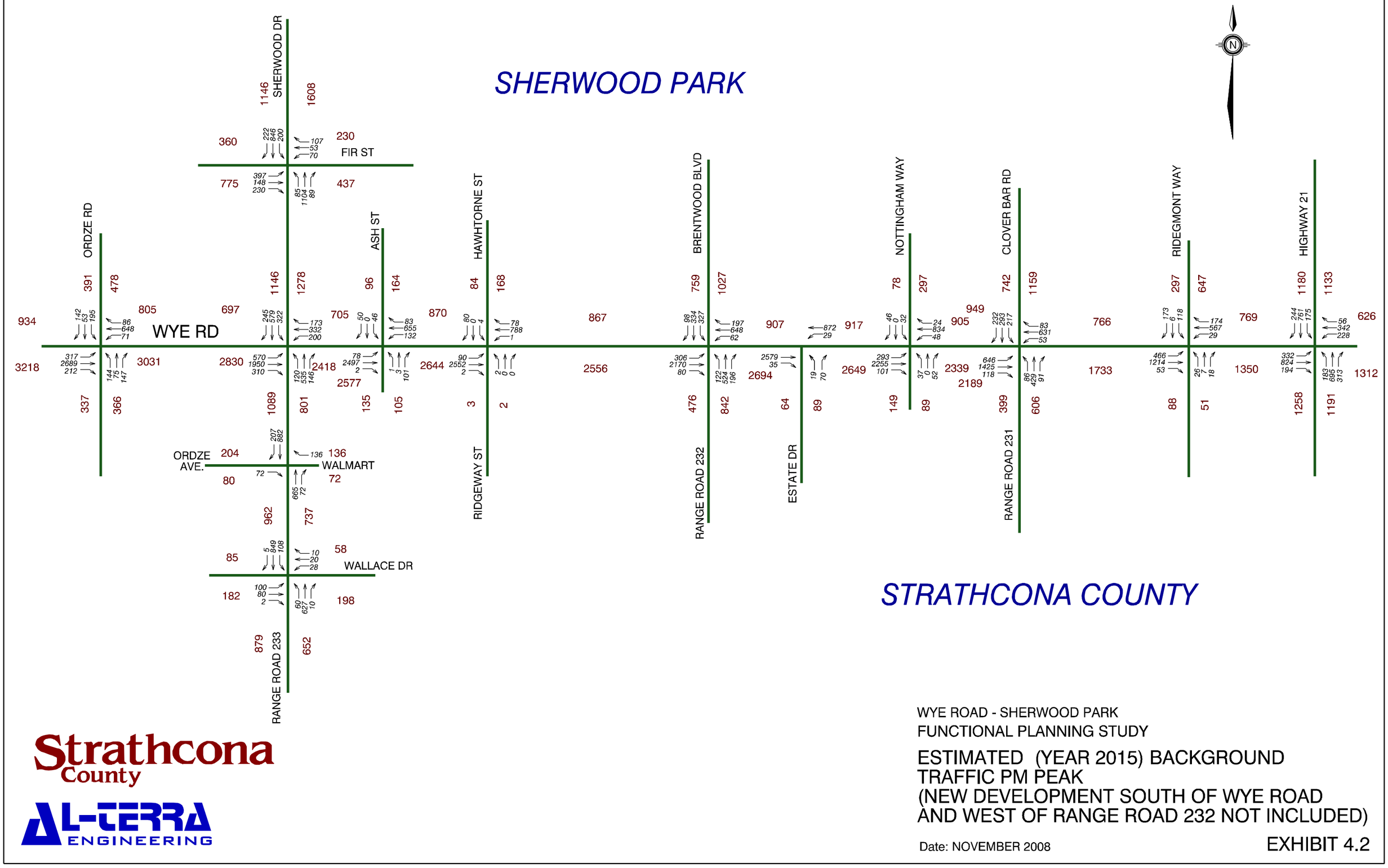
NOTE:
TRAFFIC ESTIMATE IS BASED ON PM PEAK REPRESENTING 10% OF DAILY VOLUME (EXISTING PROPORTION)

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

ESTIMATED EXISTING (YEAR 2006) TRAFFIC DAILY VOLUME

Date: NOVEMBER 2008

EXHIBIT 4.1(a)



Strathcona County

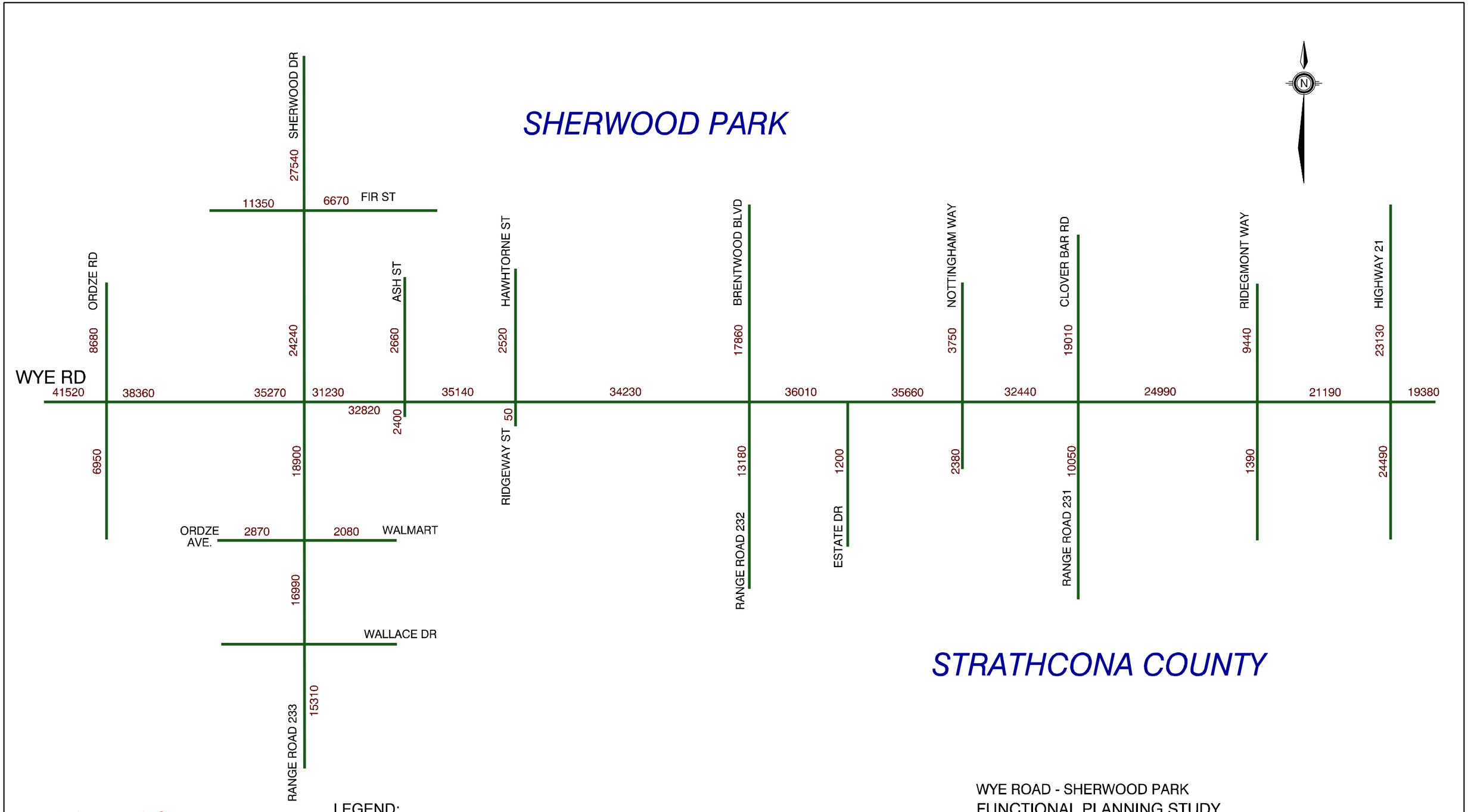
AL-TERRA ENGINEERING

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

ESTIMATED (YEAR 2015) BACKGROUND TRAFFIC PM PEAK
(NEW DEVELOPMENT SOUTH OF WYE ROAD AND WEST OF RANGE ROAD 232 NOT INCLUDED)

Date: NOVEMBER 2008

EXHIBIT 4.2



Strathcona County

AL-TERRA ENGINEERING

LEGEND:

35140 - ESTIMATED DAILY TRAFFIC VOLUME

NOTE:
TRAFFIC ESTIMATE IS BASED ON PM PEAK REPRESENTING 10% OF DAILY VOLUME (EXISTING PROPORTION)

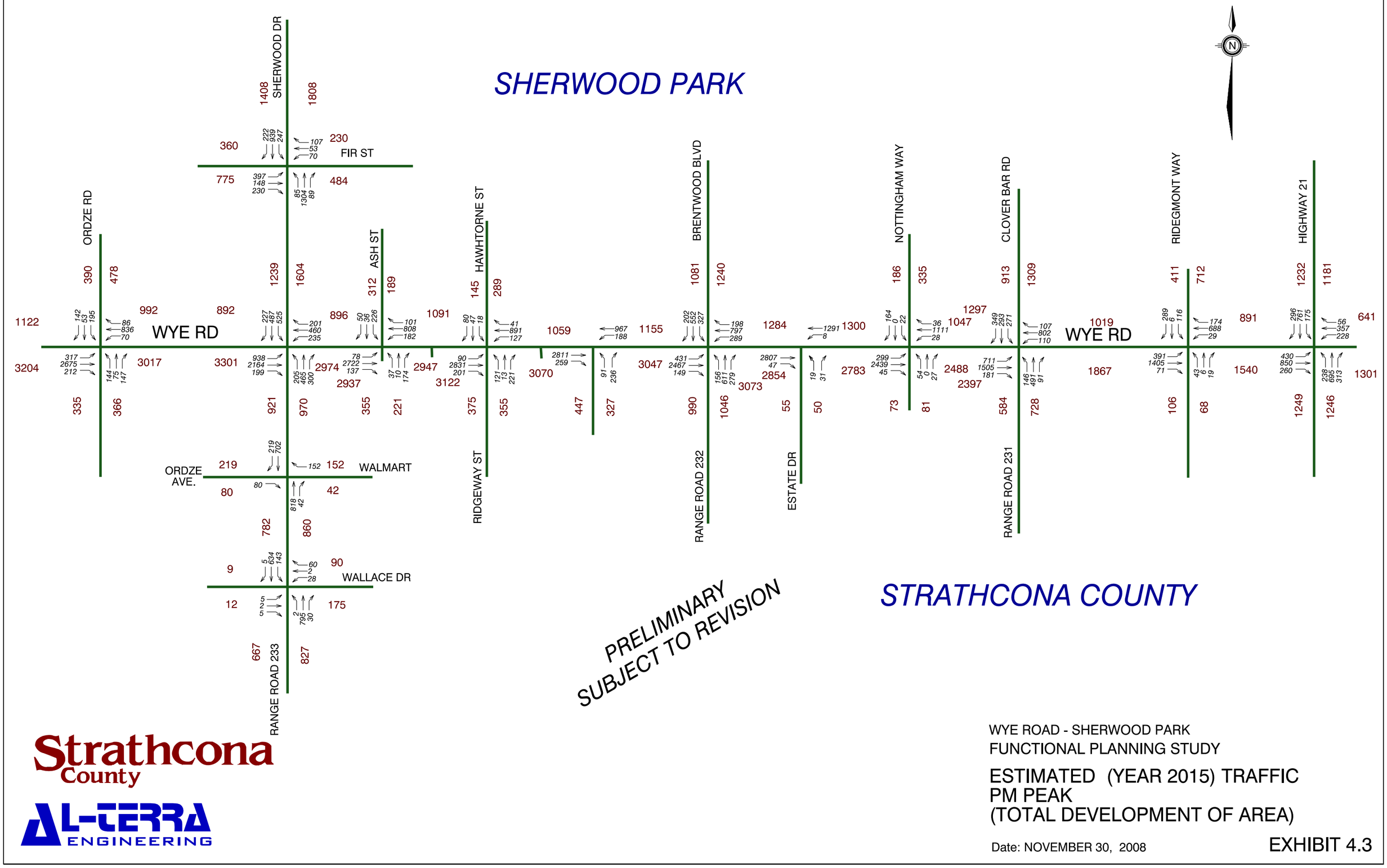
WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

ESTIMATED (YEAR 2015) TRAFFIC DAILY VOLUME (NEW DEVELOPMENT SOUTH OF WYE ROAD AND WEST OF RANGE ROAD 232 NOT INCLUDED)

Date: NOVEMBER 2008

EXHIBIT 4.2(a)

SHERWOOD PARK



PRELIMINARY
SUBJECT TO REVISION

STRATHCONA COUNTY

Strathcona County

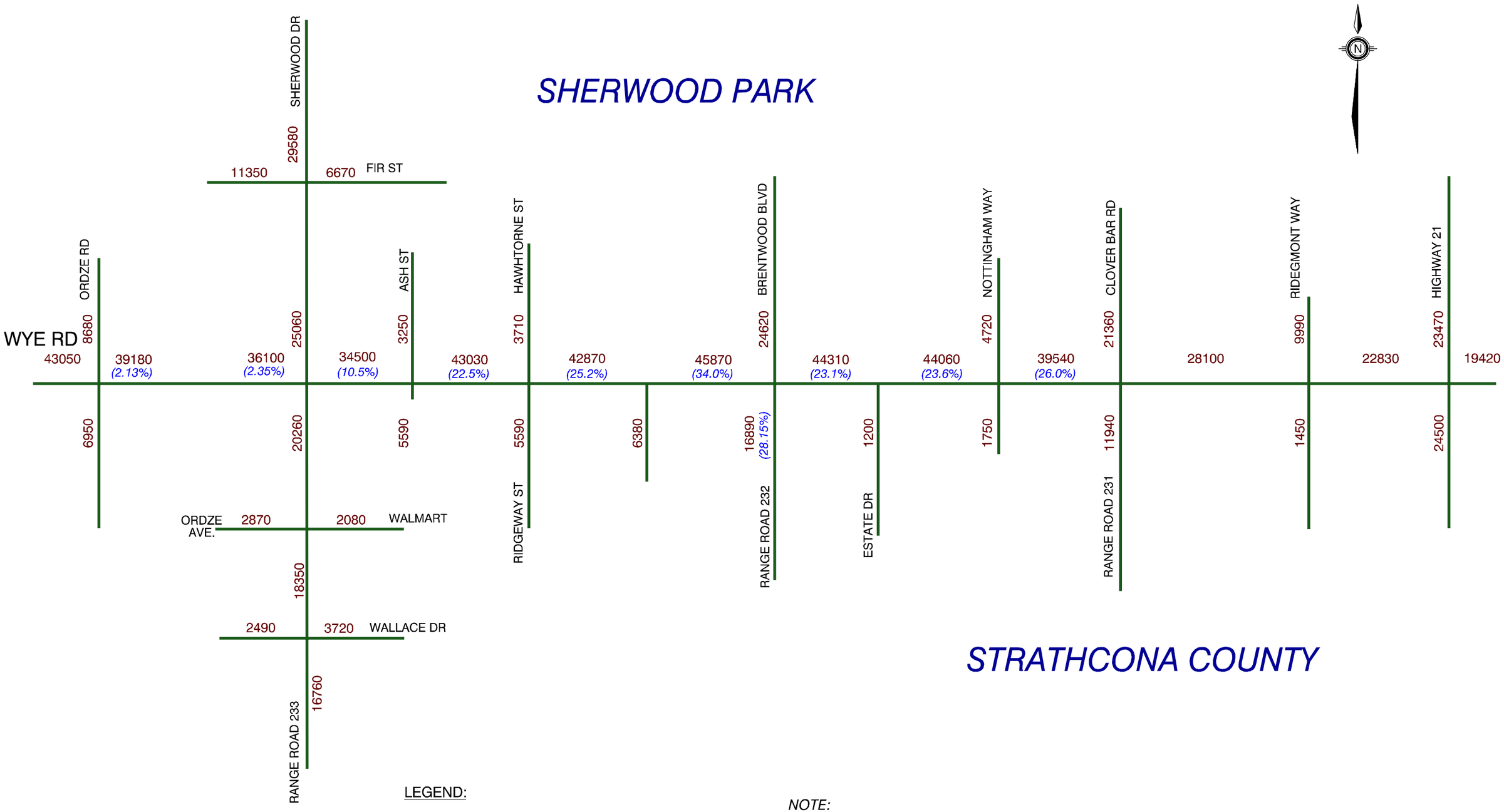
AL-TERRA ENGINEERING

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

ESTIMATED (YEAR 2015) TRAFFIC
PM PEAK
(TOTAL DEVELOPMENT OF AREA)

Date: NOVEMBER 30, 2008

EXHIBIT 4.3



LEGEND:

35140 - 2015 ESTIMATED DAILY TRAFFIC VOLUME

(15.9%) - SOUTH OF WYE ROAD DEVELOPMENT TRAFFIC (NEW) AS PERCENT OF TOTAL TRAFFIC ON ROAD SEGMENTS (BASED ON BUNT & ASSOCIATES MAY 2007 TIA FOR SOUTH WYE ASP AMENDMENT)

NOTE:
TRAFFIC ESTIMATE IS BASED ON PM PEAK REPRESENTING 10% OF DAILY VOLUME (EXISTING PROPORTION)

Strathcona County

AL-TERRA ENGINEERING

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

ESTIMATED (YEAR 2015) TRAFFIC TOTAL DEVELOPMENT OF AREA)

Date: NOVEMBER 2008

EXHIBIT 4.3(a)

5.0 FUNCTIONAL PLAN DEVELOPMENT

Functional plans were developed for Wye Road and the adjacent road network based on conclusions of the intersection / traffic analysis. Plans were developed to provide six (6) basic lanes plus auxiliary lanes, as required for Wye Road, shown on **Exhibits 5.1** through **5.11**. Through lanes and auxiliary lanes have been designed at a minimum width of 3.5 m where reconstruction is required. A brief description of the functional plans is provided as follows:

5.1 HIGHWAY 216 TO SHERWOOD DRIVE

The existing Wye Road provides three (3) lanes eastbound with the right outside lane developed at the northbound to eastbound interchange ramp from Highway 216. The right lane currently functions as an auxiliary and through lane, and carries through the Ordze Road and Sherwood Drive intersections. Lane capacity is reduced on this through / auxiliary lane by the right in/out accesses to the commercial area south of Wye Road. Widening of Wye Road eastbound is proposed to provide three (3) through lanes, plus auxiliary lanes. Widening between Ordze Road and Sherwood Drive will be approximately 7.0 m to allow much of the south median curb to remain in its current location and configuration. The resulting design will develop the outside eastbound left turn lane for Sherwood Drive immediately east of the Ordze Road intersection. Alternatively, the median south curb could be relocated; however, this would result in the loss of an eastbound lane. Therefore, we believe a cost effective and prudent approach is demonstrated on the recommended plan shown on **Exhibit 5.1**, but should be further evaluated during detailed design.

Minimal changes to Wye Road westbound between Highway 216 and Sherwood Drive are proposed, as the current roadway functions with three (3) through lanes westbound, plus auxiliary lanes. West of Ordze Road, Wye Road reduces to two (2) lanes westbound as the outside westbound lane is dropped prior to Highway 216. This dropped lane could be extended onto the northbound exit ramp of the Highway 216 interchange; however transition from six (6) lanes to four (4) lanes in the vicinity of Highway 216 is expected to be resolved in conjunction with the current Interchange Functional Planning Study by Alberta Transportation.

5.1.1 Wye Road and Ordze Road Intersection

Changes proposed at the Ordze Road intersection are expected to improve operational and capacity issues that currently exist at the intersection. Closing the access to the Chamber of Commerce in the southeast quadrant of the intersection will facilitate a longer left turn lane northbound (currently room for 2 vehicles maximum). North of Wye Road, a narrow raised median (1.0 m) is proposed to separate the southbound left turn lane from the northbound lane on Ordze Road. The median will limit all-directional vehicular movements at the first entrance to the Boston Pizza complex (located in the northeast quadrant of the intersection). All directional access to the Boston Pizza complex would be maintained at the existing entrance across from the Strathcona Transit Center and the entrance on Fir Street.

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Slotted left turn lanes eastbound and westbound on Wye Road at Ordze Road are proposed to further enhance operations.

5.1.2 Wye Road and Sherwood Drive Intersection

The long term plan for the Sherwood Drive intersection requires the removal of all left turns, except eastbound to northbound, which will remain as a double left. Reved left turn movements would be accommodated by a jughandle road in the southeast quadrant with intersections at Ash Street on Wye Road, and Wallace Drive on Range Road 233.

Significant concern regarding the removal of the westbound left turn at Sherwood Drive was expressed by some business owners south of Wye Road and west of Range Road 233. A concept which extended the Wallace Drive jughandle road west of Range Road 233 was developed to provide enhanced access to this existing commercial area; however, some opposition still remains.

In addition to the jughandle road in the southeast quadrant, access management is required on Sherwood Drive and Range Road 233 to convert the all direction accesses to the Sherwood Center and the Walmart to right in/out(s). This change was required to address operational concerns related to the current access locations being too close to the Sherwood Drive/Wye Road intersection.

As noted in **Section 4.0**, displaced left turns at the Wye Road/Sherwood Drive intersection were reassigned to determine the additional network improvements required to meet the traffic demand. Southbound to eastbound Sherwood Drive traffic was reassigned to Fir Street and Wallace Drive on the basis of one third and two thirds, respectively. The reassigned traffic requires the modification of the Sherwood Drive/Fir Street intersection to provide a double left turn lane southbound, as well as an additional eastbound lane on Fir Street (2 lanes) east of Sherwood Drive. The additional traffic would use Fir Street to Ash Street and subsequently, turn left at the Wye Road/ Ash Street intersection. A southbound, double left turn lane on Ash Street on the approach to Wye Road is required, but the southbound queue will still regularly block the Alder Avenue/Ash Street intersection in the PM Peak. This situation may result in short cutting on Alder Avenue, and therefore, traffic calming measures, particularly between Hawthorne Street and Brentwood Boulevard (a long, wide street), should be considered. A modern roundabout on Alder Avenue midway between Hawthorne and Brentwood at Sycamore Street or Ivy Crescent would likely reduce shortcutting and speeds on this roadway.

5.2 SHERWOOD DRIVE TO BRENTWOOD BOULEVARD

Wye Road is currently a four (4) lane divided urban roadway, with acceleration / deceleration lanes at the Ash Street, Hawthorne Street and Brentwood Boulevard intersections. To convert to a six (6) lane roadway, with a 9.0 m wide median (to accommodate double left turn lanes), widening to the south is required throughout. The existing westbound acceleration and deceleration lanes at Brentwood Boulevard and

Hawthorne Drive will be converted to through lanes, and no westbound auxiliary lanes will be provided due to the concrete noise fence constraint along the north side. A westbound deceleration lane at the approach to Ash Street, beyond the west end of the concrete fence, is included in the design.

An eastbound auxiliary right turn lane, which is discontinuous at major intersections, is required between Sherwood Drive and Brentwood Boulevard to support the access management plan developed for the South Wye development concept. As noted, the access management plan is considered a reasonable compromise to maintain the integrity and function of Wye Road, while providing reasonable development access.

5.2.1 Wye Road and Ash Street Intersection

Ash Street, south of Wye Road, is one of the main accesses to the proposed South Wye commercial area and forms the north-south leg of the jughandle. This road will accommodate the majority of westbound to southbound movements displaced from the Sherwood Drive intersection. Double left turn lanes westbound to southbound on Wye Road are required to handle the high volumes of left turn traffic.

The Green Street intersection location on Ash Street is a compromise reached between the Developer and Strathcona County, as a longer throat length between Wye Road and Green Street would be desirable. The TIA completed by the Developer's Consultant, and reviewed in conjunction with the study, confirmed appropriate operations at the Green Street and Wye Road intersections on Ash Street, based on projected traffic for the development. Analysis suggests that signals will not be required at the Ash Street/Green Street intersection.

5.2.2 Wye Road and Hawthorne Street Intersection

Hawthorne Street north provides one of the main accesses to Wye Road from the Sherwood Heights and Maple Grove residential areas of Sherwood Park. The south leg of this intersection was also identified as a major access to the South Wye development. A double left turn lane westbound is required on Wye Road, and a single left with a through/left lane northbound are required to meet traffic demand. The intersection will require signals.

5.2.3 Wye Road and Jughandle Intersection (West of Brentwood Boulevard)

The original jughandle concept was developed to accommodate only displaced left turn movements from the Wye Road/Brentwood Boulevard intersection; however, the need for additional access required that this jughandle also serve as a main access to the South Wye development. Additional traffic, particularly westbound to southbound, will require a double left turn lane to meet the high traffic demand.

South of Wye Road, an intersection on the jughandle is required to separate development traffic from jughandle traffic. Optimum operations will be achieved with essentially free flow movement of jughandle traffic, and therefore, interference from development access traffic should be avoided. The design of the jughandle/

development access should provide relatively free flow movement for jughandle traffic to avoid queue building, which could result in operational concerns on Wye Road. Access to the area encircled by the jughandle should be avoided, and retaining this as a natural area would be desirable.

5.3 WYE ROAD AND BRENTWOOD BOULEVARD INTERSECTION

The long term plan for Brentwood Boulevard reflects a traffic demand for a six (6) lane north-south roadway through the intersection. Limited right-of-way north of Wye Road restricts the ability to implement a six (6) lane cross-section with southbound double left turn lanes, but would marginally accommodate a six (6) lane through roadway without additional right-of-way. This further supports the jughandle concept, which facilitates the removal of the southbound left turn lanes, as well as the northbound and westbound left turns.

A jughandle concept, with all left turns except eastbound to northbound removed, provides the best intersection operations at this location, and is therefore the recommended long term plan. Right-of-way for widening Range Road 232 on the west side, which is currently undeveloped, is required and should be protected as a condition of development. The six (6) lane configuration, plus auxiliary lanes on Range Road 232 should be constructed as part of the Wye Road/Brentwood Boulevard intersection improvements, at least to the jughandle/Range Road 232 intersection.

5.4 BRENTWOOD BOULEVARD TO CLOVER BAR ROAD

Similar to west of Brentwood Boulevard, widening of Wye Road to the east will be to the south, as the north side noise wall constraint exists for an additional 550 m east of Brentwood Boulevard. The functional plans are based on maintaining the north curb in its current location and developing the required six (6) lanes, plus 9.0 m median, configuration from the existing north curb alignment. Acceleration and deceleration lanes would be developed for the intersections. The functional plans indicate that the westbound deceleration lane at Brentwood Boulevard could be shortened from the current 300 m to 130 m, but this could be further evaluated at detailed design, as it may be appropriate to maintain the longer deceleration lane.

East of the CBC Tower Site (Nottingham), additional right-of-way is available on the north side of the existing road; however, since the north boulevard has recently been landscaped, and a new trail constructed, it was considered desirable to retain the north curb line in its current alignment and not disturb the north boulevard. The south side of the existing Wye Road is a rural section, and therefore, urbanization will require storm drainage and the profile should be reviewed to determine if adjustments are required (current standard is 0.6% minimum gradient where as 0.5% was minimum when westbound Wye Road urbanization was completed). It will be prudent to construct the ultimate south curb line in conjunction with the urbanization of Wye Road.

5.4.1 Wye Road and Estate Drive Intersection

The existing tee intersection will remain essentially as it currently exists, but will require signalization as traffic volumes increase on Wye Road. A slotted left turn lane westbound has been suggested.

5.4.2 Wye Road and Nottingham Way Intersection

Functional plans indicate a double left turn lane eastbound on Wye Road at the Nottingham Way intersection; however, our current 2015 traffic analysis suggests a single left turn will meet the traffic demand. An evaluation of the intersection should be completed in conjunction with design of Wye Road widening, intersection improvements, and/or implementation of development to the south.

The commercial accesses north of Wye Road between Clover Bar Road and Nottingham Way are expected to remain in their current configuration, although the eastbound left turn into the area may be enhanced.

5.4.3 Wye Road and Clover Bar Road Intersection

A four (4) lane roadway is indicated for Clover Bar Road through the Wye Road intersection, with double left turn lanes for both northbound and southbound. Traffic demand also indicates a requirement for double left turn lanes eastbound to northbound. Traffic analysis confirmed that a conventional intersection as shown will meet the long term traffic demand (2015) with approximately 10% spare capacity, and therefore, achieves the project Target LOS. However, it is suggested that the right-of-way be protected in the southwest quadrant to allow the implementation of a jughandle in the future. The right-of-way required, as indicated on **Exhibit 5.6,** is currently publically controlled, and it should therefore be possible to protect for this for the future jughandle.

5.5 CLOVER BAR ROAD TO HIGHWAY 21

The six (6) lane cross-section, with a 9.0 m wide median, for Wye Road is proposed to continue to Highway 21 and connect to the at-grade intersection in the interim, and to the interchange in the long term. The north curb alignment will be retained and all widening is proposed to the south to avoid disturbing the north boulevard, which has recently been landscaped and a new trail constructed. The south side of the existing Wye Road is a rural section, and therefore, urbanization will require storm drainage and the profile should be reviewed to determine if profile adjustments are required. As built plans indicate that a minimum gradient of 0.5% was used for the previous construction, and it may be prudent to apply this standard to avoid reprofiling the road during subsequent construction. It would be prudent to construct the ultimate six (6) lane south curb line in conjunction with the urbanization of Wye Road.

5.5.1 Wye Road and Ridgemont Way Intersection

One intersection is proposed between Clover Bar Road and Highway 21 (≈ 900 m east of Clover Bar Road). The intersection requires a double left turn lane eastbound into The Ridge / Regency Park residential area and a single left turn lane westbound into the Sherwood Hills Estates area.

5.6 MULTI-USE TRAILS

A multi-use trail system along the south side of the Wye Road corridor, between Ordze Road and Highway 21 will provide desirable pedestrian / cyclist connectivity for the area. Although the trail is indicated as a linear trail, the intent is to create a meandering facility utilizing the adjacent Atco right-of-way, subject to negotiations for each section of road. The “Wye Road Urban Design Guidelines” are intended to be the governing document for the design of the trail and south boulevard landscaping, with the expectation that an attractive, pedestrian friendly environment can be created along this gateway to Sherwood Park.

No additional multi-use trail is proposed on the north side of Wye Road due to the lack of available right-of-way between the north curb line and the concrete noise fence. A multi-use trail along the north side of Wye Road, between the CBC Tower (Nottingham Area) and Highway 21 was recently installed, as adequate right-of-way is available through this area. Pedestrian / cyclist crossings of Wye Road between the north and south side, to access trails should be permitted at signalized intersections only.

FIR STREET

ORDZE ROAD

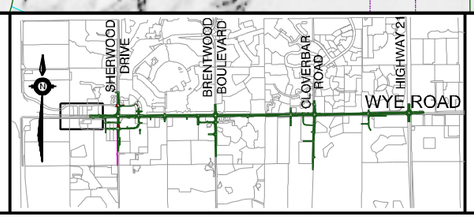
SIGNALIZED INTERSECTION

WYE ROAD

ORDZE AVENUE

N

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.1

FIR STREET

ASH STREET

SHERWOOD DRIVE

SIGNALIZED INTERSECTION

SIGNALIZED INTERSECTION

SIGNALIZED INTERSECTION

WYE ROAD

WYE ROAD

ORDZE AVENUE

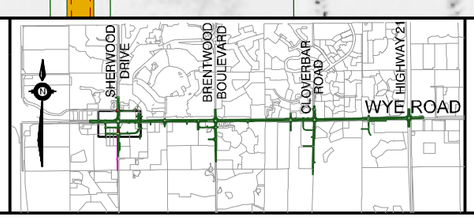
GREEN STREET

CONFIGURATION OF INTERSECTION TO BE DETERMINED

SIGNALIZED INTERSECTION

WALLACE DRIVE

FUNCTIONAL PLAN ONLY SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.2

ASH STREET

HAWTHORNE STREET

WYE ROAD

SIGNALIZED INTERSECTION

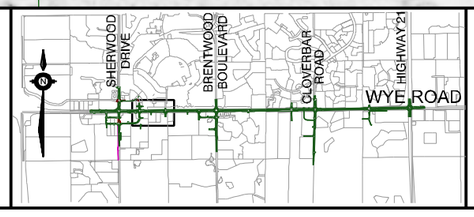
SIGNALIZED INTERSECTION

RIGHT-IN/RIGHT-OUT ONLY

GREEN STREET

N

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.3

WYE ROAD

BRENTWOOD BOULEVARD

RANGE ROAD 232

SIGNALIZED INTERSECTION

SIGNALIZED INTERSECTION

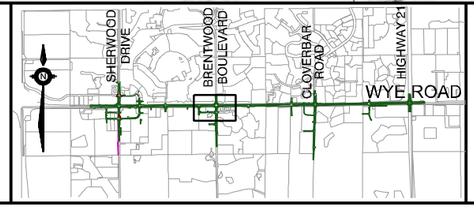
SIGNALIZED INTERSECTION

RIGHT-IN/ RIGHT-OUT ONLY

INTERSECTION TREATMENT TO BE DETERMINED

N

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

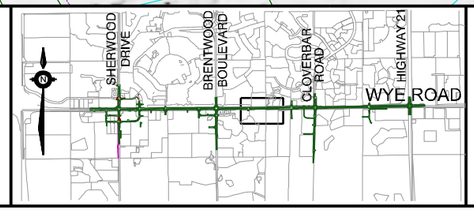
Date: NOVEMBER 2008

EXHIBIT 5.4

SIGNALIZED INTERSECTION

ESTATE DRIVE

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.5

NOTTINGHAM WAY

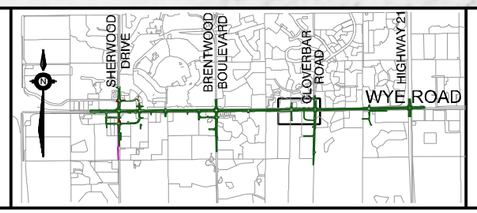
CLOVERBAR ROAD

WYE ROAD

SIGNALIZED INTERSECTION

SIGNALIZED INTERSECTION

FUNCTIONAL PLAN ONLY SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.6

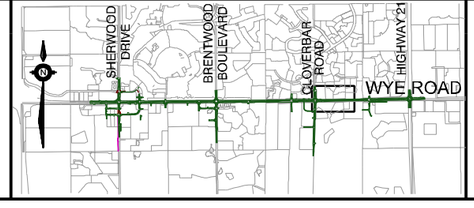
CLOVERBAR ROAD

WYE ROAD

SIGNALIZED INTERSECTION

N

FUNCTIONAL PLAN ONLY SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

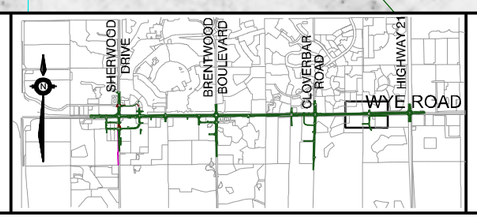
EXHIBIT 5.7

RIDGEMONT WAY

WYE ROAD

SIGNALIZED INTERSECTION

FUNCTIONAL PLAN ONLY SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

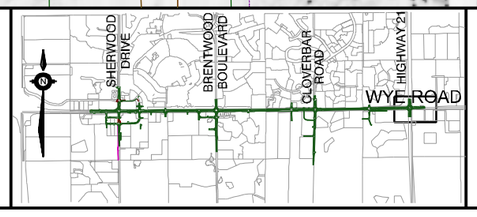
EXHIBIT 5.8

HIGHWAY 21

WYE ROAD

SIGNALIZED INTERSECTION
INTERCHANGE LOCATION IN LONG TERM

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.9

INTERESCTION TREATMENT TO BE DETRMINED

ORDZE AVENUE

SIGNALIZED INTERSECTION

SIGNALIZED INTERSECTION

RANGE ROAD 233

SIGNALIZED INTERSECTION

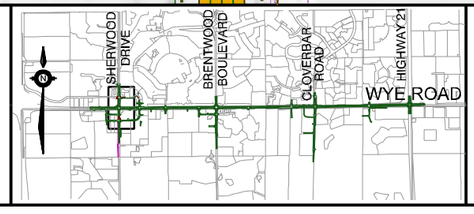
WALLACE DRIVE

WYE ROAD

SHERWOOD DRIVE

FIR STREET

FUNCTIONAL PLAN ONLY
SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

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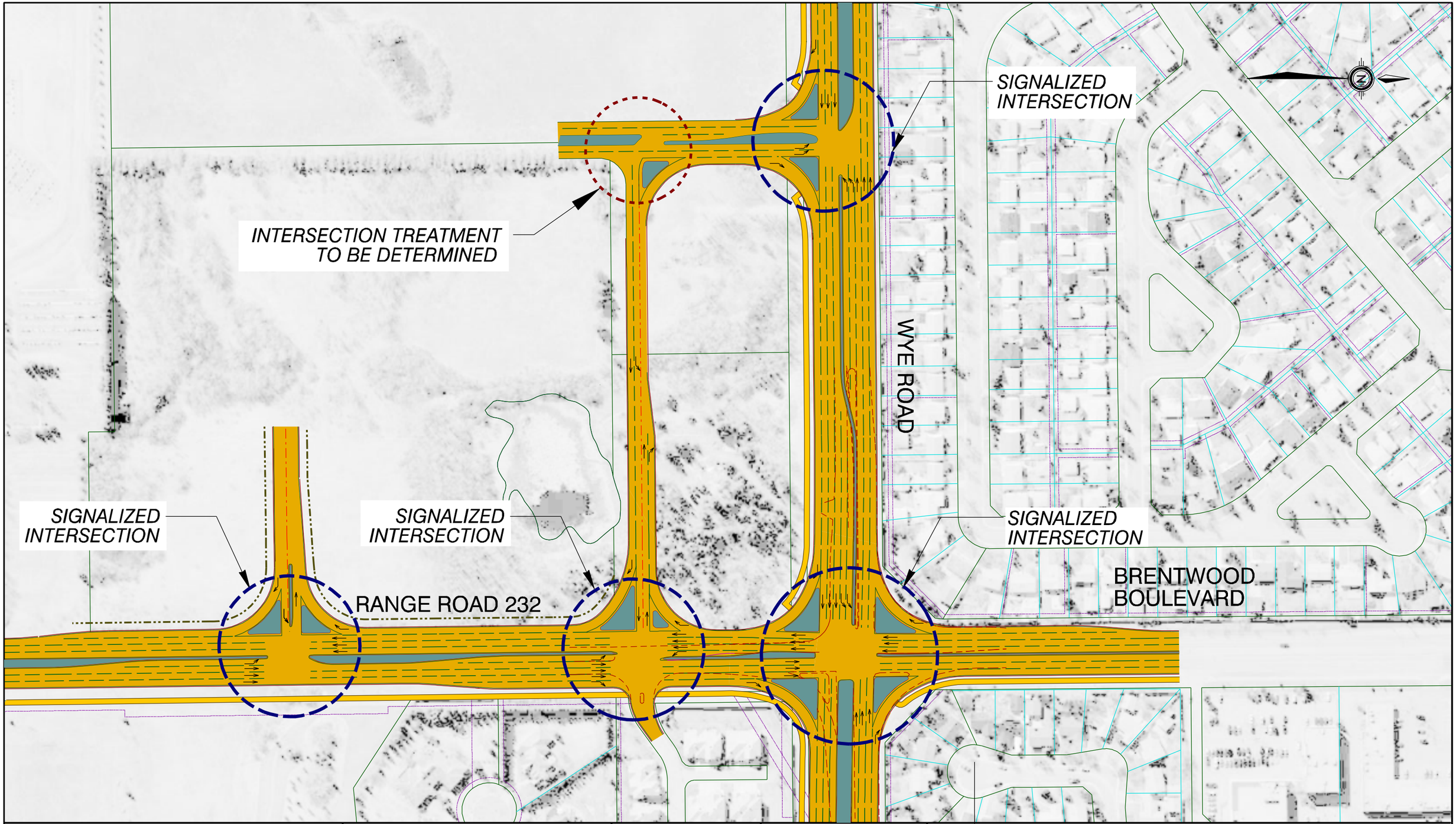
HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

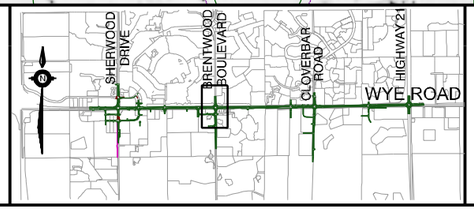
RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.10



FUNCTIONAL PLAN ONLY SUBJECT TO REVISIONS



Strathcona County

AL-TERRA ENGINEERING

Scale 1:2,000

20m 0 40m

HORIZONTAL

WYE ROAD - SHERWOOD PARK
FUNCTIONAL PLANNING STUDY

RECOMMENDED LONG TERM PLAN

Date: NOVEMBER 2008

EXHIBIT 5.11

6.0 PAVEMENT EVALUATION / DESIGN / SURFACING STRATEGY

Investigation of the existing pavement, the pavement design for widening, and the surfacing strategy for the existing pavement were completed by J.R. Paine & Associates Ltd. and are documented in a report included in **Appendix "C."** Field investigation included the drilling of 46 probeholes to determine the pavement structure thickness, and the visual inspection of existing pavements. Strathcona County Detailed Deflection Report(s) for Wye Road were used as the basis for developing the surfacing strategy for each section of the existing Wye Road.

Table 6.1 has been extracted from the Pavement Evaluation Report and provides recommendations for the asphalt overlay thickness required for each section of Wye Road.

Table 6.1
Design and Recommended Overlay Thickness
Wye Road – Highway 21 to Transportation Utility Corridor

Road Section	Station	Section #	Direction	RRD	Design Overlay Thickness (mm)	Recommended Overlay Thickness (mm)
Highway 21 to Clover Bar Road	All	01011	WB	38.2	40	40
Clover Bar Road to Brentwood Boulevard	All	02011	WB	41.8	50	50
Brentwood Boulevard to Hawthorne Street	All	03011	WB	56	75	80
Hawthorne Street to Ash Street	All	03013	WB	39.1	45	50
Ash Street to Sherwood Drive	All	03015	WB	38.9	45	50
Sherwood Drive to Transport Utility Corridor	All	4011	WB	55.2	80	80
Highway 21 to Clover Bar Road	All	01012	EB	51.1	65	70
Clover Bar Road to Brentwood Boulevard	0-1050	02012	EB	93.7	135	140
Clover Bar Road to Brentwood Boulevard	1050-1650	02012	EB	50.1	65	70
Brentwood Boulevard to Hawthorne Street	All	03012	EB	44.4	60	60
Hawthorne Street to Ash Street	All	03014	EB	36.4	30	40
Ash Street to Sherwood Drive	All	03016	EB	31.6	10	40
Transport Utility Corridor to Sherwood Drive	All	4012	EB	50.4	70	70

Notes: RRD – Representative Rebound Deflection (mean plus 2 standard deviations)
Design thickness based on County July 2007 Dynaflect data

The recommended pavement structure for new construction and/or widening is shown in **Table 6.2**.

Table 6.2 Surfacing Strategy – New Construction	
Asphaltic Concrete Pavement	**Granular Base Course**
175 mm - 50 mm ACO over - 125 mm ACB or staged ACO/ACB	350 mm - 2 lifts (maximum of 200 mm thickness per lift) - 20 mm Crush

It should be noted that the ACP mix types and GBC are as per City of Edmonton specifications.

The recommended structure has a pavement thickness 15 mm greater than recommended in the J.R. Paine report to comply with the minimum Strathcona County arterial road standard, but also to facilitate staged pavement construction.

The final 50 mm lift of pavement on the widening and overlay of the existing road should be deferred two or three years after the widening construction has been completed.

Each section of Wye Road should be re-evaluated prior to detailed design to determine a feasible approach to balance pavement overlay of the existing, and structural requirements for new construction and/or widening. Where required, overlay of the existing pavement is 80 mm or less; a single lift overlay of the existing and widened roadway is expected to be feasible. It is suggested that the section of Wye Road between Clover Bar Road and Brentwood Boulevard (eastbound), which requires 140 mm overlay, be completed in two stages; an initial 90 mm to 100 mm overlay in conjunction with the widening and subsequent (staged) 40 mm or 30 mm overlay of the existing and widened area at some later date.

7.0 STORM SEWER CONDITION AND CAPACITY ASSESSMENT

7.1 GENERAL

The Functional Planning Study for Wye Road identified roadway improvements required along Wye Road from Ordze Avenue to Highway 21. As Wye Road has an existing storm sewer system, the roadway improvements will necessitate storm sewer modifications, primarily catchbasin relocation and catchbasin lead extension. Some sections of the storm sewer on Wye Road were constructed as early as 1977 and the original design did not consider the widening of Wye Road to six (6) lanes plus an auxiliary lane. Therefore, it is recommended that prior to any improvements along Wye Road, the storm sewer system be reviewed for condition and capacity. The timely review of the system will identify any deficiencies and allow the system to be repaired, replaced or upgraded (as required) in conjunction with the roadway widening, reducing construction costs and disruption to the travelling public. A report describing the storm sewer condition and capacity assessment was prepared by Al-Terra and is included in **Appendix "D."**

7.2 CONDITION ASSESSMENT

In preparation for the first phase of Wye Road widening and improvements between Sherwood Drive and Hawthorne Street, a video inspection of the storm sewer system (including catchbasin leads) was completed from Ordze Avenue to east of Brentwood Boulevard in March 2008.

In general, and as expected, the oldest sections reviewed showed the most deterioration; additionally there was some damage from third party shallow utility installations. The section from Sherwood Drive to east of Hawthorne Street was identified as the area requiring the most replacement and repair. Due to the poor condition of the Wye Road storm sewer system near Sherwood Drive, a video inspection of the storm sewer on Sherwood Drive downstream of Wye Road was completed to identify if any repairs and/or replacements should be coordinated with the Wye Road work.

A full review of the storm sewer tapes (completed by both Al-Terra Engineering and Strathcona County) are included in the report in **Appendix "D."**

7.3 CAPACITY ASSESSMENT

Using the Rational method, the functionality of the Wye Road storm sewer from Ordze Avenue to east of Brentwood Boulevard was evaluated for the two year and five year storm events. A time of concentration of 8 minutes and 15 minutes were used for both storm events, although, given the largely impervious area of the Wye Road right-of-way, the 8 minute time of concentration is generally felt to provide more accurate results.

The capacity analysis was undertaken as a supplement to the overall Sherwood Park Urban Area Drainage System Assessment completed by SamEng in 2007. Wye Road is a very specific portion of the Gold Bar Creek Basin (as outlined in the Sam-Eng report)

with a much higher run-off coefficient than the average used to identify capacity in the SamEng Report.

The SamEng analysis of the Wye Road capacity did not consider the expansion of Wye Road; at the time of the report's completion, the functional planning study for Wye Road was not completed and at any rate, the SamEng report was not intended to be specific enough to focus on individual characteristics of the various sections of the basin. For example, the proposed 2008 construction will widen Wye Road between Sherwood Drive and Hawthorne Street to a six (6) lane cross-section with a continuous auxiliary lane on the south side and double lefts. The Wye Road right-of-way, which is generally 80% impervious, is calculated to have a run-off co-efficient of 0.70 – 0.80 using 95% run-off for the impervious surfaces and 10% for the grassed boulevards.

Using this rationale, the Wye Road storm sewer between Ordze Avenue to east of Brentwood Boulevard has the capacity for the two and five year storms, with some surcharge in the system. The complete analysis is included in **Appendix "D."**

The surcharge in the system was calculated for the five year storm using a time of concentration of 8 minutes. Generally, the surcharging does not rise above 0.50 m below the catchbasin rim elevation, with the exception being between east of Hawthorne Street at a sag manhole collecting drainage from approx 20 m west of Hawthorne Street to 137 m east of Hawthorne Street. Due to the larger catchment area, the analysis shows that surcharging of the system to over 1.0 m could be expected. However, the south boulevard of Wye Road drains south into an undeveloped parcel and a natural low area; therefore, ponding at the location does not exceed 0.15 m, the point at which the water overtops the curb and releases to the south. It should be noted that any development of the parcel to the south should not impede this overland drainage route, or significant flooding of Wye Road could be expected.

The condition assessment of the Wye Road storm sewer was completed from Ordze Avenue to east of Brentwood Boulevard in preparation of the 2008 Wye Road widening improvements. As subsequent sections of Wye Road are improved per the Functional Planning Study, condition assessment and storm sewer analysis should be undertaken in conjunction with each project to ensure timely repair and/or replacement of the system. Capacity analysis should also be completed for subsequent sections of Wye Road; however, it is anticipated that generally, capacity will be available with minor surcharge.

8.0 NOISE ASSESSMENT AND MODELLING

Residential areas adjacent to Wye Road all have some form of noise attenuation, including the concrete noise fence on the north side of Wye Road between Ash Street to east of Brentwood Boulevard. Other residential areas (Nottingham Estates, Regency, and The Ridge) have combinations of berm and double board wood fence for noise attenuation.

Although all the existing residential areas along Wye Road have noise attenuation, some concerns have been expressed regarding the level of attenuation provided. As a result, noise analysis was completed for three (3) locations, using the Stamson Version 3.10, noise prediction model. Analysis was completed for three conditions at the three (3) locations as shown in **Table 8.1**.

Table 8.1
Wye Road Functional Planning Study
Noise Prediction Model

Location	Site	Existing Road/ Existing Traffic		Existing Road/Year 2015 Traffic		Future Road/Year 2015 Traffic	
		Noise Level		**Noise Level**		**Noise Level**	
		PM Peak	24h Equivalent	PM Peak	24h Equivalent	PM Peak	24h Equivalent
Lot 117, Estates of Sherwood Park (South of Wye Road)	A	57.6	55.0	62.9	59.5	65.5	61.7
Lot 111, Estates of Sherwood Park (South of Wye Road)	B	54.6	52.4	60	57.0	62.4	59.0
Lot 109, Maplewood at Rosewood Drive (North of Wye Road)	C	55.0	52.8	60.7	57.6	58.9	56.8

Notes: Sites A and B – Existing 1.8 m noise barrier (double boarded fence)
Site C – Existing 3.0 m noise wall

The table illustrates that based on the existing traffic and road configuration, predicted noise levels behind the concrete fence on the north side (Maplewood) are at 52.8 dBA L_{eq} 24, and 52.4 dBA L_{eq} 24, and 55.0 dBA L_{eq} 24 behind berm and wooden fence on the south side in the Estates of Sherwood Park. The predicted noise levels for the 2015 traffic and the improved six lane Wye Road are 56.8 dBA behind the concrete wall and 59.0 dBA and 61.7 dBA behind the berm/fence combination, all expressed as L_{eq} 24. These predicted noise levels are well below the Noise Policy trigger of 65 dBA L_{eq} 24, at which noise attenuation improvements are considered.

In addition to the noise prediction work completed during the study, ACI Acoustical Consultants Inc. (ACI), of Edmonton AB, were retained to conduct an environmental noise survey for the Estates of Sherwood Park residential development in Sherwood Park. The purpose of the work was to determine the current noise climate in the area and generate a computer noise model to illustrate the noise contours under current and

future conditions with the proposed modifications to Wye Road. Site work was conducted by ACI on November 4-5, 2008.

As part of the study, a total of three (3) baseline noise monitorings were conducted in residential backyards directly adjacent to Wye Road. The overnight monitoring resulted in adjusted $L_{eq}24$[1] levels of 57.8 dBA, 58.2 dBA and 56.8 dBA, respectively. The results were adjusted to remove "non-typical" sounds near the monitors. It was found that the dominant noise source in this area was Wye Road.

The results of the baseline noise modeling confirmed the measured results and, as such, they were used to calibrate the model for future conditions. The modeling results for future conditions indicated that the noise levels at all receptors within the study area would increase by approximately 3 dBA (related to the approximate proposed doubling of traffic) and would remain below Outdoor Trigger Criterion Sound Level $L_{eq}24$ of 65 dBA.

The results of the noise monitoring compare well with the Stamson prediction model, and although monitoring shows noise levels 1 to 3 dBA higher than predicted, this seems reasonable as gaps between the fence and ground, and in the fence itself were noted at the monitoring locations. The minimum difference in noise level noticeable to the typical human listener is 3dBA. A complete copy of the noise report is included in **Appendix "F."**

The assessment and modeling indicates no further noise attenuation is required along Wye Road adjacent to the existing residential development, provided that noise attenuation fencing (both concrete and double board) is maintained in good repair, free of gaps both under and along the fence.

9.0 ROADWAY LIGHTING

Existing roadway lighting along Wye Road is currently operated by Fortis Canada and consists of a combination of centre median lighting and lights along each side of the arterial roadway. This lighting system has been in place for twenty-five (25) to thirty (30) years, depending on location, and many of the light standards would be described as only in adequate condition.

A lighting assessment was not completed during the Functional Planning Study, as it was determined that widening would require the removal and/or relocation of the south side lights. In addition, the median modifications resulting from the widening will also require the removal and/or relocation of any median lights. These factors and the decorative lighting recommended in the "Wye Road Urban Design Guidelines" suggested that a new lighting system would be required as part of any Wye Road widening and improvements. In accordance with Strathcona County's current practice, the lighting system should be County owned and a metered facility.

10.0 PUBLIC CONSULTATION

Public consultation during the planning study included stakeholder information meetings, a public open house, and council workshops. Separate stand alone reports documenting the process were prepared by IMI Strategies and are summarized as follows.

An update and initial study findings were presented at a council workshop in November 2006. The presentation identified capacity deficiencies at intersections, the need for widening (6 lanes) of traditional, and nontraditional intersection analysis. Council was informed that nontraditional (jughandle) intersections at Sherwood Drive and Brentwood Boulevard appeared to provide additional capacity and enhanced operations, and that subject to further study, this type of improvement would likely be recommended. Council agreed that public consultation on the project should be deferred until negotiations with Atco Pipelines provided an indication on the feasibility of widening Wye Road to the south into the Atco right-of-way. Discussions with Atco Pipelines commenced in late 2006, but it was not apparent until early 2008, that a resolution with Atco Pipelines would be achieved.

A stakeholder information meeting was held on March 19, 2008, for the purpose of presenting the proposed Wye Road Plan to stakeholders. Tenants and landowners/ business owners adjacent to Wye Road were invited to attend by a mailed and/or hand delivered invitation.

The proposed plan, particularly intersection improvements at Sherwood Drive, was a significant concern to some landowner/business owners, predominantly west of Range Road 233 and south of Wye Road. Replacing the westbound to southbound left turn movements on Wye Road at Sherwood Drive to a jughandle was considered a detriment to “way finding” and convenient access. There was also some concern expressed about the jughandle concept at the Wye Road/Brentwood Boulevard intersection for many of the same reasons. Few other concerns were expressed at the stakeholder meeting.

An open house for the public was held on May 7, 2008 for presenting the proposed Wye Road Plan to community members. A total of 134 people attended the open house, including many of the stakeholders. Approximately 50% of respondents to the questionnaire were generally very or somewhat satisfied with the proposed Wye Road improvements, but only 35% were very or somewhat satisfied with the proposed Wye Road/Sherwood Drive intersection improvements. Other concerns related primarily to higher traffic volumes and additional traffic noise. Many respondents were pleased with the proposed pedestrian/cyclist accommodation and the enhanced aesthetics along Wye Road.

11.0 IMPLEMENTATION AND COST ESTIMATES

The implementation of the plans for Wye Road improvements is expected to be staged over a period of years, subject to Strathcona County Council approval and available funding.

Staging for the project was developed based on numerous criteria and should be reviewed occasionally based on the changing demand and/or development of adjacent land. The major consideration was to address those areas currently experiencing congestion and operational concerns. A secondary consideration related to coordinating Wye Road improvements with the development of adjacent areas, particularly between Range Roads 232 and 233, to achieve construction savings by combining Wye Road widening with auxiliary lane construction, which are a Developer responsibility. Further consideration included required transitions between stages and logical project size.

Based on the study, the following staging was developed:

- Stage 1
  - Widening Wye Road – Sherwood Drive and Hawthorne Street
  - Construction of a jughandle roadway at Wallace Drive behind Walmart
- Stage 2
  - Widening Wye Road – Hawthorne Street and Brentwood Boulevard
- Stage 3
  - Widening Wye Road – Brentwood Boulevard to west of Nottingham Boulevard
- Stage 4
  - Widening Wye Road – Nottingham Boulevard to Clover Bar Road
- Stage 5
  - Widening Wye Road – Ordze Road to Sherwood Drive
- Stage 6
  - Widening Wye Road – Clover Bar Road to Highway 21

Cost estimates, based on typical 2008 construction costs, were prepared for the staging identified and are shown in **Table 11.1**. The total estimated cost is **$59,115,406.00**.

Stage 1 of the project was approved in the 2008 budget by County Council, and construction is expected to be completed in 2009. Full implementation of the recommended plans for improvements related to the Wye Road/Sherwood Drive intersection and the Wallace Drive jughandle are illustrated on **Exhibit 11.1**. These improvements are proposed to be implemented in accordance with the staging indicated on **Exhibit 11.1** and will be subject to further discussion with impacted stakeholders, and will also require Council approval prior to implementation. The westbound to southbound left turn on Wye Road at Sherwood Drive will be monitored after the completion of Stage 1 improvements and prior to the removal of this movement.

Stage 2 improvements should be scheduled prior to, and concurrent with, the development of lands south of Wye Road and west of Hawthorne Street. It is noted that the Atco Pipeline and Atco Gate Station #1 relocation, to facilitate Stage 2 improvements, are in the planning/design stage, and this work should be expedited to avoid untimely delays. In addition, negotiations with Atco for the required right-of-way and/or modification and relocation of Atco facilities, for all stages of the proposed Wye Road improvements, should be continued and brought to conclusion to provide certainty for future implementation.

Condition assessments of the storm sewer system on Wye Road, between Brentwood Boulevard and Highway 21 should be completed well in advance of Wye Road improvements in these areas. Camera surveys and condition assessment to the storm sewer system between Ordze Road and Brentwood Boulevard were completed during the study in view of the anticipated construction.

Urbanization of the eastbound lanes of Wye Road, east of Estates Drive, if implemented prior to the Wye Road improvements, should consider the proposed six (6) lane configuration, and should therefore include the widening and construction of the south curb and gutter on the long term (ultimate) alignment.

COST OF IMPROVEMENTS - WYE ROAD
ORDZE ROAD TO CLOVER BAR ROAD

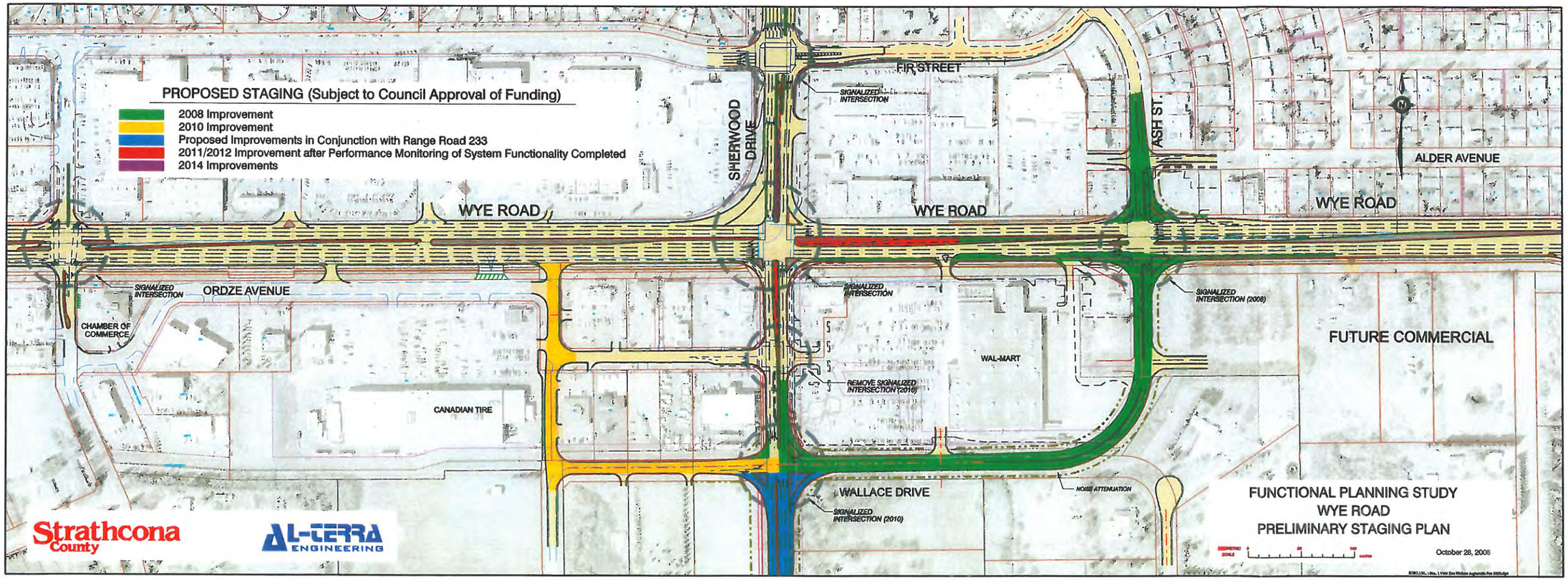
Road Segment	Approx. Length (m)	Estimated Construction Cost (2008)	Utility Costs				Landscaping	Wye Road Overlay	Engineering & Testing (15%)	Total
			ATCO Pipelines (Abandonned Pipe Removal)	ATCO Gas (Gate Station Relocation)	Streetlighting & Signals	Fortis (Overhead Power relocation)				
Ordze Road - Sherwood Drive	663	$ 2,445,890	$ 253,000	$ 980,000	$ 437,553		$ 703,294	$ 1,140,836	$ 894,086	$ 6,854,659
Canadian Tire Jughandle - includes full signals at RR233		$ 2,660,038			$ 610,000		$ 160,200		$ 514,536	$ 3,944,774
Fir Street Improvements		$ 900,000					$ 10,000		$ 136,500	$ 1,046,500
Sherwood Drive - Hawthorne	780	$ 2,877,518	$ 245,000		$ 977,475	$ 566,164	$ 827,405		$ 824,034	$ 6,317,596
Wallace Drive Jughandle (2008 costs)		$ 1,330,019			$ 348,190	$ 65,128	$ 80,100		$ 273,516	$ 2,096,953
Ash Street Improvements		$ 350,000			$ 50,000		$ 10,000		$ 61,500	$ 471,500
Hawthorne to Brentwood	850	$ 3,135,756	$ 172,000	$ 980,000	$ 861,510	$ 168,464	$ 901,659	$ 1,039,108	$ 1,088,775	$ 8,347,272
Brentwood Jughandle - includes full signals at RR232		$ 2,660,038			$ 610,000		$ 160,200		$ 514,536	$ 3,944,774
Range Road 232		$ 750,000			$ 50,000		$ 10,000		$ 121,500	$ 931,500
Brentwood Boulevard - Estate Drive	538	$ 1,984,749	$ 168,987		$ 655,058	$ 106,628	$ 570,697	$ 833,862	$ 647,997	$ 4,967,979
Estate Drive - Nottingham Way	726	$ 2,678,305	$ 228,038		$ 779,130	$ 343,888	$ 770,123	$ 1,125,249	$ 888,710	$ 6,813,444
Nottingham Way - Clover Bar Road	397	$ 1,464,583	$ 124,699		$ 262,004	$ 78,683	$ 421,128	$ 415,992	$ 415,063	$ 3,182,152
Clover Bar Road Improvements		$ 750,000			$ 50,000		$ 10,000		$ 121,500	$ 931,500
Clover Bar Road - Highway 21	1201	$ 4,430,639	$ 377,237		$ 792,611	$ 238,030	$ 1,273,992	$ 943,842	$ 1,208,453	$ 9,264,803
Total	**5155**	**$ 28,417,535**	**$ 1,568,962**	**$ 1,960,000**	**$ 6,483,531**	**$ 1,566,985**	**$ 5,908,798**	**$ 5,498,890**	**$ 7,710,705**	**$ 59,115,406**

Notes:

Cost Estimate does not include any land costs
Costs are represented as 2008 Construction costs
Auxiliary lane consts as shown in the Functional Plans are included in the estimate. Construction recoveries from adjacent developers have not been subtracted.

Prepared by **Al-Terra Eng.**
Revised 10/21/2011

Table 11.1


PROPOSED STAGING (Subject to Council Approval of Funding)
2008 Improvement
2010 Improvement
Proposed Improvements in Conjunction with Range Road 233
2011/2012 Improvement after Performance Monitoring of System Functionality Completed
2014 Improvements
WYE ROAD
SHERWOOD DRIVE
FIR STREET
SIGNALIZED INTERSECTION
ASH ST.
ALDER AVENUE
WYE ROAD
WYE ROAD
SIGNALIZED INTERSECTION
ORDZE AVENUE
CHAMBER OF COMMERCE
SIGNALIZED INTERSECTION
SIGNALIZED INTERSECTION (2008)
FUTURE COMMERCIAL
WAL-MART
REMOVE SIGNALIZED INTERSECTION (2010)
CANADIAN TIRE
WALLACE DRIVE
SIGNALIZED INTERSECTION (2010)
NOISE ATTENUATION
Strathcona County
AL-TERRA ENGINEERING
FUNCTIONAL PLANNING STUDY
WYE ROAD
PRELIMINARY STAGING PLAN
October 28, 2008

APPENDIX “A”

Traffic

Strathcona County Trip Generation Study

Trip Generation and Distribution Assumption

Traffic Assessment

Existing Traffic (2006) 1-2
New Development Primary Trips (2015) 3-20
New Development Pass-by Trips (2015) 21-30
Total New Development Traffic (2015) 31-36

Strathcona County Trip Generation Study

Table 4.1

Nottingham Centre Commercial — IGA, Commercial Strip, Gas Station - 6 pumps, 2 Liquor Stores, Car Wash, Tim Horton's, Medical Services

Total Site Area	34,100 m^2		367,100 ft^2			
Buildings Area	7,250 m^2		78,000 ft^2			
Number of Employees	Full Time	89	Part Time	184		
Site Coverage	21%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	263	275	538	449	531	980
Rate per 1,000 sq. ft	3.37	3.53	**6.90**	5.76	6.81	**12.56**
Rate per Employee	0.96	1.01	**1.97**	1.64	1.95	**3.59**
Directional Split	49%	51%		46%	54%	

Ordze Ave. Canadian Tire — Auto Service, Car Wash, 2 Banks, Gas Station, Tire Store, Restaurant, 2 Fast Food Restaurants, Canadian Tire , Home Hardware, Paint Store and other small business

Total Site Area	115,223 m^2		1,240,300 ft^2		28.46	acres
Buildings Area	15,680 m^2		168,800 ft^2			
Number of Employees	Full Time	188	Part Time	271		
Site Coverage	14%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	352	329	681	329	355	684
Rate per 1,000 sq. ft	2.09	1.95	**4.03**	1.95	2.10	**4.05**
Rate per Employee	0.77	0.72	**1.48**	0.72	0.77	**1.49**
Directional Split	52%	48%		48%	52%	

Caffrey's at Ordze, South of Wye Rd. — Gas Station, 2 Restuarants, Shop, Fast Food Restaurant

Total Site Area	13,036 m^2		140,300 ft^2		3.22	acres
Buildings Area	2,550 m^2		27,400 ft^2			
Number of Employees	Full Time	188	Part Time	271		
Site Coverage	20%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	41	22	63	178	181	359
Rate per 1,000 sq. ft	1.50	0.80	**2.30**	2.28	2.32	**13.10**
Rate per Employee	0.09	0.05	**0.14**	0.39	0.39	**0.78**
Directional Split	65%	35%		50%	50%	

Wal-Mart Area — Walmart, Bank, Shoe Store, Gas Station

Total Site Area	54,251 m^2		584,000 ft^2		13.4	acres
Buildings Area	10,420 m^2		112,200 ft^2			
Number of Employees	Full Time	89	Part Time	126		
Site Coverage	19%					
	AM Peak			**PM Peak**		
	In	Out	Total	In	Out	Total
Trips Generated	53	44	97	420	453	873
Rate per 1,000 sq. ft	0.47	0.39	**0.86**	2.49	5.81	**7.78**
Rate per Employee	0.25	0.20	**0.45**	1.95	2.11	**4.06**
Directional Split	55%	45%		48%	52%	

Strathcona County Trip Generation Study

Table 4.1

Mazda Dealer

Total Site Area	50,202 m^2		540,400 ft^2		12.4	acres
Buildings Area	13,170 m^2		141,800 ft^2			
Number of Employees	Full Time	220	Part Time	147		
Site Coverage	26%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	134	96	230	266	279	545
Rate per 1,000 sq. ft	0.94	0.68	**1.62**	9.71	3.58	**3.84**
Rate per Employee	0.37	0.26	**0.63**	0.72	0.76	**1.49**
Directional Split	58%	42%		49%	51%	

Village Market Safeway, Bank, London Drugs, Restaurants incl. Tim Hortons, Pizza, Vet Clinic, Gas Station

Total Site Area	47,004 m^2		506,000 ft^2		11.61	acres
Buildings Area	10,410 m^2		112,100 ft^2			
Number of Employees	Full Time	126	Part Time	172		
Site Coverage	22%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	193	185	378	489	506	995
Rate per 1,000 sq. ft	1.72	1.65	**3.37**	4.36	6.49	**8.88**
Rate per Employee	0.65	0.62	**1.27**	1.64	1.70	**3.34**
Directional Split	51%	49%		49%	51%	

Sherwood Centre Save-on-Foods, Restairants, Commercial

Total Site Area	43,806 m^2		471,500 ft^2		10.82	acres
Buildings Area	11,600 m^2		124,900 ft^2			
Number of Employees	Full Time	148	Part Time	209		
Site Coverage	26%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Trips Generated	115	99	214	462	425	887
Rate per 1,000 sq. ft	0.92	0.79	**1.71**	3.26	5.45	**7.10**
Rate per Employee	0.32	0.28	**0.60**	1.29	1.19	**2.48**
Directional Split	54%	46%		52%	48%	

Average of all sites

Site Coverage	21%					

	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Rate per 1,000 sq. ft	1.38	1.22	**2.61**	4.08	4.46	**7.82**
Rate per Employee	0.45	0.41	**0.84**	1.16	1.23	**2.62**
Directional Split	55%	45%		49%	51%	

Total Area of All Sites 765,200 sq. ft.

All Trips	2201	5323
	2.88 Trips/1000sq.ft.	**6.96** Trips/1000sq.ft.

Description	ITE Land Use Code	Trips Generation Rates						
		Weekday Rate	AM Peak	% In	% Out	PM Peak	% In	% Out
Residential	Local Info	12	0.92	26%	74%	1.01	65%	35%
Convenience Store (in trips/ 1000 sq.ft. GFA)	ITE (852)		31.02	50%	50%	34.57	49%	51%
Convenience Store/Gas Bar (in trips/ 1000 sq.ft. GFA)	ITE (853)		45.58	50%	50%	60.61	50%	50%
Hotel/Motel (trips/room)	ITE (320)		0.64	36%	64%	0.58	53%	47%
Fast Food (in trips/ 1000 sq.ft. GFA)	ITE (933)		53.11	51%	49%	34.64	52%	48%
Office (in trips/ 1000 sq.ft. GFA)	ITE(710)		1.55	88%	12%	1.49	17%	83%
General Office Building (in trips/ employee)	ITE(710)		0.48	88%	12%	0.46	17%	83%
Speciality Store (in trips/ 1000 sq.ft. GFA)	ITE(814)		0.84	68%	32%	2.71	44%	56%
Retail Outlet (in trips/ 1000 sq.ft. GFA)	ITE(815)		0.84	68%	32%	5.06	51%	49%
Mixed Retail/Services (in trips/ 1000 sq.ft. GFA)	Local Info		2.61	55%	45%	8.71	48%	52%
Bank (in trips/ 1000 sq.ft. GFA)	ITE (911)		4.07	57%	43%	33.15	50%	50%
Bank (in trips/ 1000 sq.ft. GFA)	ITE (912)		2.85	57%	43%	8.65	48%	52%
Retail Shopping Centre	ITE(820)		1.03	61%	39%	3.75	48%	52%
School (in trips/ 1000 sq.ft.GFA)	ITE(522)		4.69	54%	46%	1.55	54%	46%
Gymnasium (in trips/ 1000 sq.ft.GFA)	ITE(495)		1.62	61%	39%	1.64	29%	71%
Restaurant (trips/ seat)	ITE(931)		0.03	50%	50%	0.26	67%	33%
Office (in trips/ acre)	ITE(750)		25.65	92%	8%	28.28	15%	85%

Areas North of Wye Road

The Ridge - Zone 79

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to/from Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential	740 D.U.	12	408	106	302	448	291	157	100%	0%	40%	60%
Convenience Store (in trips/ 1000 sq.ft. GFA)	10,000 sq. ft.		62	31	31	69	34	35	40%	60%	80%	20%
New Trips Sub-Total			471	137	333	518	325	192				
Pass-by Trips Sub-Total			7	4	4	8	4	4				
Distribution New Trips: East				35%	35%		35%	40%				
West				75%	75%		65%	60%				
East				48	117		114	77				
West				103	250		211	115				
Distribution Pass-by Trips:				WB	EB		WB	EB				
				80%	20%		20%	80%				
				6	1		2	7				

Areas South of Wye Road

Sherwood Hills Estates (TIA) - Zone 265

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to/from Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential	122 D.U.		112	29	83	123	80	43	100%	0%	0%	100%
		Sub-Total	112	29	83	123	80	43				
Distribution:	East			20%	20%		35%	40%				
	West			80%	80%		65%	60%				
	East			6	17		28	17				
	West			23	66		52	26				

Wye Road South of Nottingham - Zone 262

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Residential (low density)	120 D.U.	12	110	29	82	121	79	42	100%	0%	0%	100%
School	40,000 sq. ft.		188	101	86	62	33	29	100%	0%	0%	100%
Gymnasium	10,000 sq. ft.		0	0	0	3	2	1	100%	0%	0%	100%
Skate Church	16,000 sq. ft.		0	0	0	4	3	1	100%	0%	0%	100%
New Trips Sub-total			298	130	168	190	117	73				
School Distribution:	North to Clover Bar			58%	22%		23%	32%				
	South - 231			17%	12%		12%	9%				
	East - Wye Rd.			17%	14%		18%	34%				
	West - Wye Rd.			8%	52%		47%	25%				
	North to Clover Bar			59	19		9	10				
	South - 231			17	10		5	3				
	East - Wye Rd.			17	12		7	11				
	West - Wye Rd.			8	45		18	8				
Distribution Residential:	East			20%	20%		35%	30%				
	West			60%	60%		45%	50%				
	North to Clover Bar			20%	20%		20%	20%				
	East			6	16		28	13				
	West			17	49		35	21				
	North to Clover Bar			6	16		16	8				

Rge Rd 232, S of Wye Road (26.7 acres) IMC TIA - Devco Properties Inc. (Zone 1 as per TIA by Schaffer Consultants Ltd.) East Part of Zone 71

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Retail Shopping Centre	150,000 sq. ft.		155	92	60	563	270	293	60%	40%	0%	100%
Residential											10%	90%
Total Area	10.6 ha											20%
New Trips Sub-total			93	55	36	338	162	176				
Pass-by Trips Sub-total			62	37	24	225	108	117				
		Sub-Total	155	92	60	563	270	293				

Distribution: New Trips	East Wye Rd.	15%	15%		20%	20%	
	North Brentwood Rd.	20%	20%		25%	25%	
	South Rge Rd 232	25%	25%		25%	25%	
	West Wye Rd.	40%	40%		30%	30%	
	East Wye Rd.	8	5		32	35	
	North Brentwood Rd.	11	7		41	44	
	South Rge Rd 232	14	9		41	44	
	West Wye Rd.	22	14		49	53	

Distribution Pass-by Trips:	WB	EB	NB	SB	WB	EB	NB	SB
	60%	20%	10%	10%	20%	60%	10%	10%
	37	12	6	6	45	135	23	23

South of Wye Road (Zone 2,3 & 4 as per TIA by Schaffer Consultants Ltd.) - Mid Part of Zone 71

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Big Box (ITE Land Use Code 815)	215,000 sq. ft.		181	123	58	1088	555	533	70%	30%	0%	100%
Residential	units		0	0	0	0	0	0	100%	0%	10%	90%
New Trips Sub-total			126	86	40	762	388	373				
Pass-by Trips Sub-total			54	37	17	326	166	160				

Distribution: New Trips	East Wye Rd.	100%	25%	25%	100%	25%	25%
	North Brentwood Rd.		30%	30%		25%	25%
	South Rge Rd 232		25%	25%		30%	30%
	West Wye Rd.		20%	20%		20%	20%
	East Wye Rd.		21	10		97	93
	North Brentwood Rd.		26	12		97	93
	South Rge Rd 232		21	10		117	112
	West Wye Rd.		17	8		78	75

Distribution Pass-by Trips:	WB	EB		WB	EB
	80%	20%		20%	80%
	43	11		65	261

Harbour Park, TIA by Bunt and Associates - West Part of Zone 71 - Intersections at Ash St, Ridgeway St., and Hawthorne St.

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	% of Trips to Wye Road
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
Retail Shopping Centre	91,000 sq. ft.		94	57	37	341	164	177	60%	40%	0%	100%
Speciality Store (in trips/ 1000 sq.ft. GFA)	37,000 sq. ft.		31	21	10	100	44	56	60%	40%	0%	100%
Fast Food (in trips/ 1000 sq.ft. GFA)	4,000 sq. ft.		186	95	91	121	63	58	50%	50%	0%	100%
Bank (in trips/ 1000 sq.ft. GFA)	6,000 sq. ft.		24	14	11	199	99	99	55%	45%	0%	100%
New Trips Sub-total			181	102	79	435	211	224				
Pass-by Trips Sub-total			154	85	69	327	159	167				
	137,000 sq. ft.					761						
Distribution: New Trips	East Wye Rd.			60%	60%		60%	60%				
	West Wye Rd.			40%	40%		40%	25%				
	East Wye Rd.			61	48		126	134				
	West Wye Rd.			41	32		84	56				
Distribution Pass-by Trips:				WB	EB		WB	EB				
				80%	20%		20%	80%				
				123	31		65	261				

Harbour Park, TIA by Bunt and Associates - West Part of Zone 71 - Intersections at Ash St, Ridgeway St., and Hawthorne St. (1600 medium density @0.83 trips/unit for pm peak)

Description	Number of Units	Trips Generated by Development							Trip Type (%)		% of Internal/to North Trips	Wye Road/Brentwood
		Weekday	AM Peak	In	Out	PM Peak	In	Out	New	Pass-by		
0	1600 units		1472	383	1089	1328	863	465	100%	0%	10%	90%
New Trips Sub-total			1325	344	980	1195	777	418				
Distribution: New Trips	West Through Commercial			25%	25%		25%	25%				
	Through Rge Rd 232			75%	75%		75%	75%				
	Through Commercial West			86	245		194	105				
	Through Rge Rd 232											
	Through Rge Rd 232 East		20%	69	196	20%	155	84				
	Through Rge Rd 232 South		30%	103	294	30%	233	125				
	Through Rge Rd 232 Brentwo		25%	86	245	25%	194	105				
				344	980		777	418	1195			

Existing PM Peak Traffic 2006								
Highway 21								
PM Peak								
				375		935		
			Right	Through	Left			
			29	303	43	94	Right	
570						351	Through	595
						150	Left	
	Left	126						
515	Through	308						521
	Right	81						
				190	715	170		
				Left	Through	Right		
			534		1075			
RIDGEMONT WAY								
PM Peak								
				534		1075		
			Right	Through	Left			
			59	474	1	1	Right	
215						0	Through	2
						1	Left	
	Left	36						
168	Through	0						12
	Right	132						
				156	1038	11		
				Left	Through	Right		
			607		1205			
CLOVER BAR ROAD								
PM Peak								
				607		1205		
			Right	Through	Left			
			93	421	93	48	Right	
921						312	Through	432
						72	Left	
	Left	245						
704	Through	197						412
	Right	262						
				516	912	122		
				Left	Through	Right		
			755		1550			
NOTTINGHAM WAY								
PM Peak								
		130		625		1641		91
			Right	Through	Left			
			27	598	0	5	Right	
266			0			0	Through	15
						10	Left	
	Left	20						
138	Through	0						0
	Right	118						
				239	1616	0		
				Left	Through	Right		
			726		1855			
BRENTWOOD BLVD								
PM Peak		45					35	
				681		1890		
			Right	Through	Left			
			149	499	33	55	Right	
667						207	Through	356
						94	Left	
	Left	264						
507	Through	149						267
	Right	94						
				311	1571	85		
				Left	Through	Right		
			687		2222			

Wye Road - Sherwood Park/Strathcona County
East of Highway 216 to Highway 21
Functional Planning Study
Future Peak Hour Traffic Estimate - PM Peak Existing 2006 Traffic

NEW ACCESS TO ZONE 71								
PM Peak								
				687		2222		
			Right	Through	Left			
			0	687	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	2222	0		
				Left	Through	Right		
			687		2222			
HAWTHORNE STREET								
PM Peak								
				687		2222		
			Right	Through	Left			
			15	671	1	0	Right	
105						0	Through	2
						2	Left	
	Left	2						
67	Through	0						3
	Right	65						
				90	2220	2		
				Left	Through	Right		
			738		2312			
ASH STREET								
PM Peak								
				738		2312		
			Right	Through	Left			
			75	531	132	101	Right	
156						3	Through	105
						1	Left	
	Left	220						
269	Through	0						132
	Right	49						
				78	1991	0		
				Left	Through	Right		
			581		2069			
SHERWOOD DRIVE								
PM Peak							126	
				581		1943		
			Right	Through	Left			
			155	280	146	139	Right	
1474						429	Through	668
						100	Left	
	Left	398						
940	Through	315						590
	Right	227						
				890	1406	129		
				Left	Through	Right		
			607		2425			
ORDZE ROAD								
PM Peak								27
		179		786		2452		
			Right	Through	Left			
			81	634	71	140	Right	
410						74	Through	358
						144	Left	
	Left	174						
370	Through	54						276
	Right	142						
				255	2138	151		
				Left	Through	Right		
			920		2544			

The Ridge Development								
Highway 21								
PM Peak								
				6		4		
			Right	Through	Left			
			0	6	0	0	Right	
46						0	Through	40
						40	Left	
	Left	0						
68	Through	0						27
	Right	68						
				46	4	27		
				Left	Through	Right		
			114		77			
RIDGEMONT WAY								
PM Peak								
				114		77		
			Right	Through	Left			
			114	0	0	0	Right	
151						0	Through	0
						0	Left	
	Left	77						
192	Through	0						0
	Right	115						
				211	0	0		
				Left	Through	Right		
			115		211			
CLOVER BAR ROAD								
PM Peak								
				115		211		
			Right	Through	Left			
			12	104	0	0	Right	
12						0	Through	0
						0	Left	
	Left	21						
21	Through	0						0
	Right	0						
				0	190	0		
				Left	Through	Right		
			104		190			
NOTTINGHAM WAY								
PM Peak								
				104		190		
			Right	Through	Left			
			0	104	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	190	0		
				Left	Through	Right		
			104		190			
BRENTWOOD BLVD								
PM Peak								
				104		190		
			Right	Through	Left			
			23	69	12	21	Right	
23						0	Through	21
						0	Left	
	Left	42						
42	Through	0						12
	Right	0						
				0	127	0		
				Left	Through	Right		
			69		127			

NEW ACCESS TO ZONE 71								
PM Peak								
				69		127		
			Right	Through	Left			
			0	69	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	127	0		
				Left	Through	Right		
			69		127			
HAWTHORNE STREET								
PM Peak								
				69		127		
			Right	Through	Left			
			0	69	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	127	0		
				Left	Through	Right		
			69		127			
ASH STREET								
PM Peak								
				69		127		
			Right	Through	Left			
			0	69	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	127	0		
				Left	Through	Right		
			69		127			
SHERWOOD DRIVE								
PM Peak								
				69		127		
			Right	Through	Left			
			12	46	12	21	Right	
12						0	Through	21
						0	Left	
	Left	21						
21	Through	0						12
	Right	0						
				0	85	0		
				Left	Through	Right		
			46		85			
ORDZE ROAD								
PM Peak								
				46				
			Right	Through	Left			
			0	46	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	85	0		
				Left	Through	Right		
			46		85			

SHERWOOD HILLS								
Highway 21								
PM Peak								
				1		1		
			Right	Through	Left			
			0	1	0	0	Right	
12						0	Through	10
						10	Left	
	Left	0						
17	Through	0						7
	Right	17						
				12	1	7		
				Left	Through	Right		
			28		20			
RIDGEMONT WAY								
PM Peak								
				28		20		
			Right	Through	Left			
			0	0	28	17	Right	
0						0	Through	43
						26	Left	
	Left	0						
0	Through	0						66
	Right	0						
				0	3	52		
				Left	Through	Right		
			26		52			
CLOVER BAR ROAD								
PM Peak								
				26		52		
			Right	Through	Left			
			3	23	0	0	Right	
3						0	Through	0
						0	Left	
	Left	5						
5	Through	0						0
	Right	0						
				0	47	0		
				Left	Through	Right		
			23		47			
NOTTINGHAM WAY								
PM Peak								
				23		47		
			Right	Through	Left			
			0	23	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	47	0		
				Left	Through	Right		
			23		47			
BRENTWOOD BLVD								
PM Peak								
				23		47		
			Right	Through	Left			
			5	16	3	5	Right	
5						0	Through	5
						0	Left	
	Left	10						
10	Through	0						3
	Right	0						
				0	31	0		
				Left	Through	Right		
			16		31			

NEW ACCESS TO ZONE 71								
PM Peak								
				16		31		
			Right	Through	Left			
			0	16	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	31	0		
				Left	Through	Right		
			16		31			
HAWTHORNE STREET								
PM Peak								
				16		31		
			Right	Through	Left			
			0	16	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	31	0		
				Left	Through	Right		
			16		31			
ASH STREET								
PM Peak								
				16		31		
			Right	Through	Left			
			0	16	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	31	0		
				Left	Through	Right		
			16		31			
SHERWOOD DRIVE								
PM Peak								
				16		31		
			Right	Through	Left			
			3	10	3	5	Right	
3						0	Through	5
						0	Left	
	Left	5						
5	Through	0						3
	Right	0						
				0	21	0		
				Left	Through	Right		
			10		21			
ORDZE ROAD								
PM Peak								
				10		21		
			Right	Through	Left			
			0	10	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	21	0		
				Left	Through	Right		
			10		21			

SCHOOL AT CLOVER BAR ROAD								
Highway 21								
PM Peak								
				0		1		
			Right	Through	Left			
			0	0		0	Right	
7						0	Through	0
						0	Left	
	Left							
0	Through	0						4
	Right	0						
				7	1	4		
				Left	Through	Right		
			0		11			
RIDGEMONT WAY								
PM Peak								
				0		11		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			0		11			
CLOVER BAR ROAD								
PM Peak								
				0		11		
			Right	Through	Left			
			0	0	7	11	Right	
10						10	Through	28
						8	Left	
	Left	0						
9	Through	9						34
	Right	0						
				0	0	18		
				Left	Through	Right		
			8		18			
NOTTINGHAM WAY								
PM Peak								
				8		18		
			Right	Through	Left			
			1	7	0	0	Right	
1						0	Through	0
						0	Left	
	Left	2						
2	Through	0						0
	Right	0						
				0	16	0		
				Left	Through	Right		
			7		16			
BRENTWOOD BLVD								
PM Peak								
				7		16		
			Right	Through	Left			
			2	5	1	2	Right	
2						0	Through	2
						0	Left	
	Left	4						
4	Through	0						1
	Right	0						
				0	11	0		
				Left	Through	Right		
			5		11			

NEW ACCESS TO ZONE 71								
PM Peak								
				5		11		
			Right	Through	Left			
			0	5	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			5		11			
HAWTHORNE STREET								
PM Peak								
				5		11		
			Right	Through	Left			
			0	5	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			5		11			
ASH STREET								
PM Peak								
				5		11		
			Right	Through	Left			
			0	5	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			5		11			
SHERWOOD DRIVE								
PM Peak								
				5		11		
			Right	Through	Left			
			1	2	1	3	Right	
1						0	Through	3
						0	Left	
	Left	3						
3	Through	0						1
	Right	0						
				0	5	0		
				Left	Through	Right		
			2		5			
ORDZE ROAD								
PM Peak								
				2		0		
			Right	Through	Left			
			0	2	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	5	0		
				Left	Through	Right		
			2		5			

RESIDENTIAL SOUTH OF NOTTINGHAM								
Highway 21								
PM Peak								
				1		1		
			Right	Through	Left			
			0	1	0	0	Right	
8						0	Through	10
						10	Left	
	Left	0						
17	Through	0						4
	Right	17						
				8	1	4		
				Left	Through	Right		
			28		13			
RIDGEMONT WAY								
PM Peak								
				28		13		
			Right	Through	Left			
			0	28	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	13	0		
				Left	Through	Right		
			28		13			
CLOVER BAR ROAD								
PM Peak								
				28		13		
			Right	Through	Left			
			0	28	0	0	Right	
17						8	Through	8
						0	Left	
	Left	0						
9	Through	9						9
	Right	0						
				8	13	0		
				Left	Through	Right		
			28		21			
NOTTINGHAM WAY								
PM Peak								
				28		21		
			Right	Through	Left			
			0	0	28	21	Right	
0						0	Through	42
						21	Left	
	Left	0						
0	Through	0						63
	Right	0						
				0	0	35		
				Left	Through	Right		
			21		33			
BRENTWOOD BLVD								
PM Peak								
				21		33		
			Right	Through	Left			
			4	13	4	3	Right	
4						0	Through	3
						0	Left	
	Left	7						
7	Through	0						4
	Right	0						
				0	23	0		
				Left	Through	Right		
			13		23			

NEW ACCESS TO ZONE 71								
PM Peak								
				13		23		
			Right	Through	Left			
			0	13	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	23	0		
				Left	Through	Right		
			13		23			
HAWTHORNE STREET								
PM Peak								
				13		23		
			Right	Through	Left			
			0	13	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	23	0		
				Left	Through	Right		
			13		23			
ASH STREET								
PM Peak								
				13		23		
			Right	Through	Left			
			0	13	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	23	0		
				Left	Through	Right		
			13		23			
SHERWOOD DRIVE								
PM Peak								
				13		23		
			Right	Through	Left			
			3	7	3	5	Right	
3						0	Through	5
						0	Left	
	Left	5						
5	Through	0						3
	Right	0						
				0	12	0		
				Left	Through	Right		
			7		12			
ORDZE ROAD								
PM Peak								
				7		0		
			Right	Through	Left			
			0	7	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	12	0		
				Left	Through	Right		
			7		12			

Commercial Development - Shopping Centre 150,000 sq. ft.								
Highway 21								
PM Peak								
				2		4		
			Right	Through	Left			
			0	2	0	0	Right	
7						0	Through	3
						3	Left	
	Left	0						
6	Through	0						4
	Right	6						
				7	4	4		
				Left	Through	Right		
			11		14			
RIDGEMONT WAY								
PM Peak								
				11		14		
			Right	Through	Left			
			0	11	0	0	Right	
0						0	Through	2
						2	Left	
	Left	0						
3	Through	0						0
	Right	3						
				2	14	2		
				Left	Through	Right		
			16		18			
CLOVER BAR ROAD								
PM Peak								
				16		18		
			Right	Through	Left			
			0	16	0	0	Right	
7						0	Through	5
						5	Left	
	Left	0						
6	Through	0						5
	Right	6						
				7	18	5		
				Left	Through	Right		
			28		30			
NOTTINGHAM WAY								
PM Peak								
				28		30		
			Right	Through	Left			
			0	28	0	0	Right	
4						0	Through	2
						2	Left	
	Left	0						
3	Through	0						2
	Right	3						
				4	30	2		
				Left	Through	Right		
			32		35			
BRENTWOOD BLVD								
PM Peak								
				32		35		
			Right	Through	Left			
			0	23	10	18	Right	
44						22	Through	50
						11	Left	
	Left	0						
41	Through	20						45
	Right	20						
				22	18	15		
				Left	Through	Right		
			53		54			

NEW ACCESS TO ZONE 71								
PM Peak								
				53		54		
			Right	Through	Left			
			0	11	43	39	Right	
0						0	Through	51
						12	Left	
	Left	0						
0	Through	0						77
	Right	0						
				0	15	34		
				Left	Through	Right		
			22		49			
HAWTHORNE STREET								
PM Peak								
				22		49		
			Right	Through	Left			
			11	12	0	0	Right	
11						0	Through	0
						0	Left	
	Left	10						
10	Through	0						0
	Right	0						
				0	39	0		
				Left	Through	Right		
			12		39			
ASH STREET								
PM Peak								
				12		39		
			Right	Through	Left			
			11	1	0	0	Right	
11						0	Through	0
						0	Left	
	Left	5						
5	Through	0						0
	Right	0						
				0	34	0		
				Left	Through	Right		
			1		34			
SHERWOOD DRIVE								
PM Peak								
				1		34		
			Right	Through	Left			
			5	-15	11	10	Right	
5						0	Through	10
						0	Left	
	Left	10						
10	Through	0						11
	Right	0						
				0	15	0		
				Left	Through	Right		
			-15		15			
ORDZE ROAD								
PM Peak								
				-15		15		
			Right	Through	Left			
			0	-15	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	15	0		
				Left	Through	Right		
			-15		15			

Commercial Big Box 215,000 sq.ft.								
Highway 21								
PM Peak								
				5		5		
			Right	Through	Left			
			0	5	0	0	Right	
14						0	Through	10
						10	Left	
	Left	0						
15	Through	0						9
	Right	15						
				14	5	9		
				Left	Through	Right		
			29		28			
RIDGEMONT WAY								
PM Peak								
				29		28		
			Right	Through	Left			
			0	29	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
10	Through	0						0
	Right	10						
				9	28	0		
				Left	Through	Right		
			39		37			
CLOVER BAR ROAD								
PM Peak								
				39		37		
			Right	Through	Left			
			0	39	0	0	Right	
23						0	Through	19
						19	Left	
	Left	0						
24	Through	0						19
	Right	24						
				23	37	19		
				Left	Through	Right		
			83		79			
NOTTINGHAM WAY								
PM Peak								
				83		79		
			Right	Through	Left			
			0	83	0	0	Right	
9						0	Through	5
						5	Left	
	Left	0						
10	Through	0						5
	Right	10						
				9	79	5		
				Left	Through	Right		
			97		93			
BRENTWOOD BLVD								
PM Peak								
				97		93		
			Right	Through	Left			
			0	78	19	37	Right	
93						37	Through	86
						11	Left	
	Left	0						
97	Through	39						66
	Right	58						
				56	56	8		
				Left	Through	Right		
			147		120			

NEW ACCESS TO ZONE 71								
PM Peak								
				147		120		
			Right	Through	Left			
			0	50	97	84	Right	
0						0	Through	106
						22	Left	
	Left	0						
0	Through	0						128
	Right	0						
				0	36	31		
				Left	Through	Right		
			72		67			
HAWTHORNE STREET								
PM Peak								
				72		67		
			Right	Through	Left			
			0	34	39	28	Right	
7						7	Through	62
						26	Left	
	Left	0						
8	Through	8						70
	Right	0						
				0	39	23		
				Left	Through	Right		
			60		62			
ASH STREET								
PM Peak								
				60		14		
			Right	Through	Left			
			7	52	0	0	Right	
15						7	Through	7
						0	Left	
	Left	0						
8	Through	8						8
	Right	0						
				0	62	0		
				Left	Through	Right		
			52		62			
SHERWOOD DRIVE								
PM Peak								
				52		62		
			Right	Through	Left			
			22	15	15	16	Right	
22						0	Through	16
						0	Left	
	Left	23						
23	Through	0						15
	Right	0						
				0	23	0		
				Left	Through	Right		
			15		23			
ORDZE ROAD								
PM Peak								
				15		0		
			Right	Through	Left			
			0	15	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	23	0		
				Left	Through	Right		
			15		23			

Harbor Park								
Highway 21								
PM Peak								
						39		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
	Through	0						0
	Right	0						
				0	39	0		
				Left	Through	Right		
			0		39			
RIDGEMONT WAY								
PM Peak								
				0		39		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	6
						6	Left	
	Left	0						
13	Through	0						0
	Right	13						
				5	39	2		
				Left	Through	Right		
			19		46			
CLOVER BAR ROAD								
PM Peak								
				19		46		
			Right	Through	Left			
			0	19	0	0	Right	
10						0	Through	13
						13	Left	
	Left	0						
25	Through	0						5
	Right	25						
				10	46	5		
				Left	Through	Right		
			57		61			
NOTTINGHAM WAY								
PM Peak								
				57		61		
			Right	Through	Left			
			0	57	0	0	Right	
5						0	Through	6
						6	Left	
	Left	0						
13	Through	0						2
	Right	13						
				5	61	2		
				Left	Through	Right		
			76		68			
BRENTWOOD BLVD								
PM Peak								
				76		68		
			Right	Through	Left			
			0	76	0	13	Right	
27						0	Through	22
						8	Left	
	Left	0						
0	Through	0						27
	Right	25						
				27	54	27		
				Left	Through	Right		
			110		108			

NEW ACCESS TO ZONE 71								
PM Peak								
				110		108		
			Right	Through	Left			
			0	99	11	19	Right	
0						0	Through	32
						13	Left	
	Left	0						
0	Through	0						31
	Right	0						
				0	89	20		
				Left	Through	Right		
			111		109			
HAWTHORNE STREET								
PM Peak								
				111		109		
			Right	Through	Left			
			0	57	55	54	Right	
6						6	Through	82
						22	Left	
	Left	0						
0	Through	0						80
	Right	0						
				0	56	25		
				Left	Through	Right		
			79		81			
ASH STREET								
PM Peak								
				79		0		
			Right	Through	Left			
			0	35	44	13	Right	
0						0	Through	13
						0	Left	
	Left	0						
8	Through	8						52
	Right	0						
				0	67	0		
				Left	Through	Right		
			35		67			
SHERWOOD DRIVE								
PM Peak								
				35		67		
			Right	Through	Left			
			0	35	0	25	Right	
0						0	Through	25
						0	Left	
	Left	21						
21	Through	0						0
	Right	0						
				0	21	0		
				Left	Through	Right		
			35		21			
ORDZE ROAD								
PM Peak								
				35		0		
			Right	Through	Left			
			0	35	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	21	0		
				Left	Through	Right		
			35		21			

Total New Traffic								
Highway 21								
PM Peak								
				23		66		
			Right	Through	Left			
			0	23	0	0	Right	
110						0	Through	88
						88	Left	
	Left	0						
	Through	0						63
	Right	154						
				110	66	63		
				Left	Through	Right		
			264		239			
RIDGEMONT WAY								
PM Peak								
				264		237		
			Right	Through	Left			
			114	122	28	17	Right	
0						0	Through	59
						42	Left	
	Left	77						
233	Through	0						0
	Right	156						
				232	142	60		
				Left	Through	Right		
			320		434			
CLOVER BAR ROAD								
PM Peak								
				320		434		
			Right	Through	Left			
			14	299	7	11	Right	
98						18	Through	97
						68	Left	
	Left	26						
131	Through	17						84
	Right	87						
				65	397	59		
				Left	Through	Right		
			454		521			
NOTTINGHAM WAY								
PM Peak								
				461		519		
			Right	Through	Left			
			1	433	28	21	Right	
27						0	Through	55
						34	Left	
	Left	2						
43	Through	0						72
	Right	41						
				26	496	44		
				Left	Through	Right		
			508		566			
BRENTWOOD BLVD								
PM Peak								
				508		566		
			Right	Through	Left			
			34	279	195	183	Right	
303						164	Through	377
						30	Left	
	Left	63						
0	Through	253						498
	Right	104						
				105	320	49		
				Left	Through	Right		
			413		474			

NEW ACCESS TO ZONE 71								
PM Peak								
				413		474		
			Right	Through	Left			
			0	262	151	142	Right	
0						0	Through	220
						78	Left	
	Left	0						
0	Through	0						318
	Right	0						
				0	331	167		
				Left	Through	Right		
			340		498			
HAWTHORNE STREET								
PM Peak								
				340		498		
			Right	Through	Left			
			11	236	94	82	Right	
24			0			13	Through	185
			0			90	Left	
	Left	10						
56	Through	47						216
	Right	0						
				0	407	76		
				Left	Through	Right		
			326		483			
ASH STREET								
PM Peak								
				326		483		
			Right	Through	Left			
			18	264	44	13	Right	
25						7	Through	21
						0	Left	
	Left	5						
40	Through	36						107
	Right	0						
				0	464	27		
				Left	Through	Right		
			264		491			
SHERWOOD DRIVE								
PM Peak								
				264		491		
			Right	Through	Left			
			46	174	44	124	Right	
46						0	Through	124
						0	Left	
	Left	127						
127	Through	0						44
	Right	0						
				0	240	0		
				Left	Through	Right		
			174		240			
ORDZE ROAD								
PM Peak								
				174		0		
			Right	Through	Left			
			0	174	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	240	0		
				Left	Through	Right		
			174		240			

Residential 1080 Units								
Highway 21								
PM Peak								
				8		13		
			Right	Through	Left			
			0	8	0	0	Right	
17						0	Through	16
						16	Left	
	Left	0						
31	Through	0						8
	Right	31						
				17	13	8		
				Left	Through	Right		
			54		38			
RIDGEMONT WAY								
PM Peak								
				54		38		
			Right	Through	Left			
			0	54	0	0	Right	
0						0	Through	8
						8	Left	
	Left	0						
16	Through	0						0
	Right	16						
				4	38	4		
				Left	Through	Right		
			78		46			
CLOVER BAR ROAD								
PM Peak								
				78		46		
			Right	Through	Left			
			0	78	0	0	Right	
17						0	Through	23
						23	Left	
	Left	0						
31	Through	0						13
	Right	31						
				17	46	13		
				Left	Through	Right		
			132		75			
NOTTINGHAM WAY								
PM Peak								
				132		75		
			Right	Through	Left			
			0	132	0	0	Right	
8						0	Through	0
						0	Left	
	Left	0						
16	Through	0						0
	Right	16						
				8	75	0		
				Left	Through	Right		
			148		84			
BRENTWOOD BLVD								
PM Peak								
				148		84		
			Right	Through	Left			
			0	0	148	84	Right	
105						105	Through	188
						0	Left	
	Left	0						
194	Through	194						342
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			

NEW ACCESS TO ZONE 71								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	31
						31	Left	
	Left	0						
0	Through	0						82
	Right	0						
				0	0	82		
				Left	Through	Right		
			31		82			
HAWTHORNE STREET								
PM Peak								
				31		82		
			Right	Through	Left			
			0	31	0	0	Right	
0						0	Through	42
						42	Left	
	Left	0						
39	Through	39						66
	Right	0						
				0	82	27		
				Left	Through	Right		
			73		109			
ASH STREET								
PM Peak								
				73		109		
			Right	Through	Left			
			0	73	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
19	Through	19						47
	Right	0						
				0	109	27		
				Left	Through	Right		
			73		136			
SHERWOOD DRIVE								
PM Peak								
				73		136		
			Right	Through	Left			
			0	73	0	39	Right	
0						0	Through	39
						0	Left	
	Left	39						
39	Through	0						0
	Right	0						
				0	58	0		
				Left	Through	Right		
			73		58			
ORDZE ROAD								
PM Peak								
				73		58		
			Right	Through	Left			
			0	73	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	58	0		
				Left	Through	Right		
			73		58			

The Ridge Commercial								
Highway 21								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0		0	Right	
0						0	Through	0
						0	Left	
	Left							
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
RIDGEMONT WAY								
PM Peak								
				0		0		
			Right	Through	Left			
			1	-1	0	0	Right	
4						0	Through	0
						0	Left	
	Left	3						
4	Through	0						0
	Right	1						
				3	-3	0		
				Left	Through	Right		
			0		0			
CLOVER BAR ROAD								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
NOTTINGHAM WAY								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
BRENTWOOD BLVD								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			

NEW ACCESS TO ZONE 71								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
HAWTHORNE STREET								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
ASH STREET								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
SHERWOOD DRIVE								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			
ORDZE ROAD								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		0			

Commercial Development - Shopping Centre 150,000 sq. ft.								
Highway 21								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		10			
RIDGEMONT WAY								
PM Peak								
				0		10		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	10	0		
				Left	Through	Right		
			0		10			
CLOVER BAR ROAD								
PM Peak								
				0		10		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	10	0		
				Left	Through	Right		
			0		10			
NOTTINGHAM WAY								
PM Peak								
				0		10		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	10	0		
				Left	Through	Right		
			0		10			
BRENTWOOD BLVD								
PM Peak								
				0		10		
			Right	Through	Left			
			0	-4	4	0	Right	
0						0	Through	2
						2	Left	
	Left	0						
0	Through	0						4
	Right	0						
				0	10	0		
				Left	Through	Right		
			-2		10			

Wye Road - Sherwood Park/Strathcona County
East of Highway 216 to Highway 21
Year 2015 PM Peak Hour Traffic Estimate - New Developments Total Pass-by Trips

NEW ACCESS TO ZONE 71								
PM Peak								
				-2		10		
			Right	Through	Left			
			0	-13	11	28	Right	
0						0	Through	35
						7	Left	
	Left	0						
0	Through	0						50
	Right	0						
				0	-18	39		
				Left	Through	Right		
			-6		21			
HAWTHORNE STREET								
PM Peak								
				-6		21		
			Right	Through	Left			
			0	-12	6	35	Right	
0						0	Through	49
						14	Left	
	Left	4						
4	Through	0						26
	Right	0						
				0	-19	19		
				Left	Through	Right		
			2		1			
ASH STREET								
PM Peak								
				2		1		
			Right	Through	Left			
			0	2	0	7	Right	
0						0	Through	7
						0	Left	
	Left	0						
0	Through	0						6
	Right	0						
				0	-6	6		
				Left	Through	Right		
			2		0			
SHERWOOD DRIVE								
PM Peak								
				2		0		
			Right	Through	Left			
			0	2	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			
ORDZE ROAD								
PM Peak								
				2		0		
			Right	Through	Left			
			0	2	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			

Commercial Big Box 215,000 sq.ft.								
Highway 21								
PM Peak								
				0		0		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			0		-5			
RIDGEMONT WAY								
PM Peak								
				0		-5		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	-5	0		
				Left	Through	Right		
			0		-5			
CLOVER BAR ROAD								
PM Peak								
				0		-5		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	-5	0		
				Left	Through	Right		
			0		-5			
NOTTINGHAM WAY								
PM Peak								
				0		-5		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	-5	0		
				Left	Through	Right		
			0		-5			
BRENTWOOD BLVD								
PM Peak								
				0		-5		
			Right	Through	Left			
			0	-7	7	26	Right	
0						0	Through	27
						2	Left	
	Left	0						
26	Through	0						7
	Right	0						
				0	-31	0		
				Left	Through	Right		
			-5		-31			

NEW ACCESS TO ZONE 71								
PM Peak								
				-5		-31		
			Right	Through	Left			
			0	-28	23	38	Right	
0						0	Through	45
						6	Left	
	Left	0						
0	Through	0						77
	Right	0						
				0	-69	53		
				Left	Through	Right		
			-22		-16			
HAWTHORNE STREET								
PM Peak								
				-22		-16		
			Right	Through	Left			
			0	-25	3	51	Right	
0						0	Through	62
						11	Left	
	Left	0						
0	Through	0						57
	Right	0						
				0	-67	53		
				Left	Through	Right		
			-14		-14			
ASH STREET								
PM Peak								
				-14		14		
			Right	Through	Left			
			0	-14	0	13	Right	
0						0	Through	26
						13	Left	
	Left	0						
0	Through	0						27
	Right	0						
				0	-27	27		
				Left	Through	Right		
			-1		0			
SHERWOOD DRIVE								
PM Peak								
				-1		0		
			Right	Through	Left			
			0	-1	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			-1		0			
ORDZE ROAD								
PM Peak								
				-1		0		
			Right	Through	Left			
			0	-1	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			-1		0			

Harbor Park								
Highway 21								
PM Peak								
				0		83		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	83	0		
				Left	Through	Right		
			0		83			
RIDGEMONT WAY								
PM Peak								
				0		83		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	83	0		
				Left	Through	Right		
			0		83			
CLOVER BAR ROAD								
PM Peak								
				0		83		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	83	0		
				Left	Through	Right		
			0		83			
NOTTINGHAM WAY								
PM Peak								
				0		83		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	83	0		
				Left	Through	Right		
			0		83			
BRENTWOOD BLVD								
PM Peak								
				0		83		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	83	0		
				Left	Through	Right		
			0		83			

NEW ACCESS TO ZONE 71								
PM Peak								
				0		83		
			Right	Through	Left			
			0	-3	3	27	Right	
0						0	Through	27
						0	Left	
	Left	0						
0	Through	0						3
	Right	0						
				0	56	0		
				Left	Through	Right		
			-3		56			
HAWTHORNE STREET								
PM Peak								
				-3		56		
			Right	Through	Left			
			0	-25	22	53	Right	
0						0	Through	57
						3	Left	
	Left	0						
0	Through	0						73
	Right	0						
				0	3	51		
				Left	Through	Right		
			-22		53			
ASH STREET								
PM Peak								
				-22		0		
			Right	Through	Left			
			0	-29	6	40	Right	
0						0	Through	64
						23	Left	
	Left	0						
0	Through	0						83
	Right	0						
				0	13	76		
				Left	Through	Right		
			-5		13			
SHERWOOD DRIVE								
PM Peak								
				-5		13		
			Right	Through	Left			
			0	-5	0	13	Right	
0						0	Through	20
						7	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			
ORDZE ROAD								
PM Peak								
				2		0		
			Right	Through	Left			
			0	2	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			

Pass-by Total Traffic								
Highway 21								
PM Peak								
				0		11		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			0		11			
RIDGEMONT WAY								
PM Peak								
				0		11		
			Right	Through	Left			
			1	-1	0	0	Right	
4						0	Through	0
						0	Left	
	Left	3						
4	Through	0						0
	Right	1						
				3	8	0		
				Left	Through	Right		
			0		11			
CLOVER BAR ROAD								
PM Peak								
				0		11		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			0		11			
NOTTINGHAM WAY								
PM Peak								
				0		11		
			Right	Through	Left			
			0	0	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	11	0		
				Left	Through	Right		
			0		11			
BRENTWOOD BLVD								
PM Peak								
				0		11		
			Right	Through	Left			
			0	-11	11	26	Right	
0						0	Through	30
						4	Left	
	Left	0						
26	Through	0						11
	Right	0						
				0	-15	0		
				Left	Through	Right		
			-7		-15			

NEW ACCESS TO ZONE 71								
PM Peak								
				-7		-15		
			Right	Through	Left			
			0	-44	37	93	Right	
0						0	Through	107
						13	Left	
	Left	0						
0	Through	0						129
	Right	0						
				0	-108	92		
				Left	Through	Right		
			-31		-16			
HAWTHORNE STREET								
PM Peak								
				-31		-16		
			Right	Through	Left			
			0	-63	32	140	Right	
0						0	Through	168
						29	Left	
	Left	4						
4	Through	0						156
	Right	0						
				0	-160	124		
				Left	Through	Right		
			-34		-36			
ASH STREET								
PM Peak								
				-34		-36		
			Right	Through	Left			
			0	-41	6	60	Right	
0						0	Through	96
						36	Left	
	Left	0						
0	Through	0						116
	Right	0						
				0	-96	110		
				Left	Through	Right		
			-5		13			
SHERWOOD DRIVE								
PM Peak								
				-5		13		
			Right	Through	Left			
			0	-5	0	13	Right	
0						0	Through	20
						7	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			
ORDZE ROAD								
PM Peak								
				2		0		
			Right	Through	Left			
			0	2	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	0	0		
				Left	Through	Right		
			2		0			

New Development Traffic including Pass-by Trips

Highway 21

PM Peak								
				23		72		
			Right	Through	Left			
			0	23	0	0	Right	
110						0	Through	88
						88	Left	
	Left	0						
154	Through	0						63
	Right	154						
				110	72	63		
				Left	Through	Right		
			264		245			

RIDGEMONT WAY

PM Peak								
				264		245		
			Right	Through	Left			
			115	122	28	17	Right	
350						0	Through	59
						42	Left	
	Left	80						
238	Through	0						88
	Right	157						
				235	148	60		
				Left	Through	Right		
			320		443			

CLOVER BAR ROAD

PM Peak								
				320		443		
			Right	Through	Left			
			14	299	7	11	Right	
98						18	Through	97
						68	Left	
	Left	26						
131	Through	17						84
	Right	87						
				65	406	59		
				Left	Through	Right		
			454		530			

NOTTINGHAM WAY

PM Peak								
				461		530		
			Right	Through	Left			
			1	433	28	21	Right	
27						0	Through	55
						34	Left	
	Left	2						
43	Through	0						72
	Right	41						
				26	507	44		
				Left	Through	Right		
			508		577			

BRENTWOOD BLVD

PM Peak								
				508		577		
			Right	Through	Left			
			34	268	206	209	Right	
303						164	Through	407
						34	Left	
	Left	63						
420	Through	253						509
	Right	104						
				105	305	49		
				Left	Through	Right		
			406		459			

Wye Road - Sherwood Park/Strathcona County
East of Highway 216 to Highway 21
Functional Planning Study
Year 2015 PM Peak Hour Traffic Estimate - Total New Development Traffic

NEW ACCESS TO ZONE 71								
PM Peak								
				406		459		
			Right	Through	Left			
			0	218	188	236	Right	
0						0	Through	327
						91	Left	
	Left	0						
0	Through	0						447
	Right	0						
				0	223	259		
				Left	Through	Right		
			309		482			
HAWTHORNE STREET								
PM Peak								
				309		482		
			Right	Through	Left			
			11	173	126	221	Right	
24						13	Through	353
						119	Left	
	Left	14						
61	Through	47						372
	Right	0						
				0	247	199		
				Left	Through	Right		
			292		446			
ASH STREET								
PM Peak								
				292		446		
			Right	Through	Left			
			18	223	50	73	Right	
25						7	Through	117
						36	Left	
	Left	5						
40	Through	36						223
	Right	0						
				0	368	137		
				Left	Through	Right		
			260		505			
SHERWOOD DRIVE								
PM Peak								
				260		505		
			Right	Through	Left			
			46	170	44	137	Right	
46						0	Through	144
						7	Left	
	Left	127						
127	Through	0						44
	Right	0						
				0	240	0		
				Left	Through	Right		
			176		240			
ORDZE ROAD								
PM Peak								
				176		240		
			Right	Through	Left			
			0	176	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	240	0		
				Left	Through	Right		
			176		240			

Background Traffic Growth								
Highway 21								
PM Peak								
				243		331		
			Right	Through	Left			
			27	31	185	219	Right	
501						344	Through	563
						0	Left	
	Left	49						
563	Through	453						665
	Right	61						
				130	63	27		
				Left	Through	Right		
			92		220			
RIDGEMONT WAY								
PM Peak								
				92		220		
			Right	Through	Left			
			0	92	0	1	Right	
6						6	Through	7
						0	Left	
	Left	0						
6	Through	6						6
	Right	0						
				0	219	0		
				Left	Through	Right		
			92		219			
CLOVER BAR ROAD								
PM Peak								
				92		219		
			Right	Through	Left			
			0	82	10	32	Right	
291						161	Through	199
						6	Left	
	Left	0						
79	Through	79						89
	Right	0						
				130	187	0		
				Left	Through	Right		
			88		317			
NOTTINGHAM WAY								
PM Peak								
				88		317		
			Right	Through	Left			
			8	80	0	1	Right	
42						0	Through	11
						10	Left	
	Left	0						
5	Through	0						1
	Right	5						
				34	316	1		
				Left	Through	Right		
			95		351			
BRENTWOOD BLVD								
PM Peak								
				95		351		
			Right	Through	Left			
			15	30	50	15	Right	
270						240	Through	283
						28	Left	
	Left	0						
154	Through	150						215
	Right	4						
				15	336	15		
				Left	Through	Right		
			62		366			

NEW ACCESS TO ZONE 71								
PM Peak								
				62		366		
			Right	Through	Left			
			0	62	0	0	Right	
0						0	Through	0
						0	Left	
	Left	0						
0	Through	0						0
	Right	0						
				0	366	0		
				Left	Through	Right		
			62		366			
HAWTHORNE STREET								
PM Peak								
				62		366		
			Right	Through	Left			
			15	47	0	0	Right	
15						0	Through	0
						0	Left	
	Left	2						
17	Through	0						0
	Right	15						
				0	364	0		
				Left	Through	Right		
			62		364			
ASH STREET								
PM Peak								
				62		364		
			Right	Through	Left			
			8	54	0	0	Right	
8						0	Through	0
						0	Left	
	Left	1						
2	Through	0						0
	Right	1						
				0	363	0		
				Left	Through	Right		
			55		363			
SHERWOOD DRIVE								
PM Peak								
				55		363		
			Right	Through	Left			
			0	10	45	67	Right	
67						106	Through	193
						20	Left	
	Left	0						
160	Through	160						275
	Right	0						
				-39	296	70		
				Left	Through	Right		
			30		327			
ORDZE ROAD								
PM Peak								
				30		325		
			Right	Through	Left			
			5	26	-1	7	Right	
68						1	Through	8
						0	Left	
	Left	21						
20	Through	-1						59
	Right	0						
				62	297	61		
				Left	Through	Right		
			26		420			

Total 2015 Traffic								
Highway 21								
PM Peak								
				641		1338		
			Right	Through	Left			
			56	357	228	313	Right	
1181						695	Through	1246
						238	Left	
	Left	175						
1232	Through	761						1249
	Right	296						
				430	850	260		
				Left	Through	Right		
			890		1540			
RIDGEMONT WAY								
PM Peak								
				890		1540		
			Right	Through	Left			
			174	688	29	19	Right	
571						6	Through	68
						43	Left	
	Left	116						
412	Through	6						106
	Right	289						
				391	1405	71		
				Left	Through	Right		
			1019		1867			
CLOVER BAR ROAD								
PM Peak								
				1019		1867		
			Right	Through	Left			
			107	802	110	91	Right	
1310						491	Through	728
						146	Left	
	Left	271						
914	Through	293						585
	Right	349						
				711	1505	181		
				Left	Through	Right		
			1297		2397			
NOTTINGHAM WAY								
PM Peak								
				1174		2488		
			Right	Through	Left			
			36	1111	28	27	Right	
335						0	Through	81
						54	Left	
	Left	22						
186	Through	0						73
	Right	164						
				299	2439	45		
				Left	Through	Right		
			1329		2783			
BRENTWOOD BLVD								
PM Peak								
				1284		3073		
			Right	Through	Left			
			198	797	289	279	Right	
1240						611	Through	1046
						156	Left	
	Left	327						
1081	Through	552						991
	Right	202						
				431	2467	149		
				Left	Through	Right		
			1155		3047			

NEW ACCESS TO ZONE 71								
PM Peak								
				1155		3047		
			Right	Through	Left			
			0	967	188	236	Right	
0						0	Through	327
						91	Left	
	Left	0						
0	Through	0						447
	Right	0						
				0	2811	259		
				Left	Through	Right		
			1058		3070			
HAWTHORNE STREET								
PM Peak								
				1058		3070		
			Right	Through	Left			
			41	891	127	221	Right	
144						13	Through	355
						121	Left	
	Left	18						
145	Through	47						375
	Right	80						
				90	2831	201		
				Left	Through	Right		
			1092		3122			
ASH STREET								
PM Peak								
				1092		3122		
			Right	Through	Left			
			101	808	182	174	Right	
189						10	Through	222
						37	Left	
	Left	226						
311	Through	36						355
	Right	50						
				78	2722	137		
				Left	Through	Right		
			896		2937			
SHERWOOD DRIVE								
PM Peak								
				896		2811		
			Right	Through	Left			
			201	460	235	343	Right	
1587						535	Through	1005
						127	Left	
	Left	525						
1227	Through	475						909
	Right	227						
				851	1942	199		
				Left	Through	Right		
			813		2992			
ORDZE ROAD								
PM Peak								
				992		3017		
			Right	Through	Left			
			86	836	70	147	Right	
478						75	Through	366
						144	Left	
	Left	195						
390	Through	53						335
	Right	142						
				317	2675	212		
				Left	Through	Right		
			1122		3204			

APPENDIX “B”

Option Development and Analysis

Sherwood Drive / Wye Road

Brentwood Boulevard / Wye Road

Clover Bar Road / Wye Road

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Do Nothing No improvements to existing intersection Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 125.9% - ICU LOS H** SBL v/c = 1.36 EBT v/c = 1.41 WBL v/c = 1.0.5 **LOS F** Intersection Average Delay = 137 s/veh	▪ Intersection over capacity, congestion periods over 120 min, long queues ▪ Motorists will avoid the area – find alternate route or travel in off peak time
Option 1 a – Conventional Treatment Increased Number of Lanes WBT – 3 Lanes EBT – 4 lanes WBL – 2 lanes SBL – existing 1 lane Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 106.1% - ICU LOS G** WBT v/c = 0.95 SBL v/c = 1.01 **LOS E** Intersection Average Delay = 62.4 s/veh Critical Movement - WBL Average Delay = 100 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min ▪ Long queues are common ▪ Motorists will avoid the area – find alternate route or travel in off peak time 95th % queue: EB ~230m; SB~250m
Option 1 b Increased Number of Lanes WBT – 3 Lanes EBT – 4 lanes WBL – 2 lanes SBL – 2 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 92.0% - ICU LOS F** EBT v/c = 0.90 EBL v/c = 0.88 **LOS D** Intersection Average Delay = 42.0 s/veh Critical Movement - WBL Average Delay = 62.1 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min. ▪ Residual queues at the end of green cycle. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~230m, SB~100m Impact related to widening of Sherwood Drive. Deceleration for double SBL not provided due to existing intersection spacing - geometry
Option 2 a WBL left movement removed and accommodated at Ash Street/Wallace Drive Single SBL Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes	**ICU 103.8% - ICU LOS G** EBL v/c = 1.08 SBL v/c = 1.11 **LOS C** Intersection Average Delay = 50.3 s/veh Critical Movement - SBL 106s/veh. (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min ▪ Residual queues at the end of green cycle. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EBL ~170m, SBL~225m

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

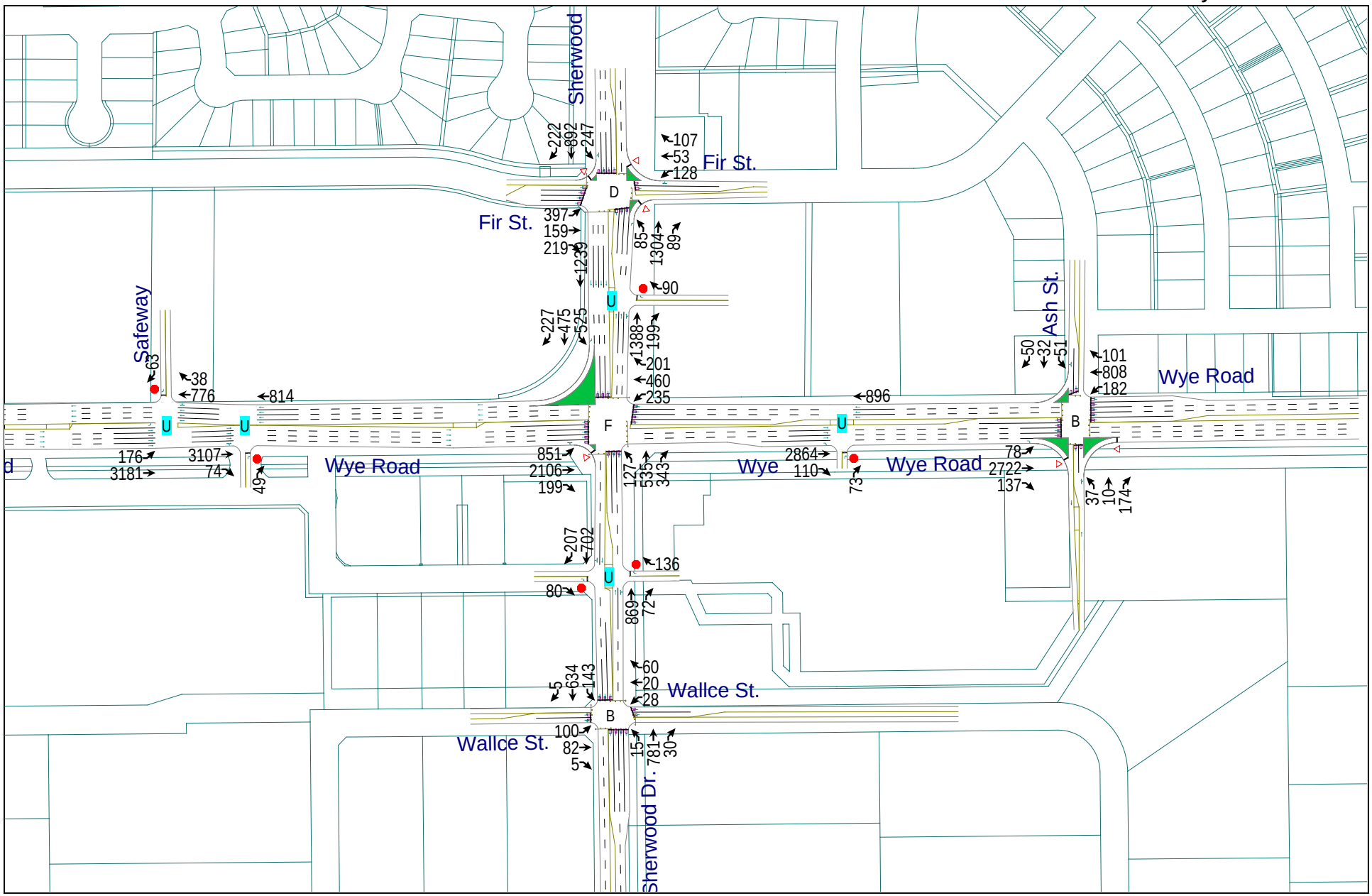
Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option 2 b – Recommended First Stage WBL left movement removed and accommodated at Ash Street/Wallace Drive Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes	**ICU 90.3% - ICU LOS E** NBT v/c = 0.86 EBT v/c = 0.83 **LOS C** Intersection Average Delay = 31.3 s/veh Critical Movement SBL = 53.6 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion ▪ Deceleration for double SBL not provided due to existing intersection spacing - geometry 95th % queue: EBL ~150m, Impact related to widening of Sherwood Drive. Deceleration for double SBL not provided due to existing intersection spacing - geometry
Option 3 a WBL left movement removed and accommodated at Ash Street EBL – removed, accommodated at Wallace Drive SBL – single left WBT – 3 lanes EBT – 3 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 110% - ICU LOS H** SBL v/c = 1.20 NBT v/c = 1.30 **LOS E** Intersection Average Delay = 56.9 s/veh Critical Movement - SBL Average Delay = 95 s/veh (LOS F)	▪ Intersection over 10% over capacity and likely will experience congestion periods over 120 min at this time of day ▪ Motorists would use alternate routes if available or travel in different time Signalized intersection at Ordze Avenue 95th % queue: EB ~230m, SBL ~ 185m
Option 3 b WBL left movement removed and accommodated at Ash Street EBL – removed, accommodated at Ordze Avenue and Wallace Drive SBL – 2 lanes WBT – 3 lanes EBT – 3 lanes Wal-Mart Access Modified Road Connection to Wallace Drive	**ICU 100.0% - ICU LOS F** EBT v/c = 0.93 NBT v/c = 0.92 **LOS D** Intersection Average Delay = 36.6 s/veh Critical Movement - SBL Average Delay = 77.6 s/veh (LOS E)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion ▪ Deceleration for double SBL not provided due to existing intersection spacing - geometry Impact related to widening of Sherwood Drive. Signalized intersection at Canadian Tire 95th % queue: EB ~175m, NBT ~ 210m

Wye Road/Sherwood Drive Intersection **Table 4.3**
Option Evaluation

Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option 4 a SBL – removed, accommodated at Fir Street (1/3) Wallace Drive (2/3) Fir Street Single SBL EBT/WBT – 3 lanes Wal-Mart Access Modified, Road Connection Wallace Drive to Ash Street	**ICU 92.0% - ICU LOS F** SBT v/c = 0.88 EBT v/c = 0.91 **LOS D** Intersection Average Delay = 43.0 s/veh Critical Movement - EBL Average Delay = 53 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, lane closure can cause significant congestion 95th % queue: EB ~170m Congestion moved to Fir Street Intersection ICU 104.4% ICU LOS G, SBL v/c = 1.62
Option 4 b SBL removed and accommodated at Wallace Drive, Fir Street Double SBL EBT – 3 lanes Wal-Mart Access Modified, Road Connection Wallace Drive to Ash Street	**ICU 92.0% - ICU LOS F** EBL v/c = 0.88 EBT v/c = 0.91 **LOS D** Intersection Average Delay = 38.4 s/veh Critical Movement - EBL Average Delay = 53.0 s/veh (LOS D)	▪ Intersection over capacity and likely will experience congestion periods of 15 to 60 min ▪ Minor traffic fluctuation, accidents, lane closure can cause significant congestion 95th % queue: EB ~170m. SB ~135m Fir Street Intersection operates at 93.1% ICU, LOS F, SBL v/c = 0.83 – congestion for 15-60 min during pm peak hour
Option 5 a Only EBL remains, other movements accommodated at Fir and Wallace accommodated at Wallace Drive, SBL at Fir St. - Single EBT – 3 lanes Wal-Mart Access Modified	**ICU 80.0% - ICU LOS D** SBT v/c = 0.77 EBL v/c = 0.73 **LOS C** Intersection Average Delay = 26.3 s/veh Critical Movement - EBL Average Delay = 44.6 s/veh (LOS D)	▪ Intersection normally has no congestion. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~130m, ~SB 110m Congestion moved to Fir Street Intersection ICU 110.9% ICU LOS H, SBL v/c = 1.15 for SBL, NBT v/c=1.05
Option 5 b Recommended Only EBL remains, other movements accommodated at Fir Street Wallace Drive, SBL at Fir St. - Double EBT – 3 lanes Wal-Mart Access Modified	**ICU 80.0% - ICU LOS D** SBT v/c = 0.78 EBL v/c = 0.77 **LOS C** Intersection Average Delay = 22.4 s/veh Critical Movement - EBL Average Delay = 42.2 s/veh (LOS D)	▪ Intersection normally has no congestion. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion 95th % queue: EB ~140m, SB ~120 All adjacent intersections operated at satisfactory LOS D or better.

Map - Year 2015 PM peak Traffic
Levels of Service

Year 2015 PM peak Traffic
2006 year road network

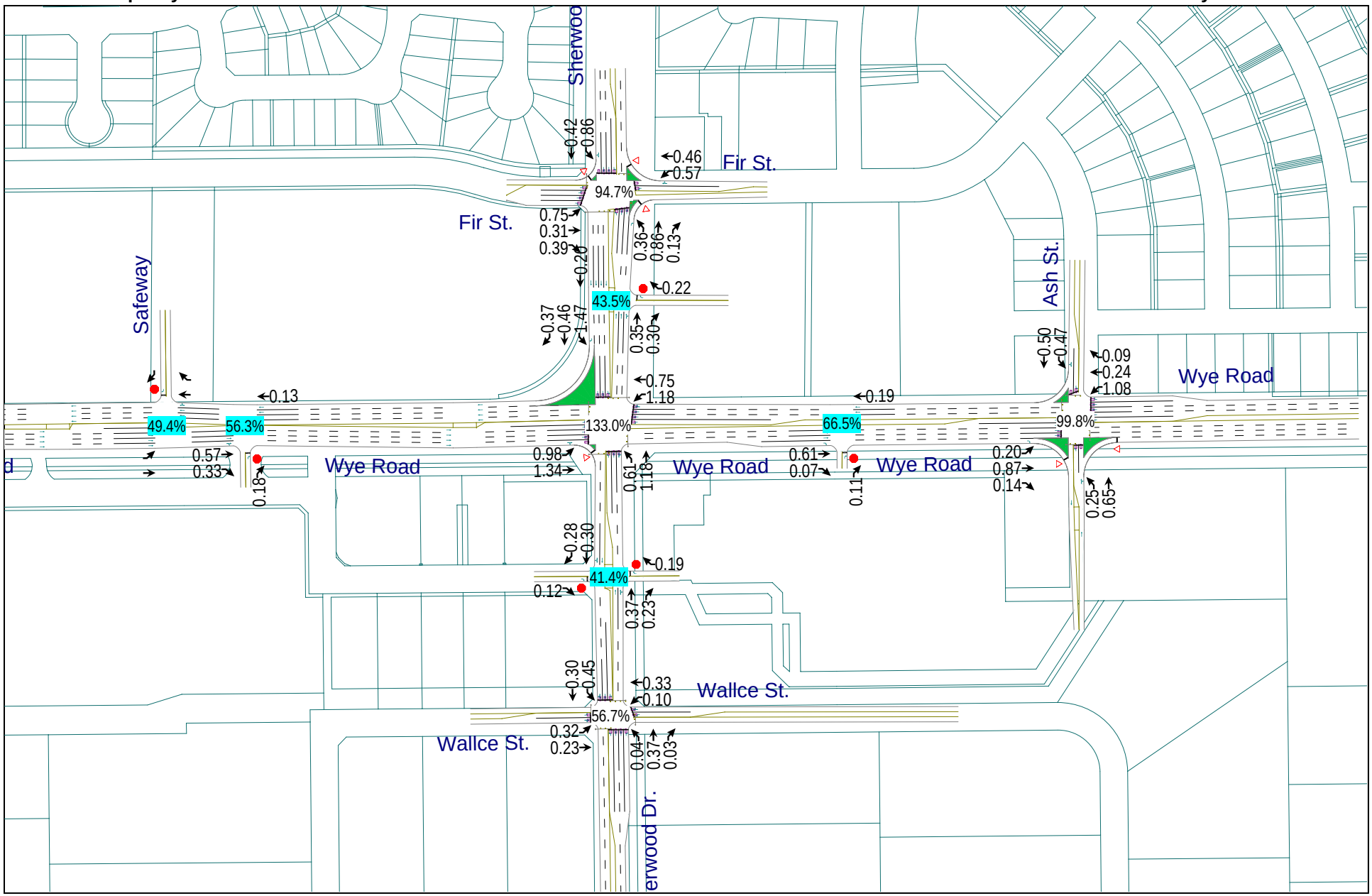


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11/27/2008

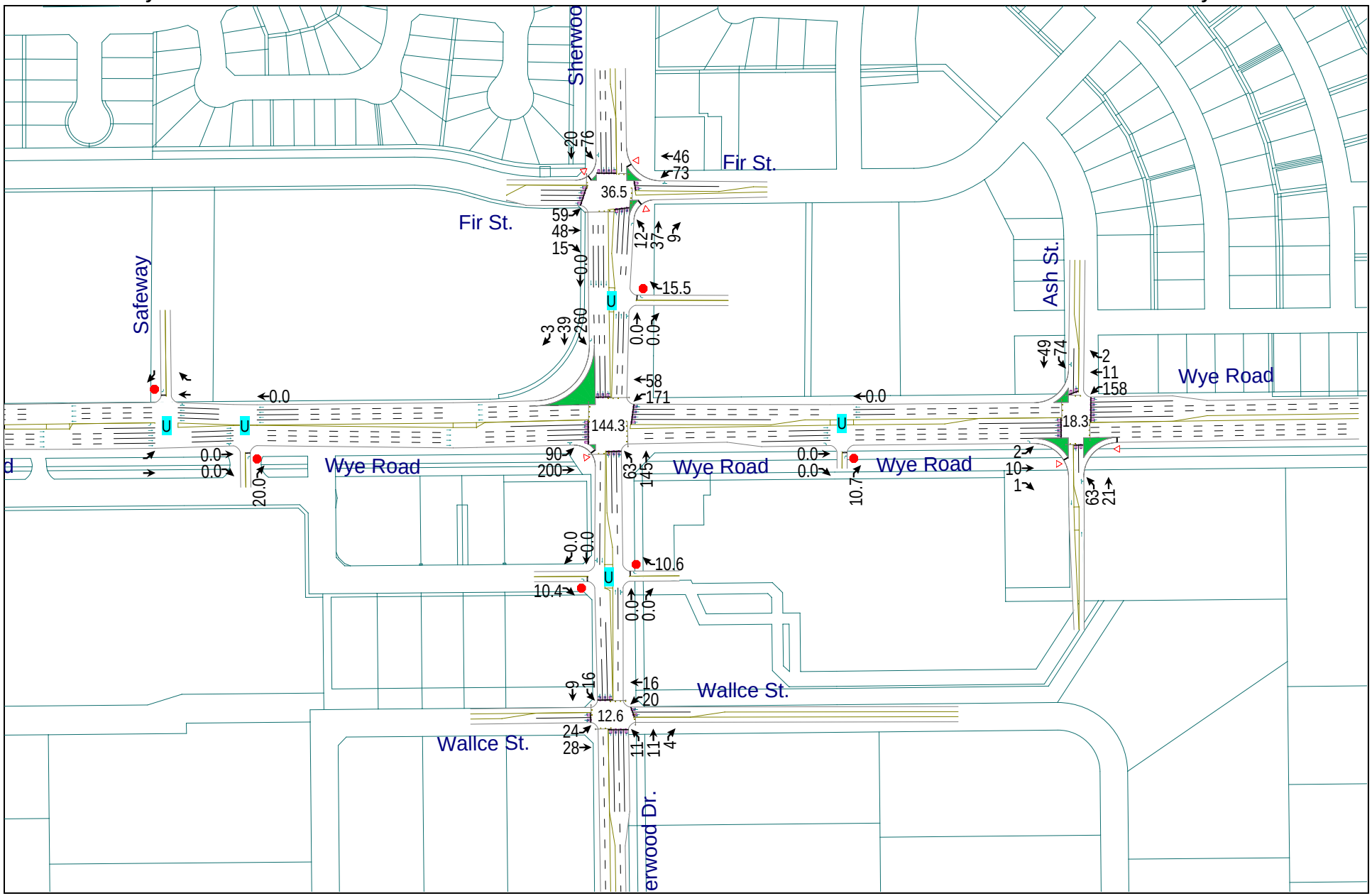
Map - Year 2015 PM peak Traffic
Volume to Capacity Ratios

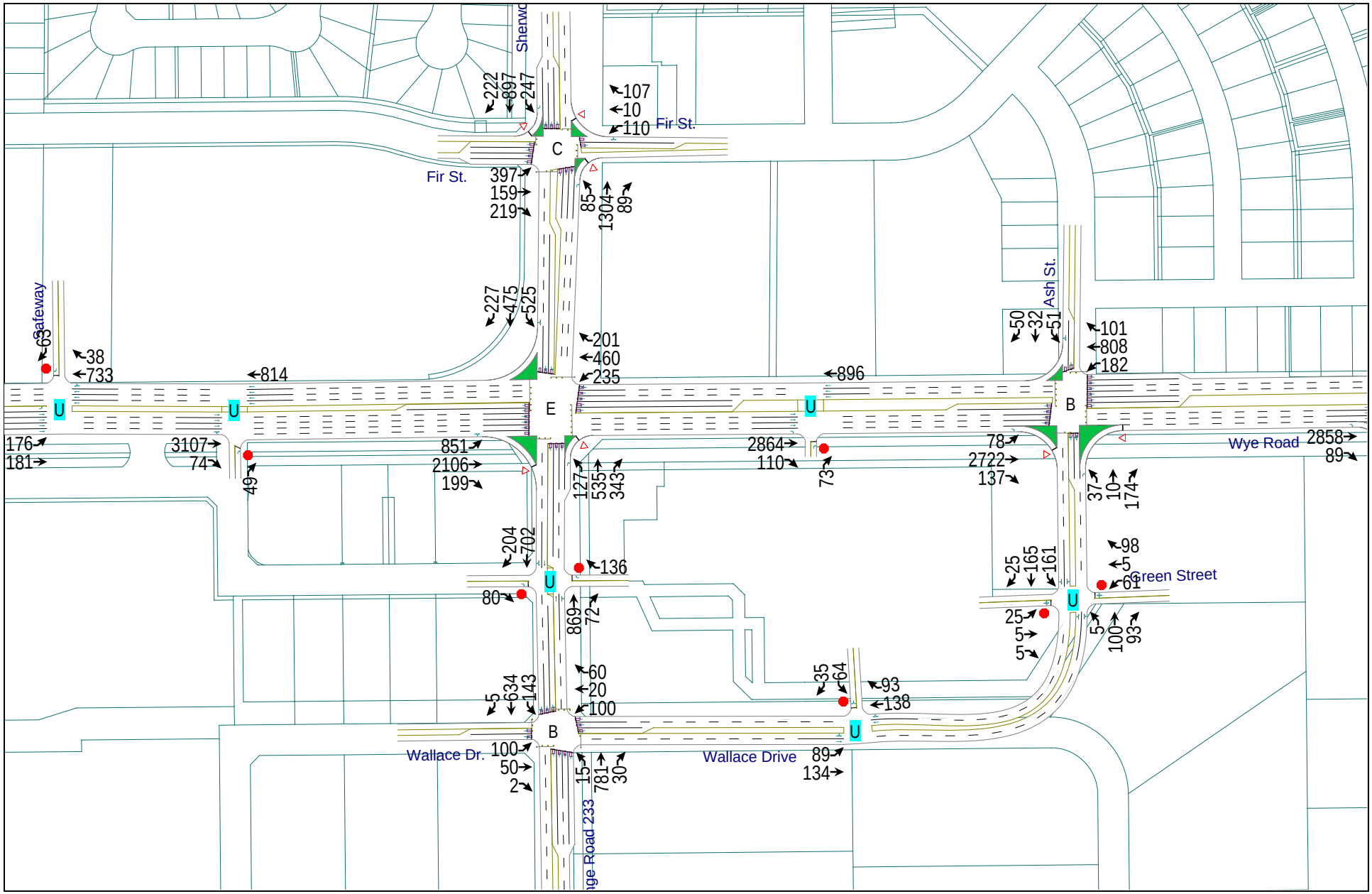
Year 2015 PM peak Traffic
2006 year road network

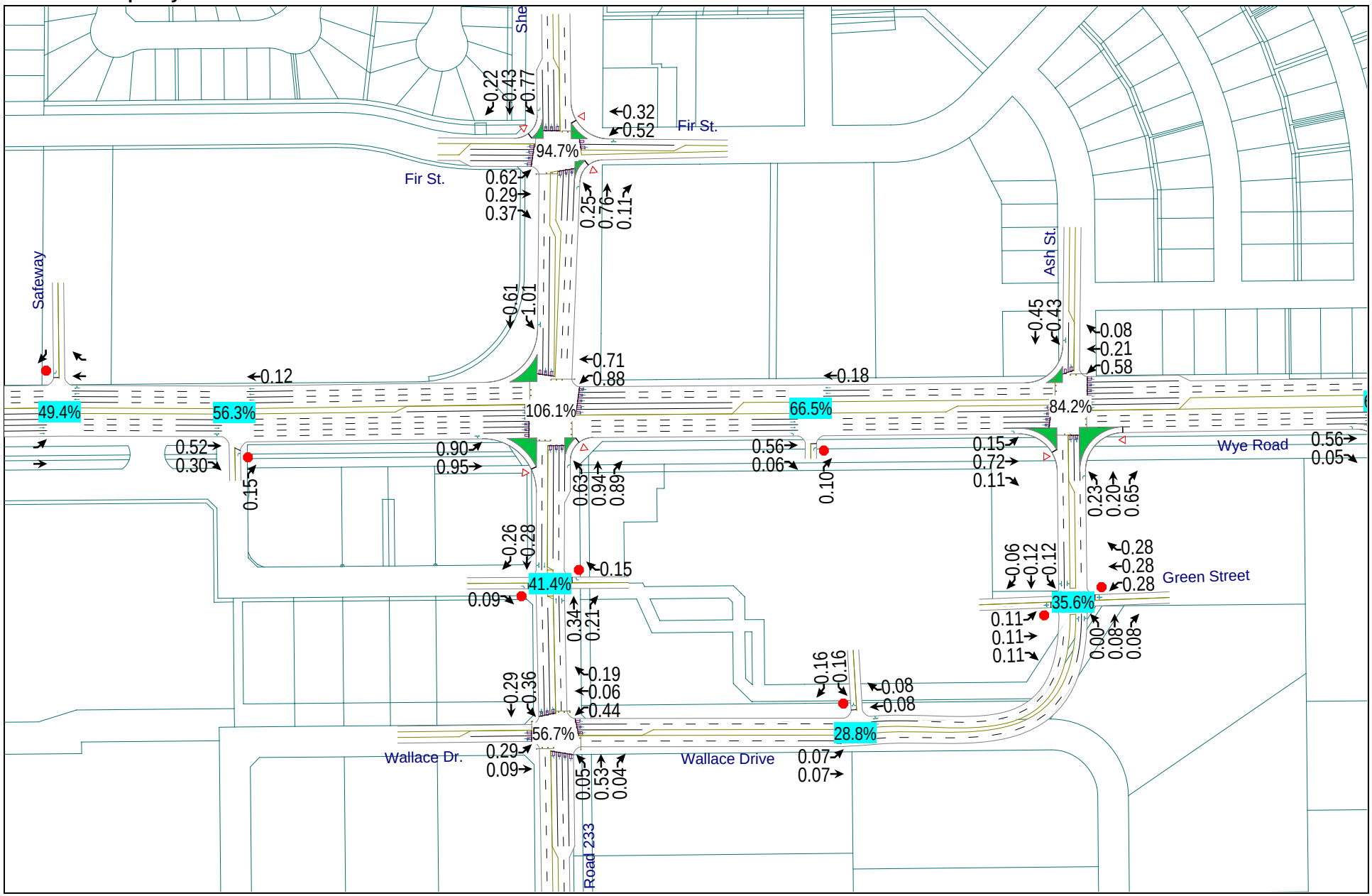


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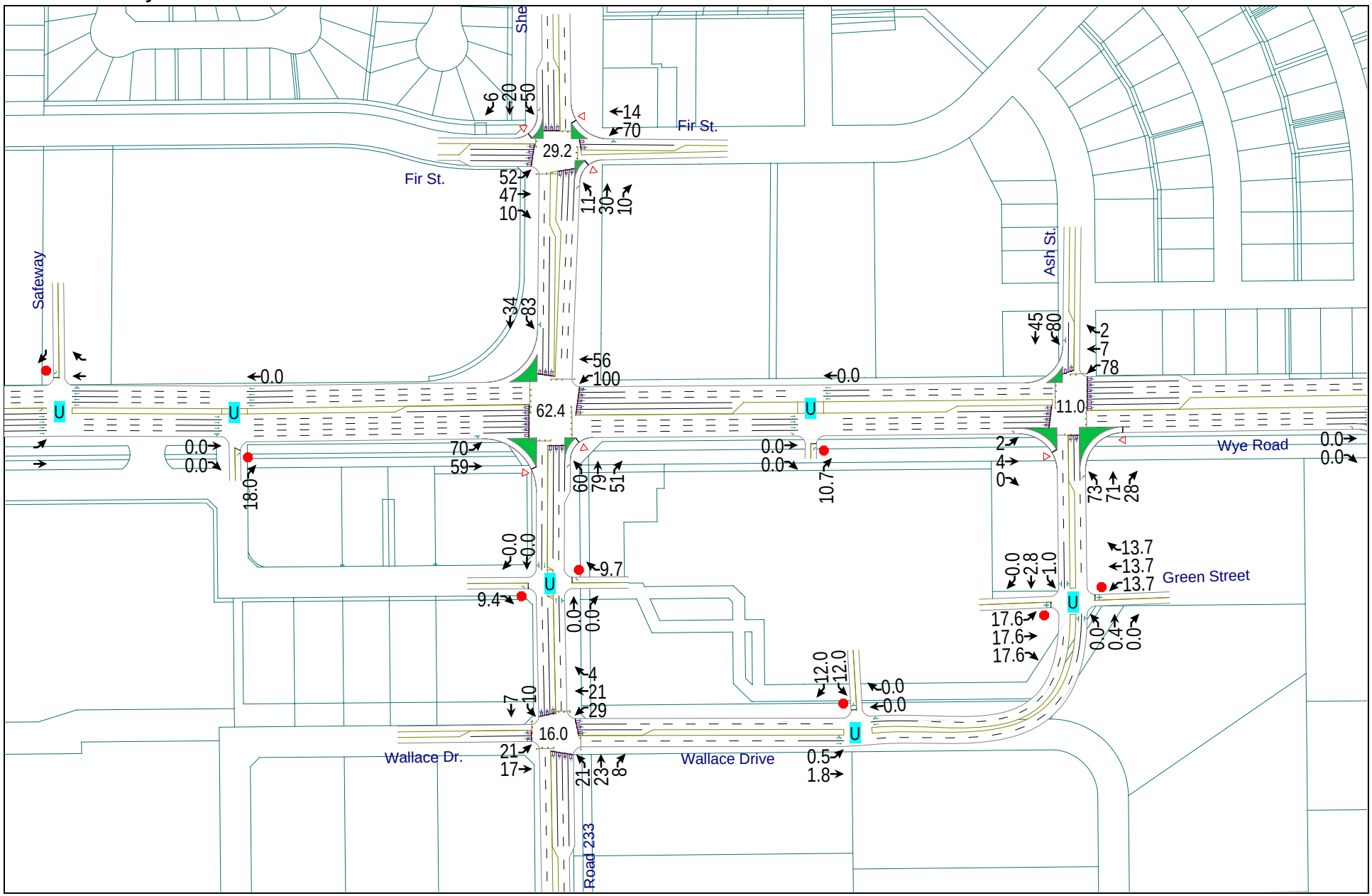
11/27/2008


Sherwood
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Wye Road
Wye Road
Wye Road
Wallce St.
Wallce St.
erwood Dr.
20
76
46
73
36.5
59
48
15
0.0
12
37
9
15.5
3
39
260
0.0
0.0
58
171
49
74
2
11
158
0.0
144.3
0.0
18.3
0.0
0.0
20.0
90
200
63
145
0.0
0.0
10.7
2
10
1
63
21
0.0
0.0
10.6
10.4
0.0
0.0
9
16
16
20
12.6
24
28
11
11
4


Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
C
E
B
B
U
222
897
247
107
10
110
397
159
219
85
1304
89
227
475
525
201
460
235
814
896
63
38
733
50
32
51
101
808
182
176
181
3107
74
49
851
2106
199
2864
110
73
78
2722
137
2858
89
127
535
343
37
10
174
204
702
136
80
869
72
25
165
161
98
5
61
25
5
5
5
100
93
5
634
143
60
20
100
35
64
93
138
100
50
2
15
781
30
89
134
ge Road 233

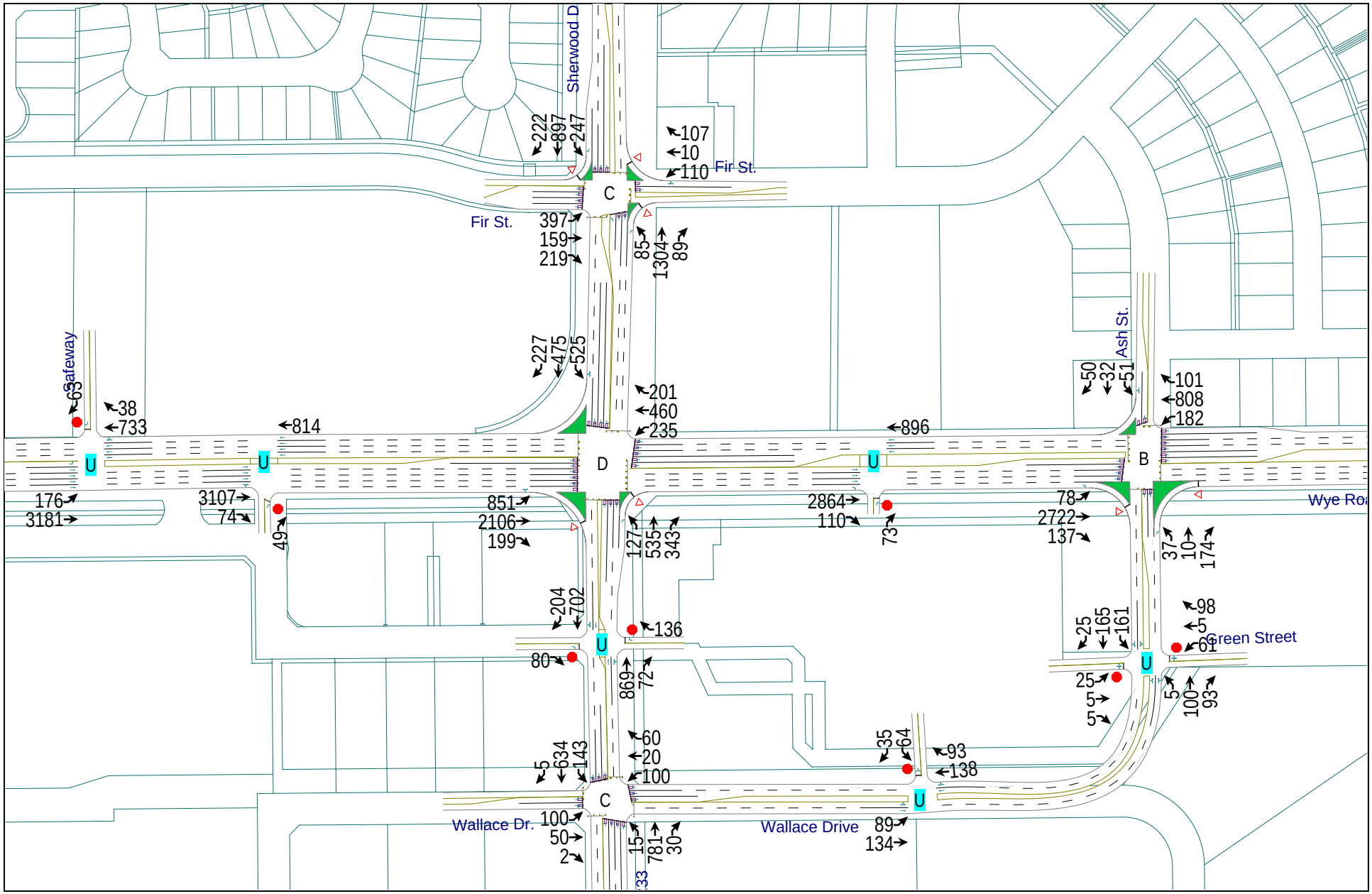


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Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Road 233
29.2
62.4
11.0
16.0
9.7
10.7
12.0
12.0
18.0
9.4

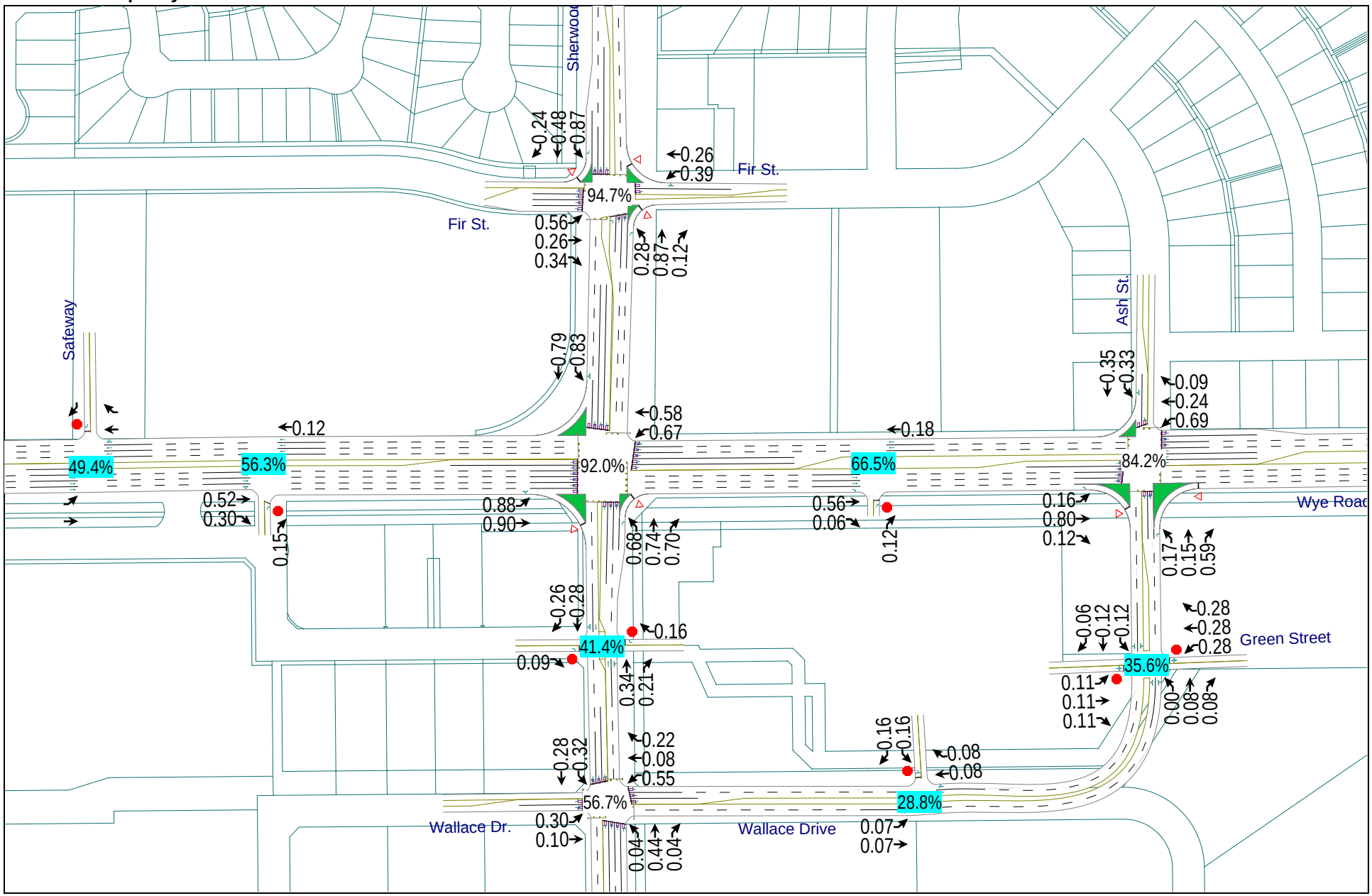
Map - Year 2015 PM peak - SBL double at Sherwood Dr
Levels of Service

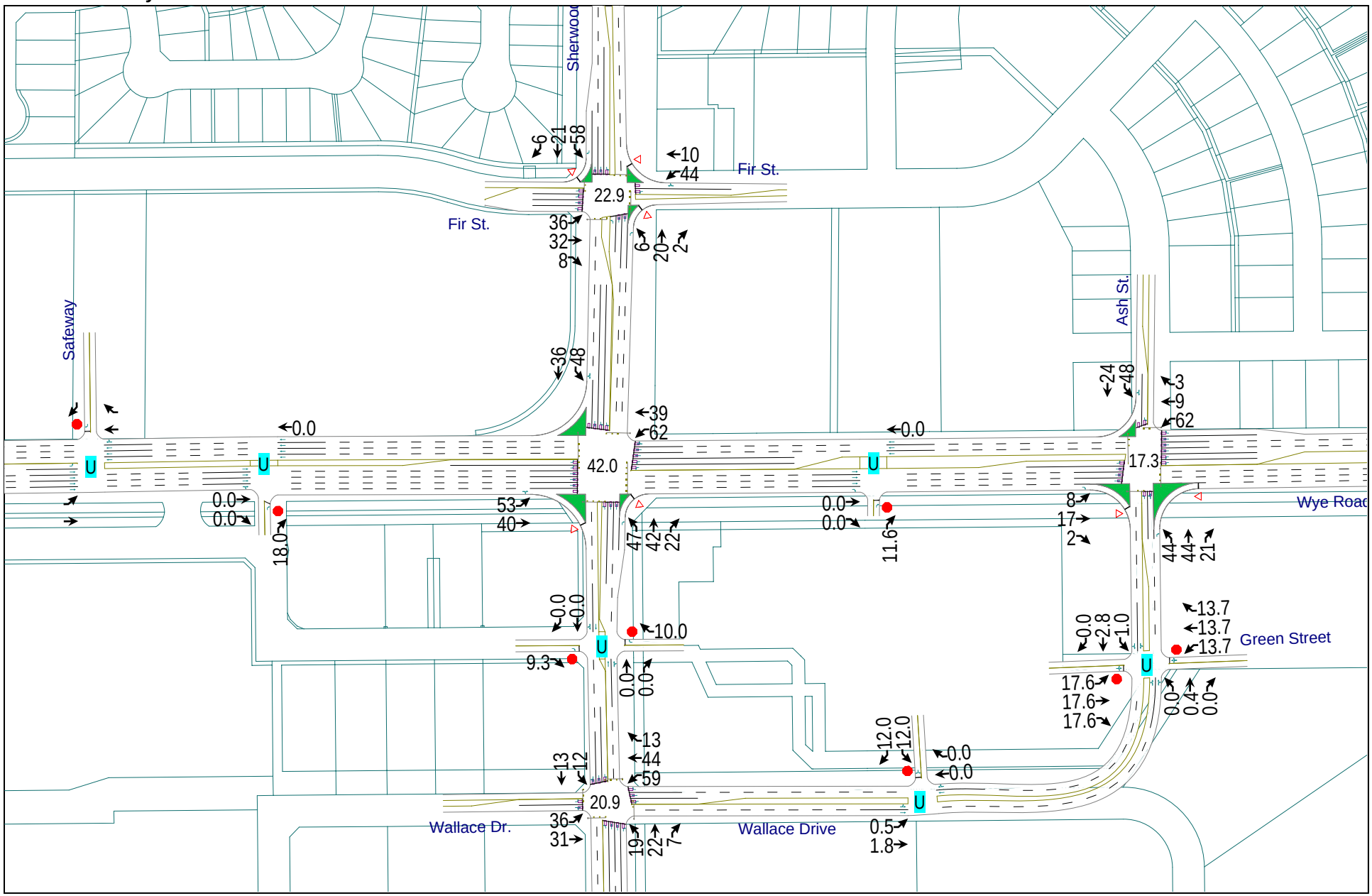
Year 2015 PM peak - SBL double at Sherwood Dr
Traditional Treatment at Sherwood Dr and Brentwood Blvd



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11/28/2008

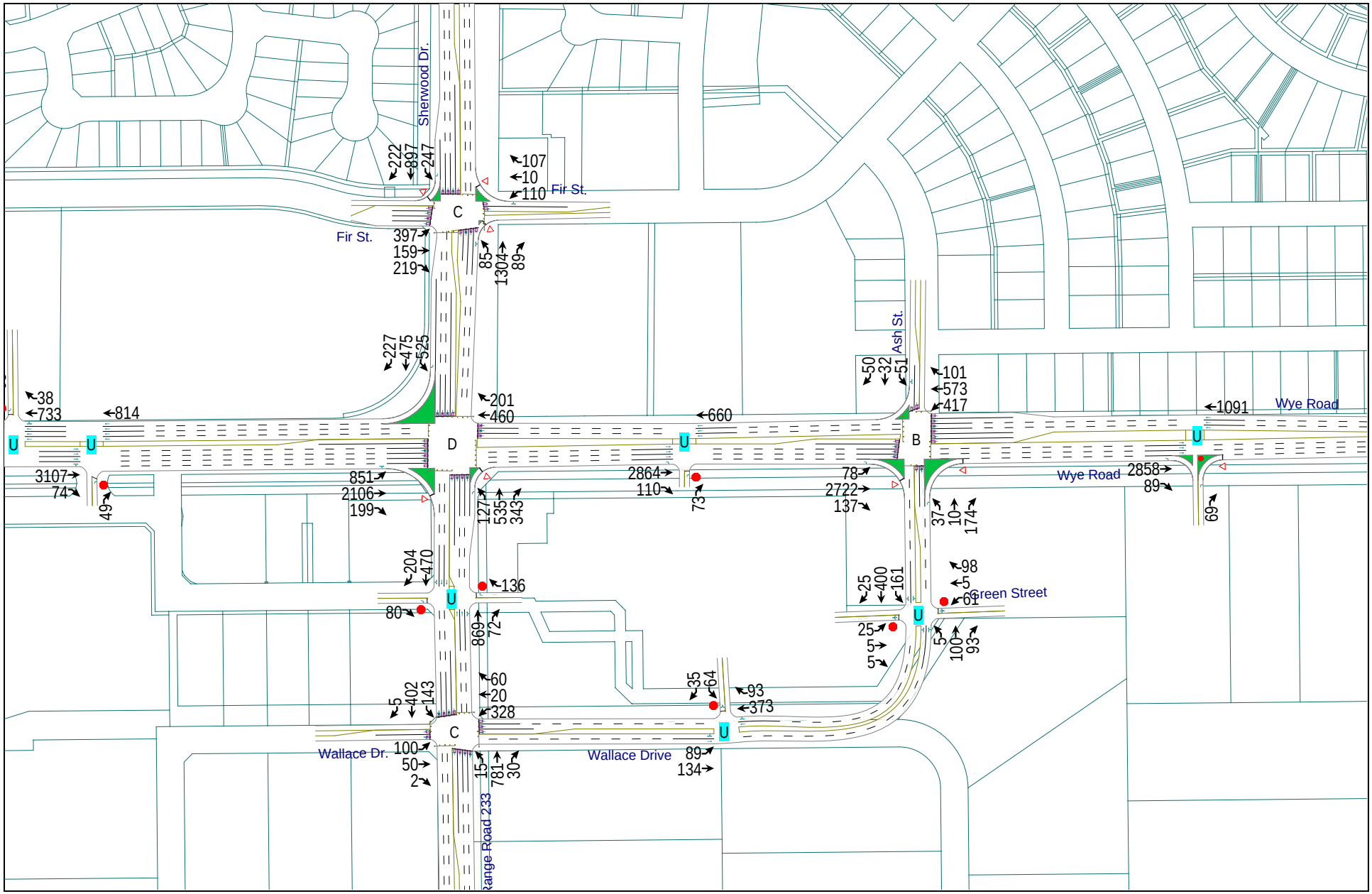

Sherwood
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
94.7%
92.0%
49.4%
56.3%
66.5%
84.2%
41.4%
35.6%
56.7%
28.8%



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Map - Year 2015 PM peak - Single SBL at Sherwood Dr
Levels of Service

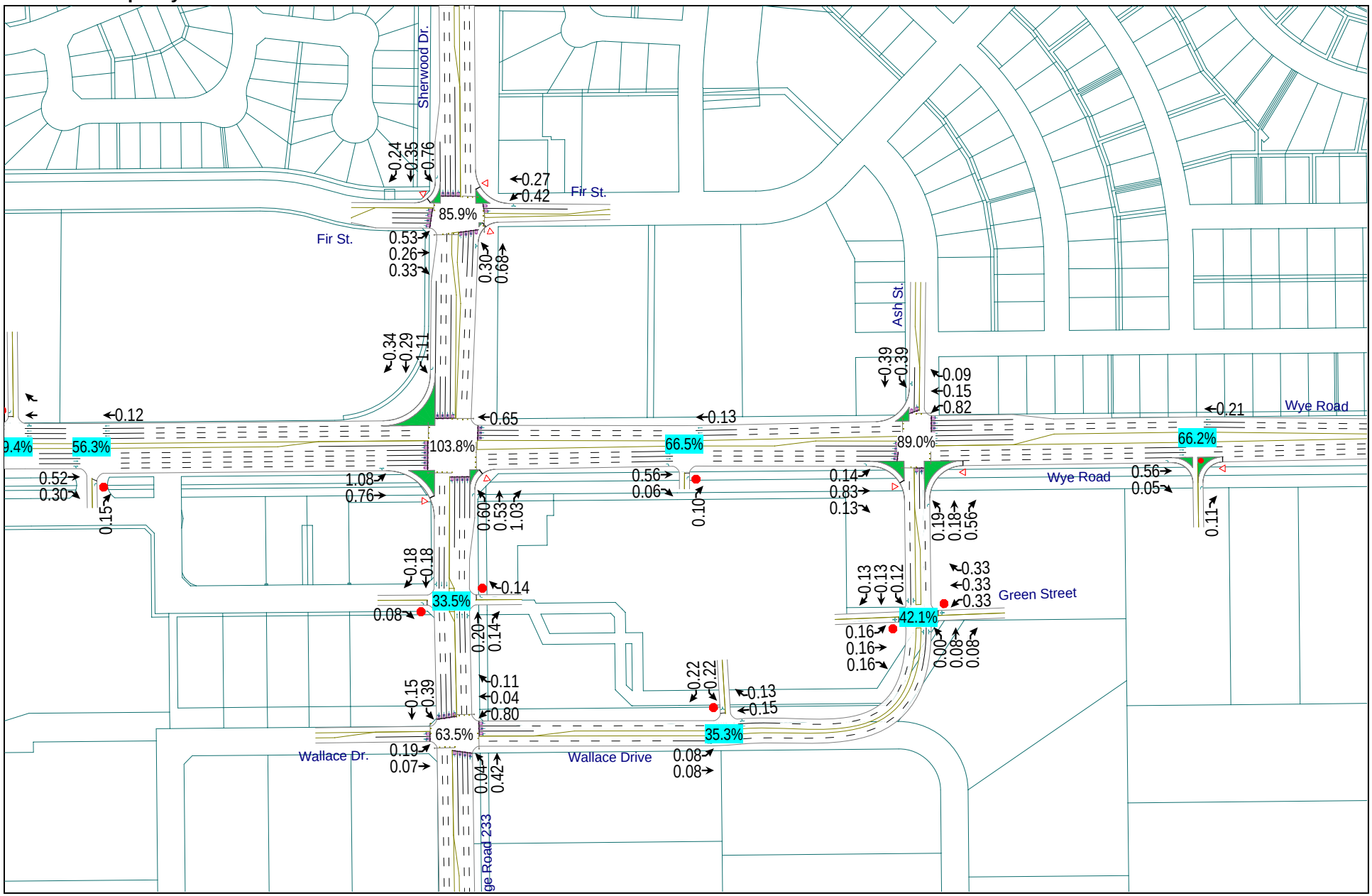
Year 2015 PM peak - Single SBL at Sherwood Dr
WBL removed



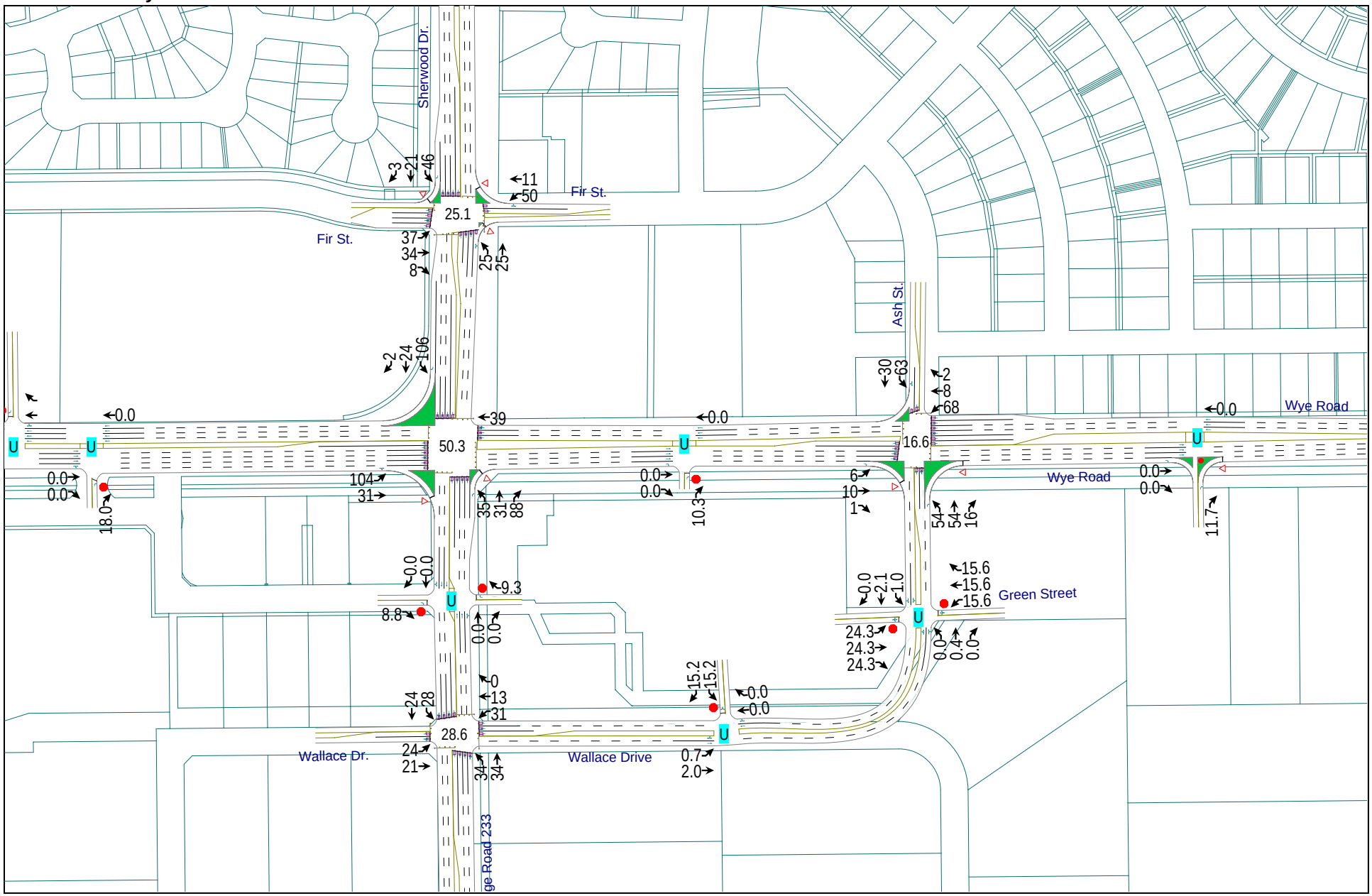
F:\Strathcona County\1149 - Wye Road\FPS Report Nov 2008\Pdf Exhibits\Synchro Files\Wye & Sherwood Year 2015 PM Peak Option 2a.syn

Map - Year 2015 PM peak - Single SBL at Sherwood Dr
Volume to Capacity Ratios

Year 2015 PM peak - Single SBL at Sherwood Dr
WBL removed

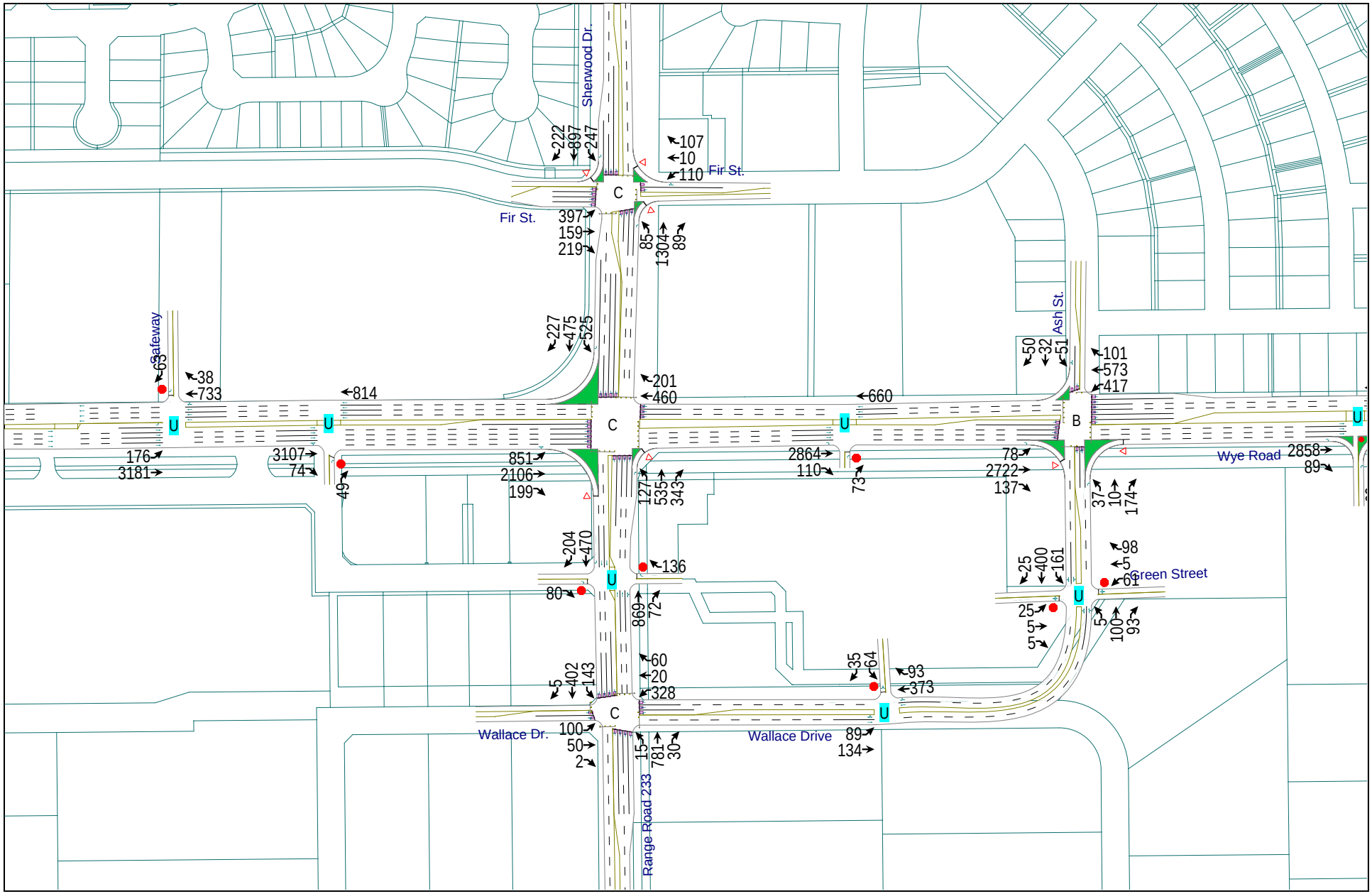


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Sherwood Dr.
Fir St.
Fir St.
Ash St.
Wye Road
Wye Road
Green Street
Wallace Dr.
Wallace Drive
ge Road 233
25.1
50.3
16.6
28.6
39
9.3
10.3
11.7
18.0
8.8
0.0
3
21
46
11
50
37
34
8
25
25
2
24
106
30
63
2
8
68
104
31
35
31
88
6
10
1
54
54
16
15.6
15.6
15.6
2.1
1.0
24.3
24.3
24.3
0.4
15.2
15.2
0
13
31
24
28
24
21
34
34
0.7
2.0
U

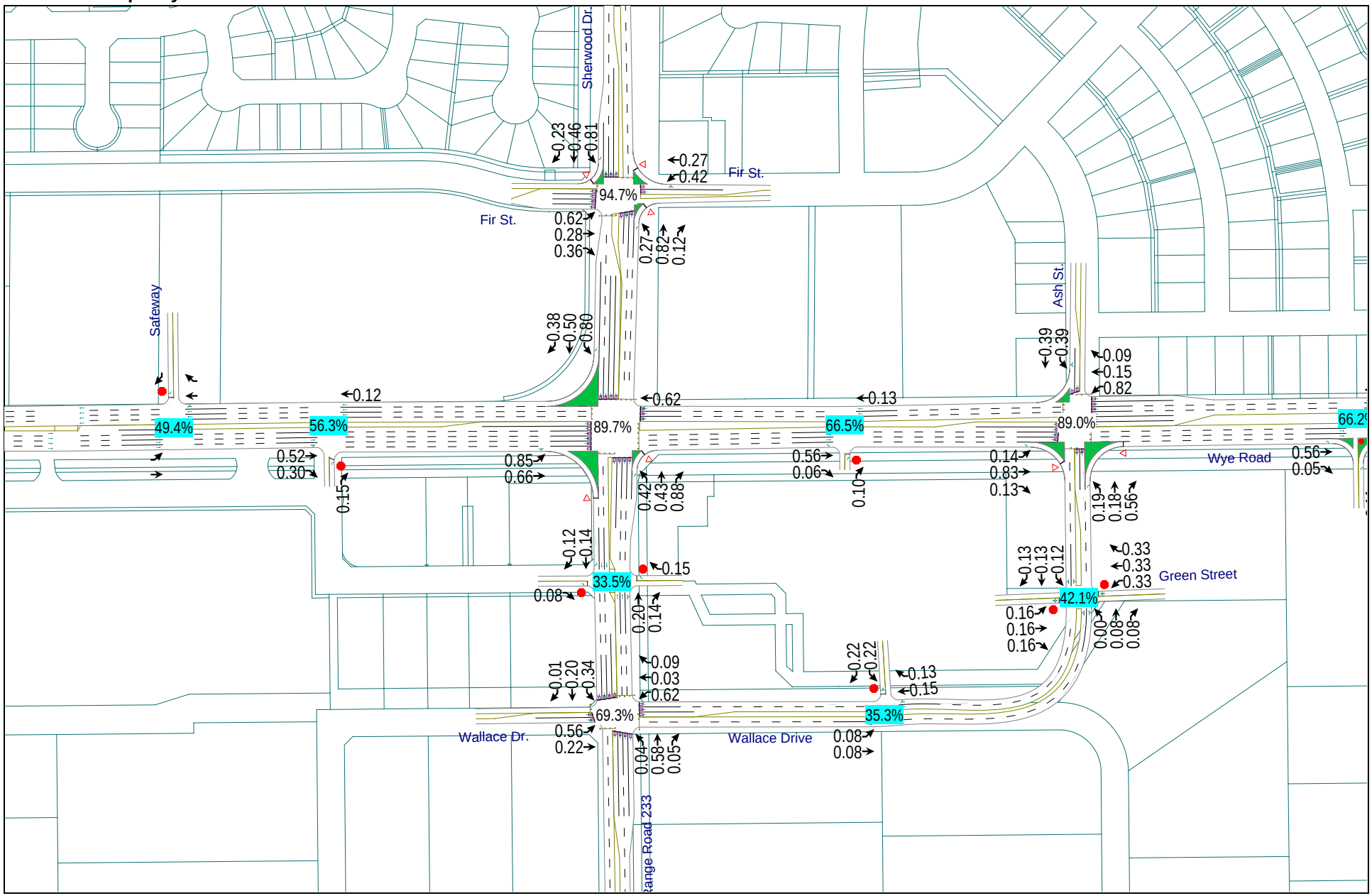
Map - Year 2015 PM peak - Double SBL at Sherwood Dr
Levels of Service

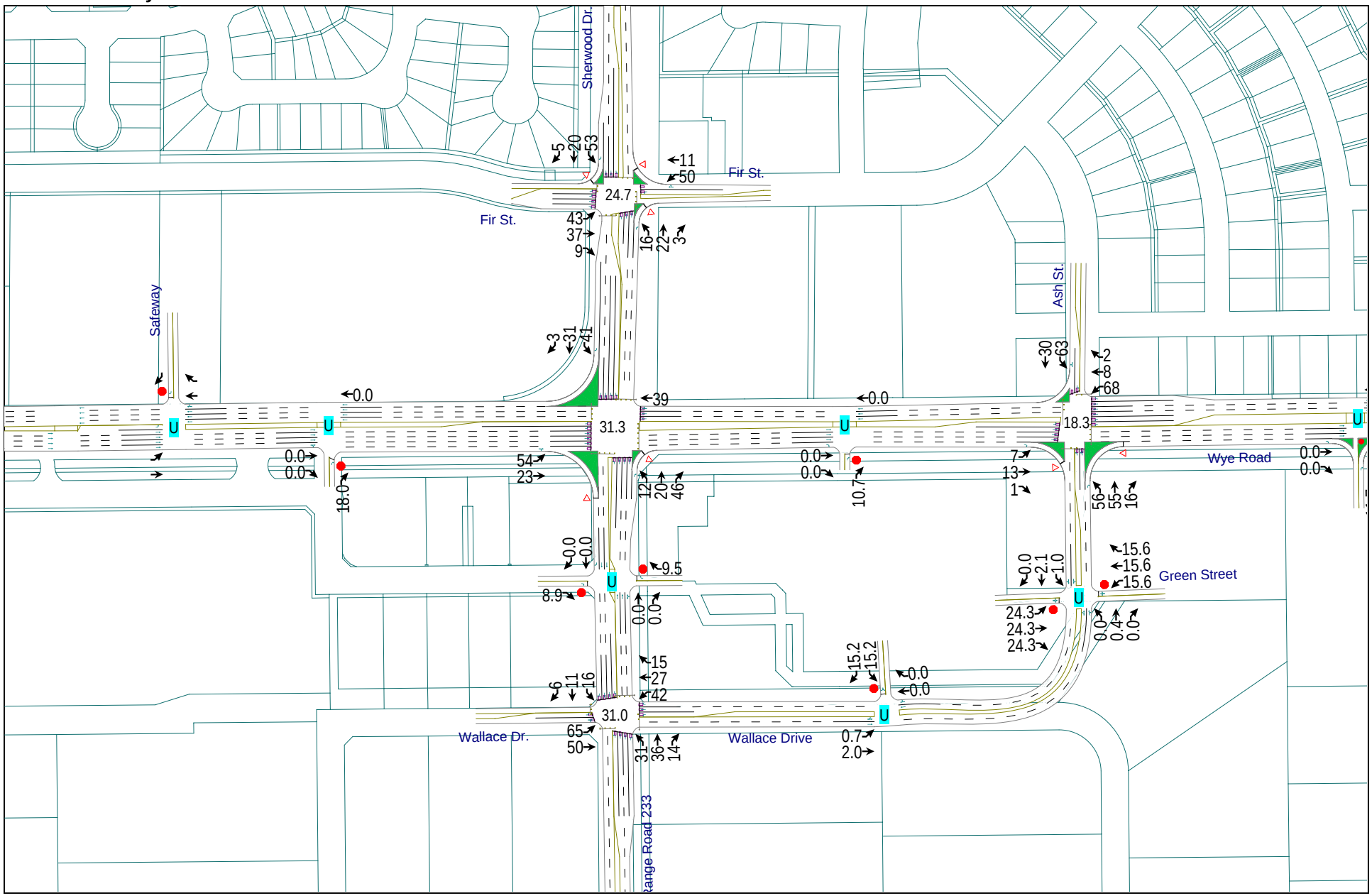
Year 2015 PM peak - Double SBL at Sherwood Dr
WBL removed



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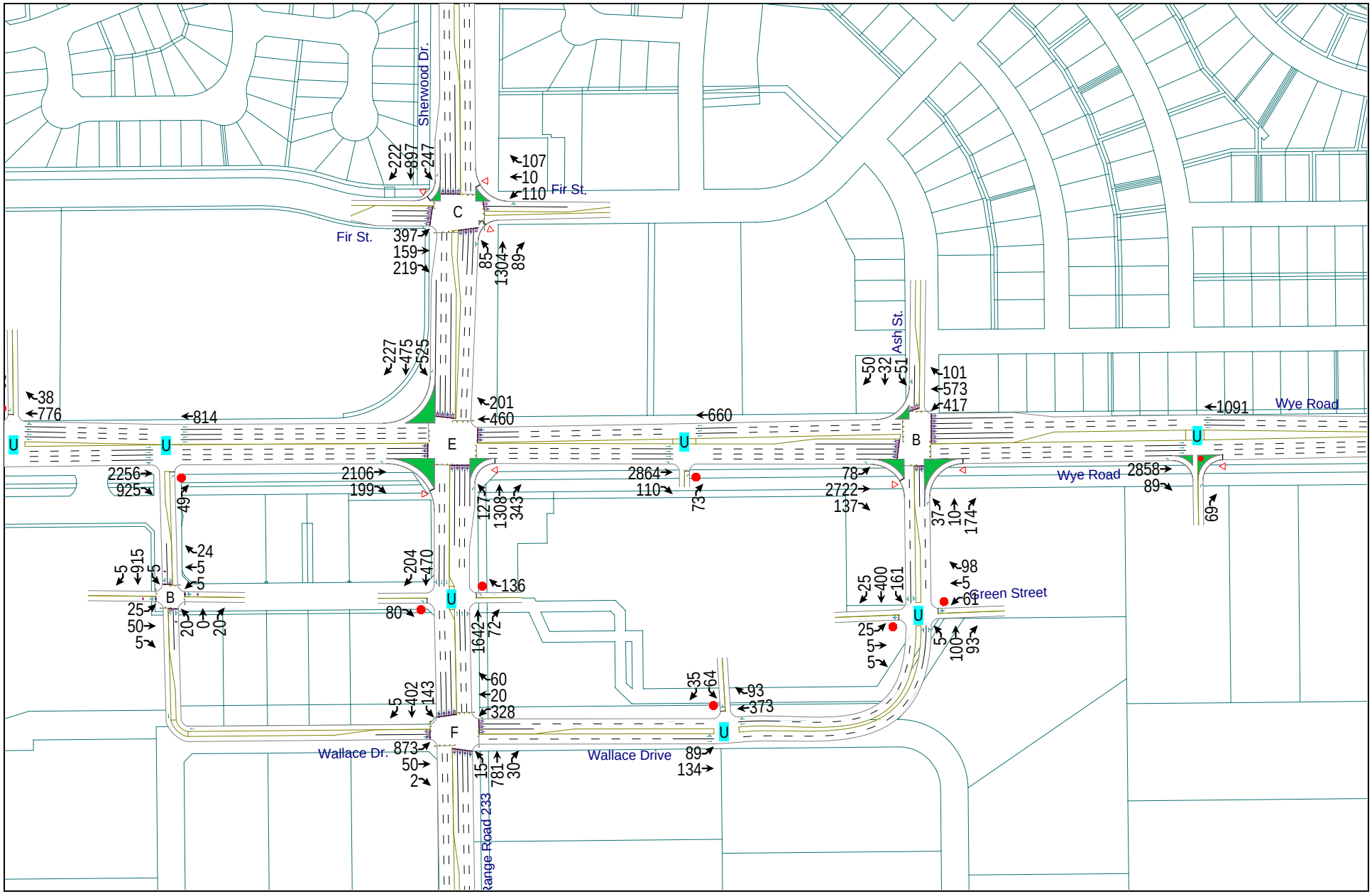
11/28/2008


Sherwood Dr.
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
94.7%
89.7%
66.5%
89.0%
49.4%
56.3%
33.5%
42.1%
69.3%
35.3%


Sherwood Dr.
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
24.7
31.3
39
18.3
31.0
9.5
8.9
10.7
18.0

Map - Year 2015 PM peak - Single SBL at Sherwood Dr
Levels of Service

Year 2015 PM peak - Single SBL at Sherwood Dr
WBL and EBL removed

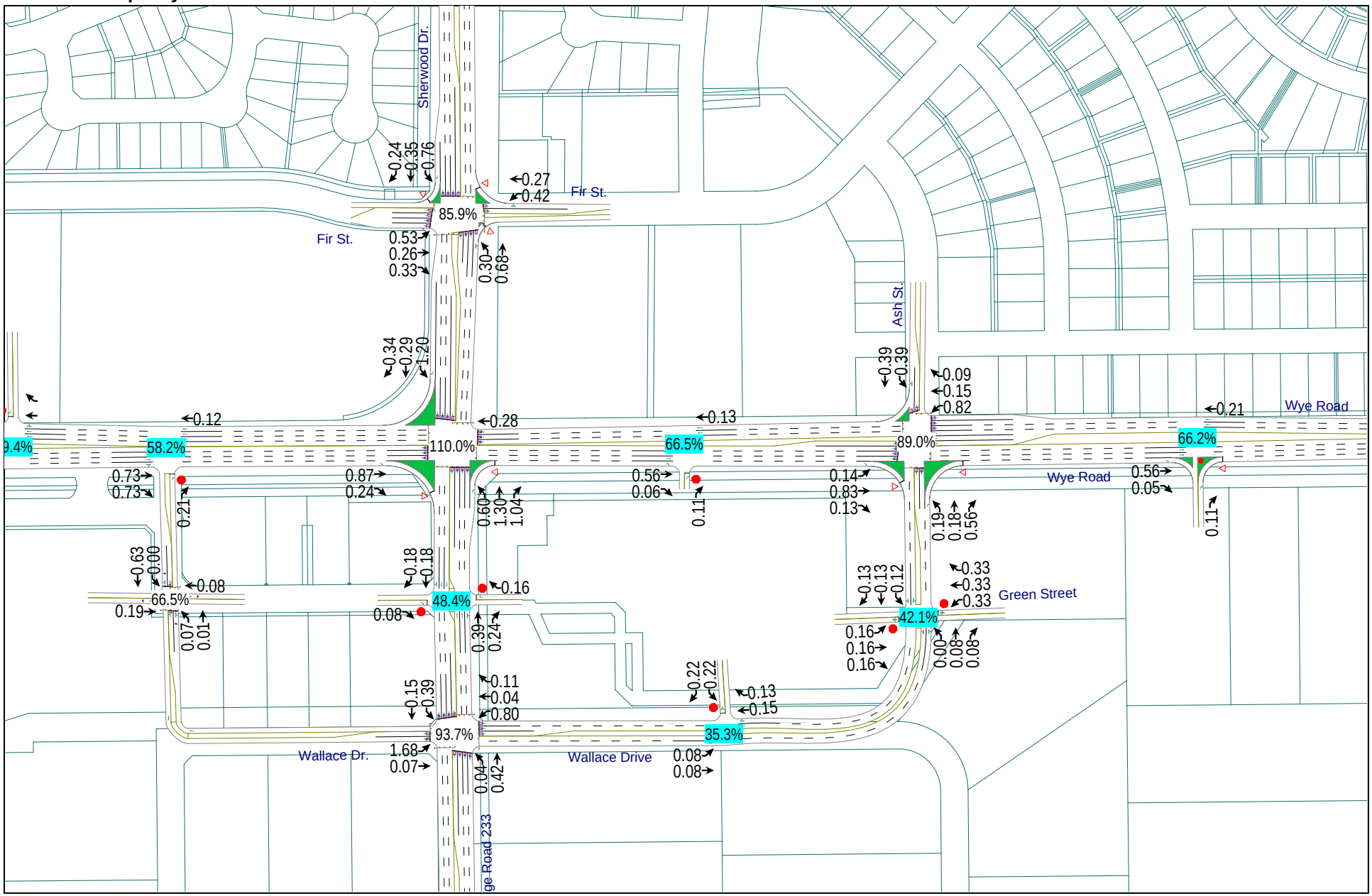


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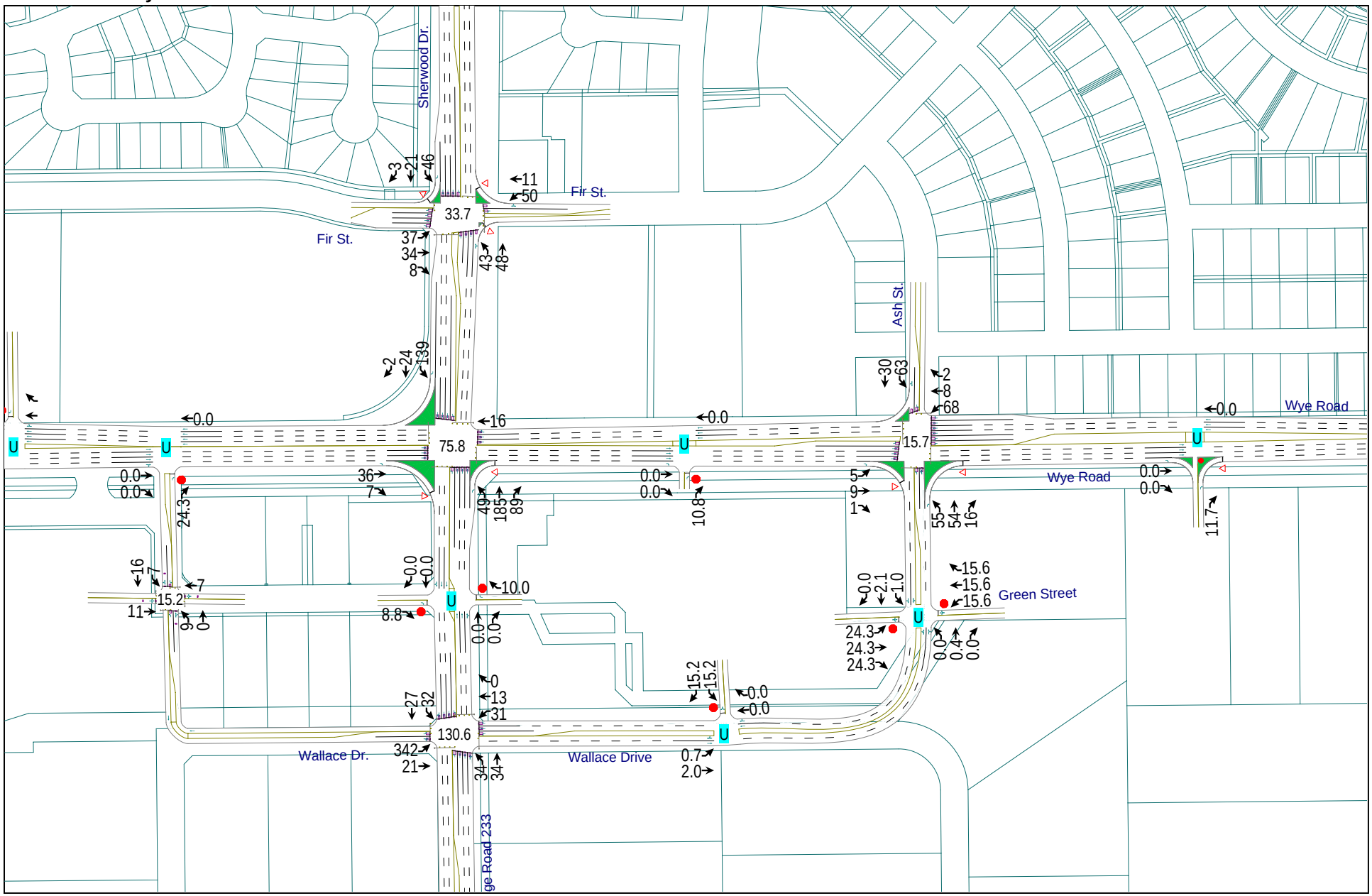
11/28/2008

Map - Year 2015 PM peak - Single SBL at Sherwood Dr
Volume to Capacity Ratios

Year 2015 PM peak - Single SBL at Sherwood Dr
WBL and EBL removed



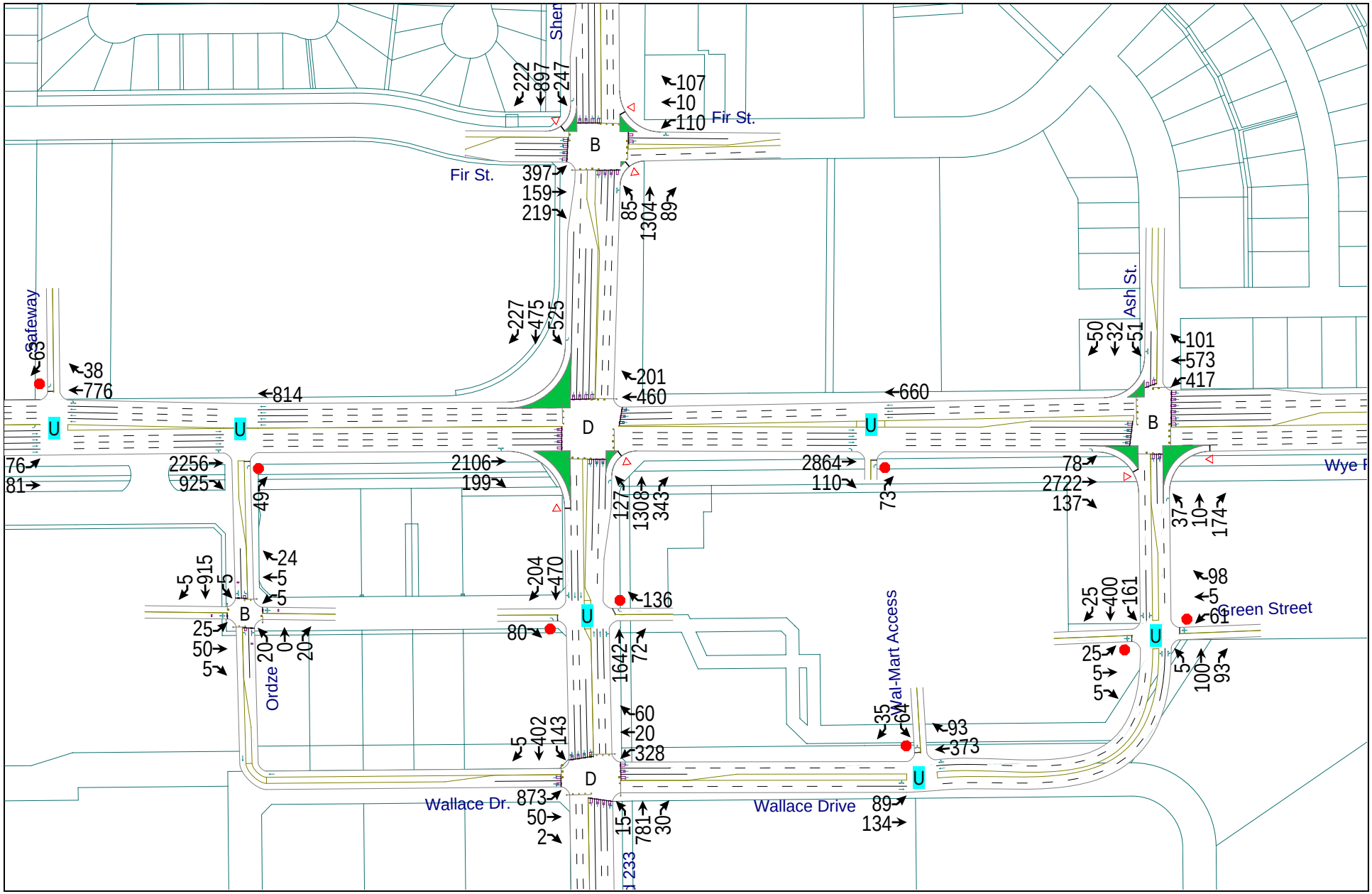
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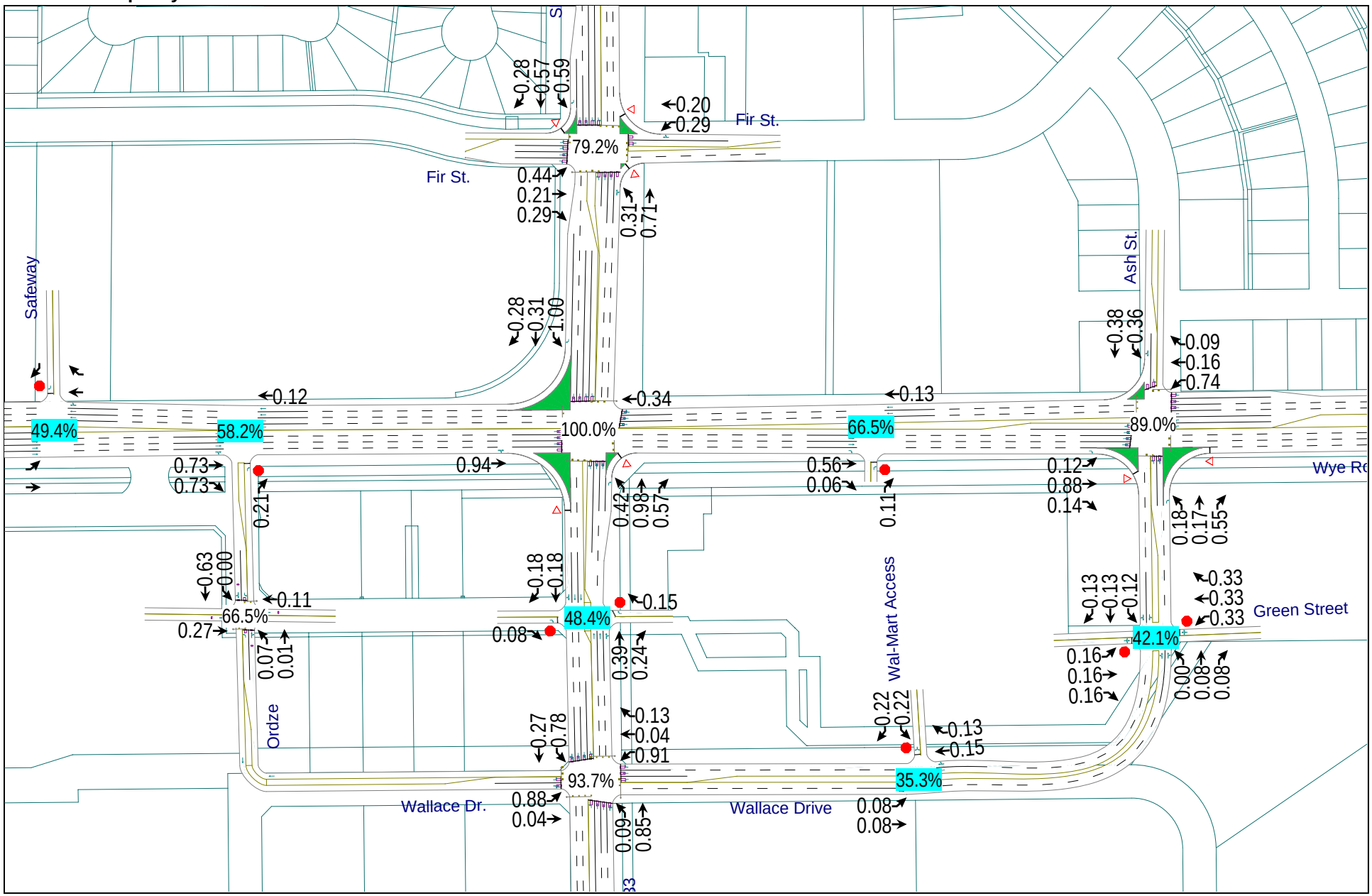
Map - Year 2015 PM peak - Double SBL at Sherwood Dr
Levels of Service

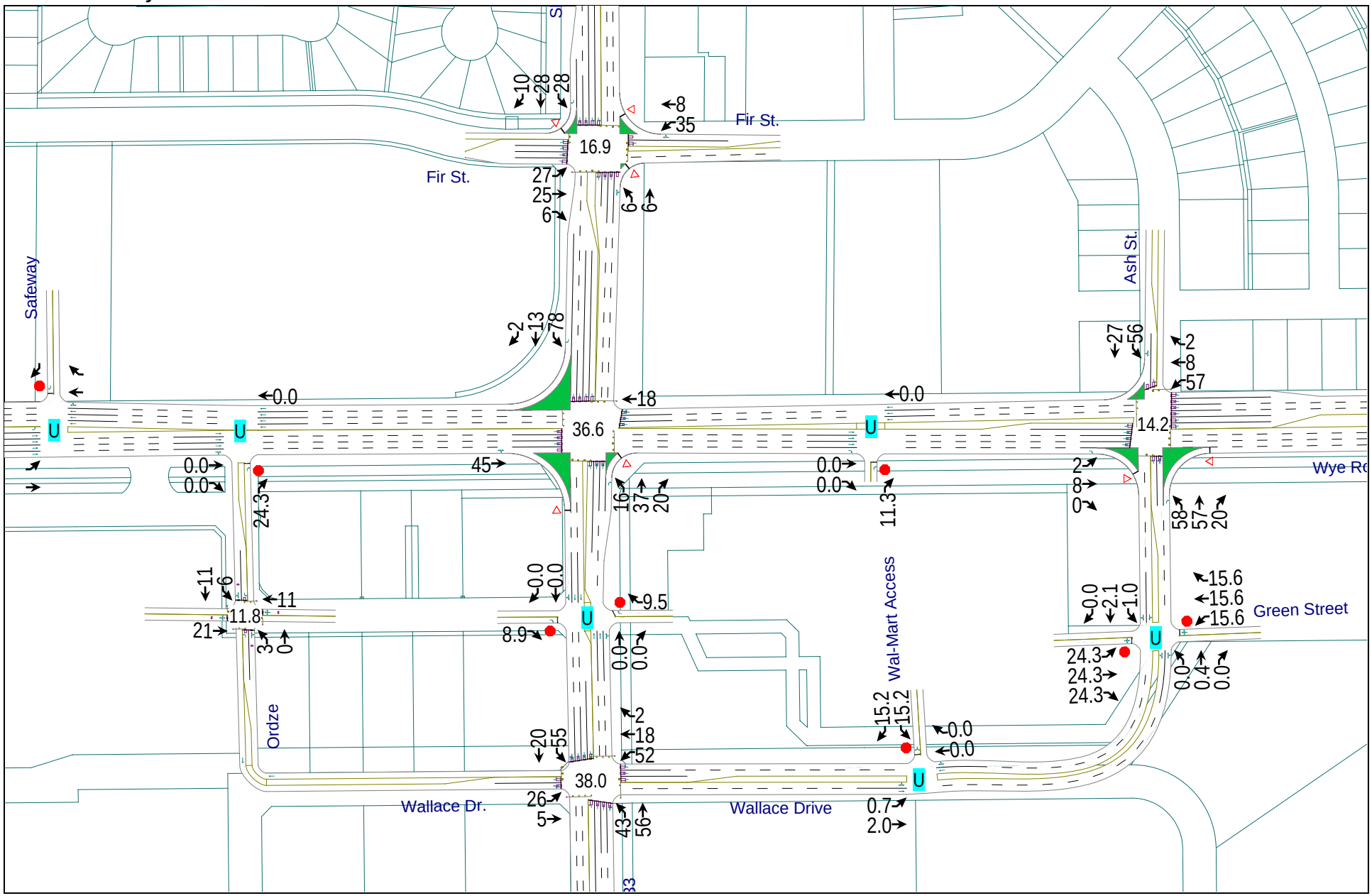
Year 2015 PM peak - Double SBL at Sherwood Dr
EBL and WBL Removed

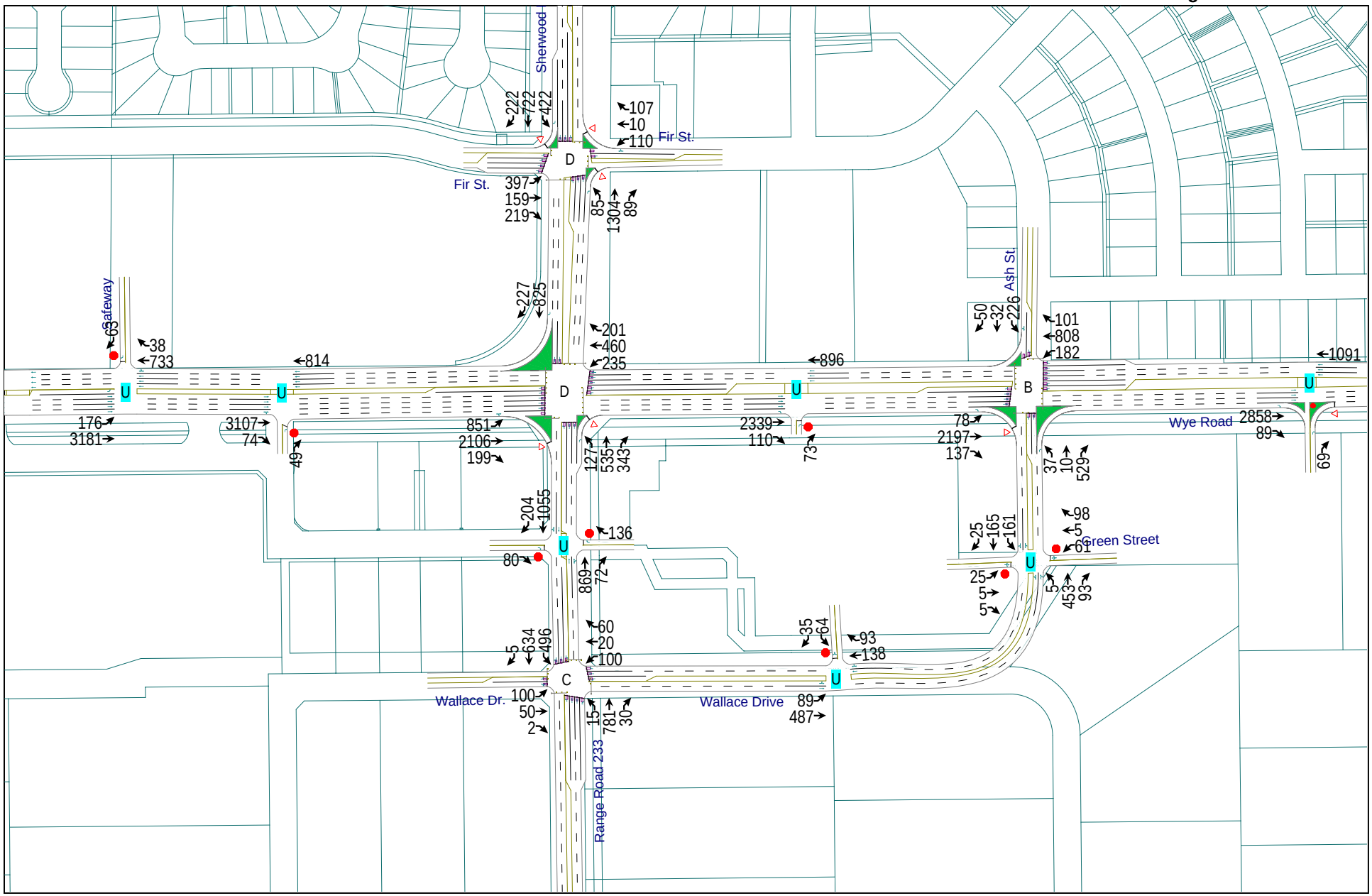


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11/28/2008

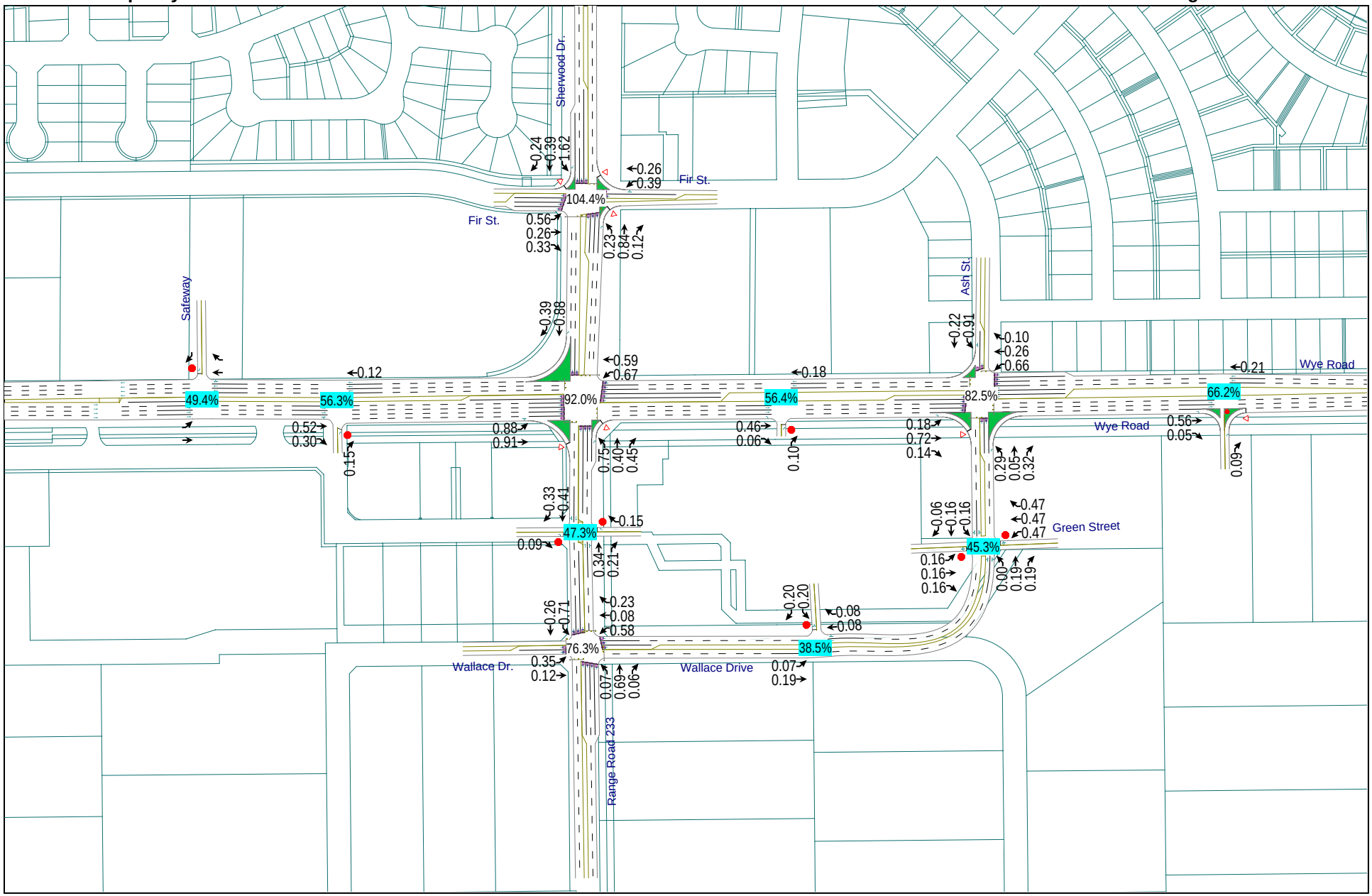

Fir St.
Fir St.
Safeway
Ash St.
Wye Rd
Wal-Mart Access
Green Street
Ordze
Wallace Dr.
Wallace Drive
79.2%
49.4%
58.2%
100.0%
66.5%
89.0%
48.4%
42.1%
93.7%
35.3%


Fir St.
Fir St.
Safeway
Ash St.
Wye Rd
Green Street
Wal-Mart Access
Ordze
Wallace Dr.
Wallace Drive
16.9
36.6
38.0
14.2
11.8
11.3
9.5
8.9
24.3
24.3
24.3
15.6
15.6
15.6
0.0
0.0
0.0


Sherwood
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
D
D
B
C
U
222 722 422
107 10 110
397 159 219
85 1304 89
227 825
201 460 235
814
896
50 32 226
101 808 182
1091
63
38 733
176 3181
3107 74
49
851 2106 199
127 535 343
2339 110
73
78 2197 137
37 10 529
2858 89
69
204 1055
136
80
869 72
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98 5 61
25 5 5
5 453 93
35 64
93 138
60 20 100
5 634 496
100 50 2
15 781 30
89 487

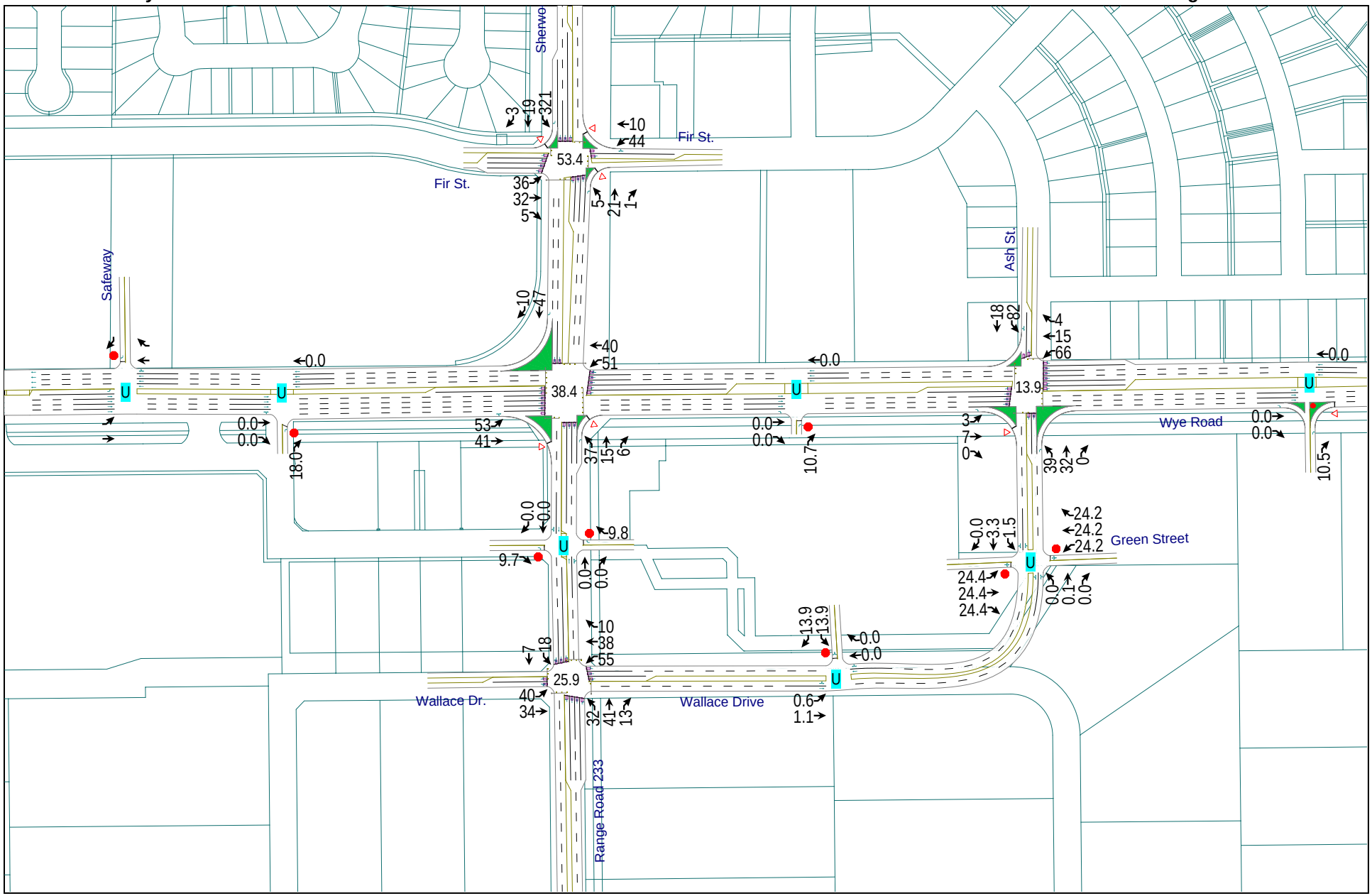
Map - Year 2015 PM peak - SBL removed at Sherwood Dr
Volume to Capacity Ratios

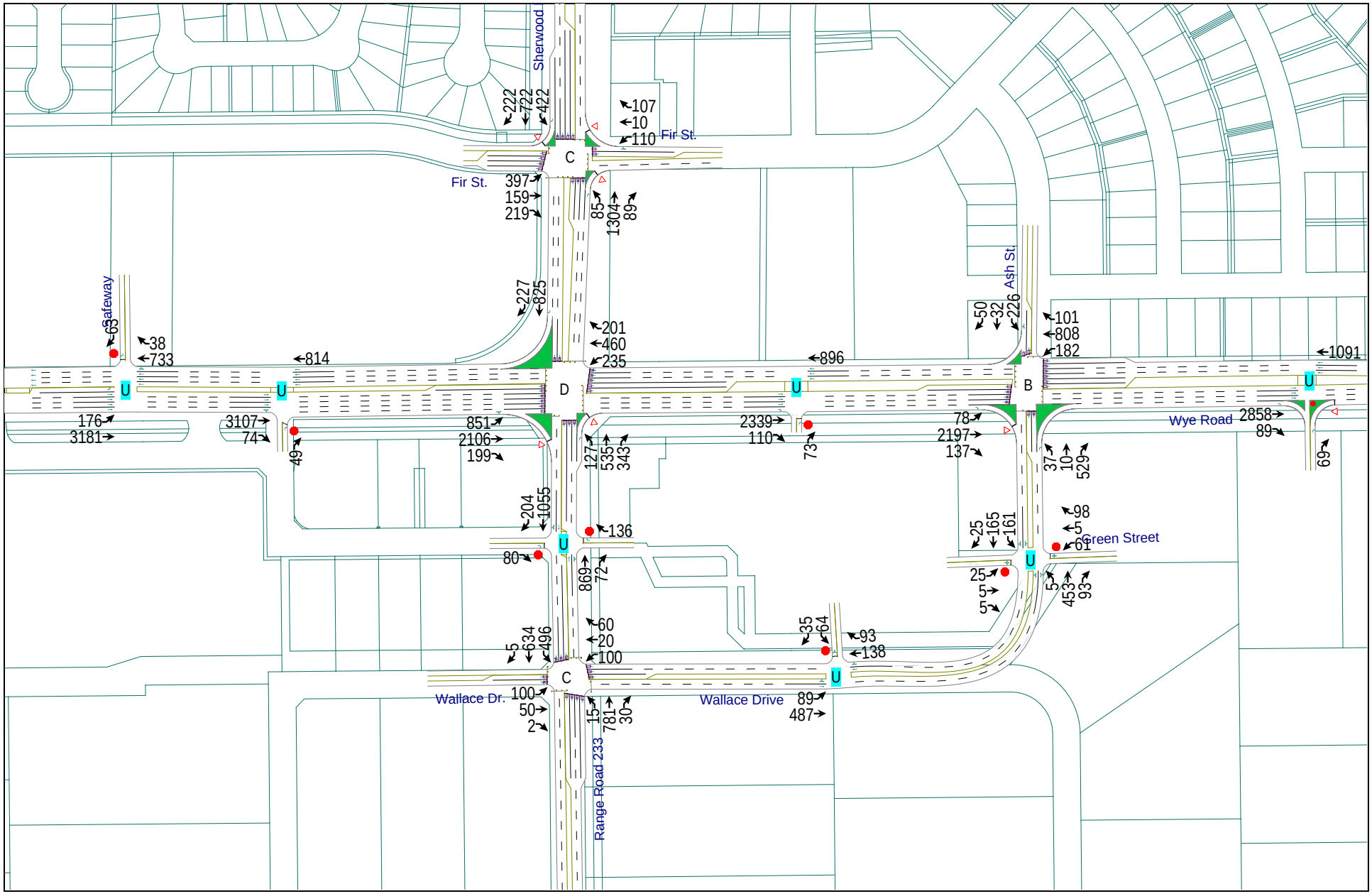
Year 2015 PM peak - SBL removed at Sherwood Dr
Single Left at Fir Street

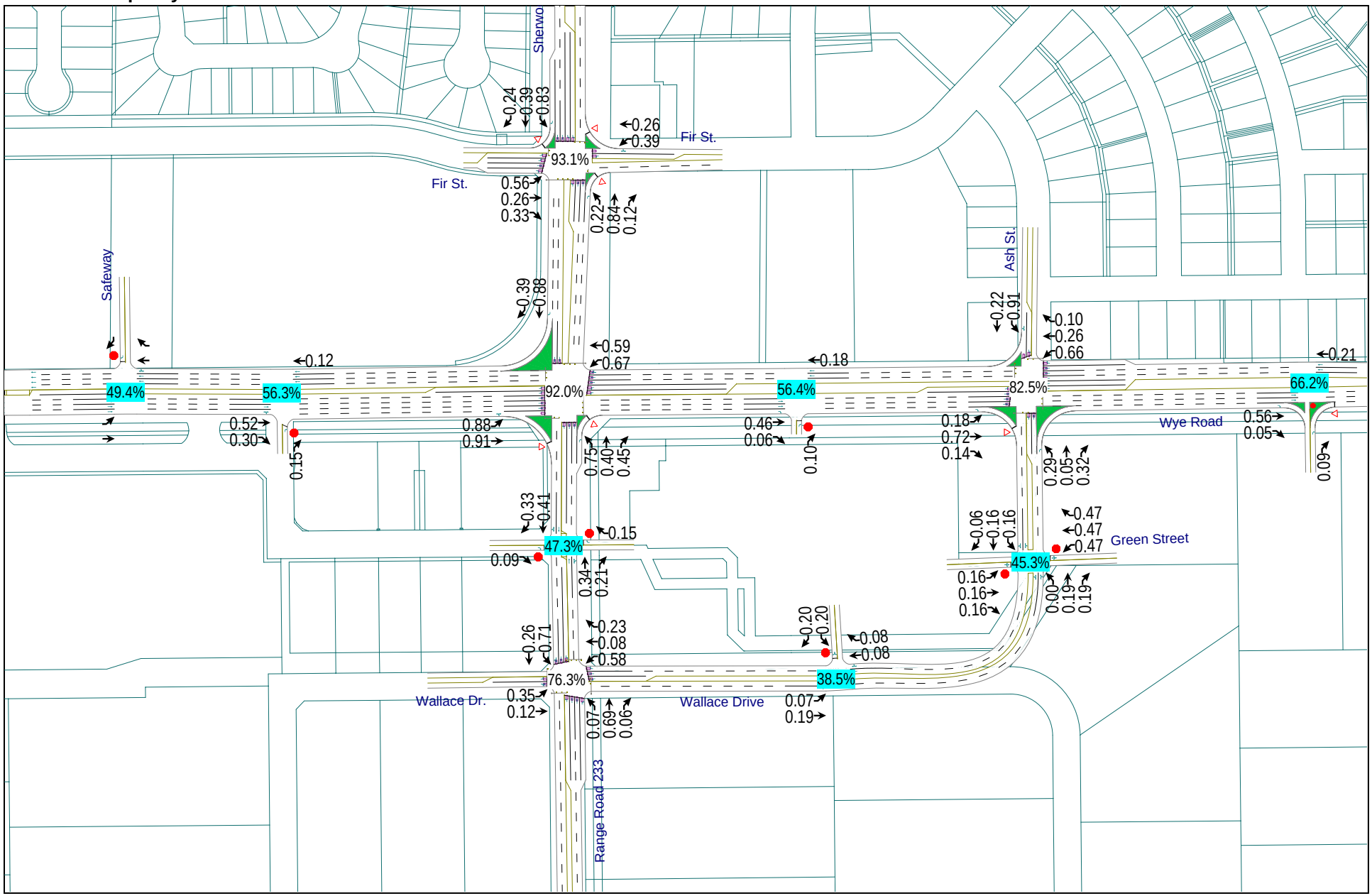


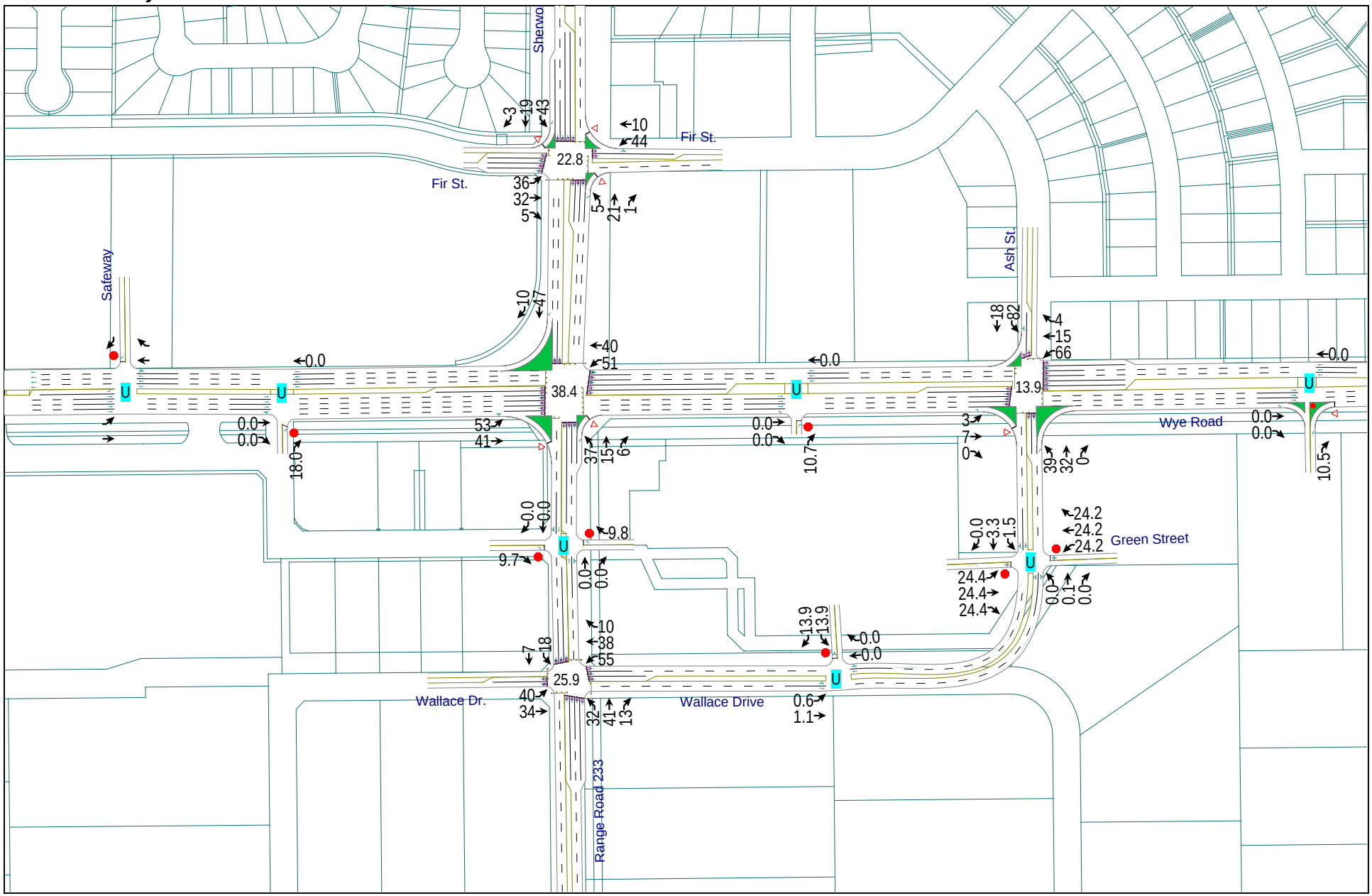
F:\Strathcona County\1149 - Wye Road\FPS Report Nov 2008\Pdf Exhibits\Synchro Files\Wye & Sherwood Year 2015 PM Peak Option 4a.syn

12/5/2008


Sherwo
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
53.4
38.4
13.9
25.9
3 19 321
10 44
36 32 5
5 21 1
10 47
40 51
18 82
4 15 66
0.0
53 41
18.0
37 15 6
10.7
3 7 0
39 32 0
10.5
0.0 0.0 9.8
9.7
0.0 3.3 1.5
24.2 24.2 24.2
24.4 24.4 24.4
0.0 0.1 0.0
13.9 13.9
0.0 0.0
7 18
10 38 55
40 34
32 41 13
0.6 1.1
U

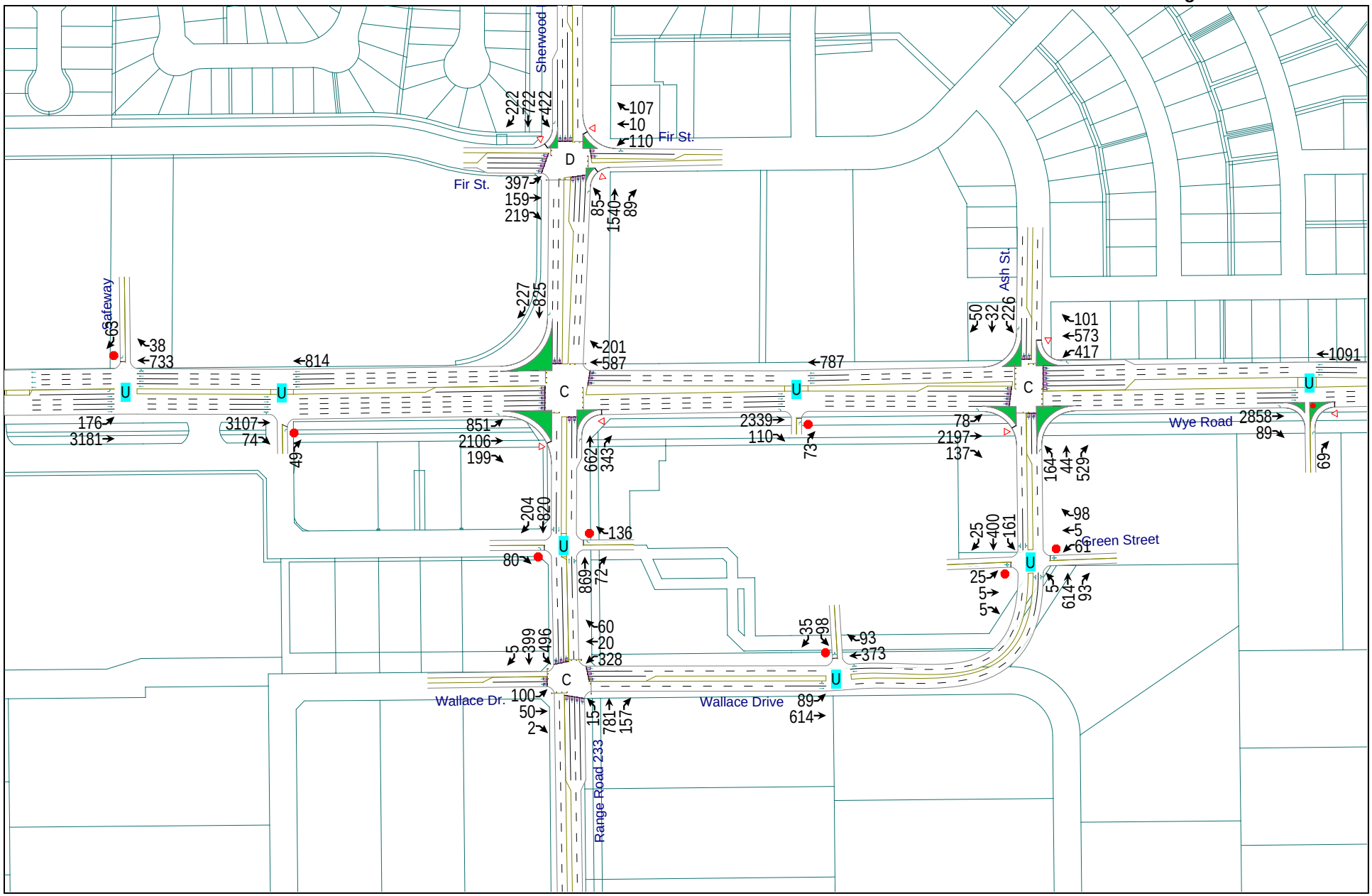

Sherwood
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
C
D
B
C
U
222
722
422
107
10
110
397
159
219
85
1304
89
227
825
201
460
235
896
50
32
226
101
808
182
1091
63
38
733
814
176
3181
3107
74
49
851
2106
199
127
535
343
2339
110
73
78
2197
137
2858
89
69
37
10
529
204
1055
136
80
869
72
25
165
161
98
5
61
25
5
5
5
453
93
35
64
93
138
5
634
496
60
20
100
100
50
2
15
781
30
89
487


Sherwo
Fir St.
Fir St.
93.1%
Safeway
Ash St.
49.4%
56.3%
92.0%
56.4%
82.5%
66.2%
Wye Road
47.3%
Green Street
45.3%
76.3%
38.5%
Wallace Dr.
Wallace Drive
Range Road 233


Sherwo
Fir St.
Fir St.
Safeway
Ash St.
Wye Road
Green Street
Wallace Dr.
Wallace Drive
Range Road 233
3
19
43
10
44
22.8
36
32
5
5
21
1
10
47
40
51
38.4
0.0
0.0
0.0
0.0
0.0
0.0
18
82
4
15
66
13.9
0.0
0.0
0.0
53
41
18.0
37
15
6
10.7
3
7
0
39
32
0
10.5
0.0
0.0
0.0
0.0
9.8
9.7
0.0
0.0
0.0
3.3
1.5
24.2
24.2
24.2
24.4
24.4
24.4
0.0
0.1
0.0
13.9
13.9
0.0
0.0
7
18
10
38
55
25.9
40
34
32
41
13
0.6
1.1
U

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Levels of Service

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street

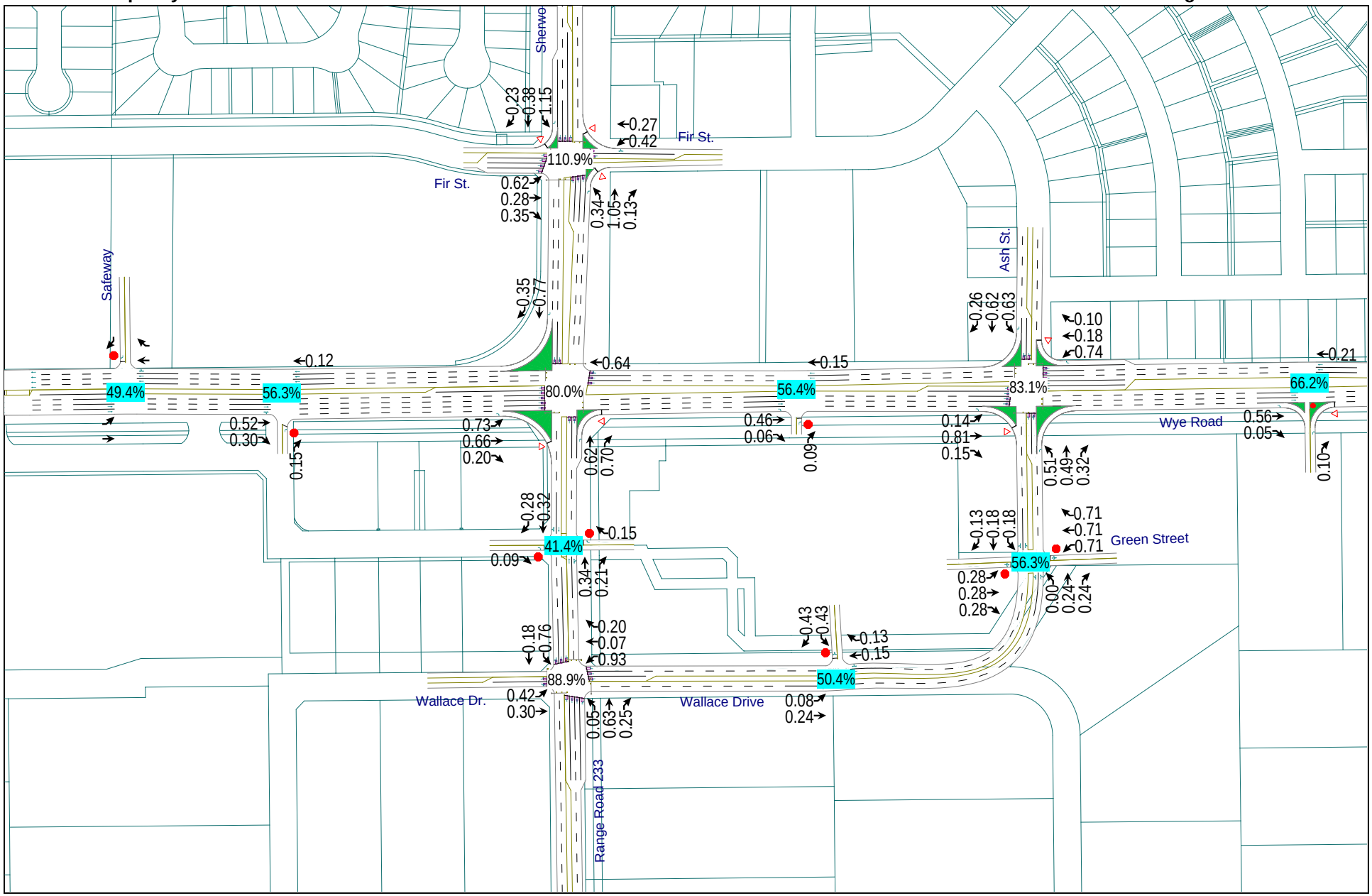


F:\Strathcona County\1149 - Wye Road\FPS Report Nov 2008\Pdf Exhibits\Synchro Files\Wye & Sherwood Year 2015 PM Peak Option 5a.syn

12/8/2008

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Volume to Capacity Ratios

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street

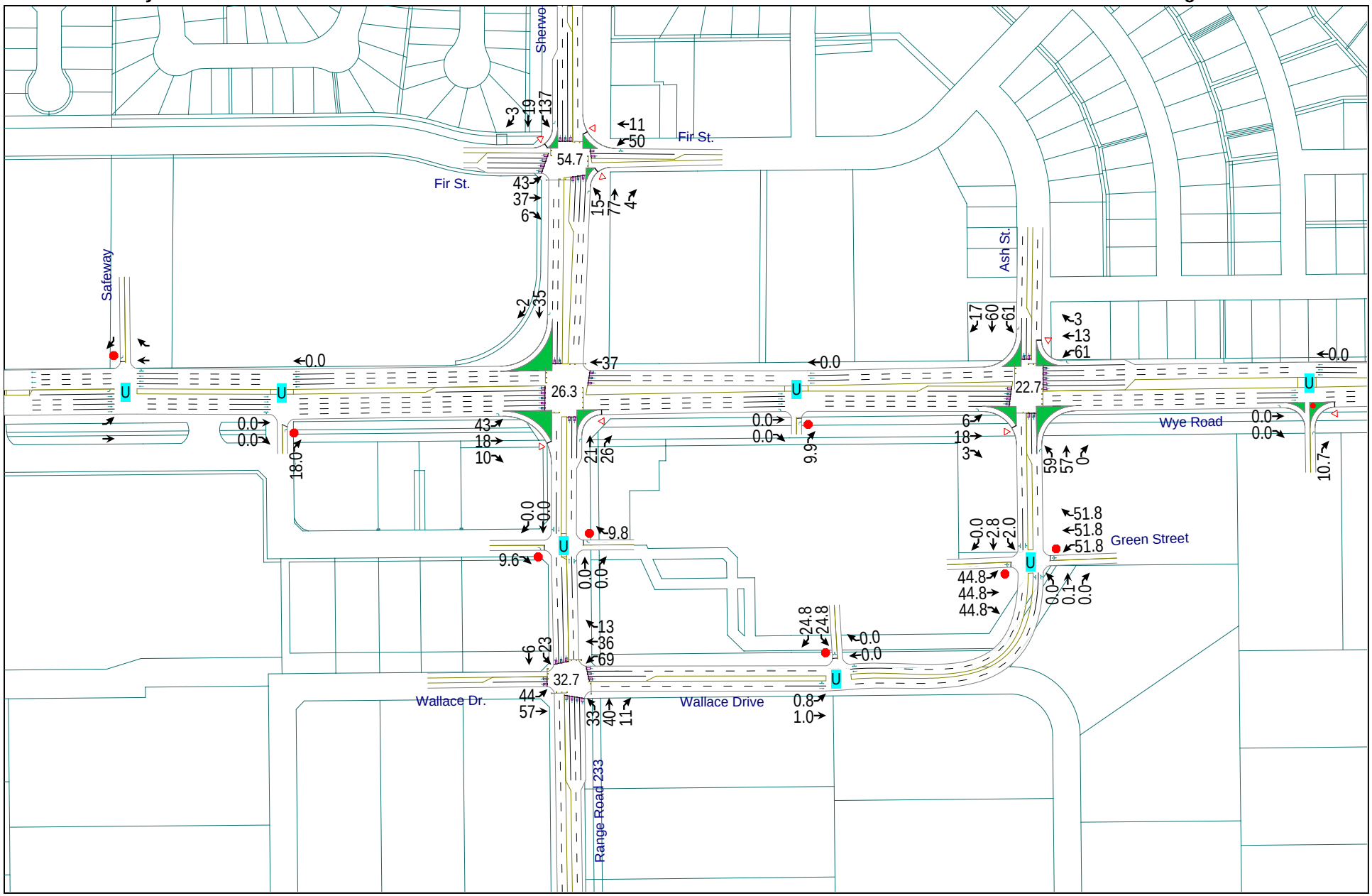


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12/8/2008

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Movement Delay

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street

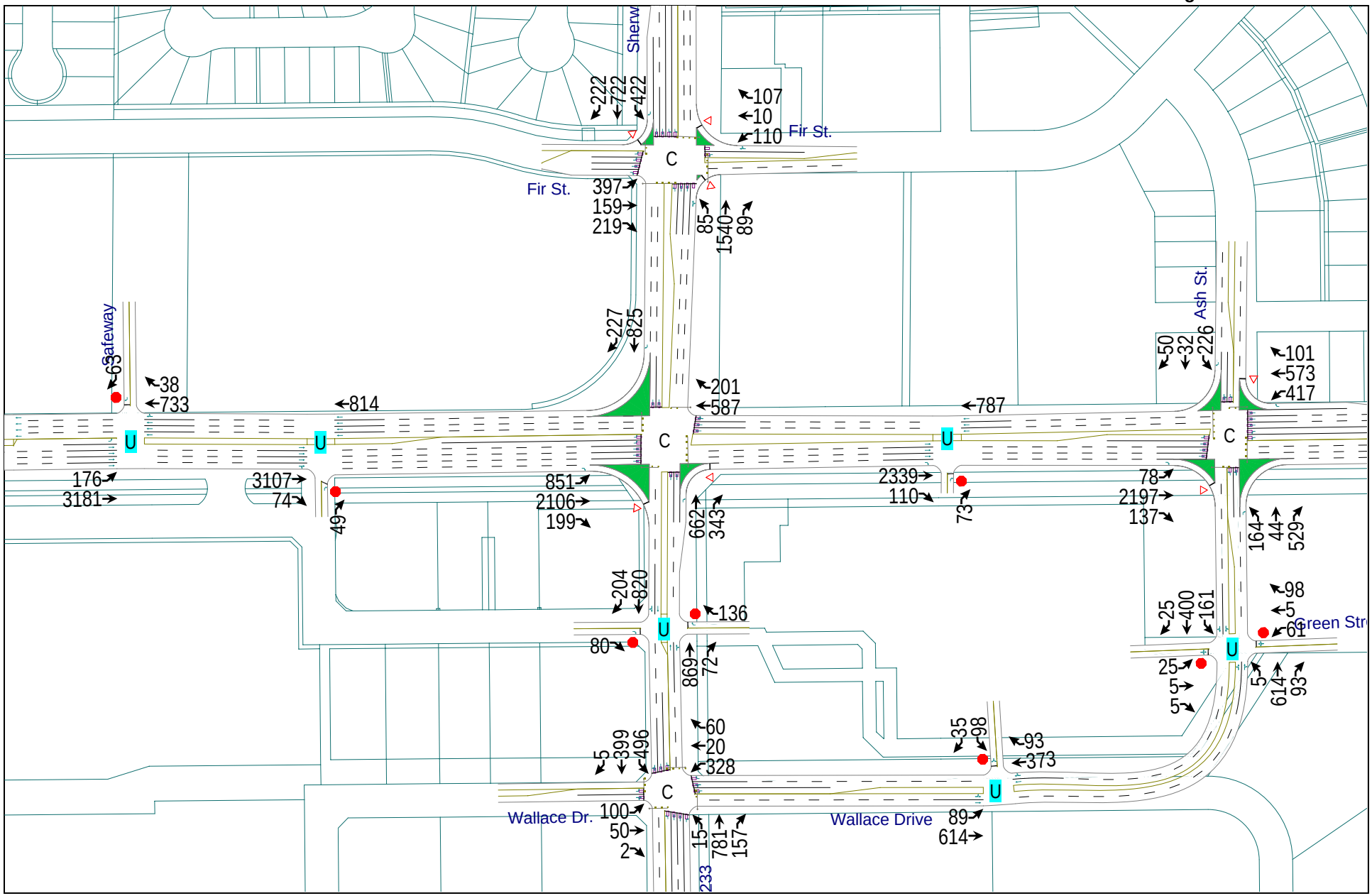


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12/8/2008

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Levels of Service

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street

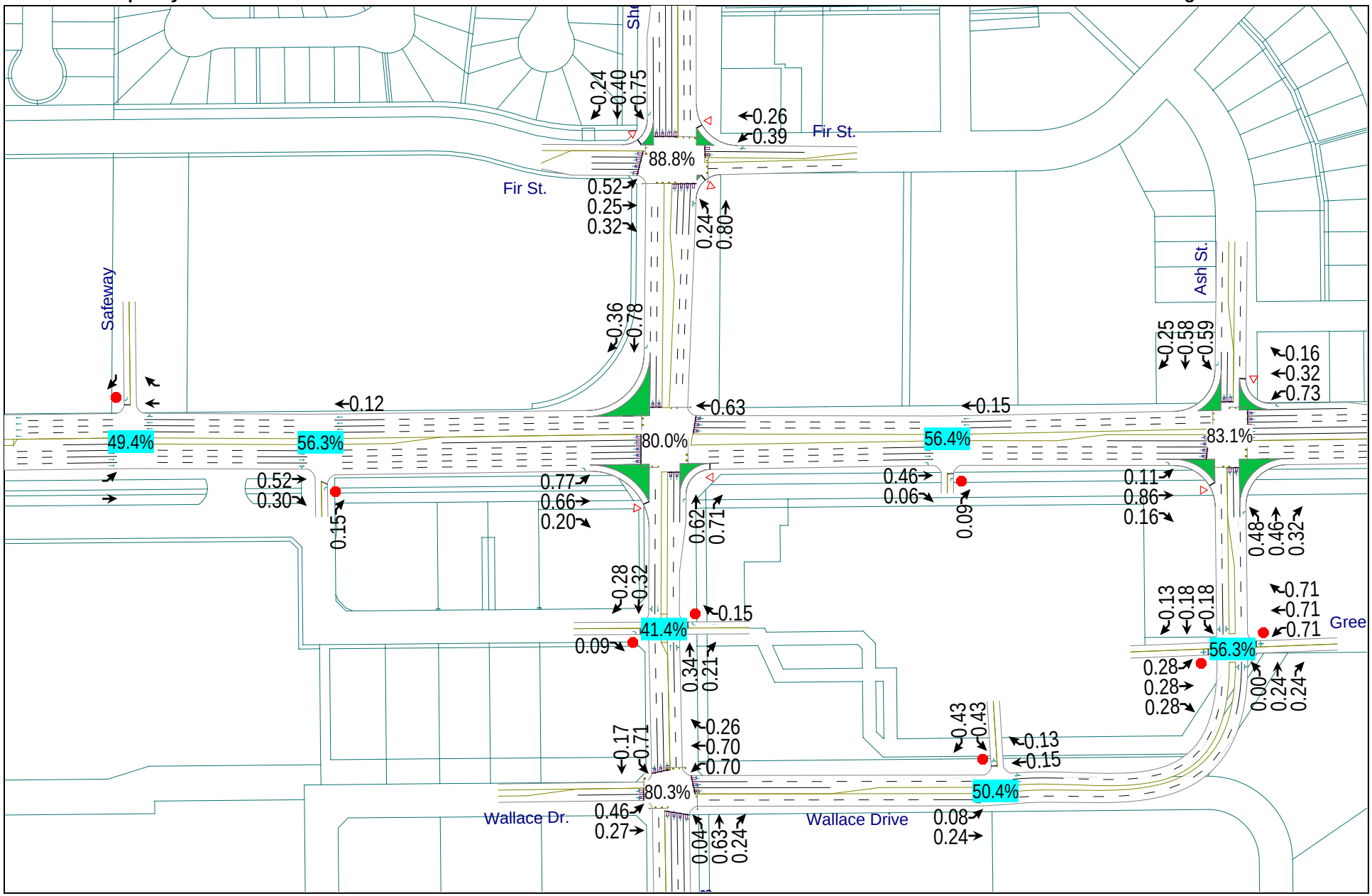


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12/8/2008

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Volume to Capacity Ratios

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street

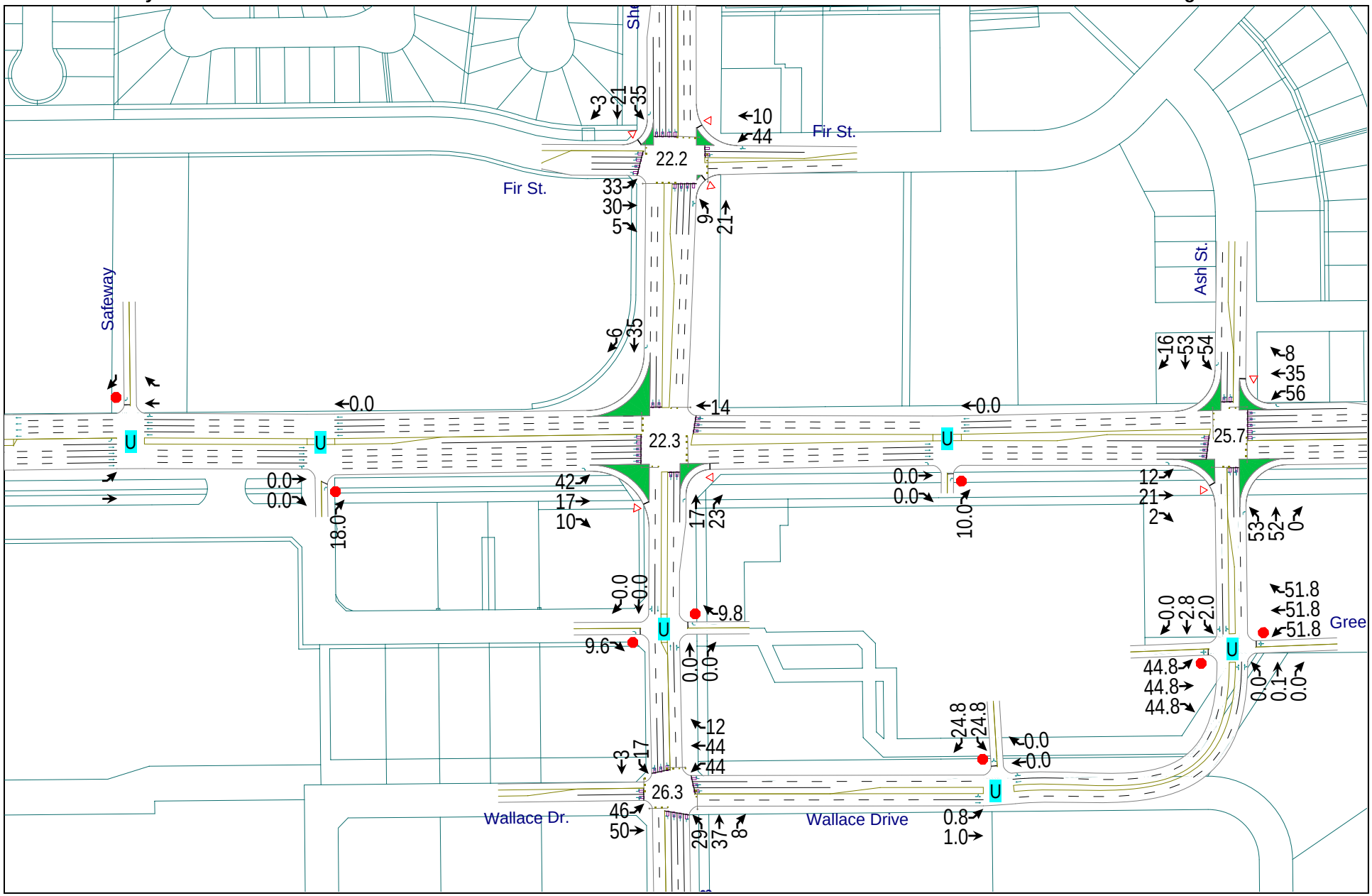


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12/8/2008

Map - Year 2015 PM peak - Only EBL at Sherwood Dr
Movement Delay

Year 2015 PM peak - Only EBL at Sherwood Dr
Single SBL at Fir Street



F:\Strathcona County\1149 - Wye Road\FPS Report Nov 2008\Pdf Exhibits\Synchro Files\Wye & Sherwood Year 2015 PM Peak Option 5b.syn

12/8/2008

Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

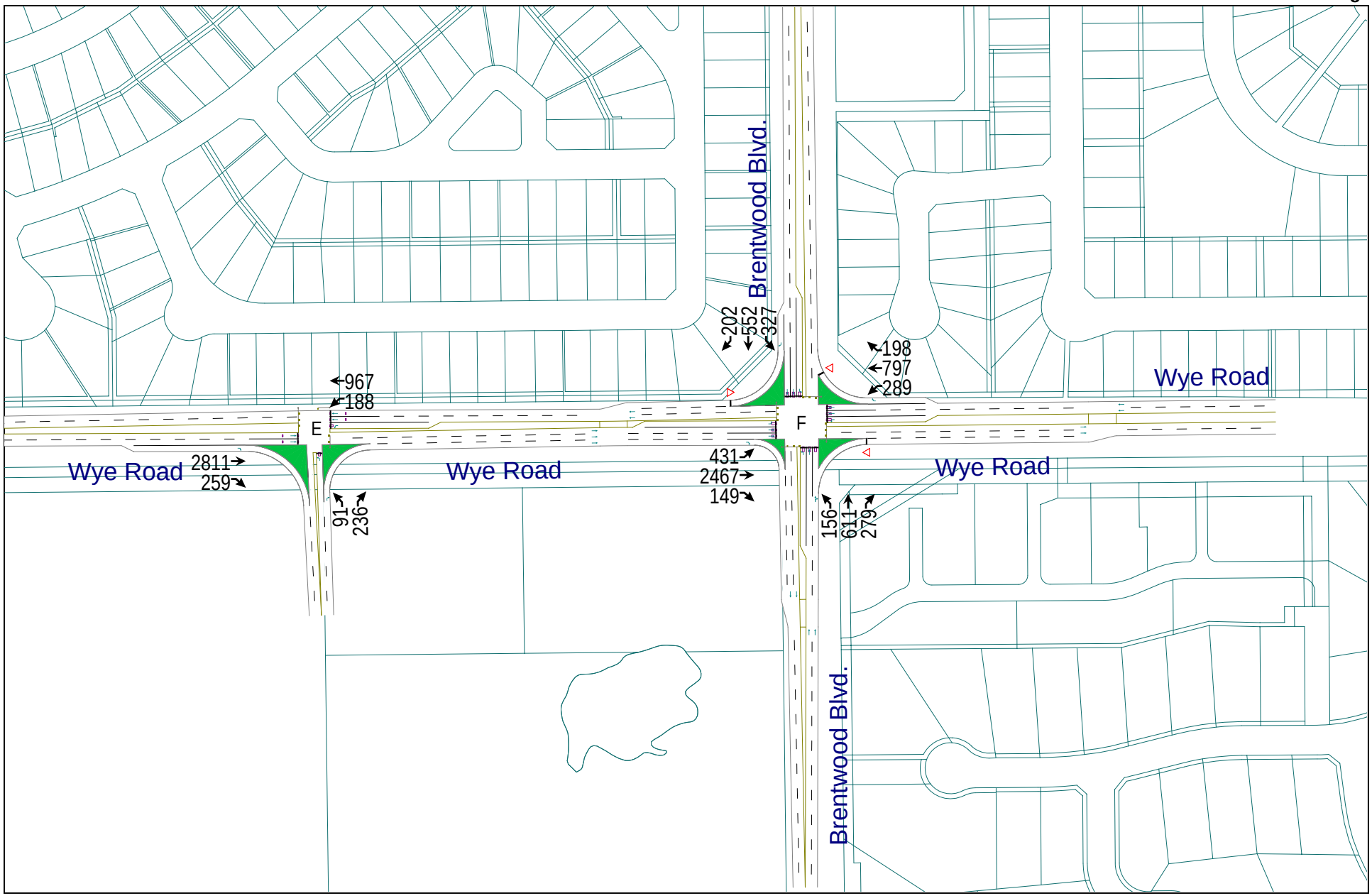
Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Do Nothing No improvements to existing intersection	**ICU 141.5% LOS H** SBL v/c = 1.40 EBT v/c = 1.29 **LOS F** Intersection Average Delay = 116.1 s/veh	▪ Intersection over capacity, congestion periods over 120 min, long queues, etc.
Option A - 1 Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes WBL – 2 lanes EBL – 2 lanes	**ICU 110.9% - ICU LOS H** SBL v/c= 1.25 EBT v/c = 1.05 WBL v/c = 1.27 **LOS E** Intersection Average Delay = 56.6 s/veh Critical Movement - WBL Average Delay = 201 s/veh (LOS F)	▪ Intersection over capacity, congestion periods over 120 min, long queues, etc.
Option A - 2 Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes WBL – 2 lanes EBL – 2 lanes SBL – 2 lanes	**ICU 102.1% - ICU LOS G** EBT v/c = 0.98 SBL v/c = 1.07 WBL v/c = 0..95 **LOS D** Intersection Average Delay = 39.7 s/veh Critical Movement - SBL Average Delay = 112 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min, long queues ▪ Motorists would use different routs or time of travel.
Option B-1 Jughandle in SW quadrant Increased Number of Lanes WBT/EBT – 3 lanes SBT/NBT – 2 lanes SBL – 1 lane WB and EB Left Turns removed	**ICU 99.5% - ICU LOS F** SBL v/c = 1.41 EBT v/c = 1.07 **LOS D** Intersection Average Delay = 46.9 s/veh Critical Movement - SBL Average Delay = 230 s/veh (LOS F)	▪ Intersection over capacity and likely experiences 15 to 60 min of congestion, residual queues at the end of the cycle is common ▪ Minor traffic fluctuation, accidents, andlane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required

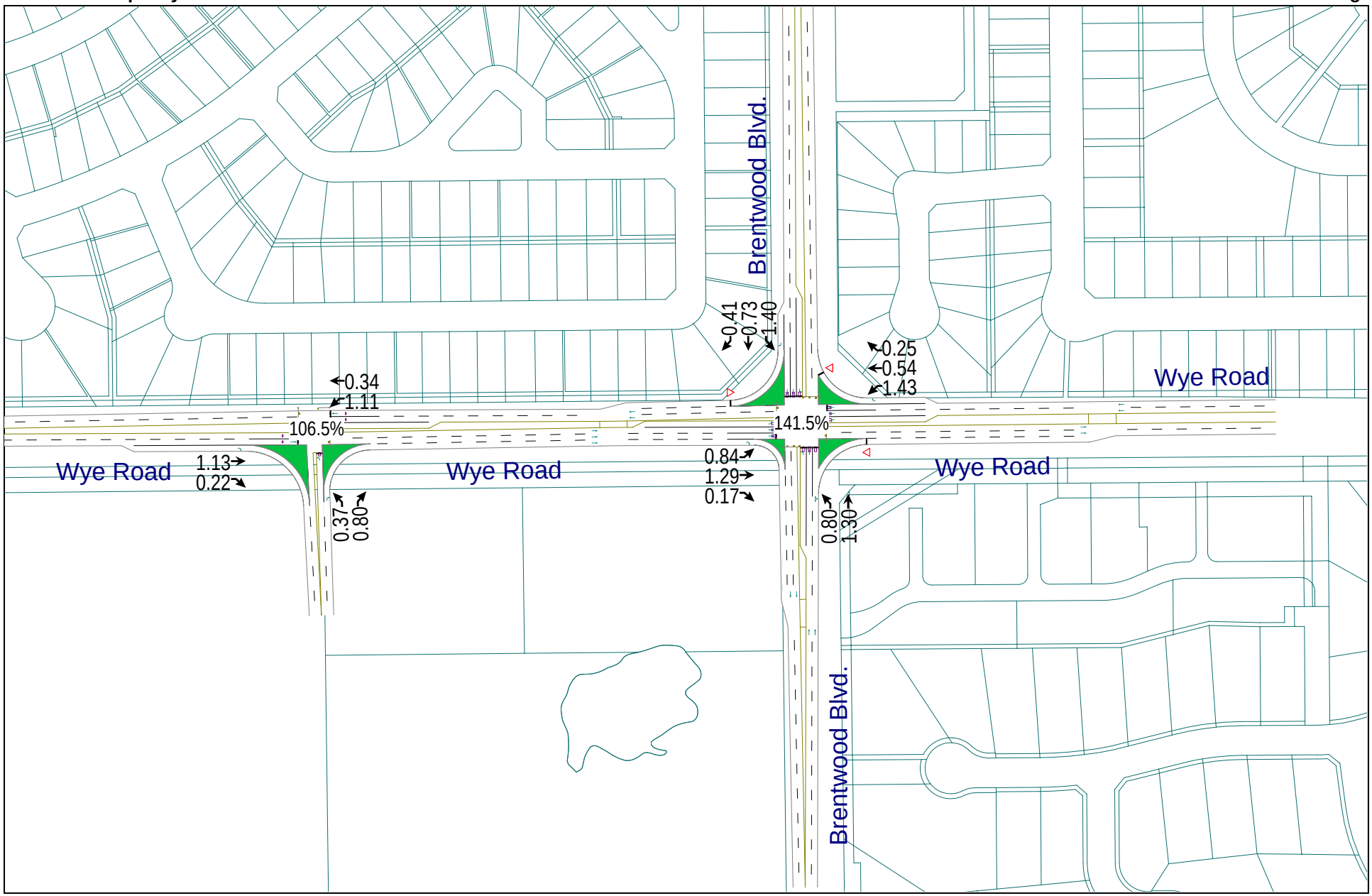
Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

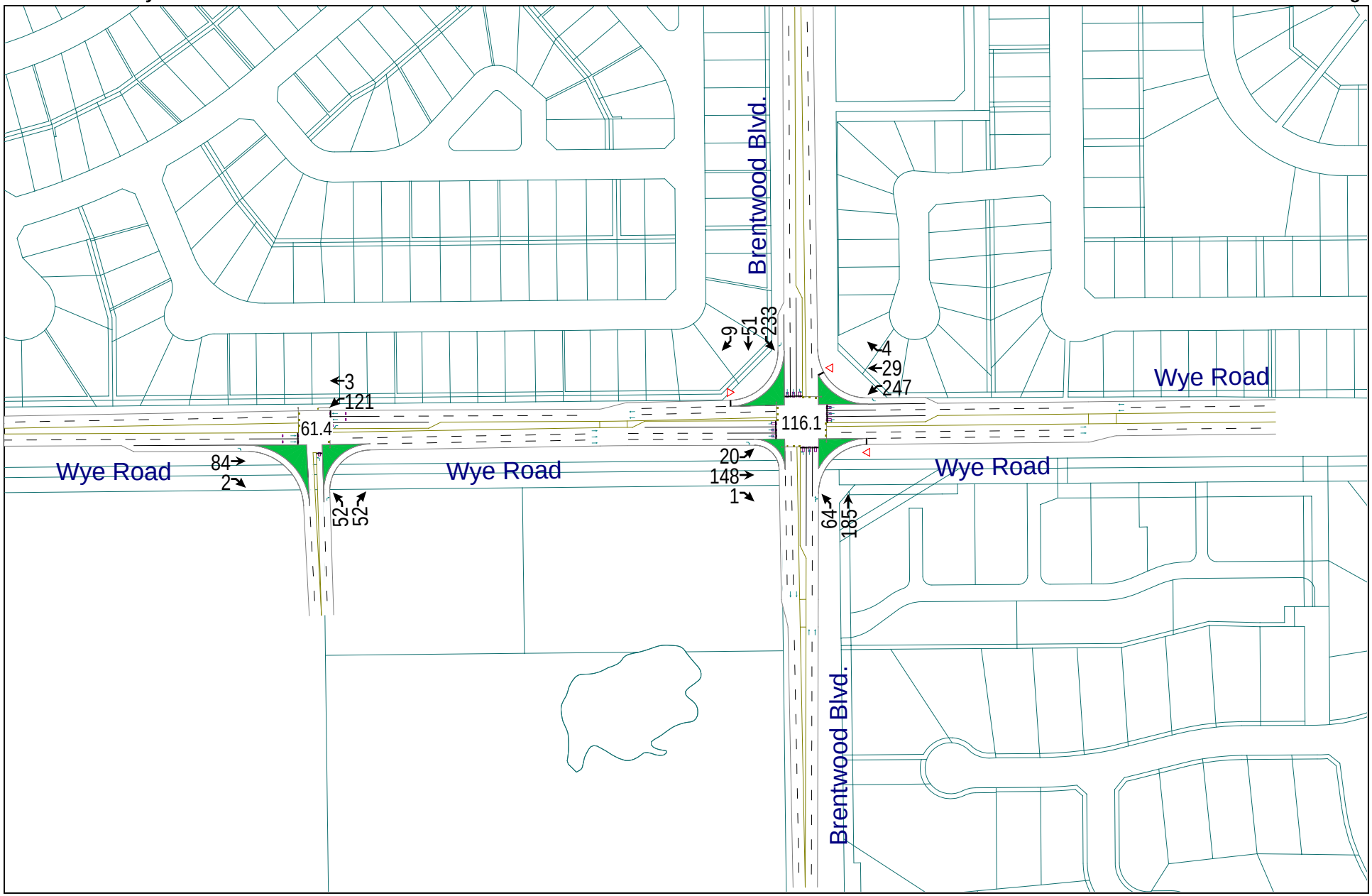
Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option B-2 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes SBL – 2 lanes WB and EB Left Turns removed	**ICU 90.7% - ICU LOS E** EBT v/c = 1.01 **LOS C** Intersection Average Delay = 28.4 s/veh Critical Movement – SBL at Jughandle Average Delay = 53 s/veh (LOS D)	▪ Intersection is right on the verge of congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause increased congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option B-3 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes SBL – 1 lanes WB and EB Left Turns removed	**ICU 98.1% - ICU LOS F** EBT v/c = 1.00 SBL v/c = 1.23 **LOS C** Intersection Average Delay = 34.2 s/veh Critical Movement - SBL Average Delay = 160 s/veh (LOS F)	▪ Intersection over capacity and likely experiences 15 to 60 min of congestion ▪ Residual queues at the end of each cycle ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option C-1 Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes Only EBL to NB Retained (single lane) Other movements accommodated through Jughandle	**ICU 86.1% - ICU LOS E** EBT v/c = 0.90 SBT v/c = 0.90 **LOS C** Intersection Average Delay = 24.2 s/veh Critical Movement - SBT Average Delay = 52.7 s/veh (LOS D) Jughandle/Wye Rd Intersection **ICU 89.7%** Single WBL v/c = 0.92, Average Delay 60 s/veh. LOS E, queues 95th % ~ 90 m	▪ Intersection is right on the verge of congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause increased congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required

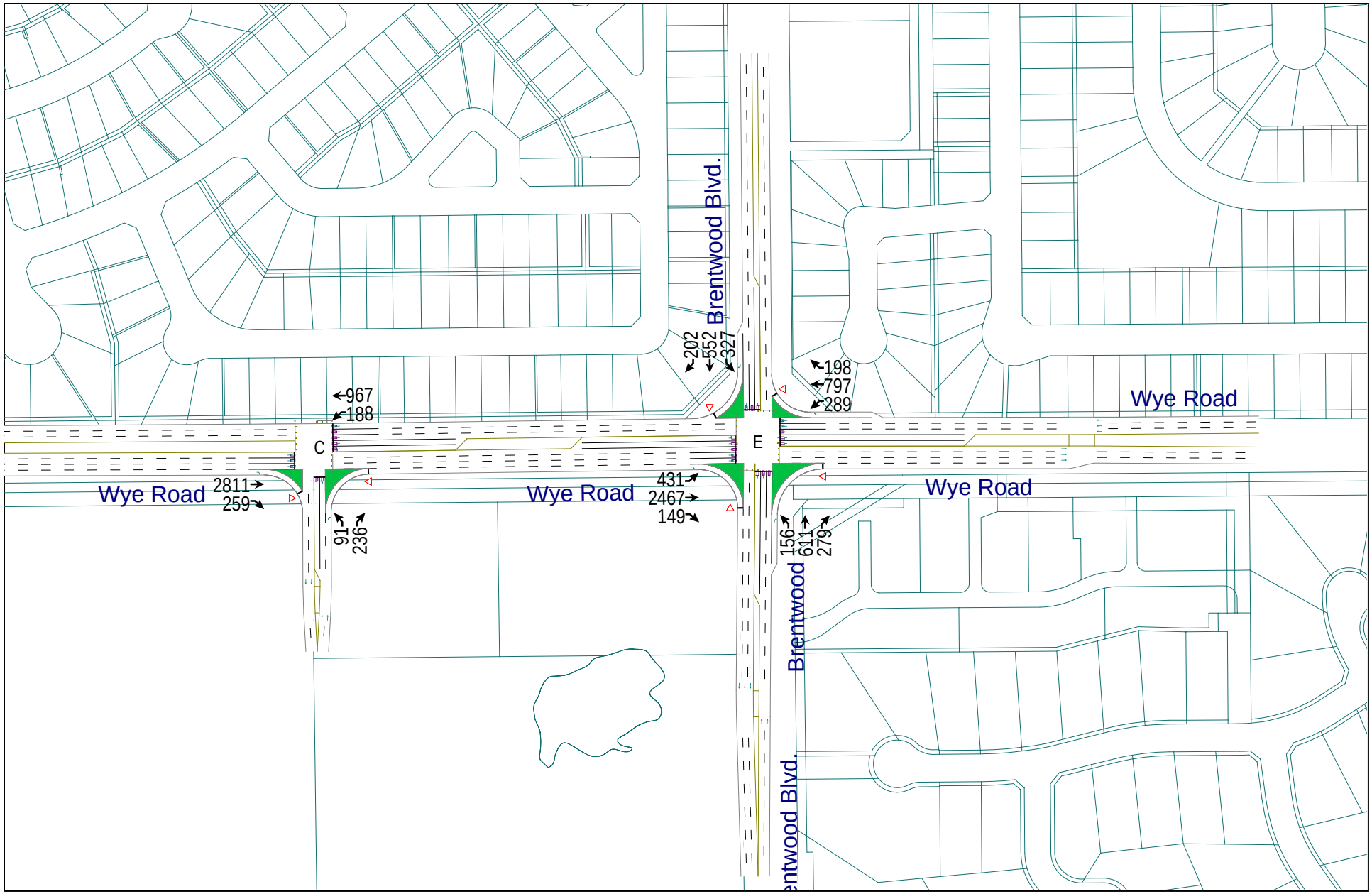
Wye Road/Brentwood Boulevard Intersection **Table 4.4**
Option Evaluation

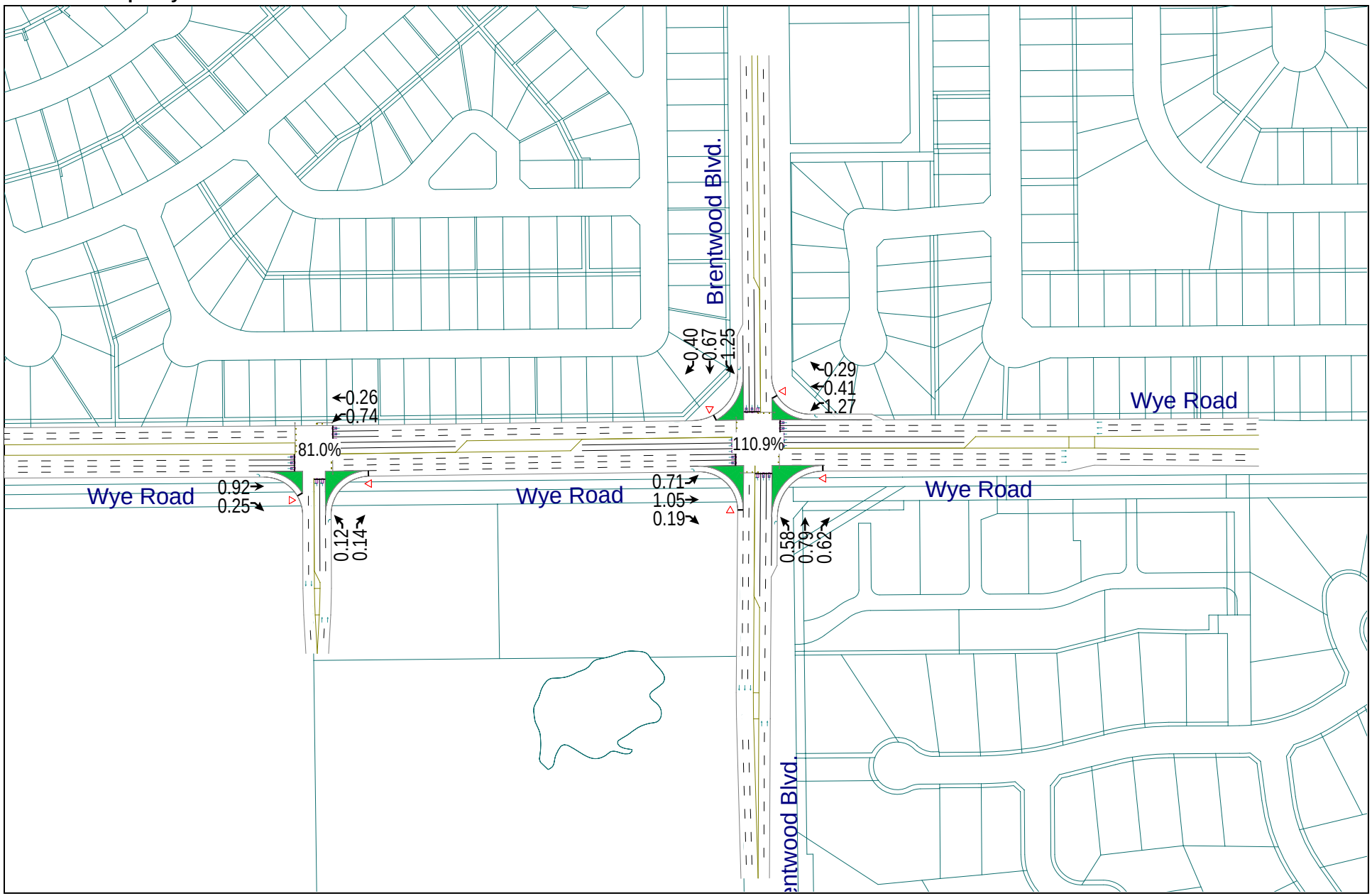
Option Year 2015 Traffic Volumes	Level of Service	Operations Additional Requirements
Option C-2 - Recommended Jughandle in SW quadrant Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes Only EBL to NB Retained (single lane) Other movements accommodated through Jughandle	**ICU 81.6% - ICU LOS D** EBT v/c = 0.93 **LOS C** Intersection Average Delay = 21.0 s/veh Critical Movement - SBT Average Delay = 39.0 s/veh (LOS D) Jughandle/Wye Rd Intersection ICU 89.78%, NBL v/c 0.95 Double WBL, LOS E	▪ Intersection normally has no congestion ▪ Minor traffic fluctuation, accidents, and lane closure may cause some congestion ▪ Spare capacity ~ 10% Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option D NBL and EBL removed SBT/NBT – 2 lanes WBT/EBT – 3 lanes Removed Left Turn Movements accommodated through Jughandle	**ICU 89.7% - ICU LOS E** EBT v/c = 0.93 **LOS C** Intersection Average Delay = 27.7 s/veh Critical Movement - NBT Average Delay = 59.0 s/veh (LOS E) Intersection Wye Rd./Jughandle ICU LOS 89.7%, EBT v/c 0.94, WBL v/c 0.91	▪ Wye Road Intersections on the verge of congestion condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required
Option E All left Turn Removed Increased Number of Lanes SBT/NBT – 3 lanes WBT/EBT – 3 lanes All Left Turn Movements accommodated through Jughandle	**ICU 84.3% - ICU LOS E** EBT v/c = 0.91 **LOS C** Intersection Average Delay = 20.8 s/veh Critical Movement - NBT Average Delay = 48 s/veh (LOS D)	▪ Wye Road Intersections on the verge of congestion condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Additional Signals at Jughandle/Wye and Jughandle/Brentwood Required Stop Controlled Intersection at Jughandle over capacity
Option F 4/5 lane Roundabout Approach Lanes – 4&5 Exit Lanes 3&4 In addition to exclusive right turns	NB v/c = 1.02	Very Complex Intersection - not suitable for the road function and traffic distribution

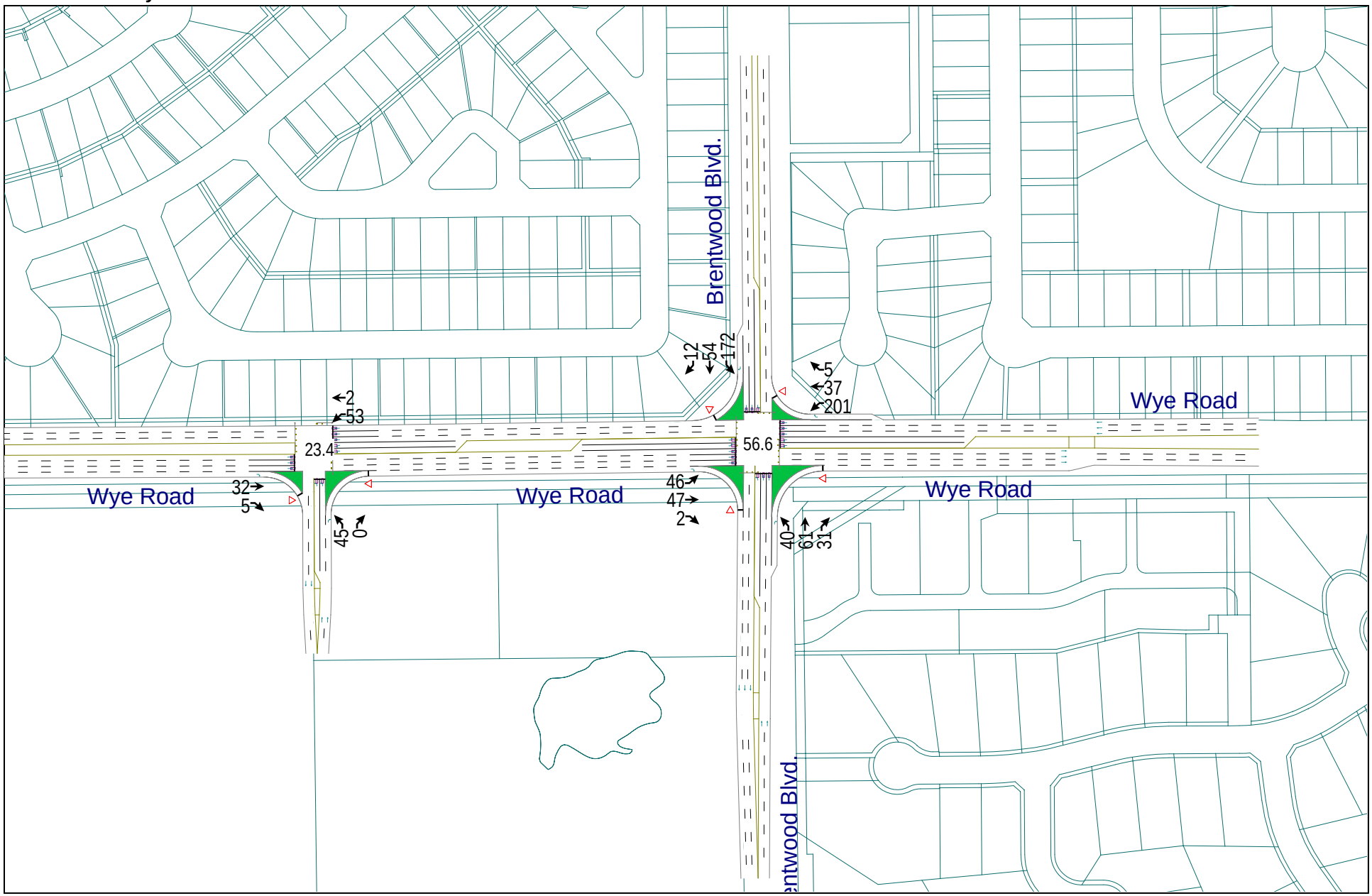

Brentwood Blvd.
202
552
327
198
797
289
Wye Road
967
188
E
F
Wye Road
2811
259
Wye Road
431
2467
149
Wye Road
91
236
156
611
279
Brentwood Blvd.

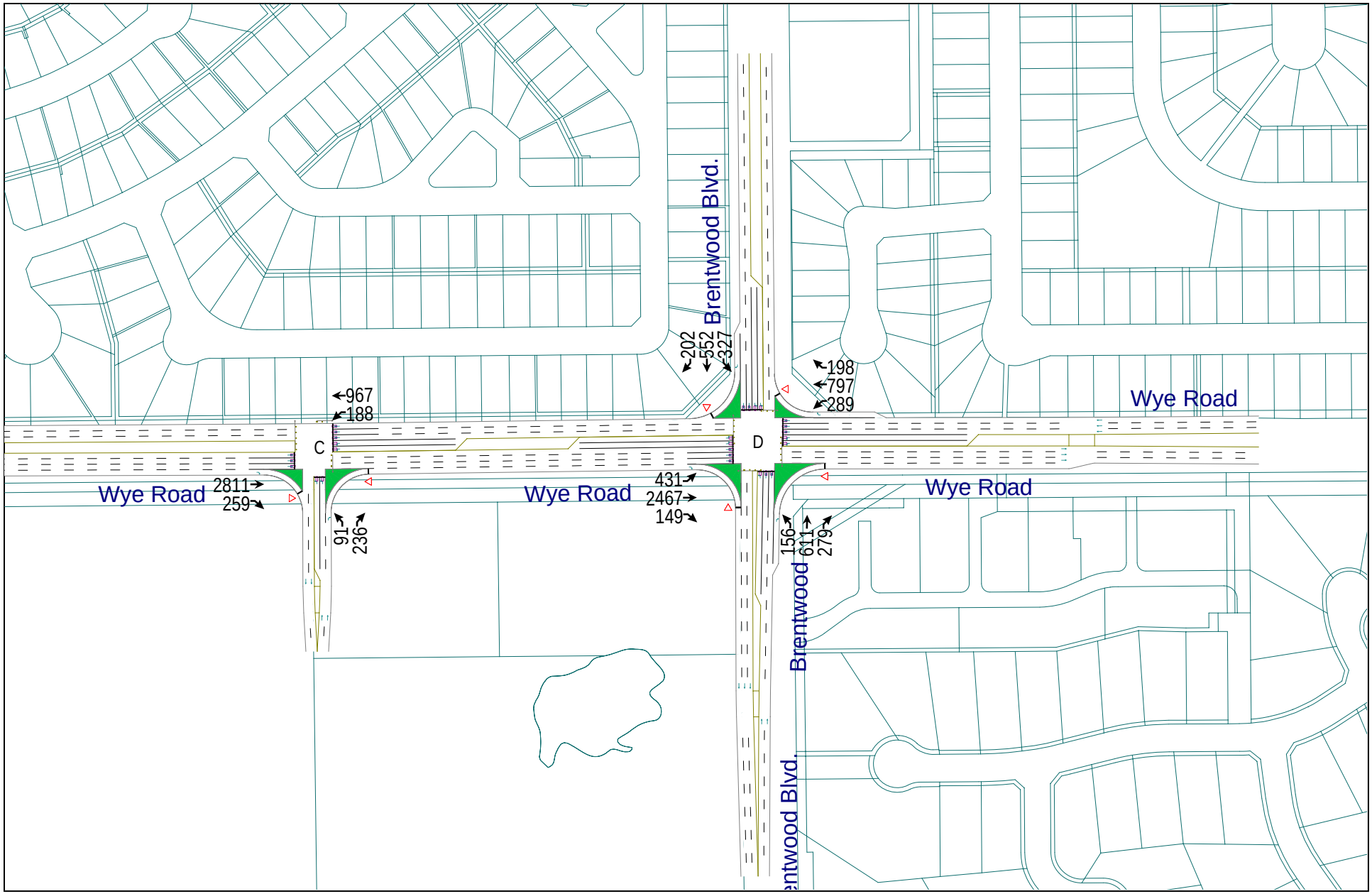

Brentwood Blvd.
0.41
0.73
1.40
0.25
0.54
1.43
Wye Road
0.34
1.11
106.5%
141.5%
Wye Road
1.13
0.22
Wye Road
0.84
1.29
0.17
Wye Road
0.37
0.80
0.80
1.30
Brentwood Blvd.

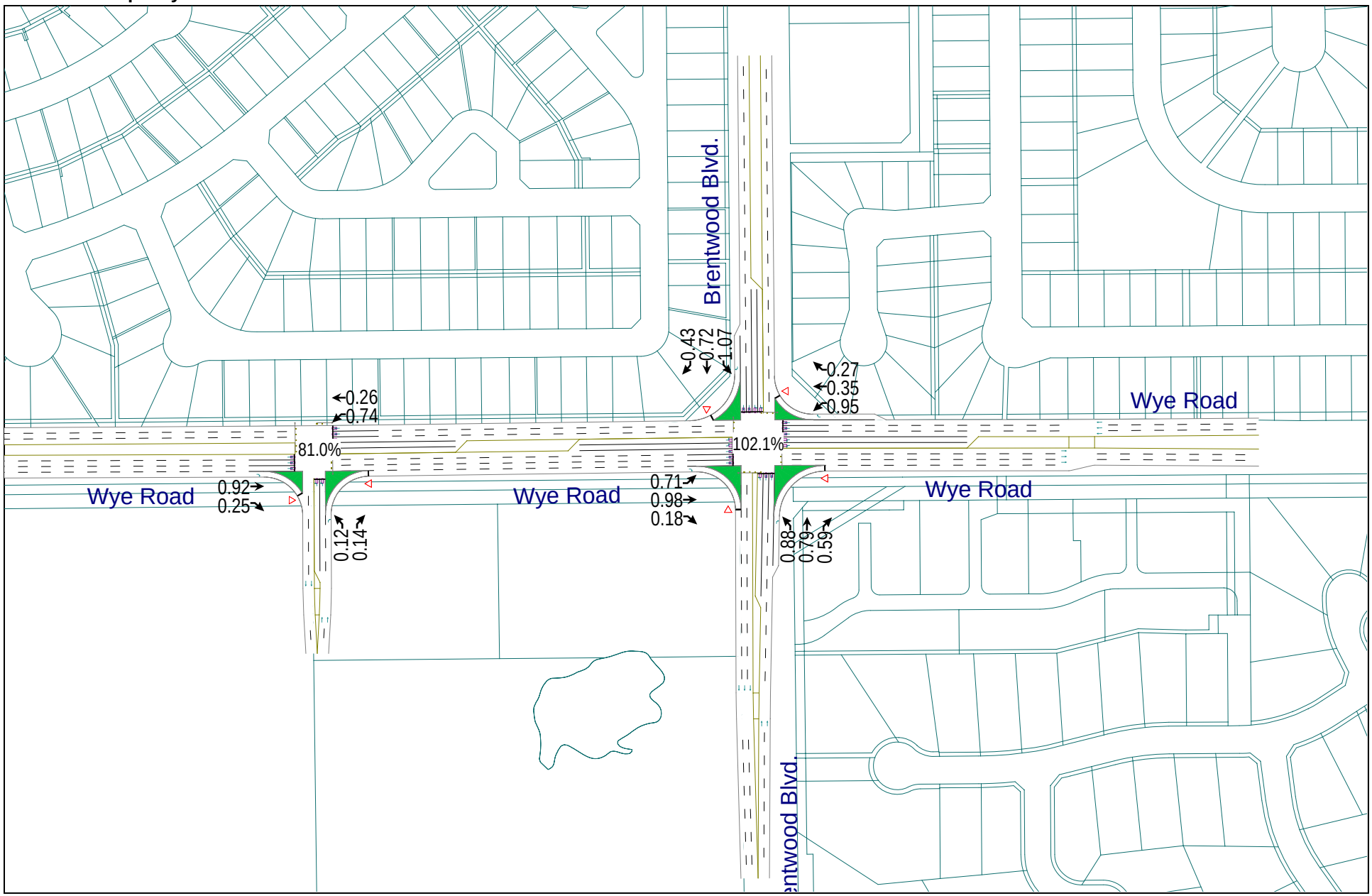

Brentwood Blvd.
Wye Road
Wye Road
Wye Road
Wye Road
Brentwood Blvd.
9
51
233
4
29
247
3
121
61.4
116.1
84
2
20
148
1
52
52
64
185

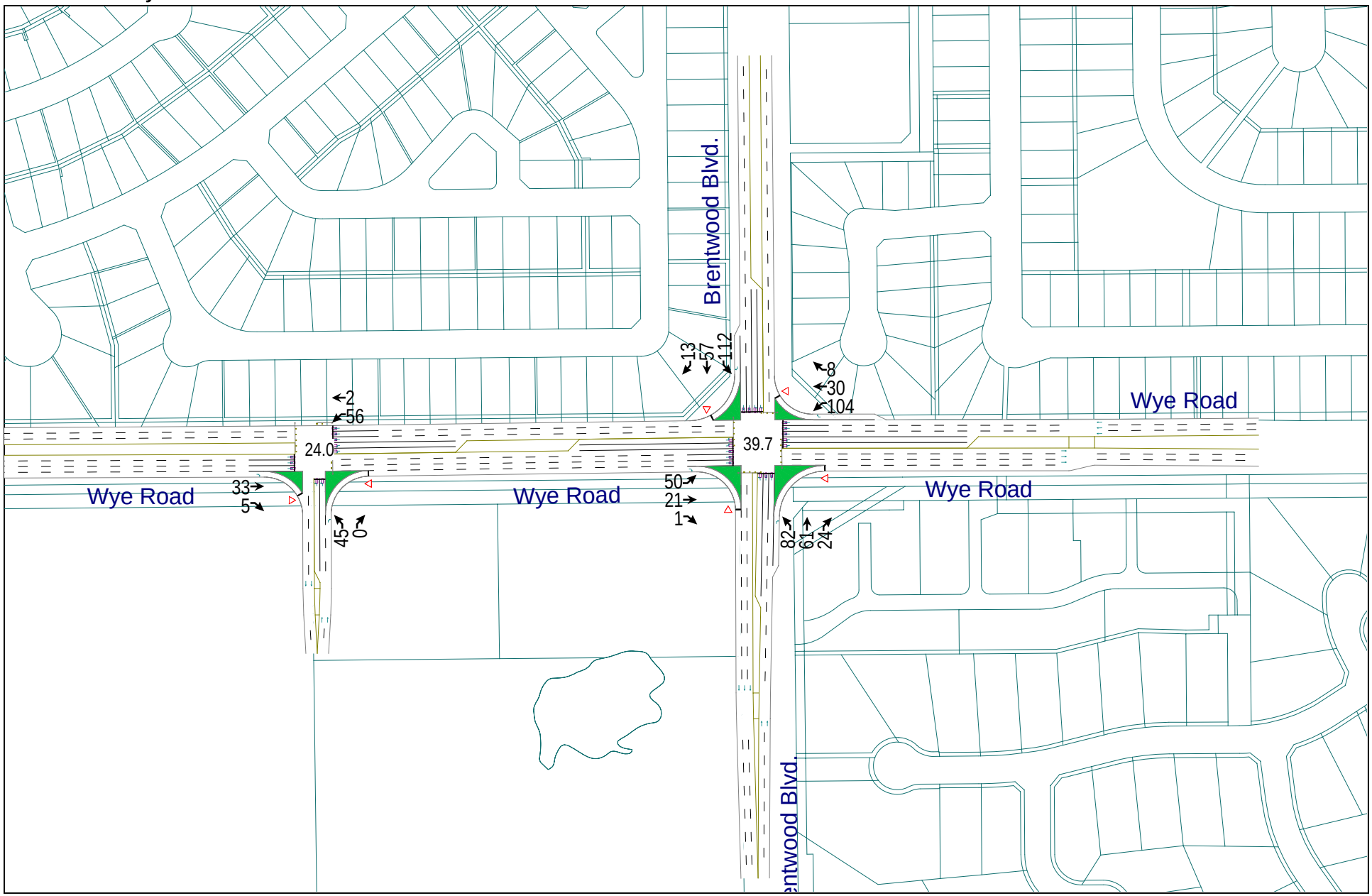

Brentwood Blvd.
202
552
327
198
797
289
Wye Road
967
188
C
E
Wye Road
2811
259
Wye Road
431
2467
149
Wye Road
91
236
156
611
279
Brentwood Blvd.

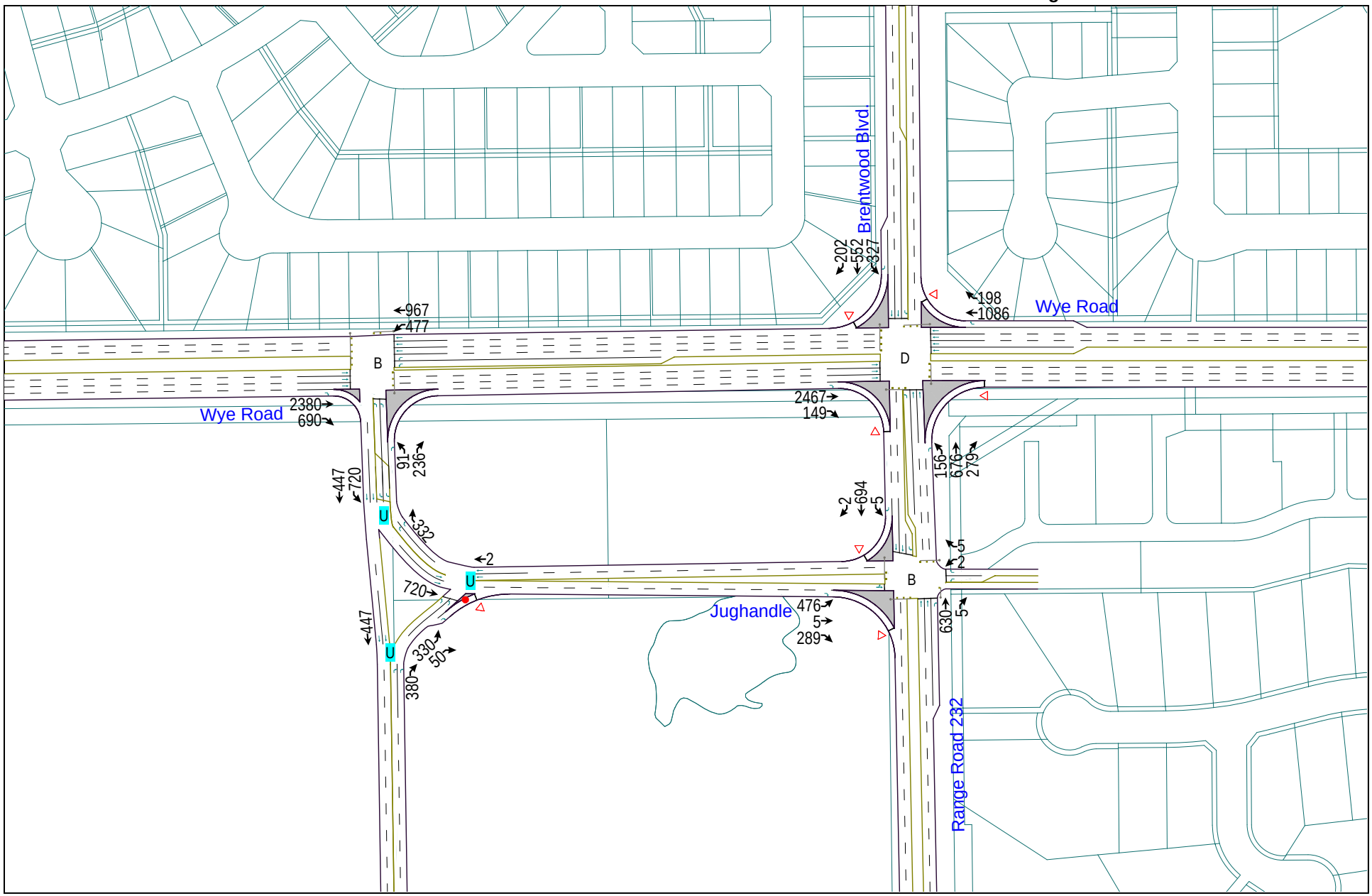

Brentwood Blvd.
Wye Road
Wye Road
Wye Road
Wye Road
0.40
0.67
1.25
0.29
0.41
1.27
0.26
0.74
81.0%
110.9%
0.92
0.25
0.12
0.14
0.71
1.05
0.19
0.58
0.79
0.62

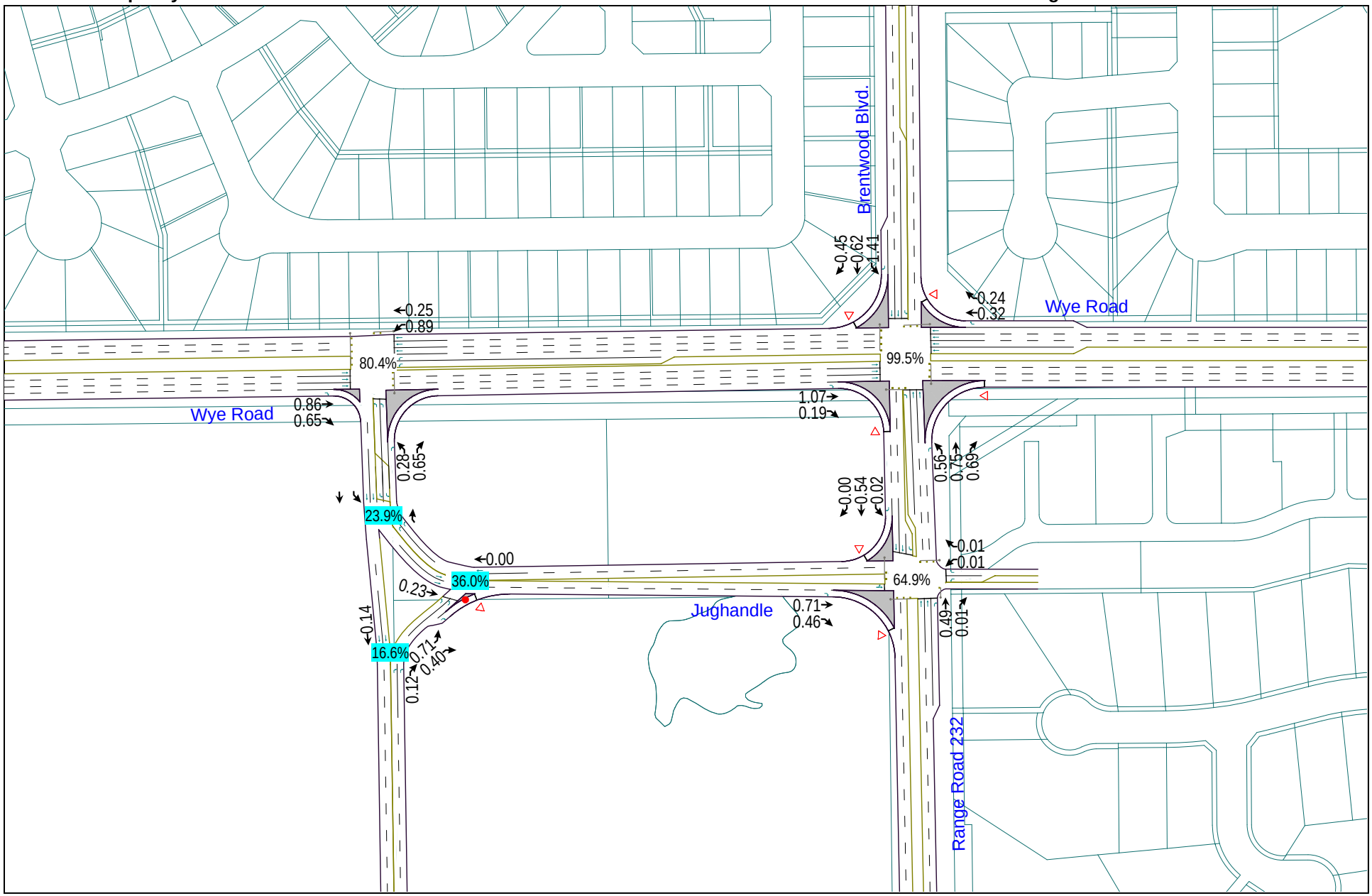

Brentwood Blvd.
Wye Road
Wye Road
Wye Road
Wye Road
12
54
172
5
37
201
2
53
23.4
56.6
32
5
45
0
46
47
2
40
61
31

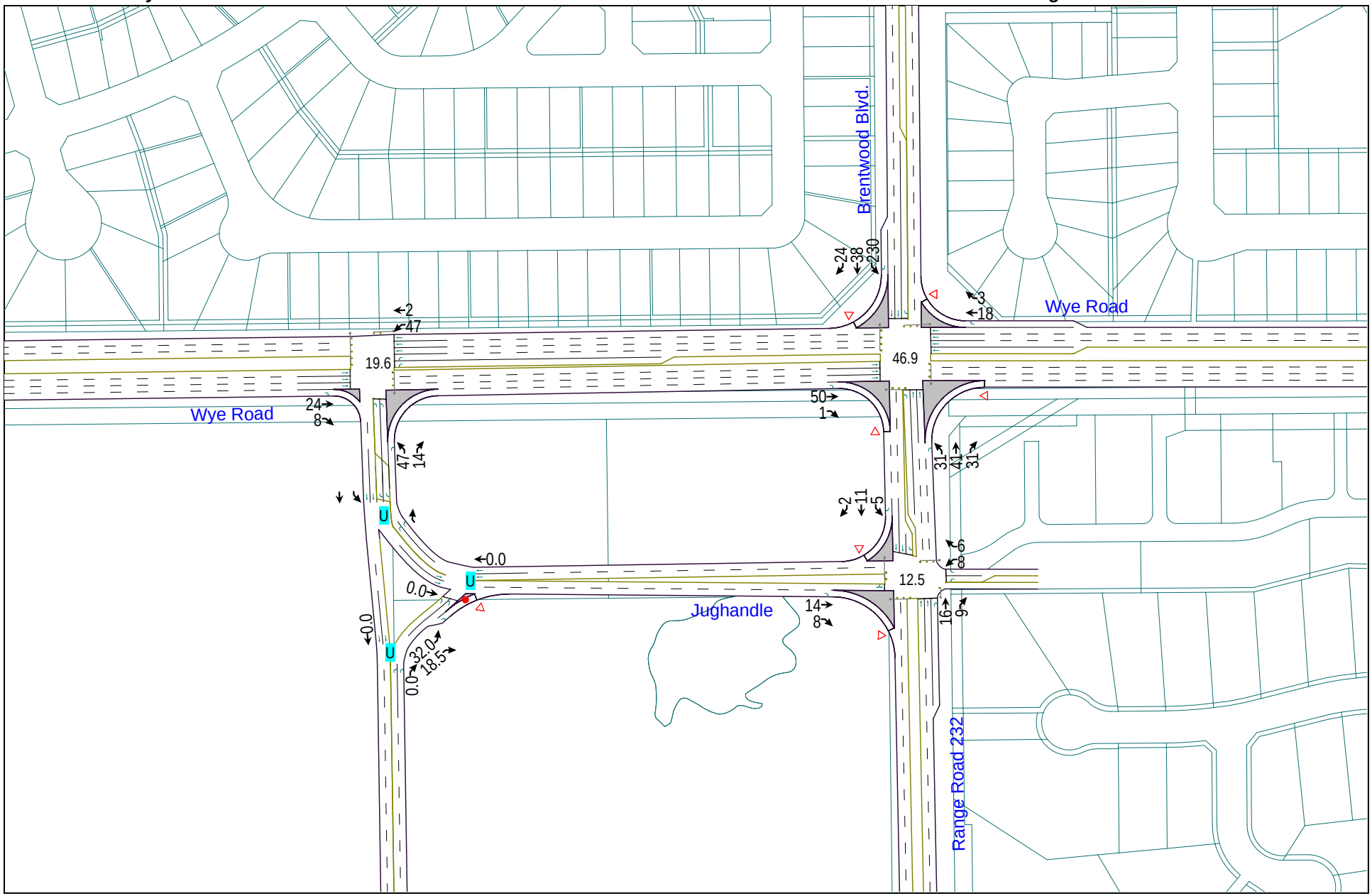

Brentwood Blvd.
202
552
327
198
797
289
967
188
Wye Road
C
D
Wye Road
2811
259
Wye Road
431
2467
149
Wye Road
91
236
156
611
279
Brentwood Blvd.

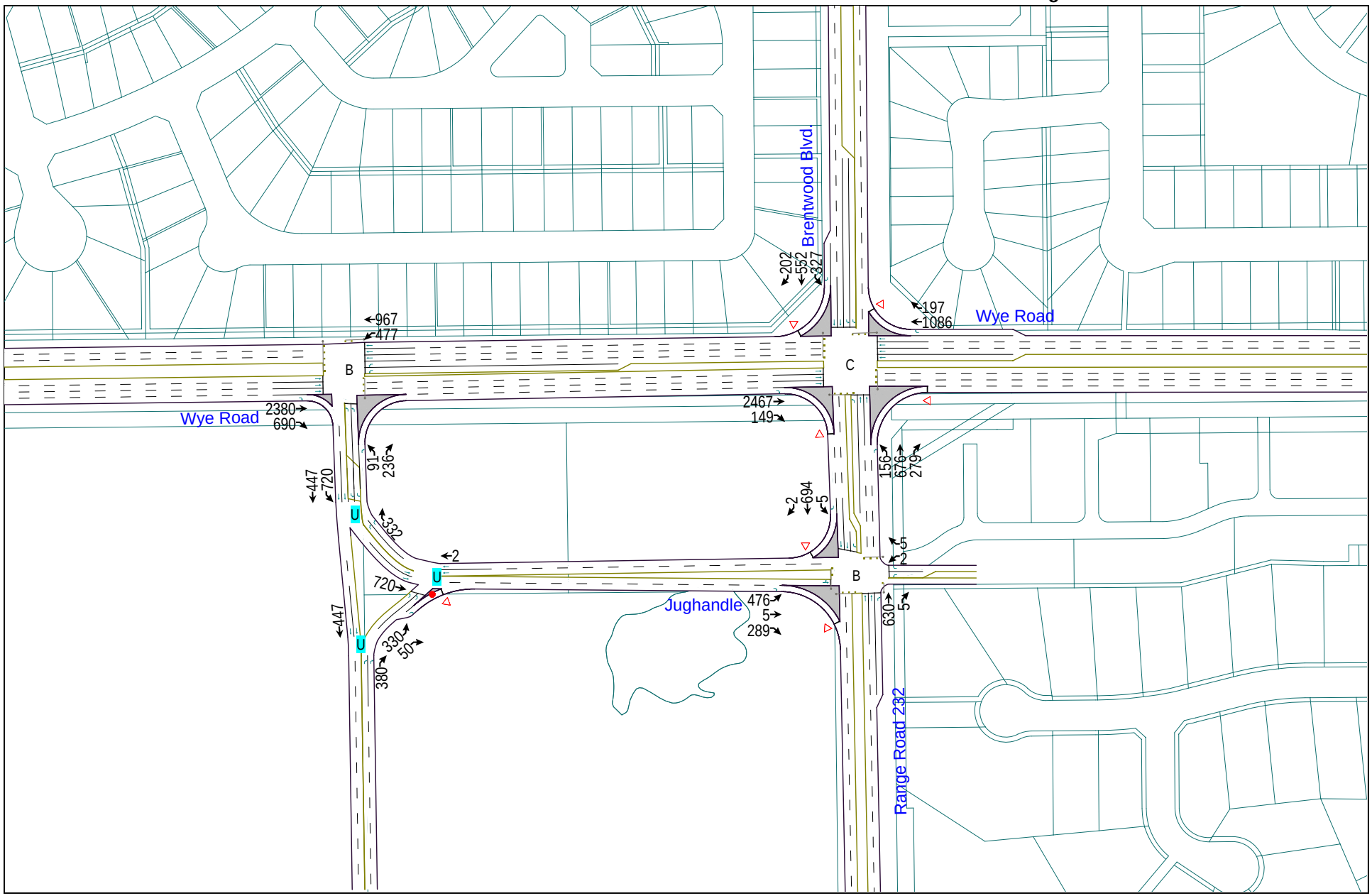

Brentwood Blvd.
0.43
0.72
1.07
0.27
0.35
0.95
Wye Road
0.26
0.74
81.0%
102.1%
Wye Road
0.92
0.25
Wye Road
Wye Road
0.71
0.98
0.18
0.12
0.14
0.88
0.79
0.59
Brentwood Blvd.


Brentwood Blvd.
Wye Road
Wye Road
Wye Road
Brentwood Blvd.
13
57
112
8
30
104
2
56
24.0
39.7
33
5
45
0
50
21
1
82
61
24

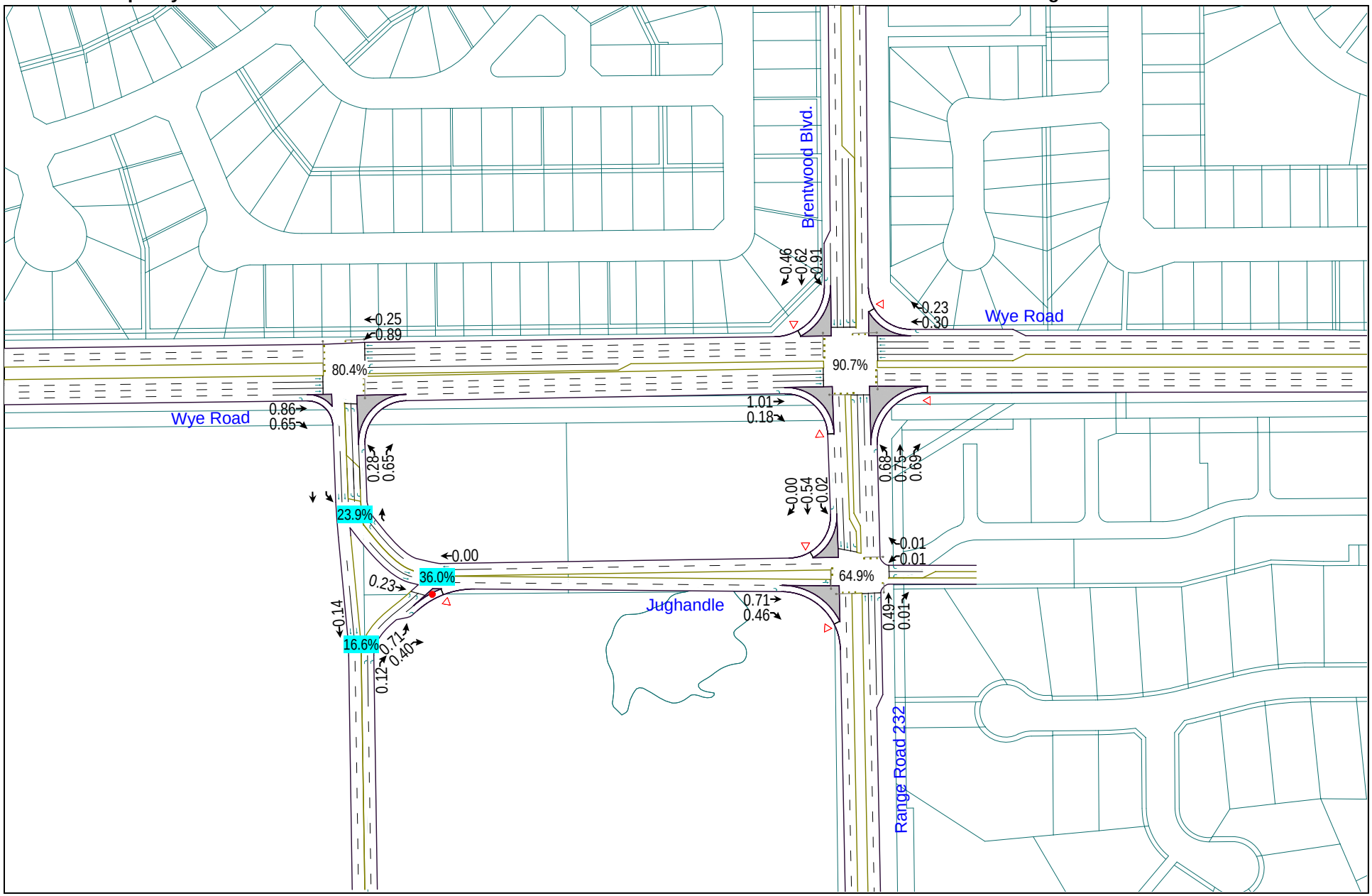

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road 232
202
552
327
198
1086
967
477
2380
690
2467
149
91
236
447
720
156
676
279
694
2
5
332
2
5
2
720
447
330
50
380
476
5
289
630
5
B
D
B
U
U

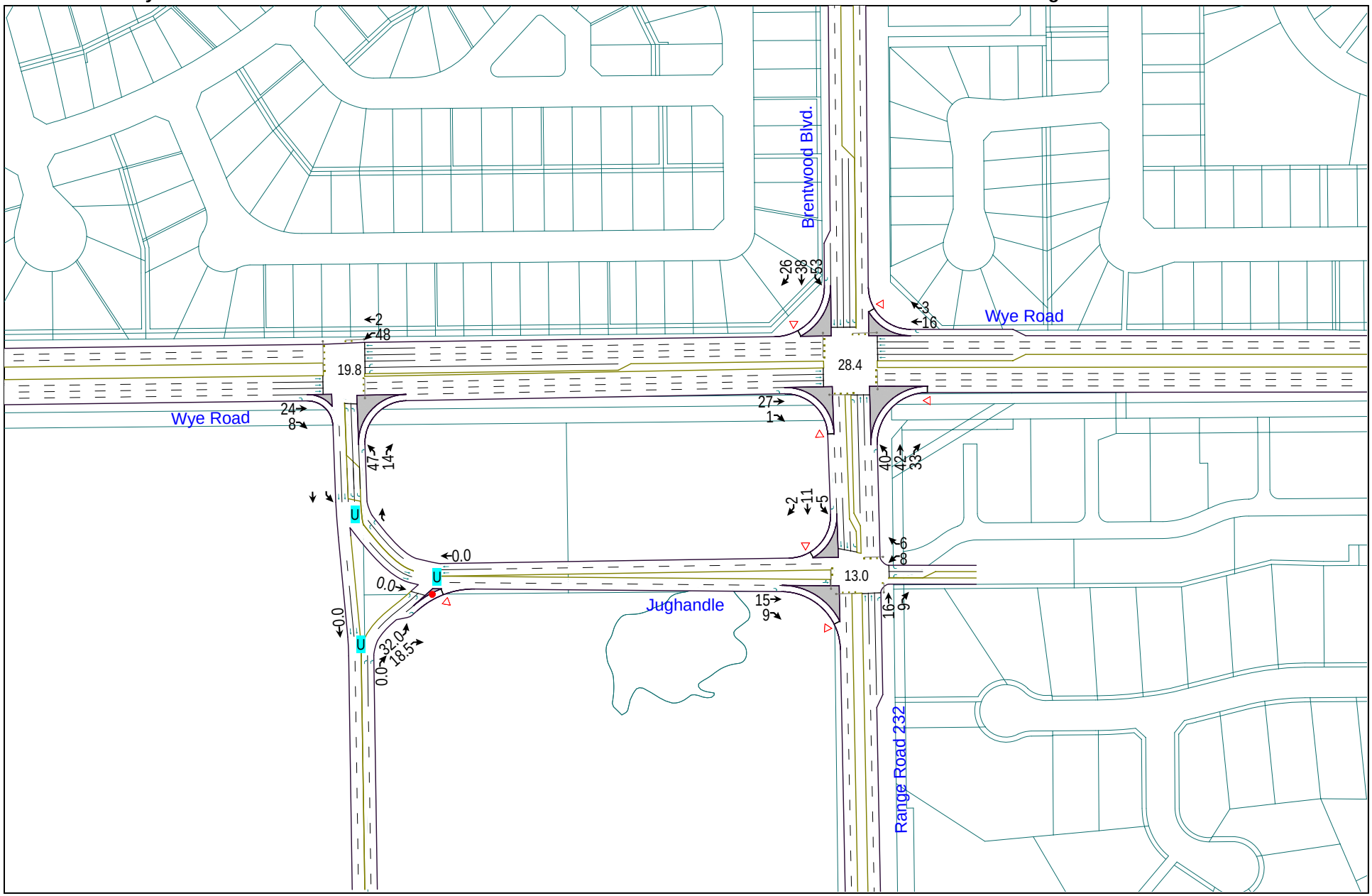

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road 232
0.45
0.62
1.41
0.24
0.32
0.25
0.89
80.4%
99.5%
0.86
0.65
1.07
0.19
0.28
0.65
0.56
0.75
0.69
0.00
0.54
0.02
23.9%
0.00
0.01
0.01
36.0%
64.9%
0.23
0.71
0.46
0.49
0.01
0.14
16.6%
0.71
0.40
0.12

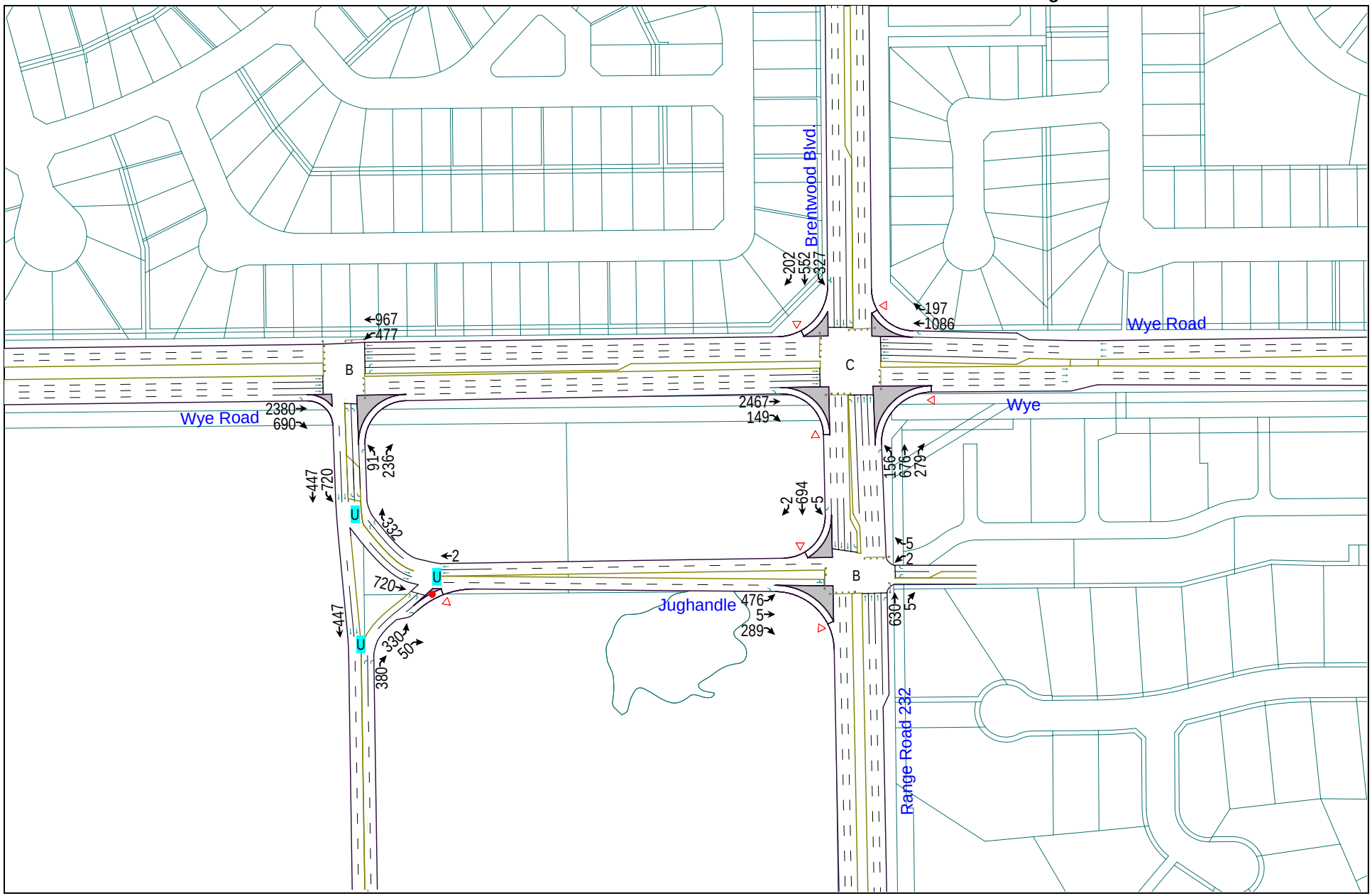

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road 232
24
38
230
3
18
2
47
19.6
46.9
24
8
50
1
47
14
31
44
31
2
11
5
6
8
0.0
0.0
12.5
14
8
16
9
0.0
0.0
32.0
18.5



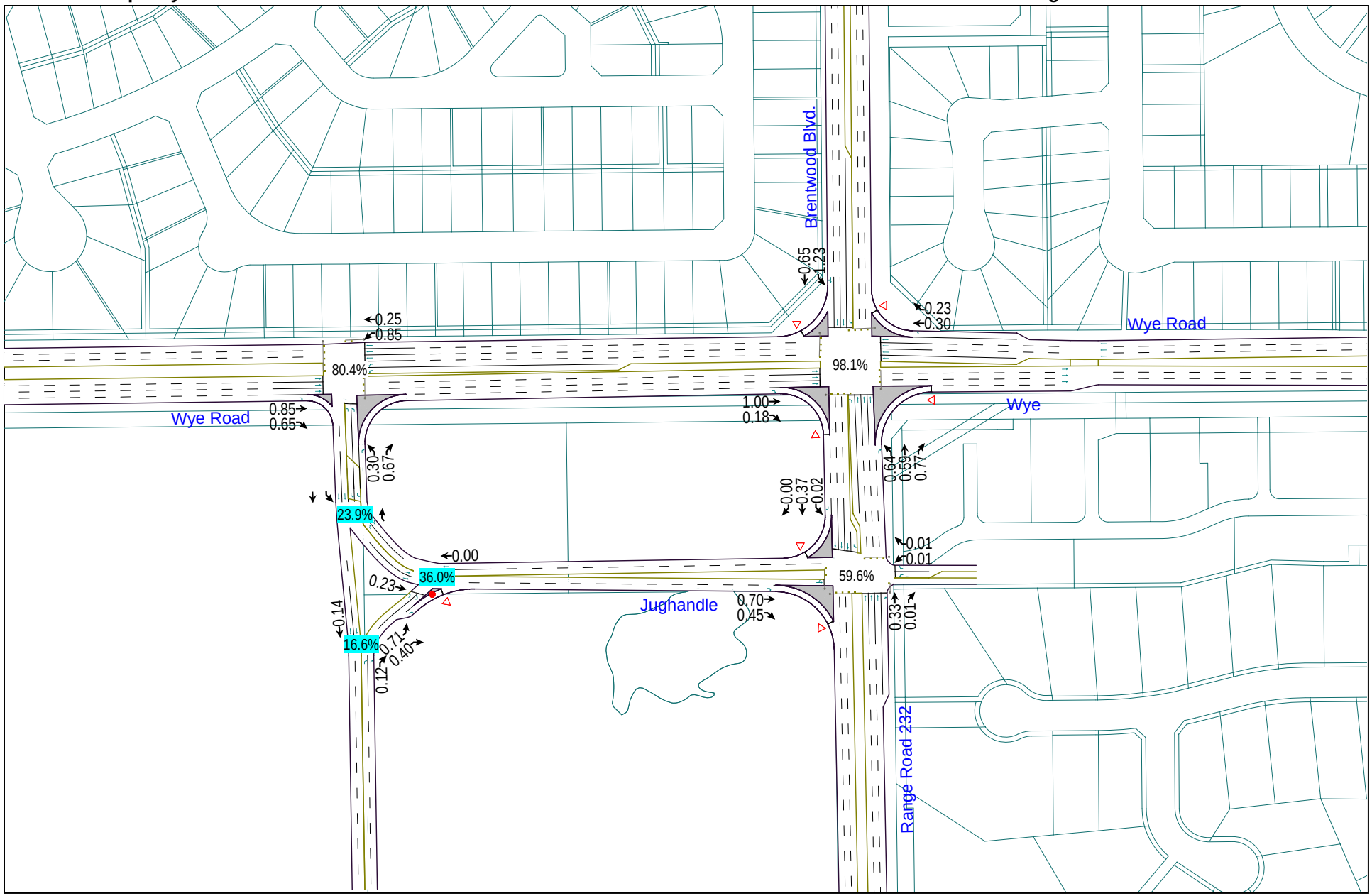
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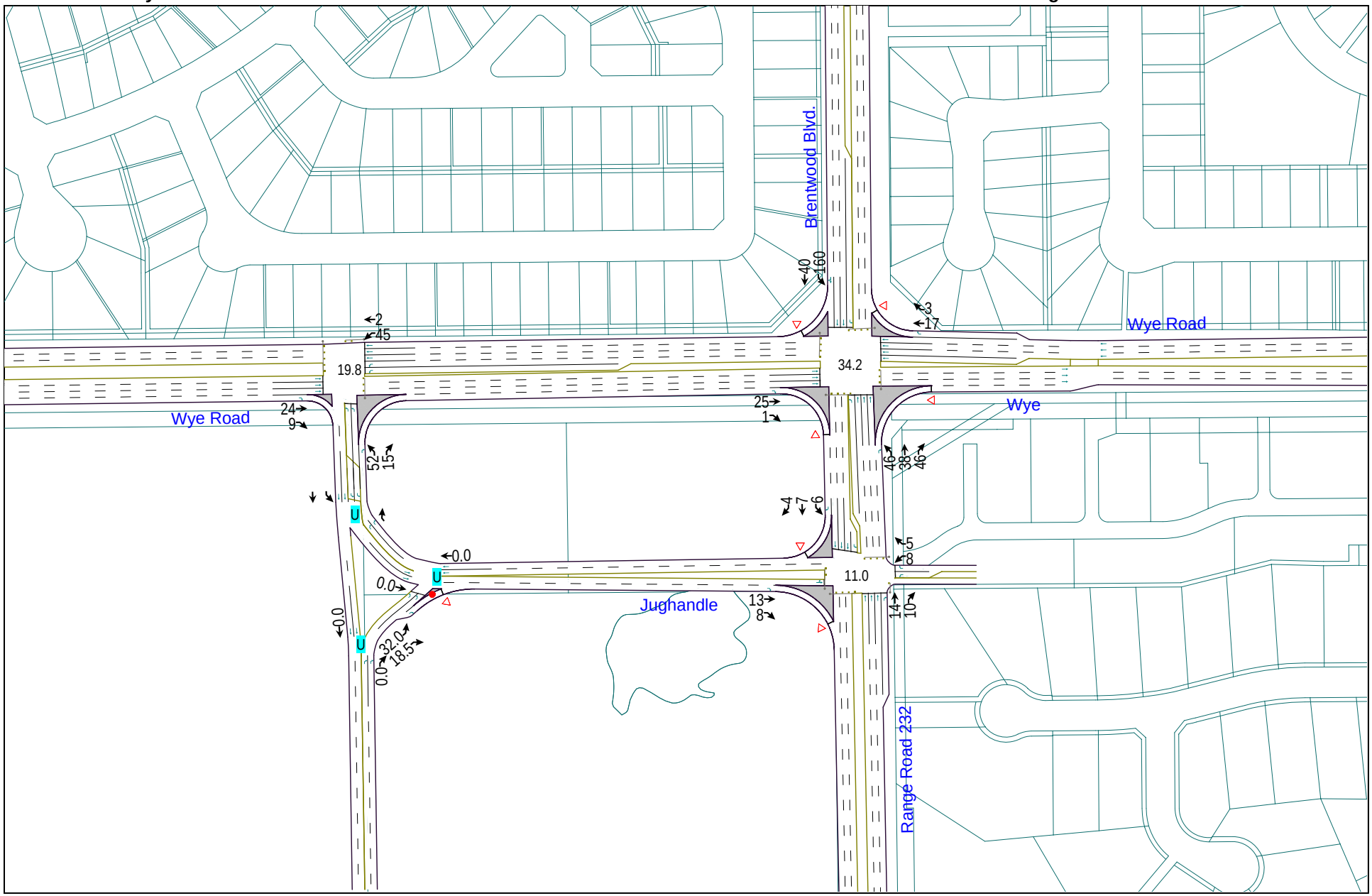

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road 232
0.46
0.62
0.91
0.23
0.30
0.25
0.89
80.4%
90.7%
0.86
0.65
1.01
0.18
0.28
0.65
0.68
0.75
0.69
0.00
0.54
0.02
23.9%
0.01
0.01
0.00
36.0%
64.9%
0.23
0.71
0.46
0.49
0.01
0.14
16.6%
0.71
0.40
0.12

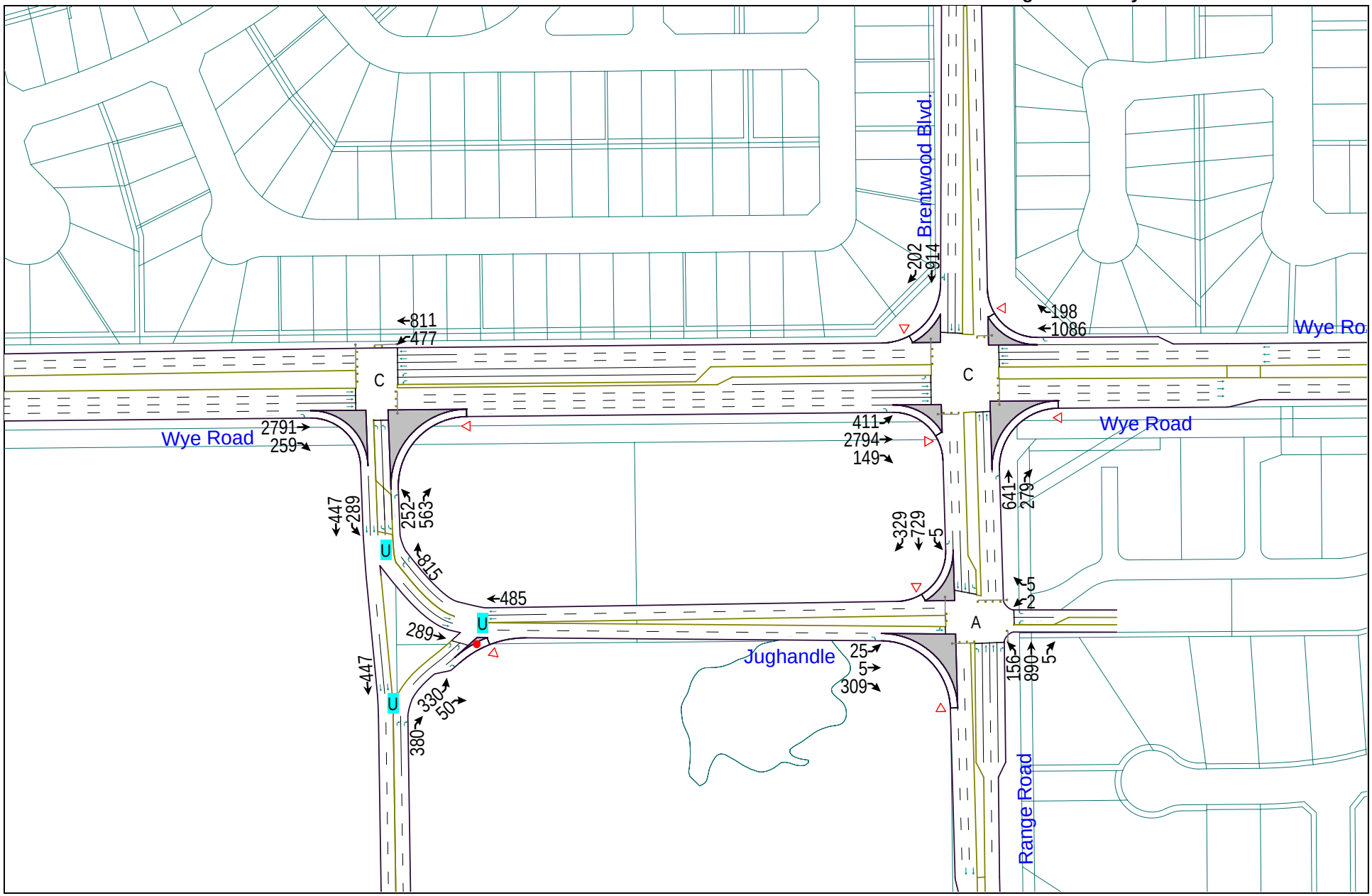

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road 232
26
38
53
3
16
2
48
19.8
28.4
24
8
27
1
47
14
40
42
33
2
11
5
6
8
0.0
0.0
13.0
15
9
16
9
0.0
0.0
32.0
18.5
U
U
U

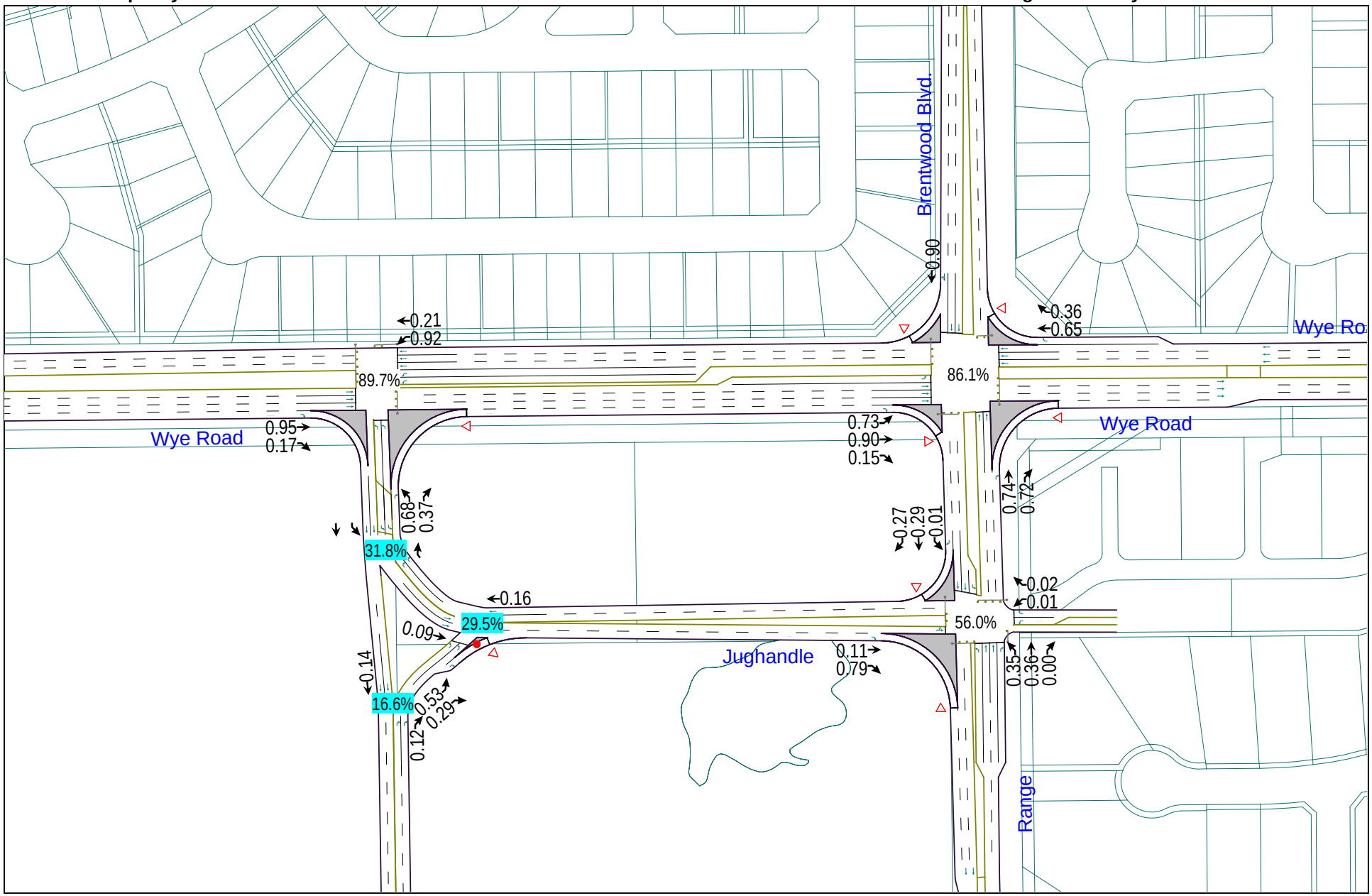


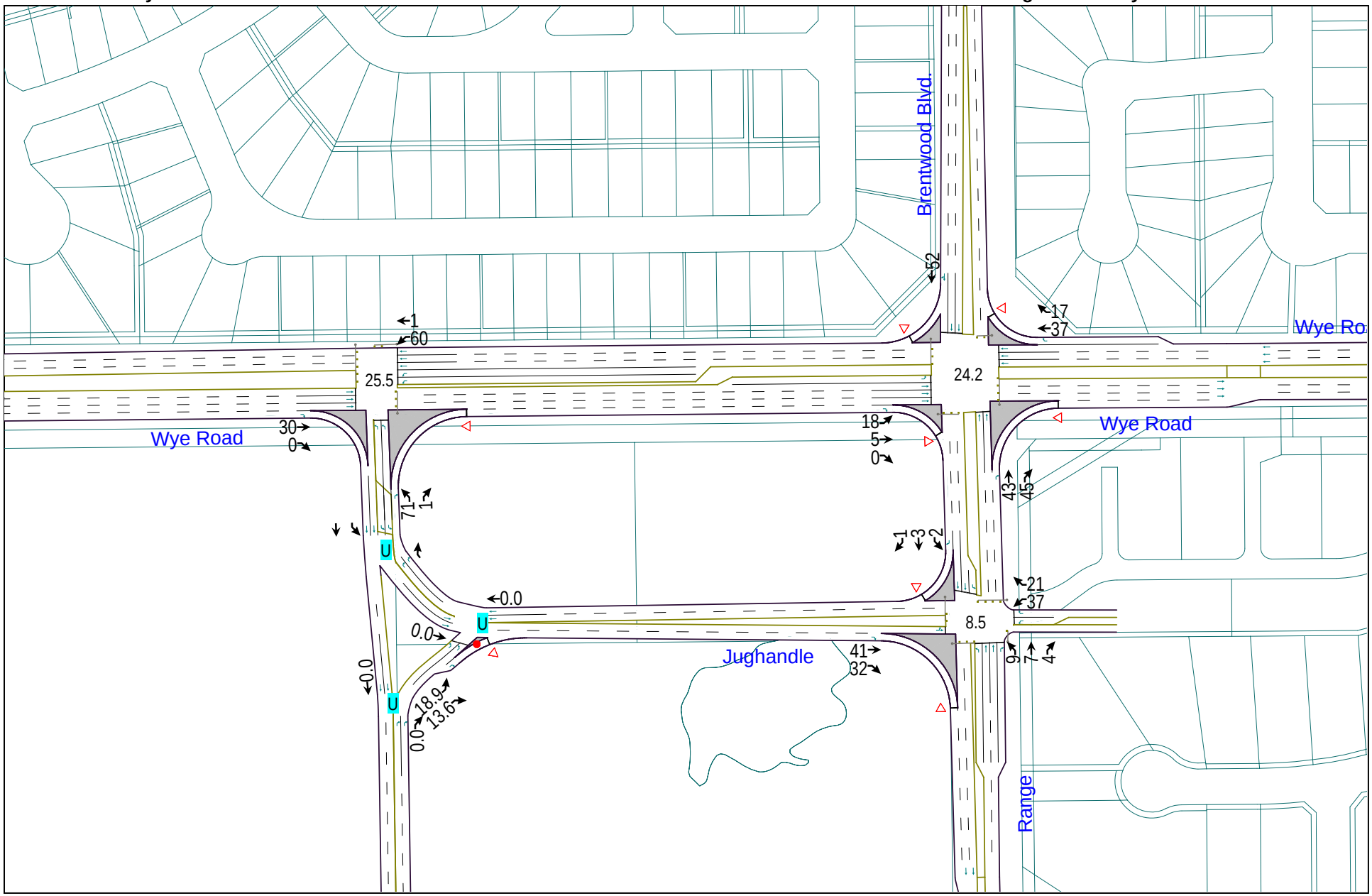
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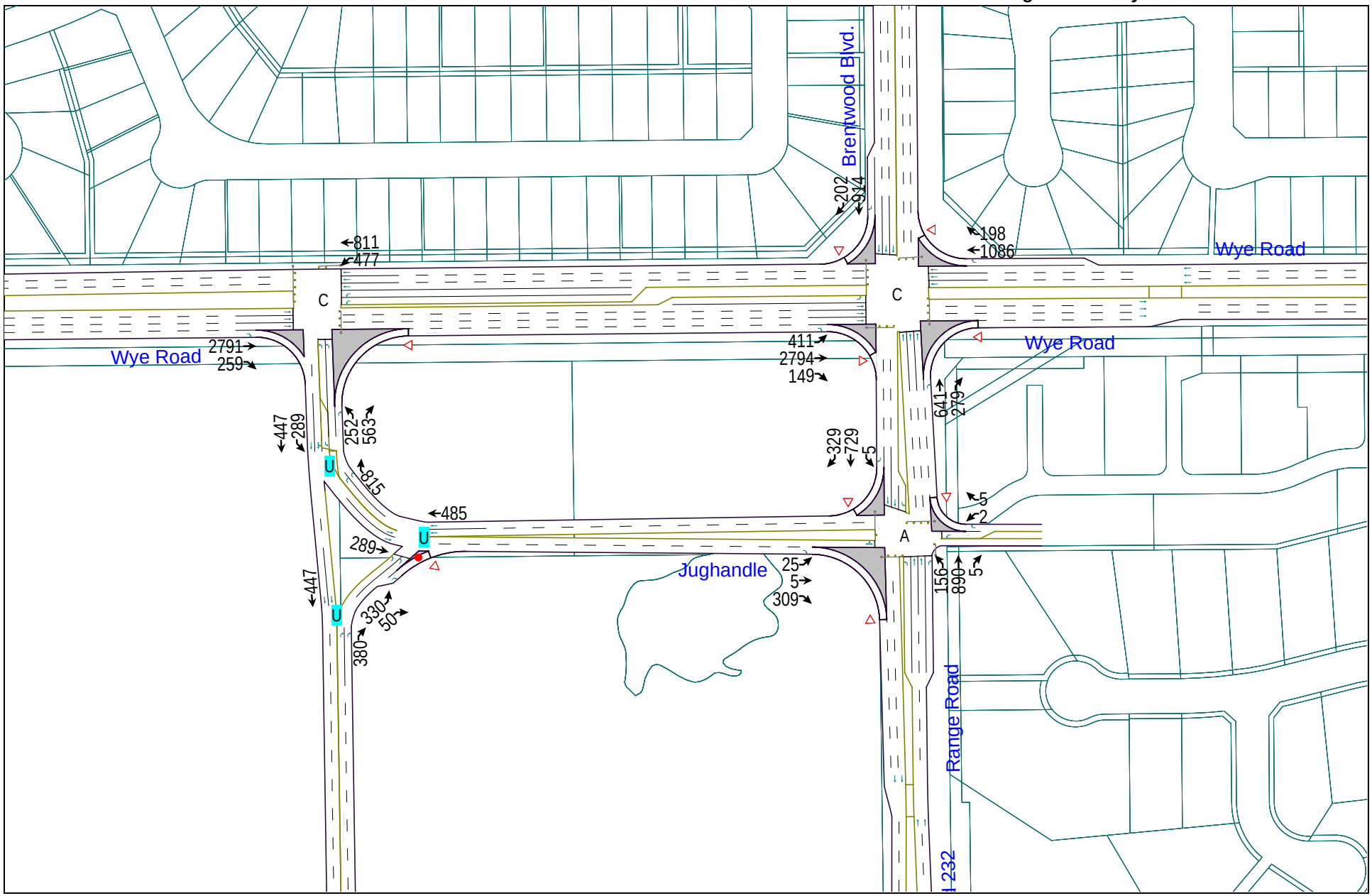

Brentwood Blvd.
Wye Road
Wye Road
Wye
Jughandle
Range Road 232
0.65
1.23
0.23
0.30
0.25
0.85
80.4%
98.1%
0.85
0.65
1.00
0.18
0.30
0.67
0.64
0.59
0.77
0.00
0.37
0.02
23.9%
0.01
0.01
0.00
36.0%
59.6%
0.23
0.70
0.45
0.33
0.01
0.14
16.6%
0.71
0.40
0.12

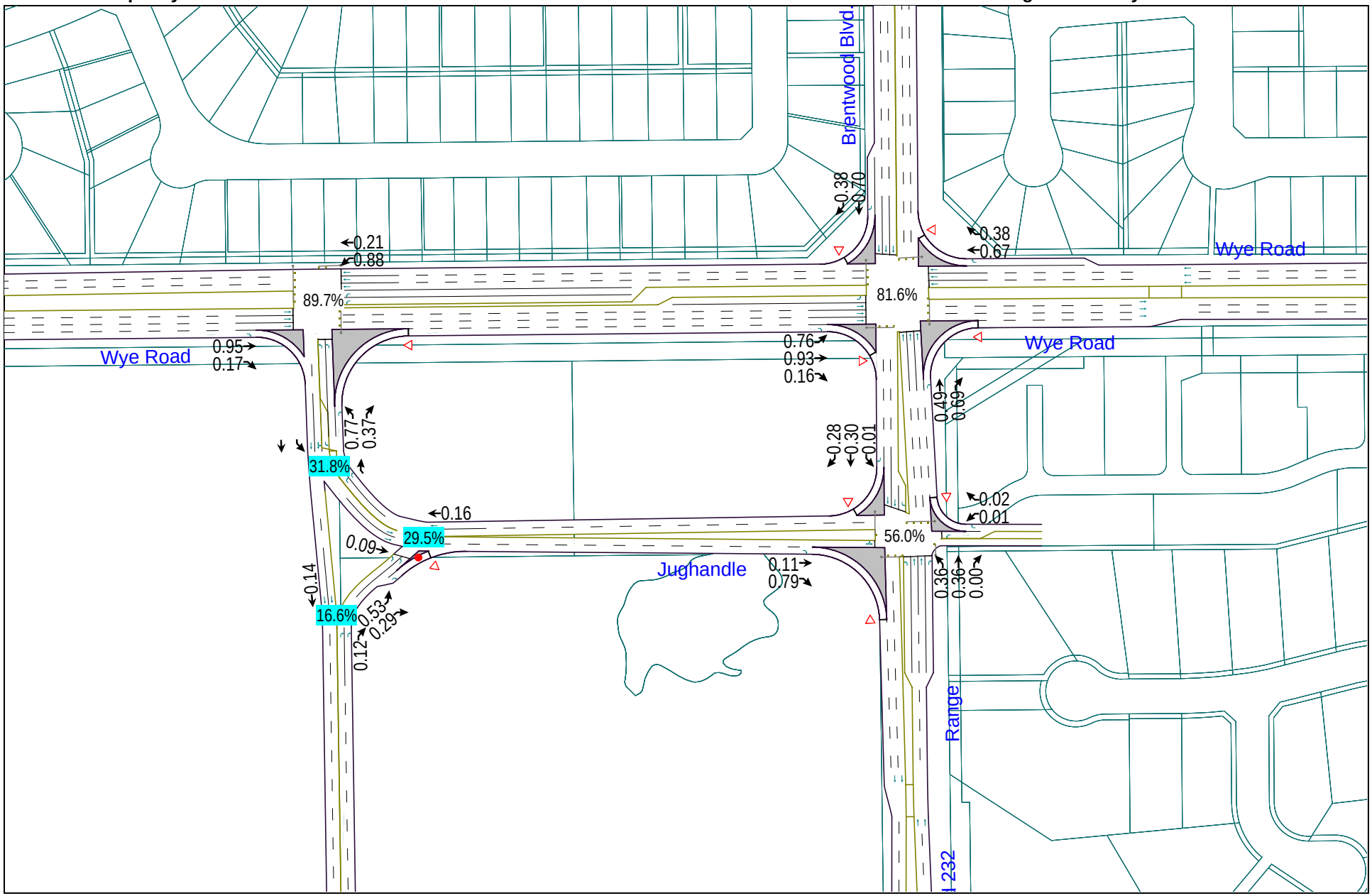

Brentwood Blvd.
Wye Road
Wye Road
Wye
Jughandle
Range Road 232
40
160
2
45
3
17
19.8
34.2
24
9
25
1
52
15
46
38
46
4
7
6
5
8
0.0
0.0
11.0
13
8
14
10
0.0
0.0
32.0
18.5
U
U
U

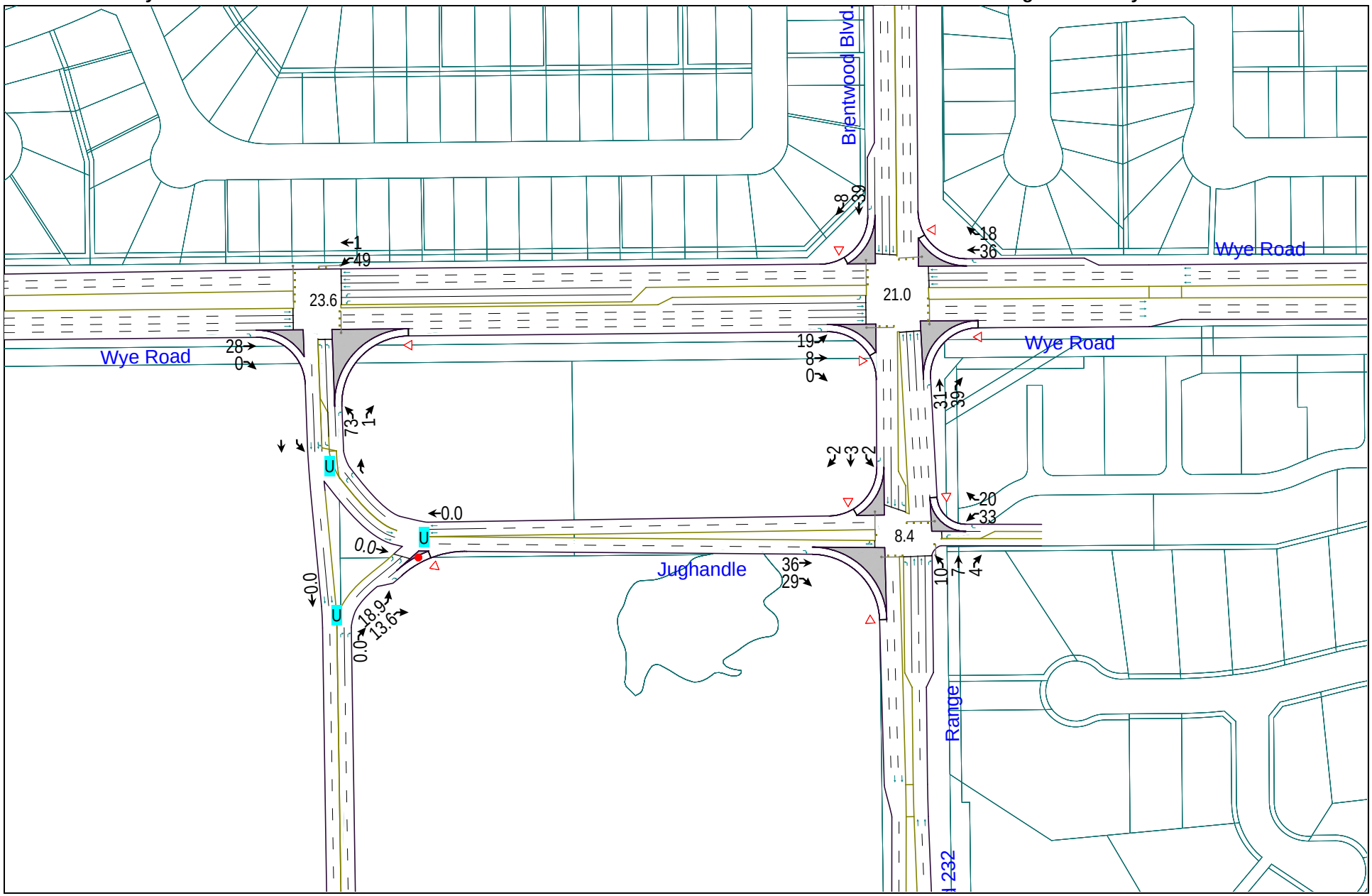

Brentwood Blvd.
202
914
198
1086
Wye Ro
811
477
C
C
Wye Road
2791
259
411
2794
149
Wye Road
641
279
447
289
252
563
329
729
5
U
815
485
5
2
U
A
289
Jughandle
25
5
309
156
890
5
447
U
330
50
380
Range Road

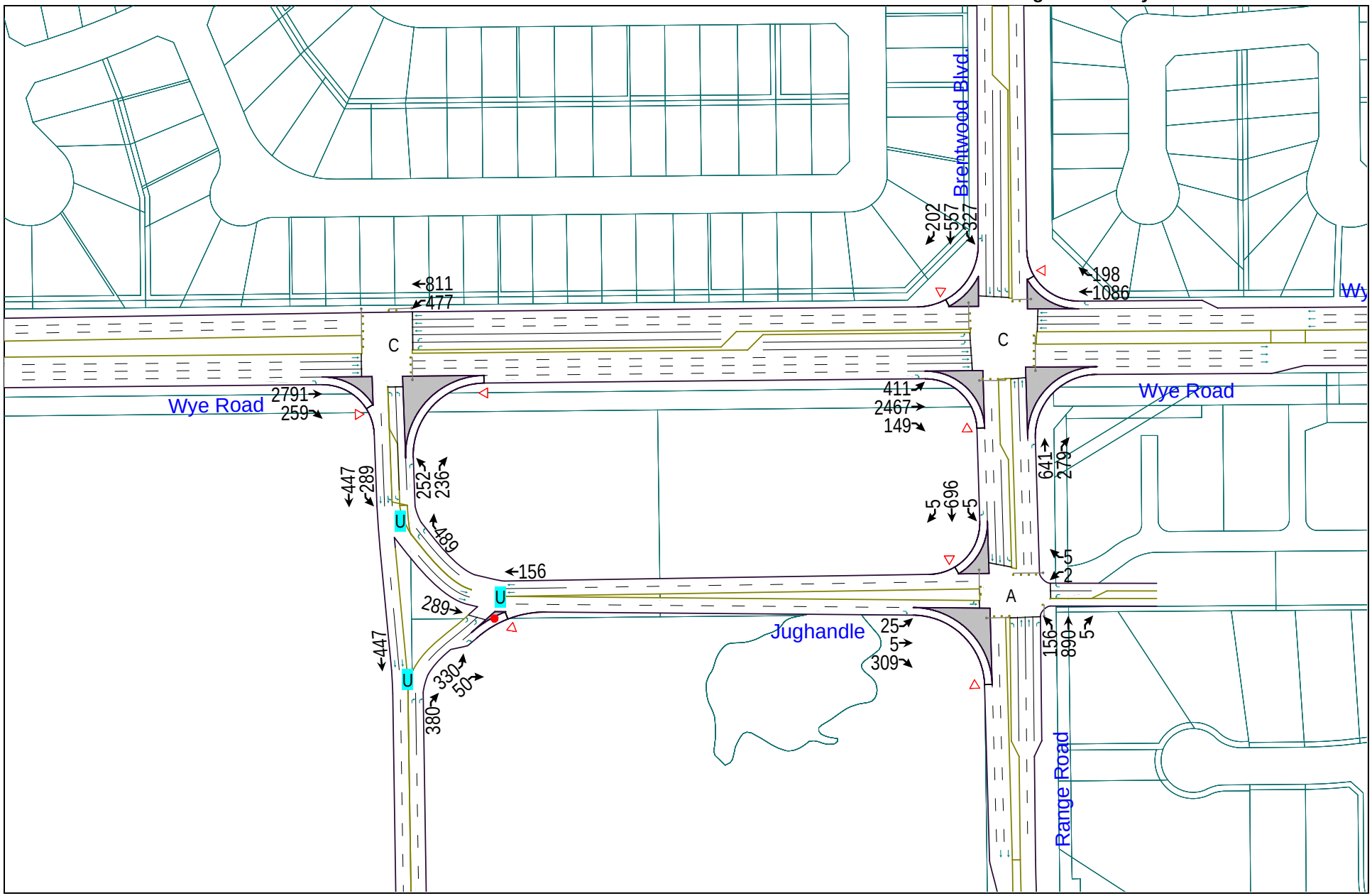

Brentwood Blvd.
0.90
0.21
0.92
0.36
0.65
Wye Ro
89.7%
86.1%
Wye Road
0.95
0.17
0.73
0.90
0.15
Wye Road
0.68
0.37
0.74
0.72
0.27
0.29
0.01
31.8%
0.16
0.02
0.01
29.5%
56.0%
0.09
Jughandle
0.11
0.79
0.35
0.36
0.00
0.14
16.6%
0.53
0.29
0.12
Range

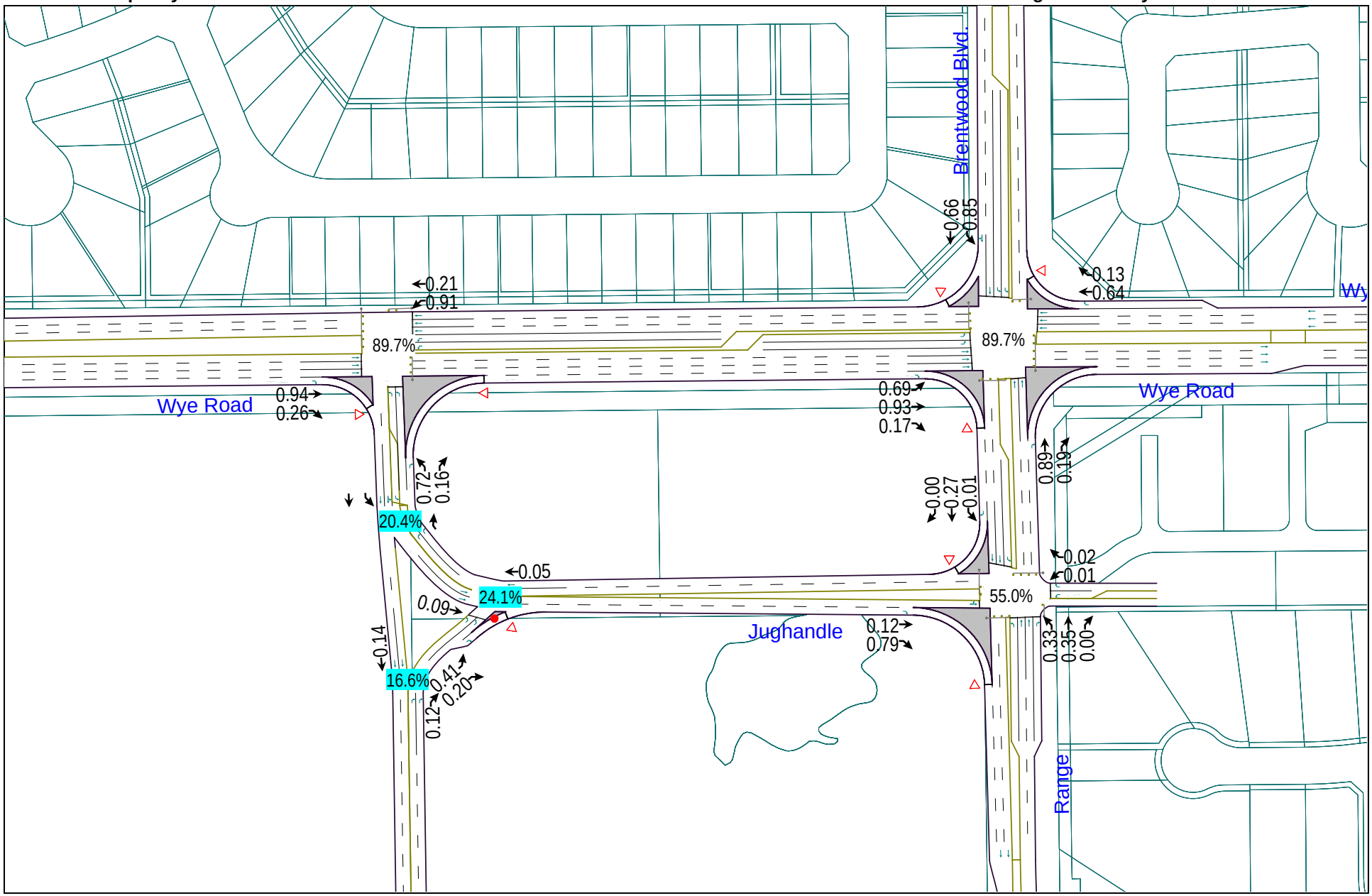

Brentwood Blvd.
Wye Road
Wye Road
Wye Ro
Jughandle
Range
52
17
37
1
60
25.5
24.2
30
0
18
5
0
43
45
71
1
1
3
2
U
0.0
U
8.5
21
37
0.0
41
32
9
7
4
0.0
U
18.9
13.6
0.0

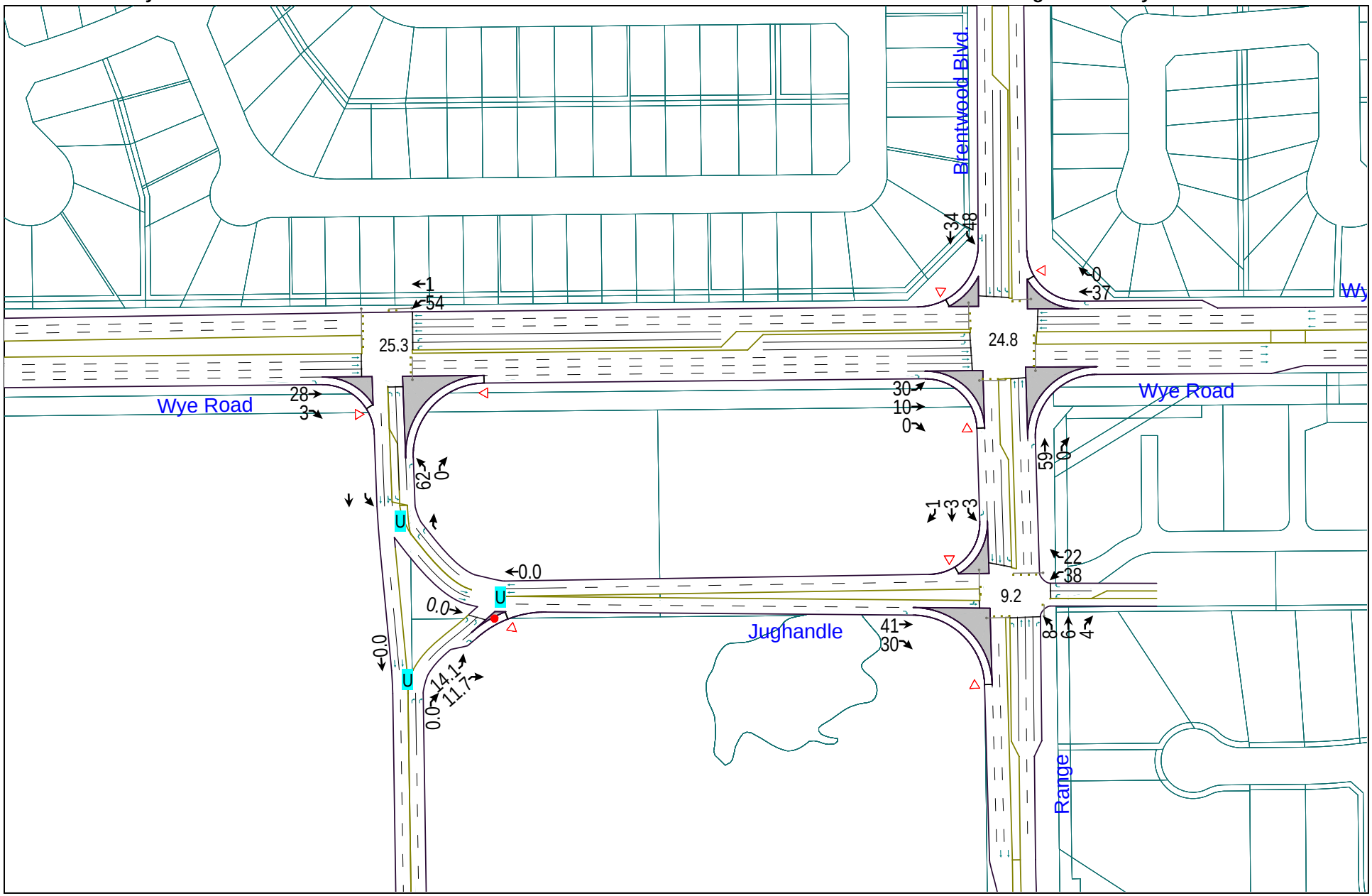

Brentwood Blvd.
Wye Road
Wye Road
Wye Road
Jughandle
Range Road
202
914
198
1086
811
477
C
C
2791
259
411
2794
149
641
279
447
289
252
563
U
815
329
729
5
485
5
2
U
A
289
25
5
309
156
890
5
447
U
330
50
380


Brentwood Blvd
Wye Road
Wye Road
Wye Road
Jughandle
Range
0.38
0.70
0.38
0.67
0.21
0.88
89.7%
81.6%
0.95
0.17
0.76
0.93
0.16
0.49
0.69
0.77
0.37
31.8%
0.28
0.30
0.01
0.16
0.02
0.01
0.09
29.5%
56.0%
0.11
0.79
0.14
0.36
0.36
0.00
16.6%
0.53
0.29
0.12
232


Brentwood Blvd
Wye Road
Wye Road
Wye Road
Jughandle
Range
232
23.6
21.0
8.4
0.0
0.0
0.0
0.0
18.9
13.6
8
39
18
36
1
49
28
0
19
8
0
31
39
73
1
2
3
2
20
33
36
29
10
7
4

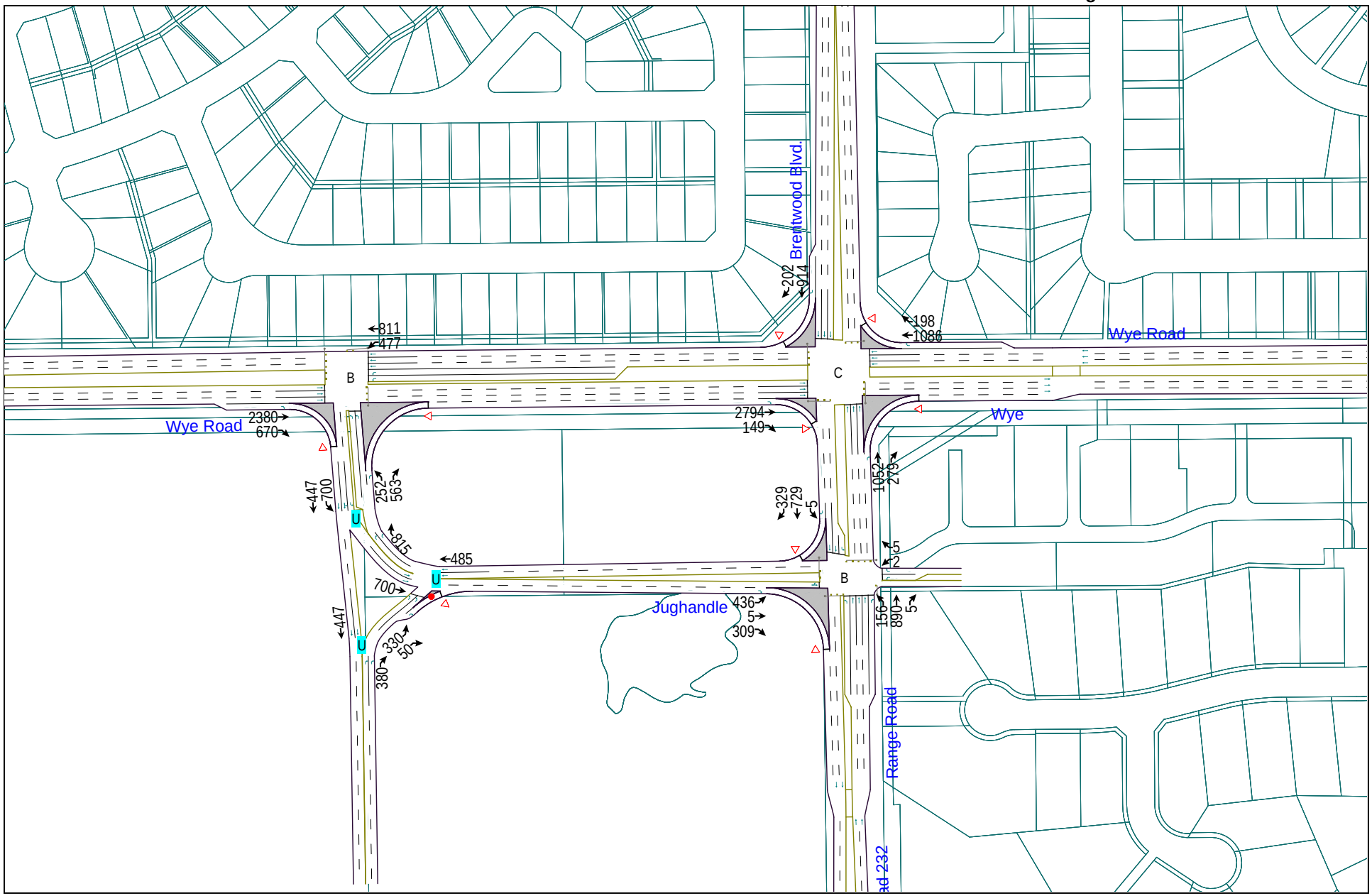

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range Road
202
557
327
198
1086
811
477
C
C
2791
259
411
2467
149
641
279
447
289
252
236
696
5
5
489
156
U
U
U
289
447
330
50
380
25
5
309
A
5
2
156
890
5


Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range
0.66
0.85
0.13
0.64
0.21
0.91
89.7%
89.7%
0.94
0.26
0.69
0.93
0.17
0.72
0.16
0.89
0.19
0.00
0.27
0.01
20.4%
0.05
0.02
0.01
24.1%
55.0%
0.09
0.12
0.79
0.33
0.35
0.00
0.14
16.6%
0.41
0.20
0.12

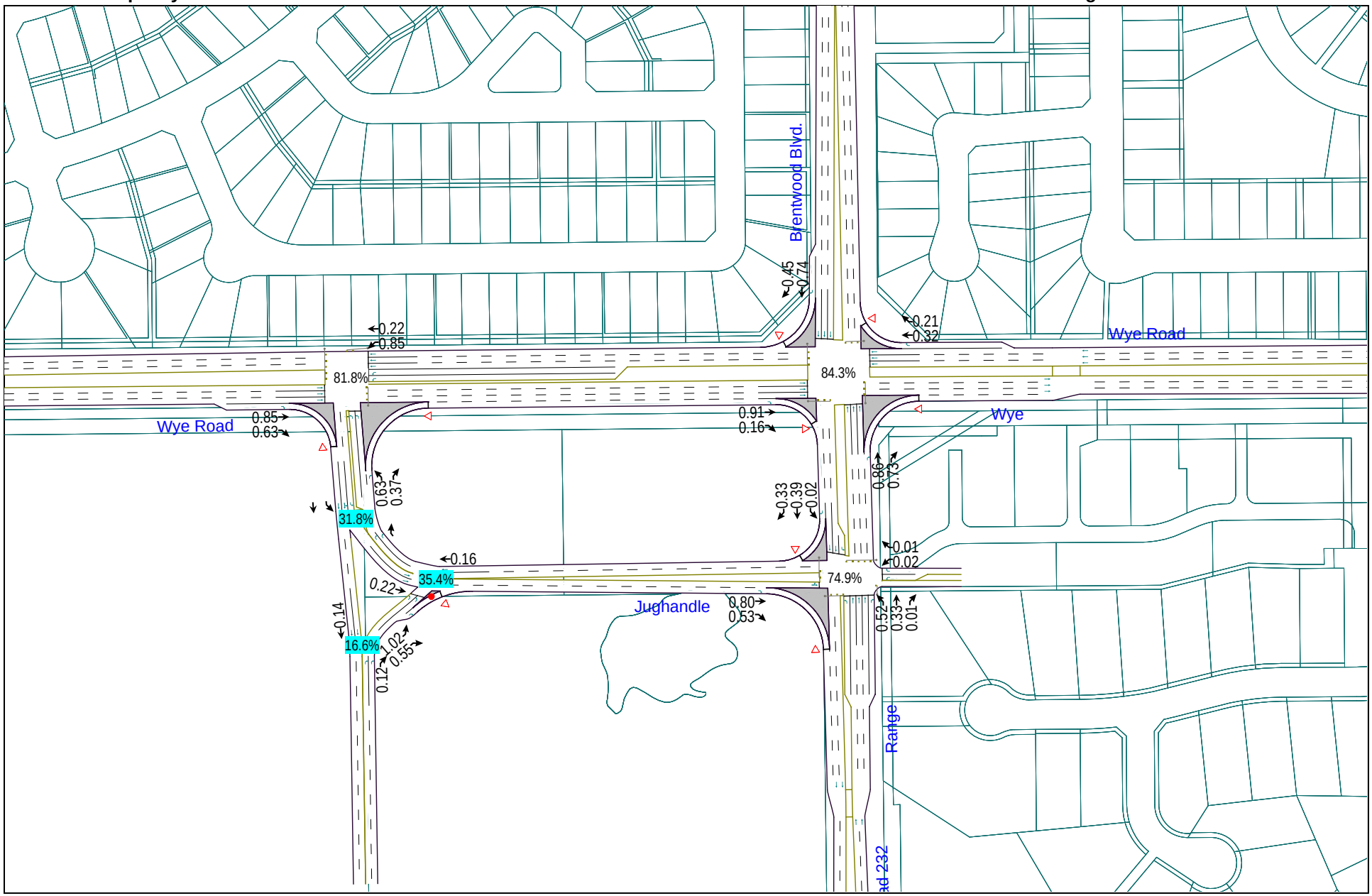

Brentwood Blvd.
Wye Road
Wye Road
Jughandle
Range
25.3
24.8
9.2
34
48
1
54
0
37
28
3
30
10
0
62
0
59
0
1
3
3
22
38
0.0
0.0
0.0
0.0
14.1
11.7
41
30
8
6
4
U
U
U

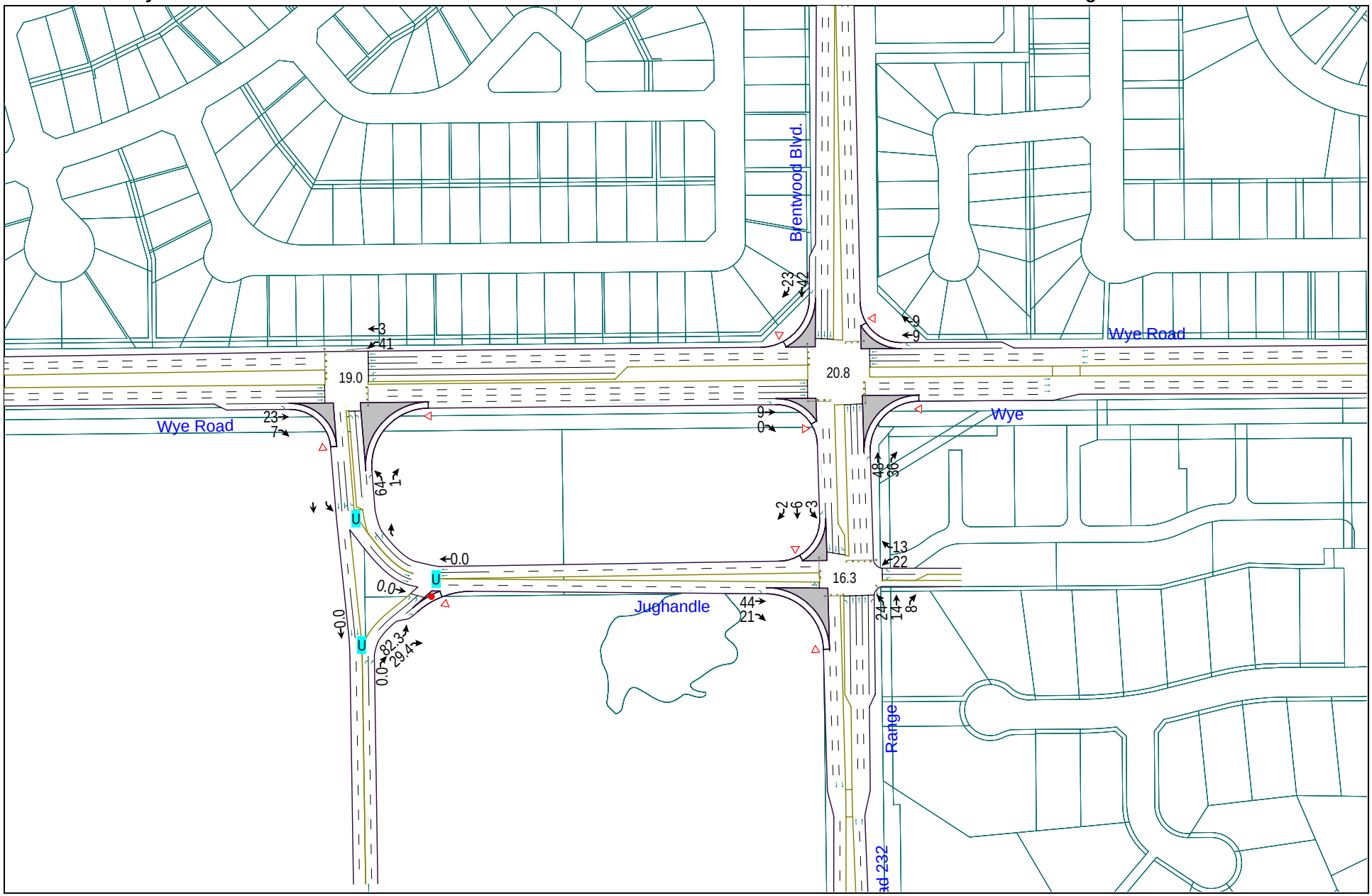
Map - Year 2015 PM peak
Levels of Service

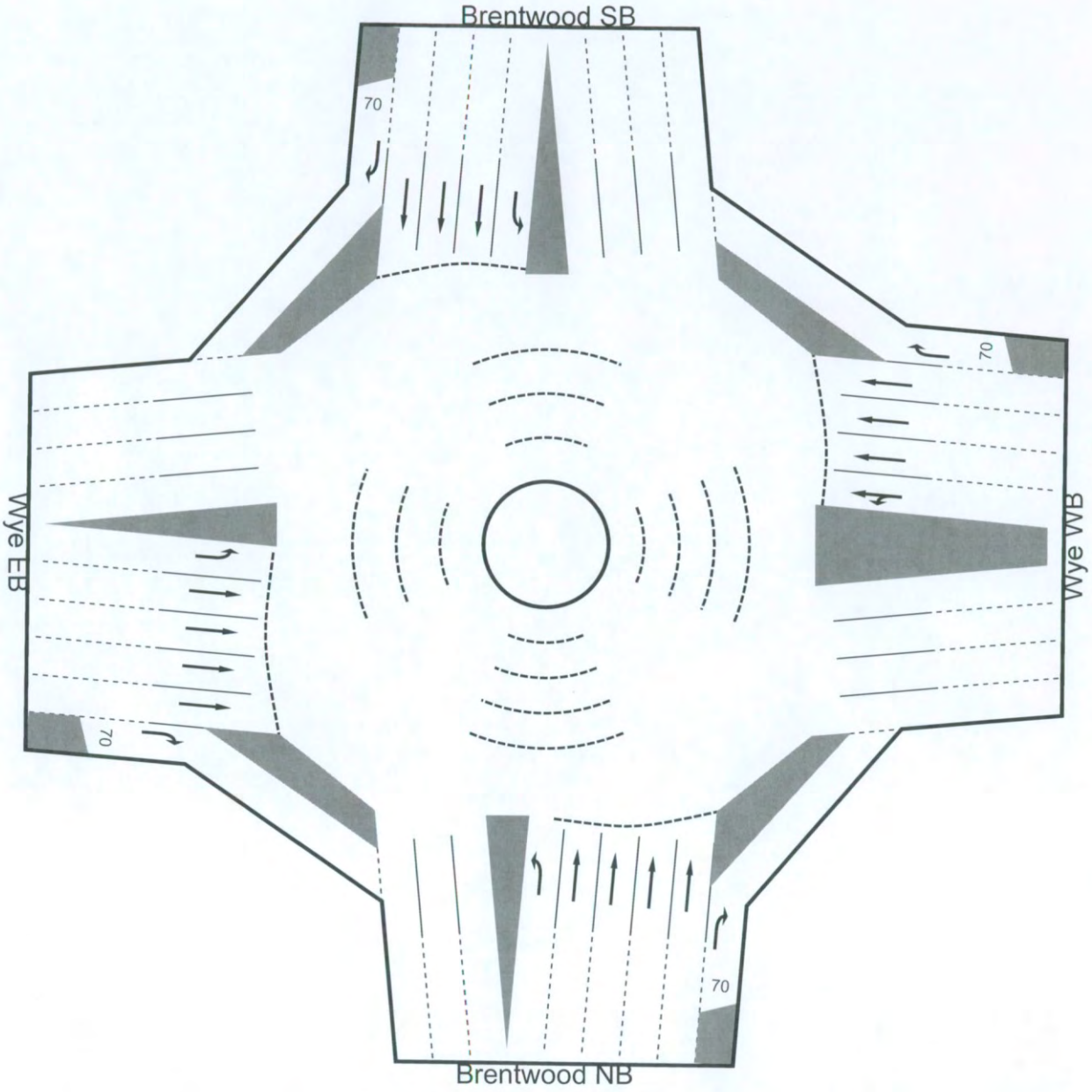
Year 2015 PM peak
6 lane Brentwood Jaghandlle - all left turn relocated



F:\Strathcona County\1149 - Wye Road\FPS Report Nov 2008\Pdf Exhibits\Synchro Files\Wye & Brentwood Year 2015 PM Peak Option E.syn


Brentwood Blvd.
Wye Road
Wye Road
Wye
Jughandle
Range
ad 232
0.45
0.74
0.22
0.85
0.21
0.32
81.8%
84.3%
0.85
0.63
0.91
0.16
0.63
0.37
0.33
0.39
0.02
0.86
0.73
31.8%
0.16
0.01
0.02
35.4%
74.9%
0.22
0.80
0.53
0.52
0.33
0.01
0.14
16.6%
1.02
0.55
0.12


Brentwood Blvd.
Wye Road
Wye Road
Wye
Jughandle
Range
ad 232
19.0
20.8
16.3
23
42
3
41
9
9
23
7
9
0
64
1
2
6
3
48
36
13
22
0.0
0.0
0.0
0.0
82.3
29.4
44
21
24
14
8
U
U
U


Brentwood SB
70
70
Wye EB
Wye WB
70
70
Brentwood NB

SIDRA INTERSECTION

Intersection Summary

Brentwood Dr / Wye Road

Year 2015 TRaffic

Performance Measure	Vehicles	Persons
Demand Flows - Total	7142 veh/h	8570 pers/h
Percent Heavy Vehicles	2.0 %	
Degree of Saturation	1.020	
Effective Intersection Capacity	7005 veh/h	
95% Back of Queue (m)	100 m	
95% Back of Queue (veh)	13.0 veh	
Control Delay (Total)	44.30 veh-h/h	53.16 pers-h/h
Control Delay (Average)	22.3 s/veh	22.3 s/pers
Level of Service	LOS C	
Level of Service (Worst Movement)	LOS F	
Total Effective Stops	6234 veh/h	7480 pers/h
Effective Stop Rate	0.87 per veh	0.87 per pers
Proportion Queued	0.78	0.78
Travel Distance (Total)	4775.3 veh-km/h	5730.4 pers-km/h
Travel Distance (Average)	669 m	669 m
Travel Time (Total)	120.8 veh-h/h	145.0 pers-h/h
Travel Time (Average)	60.9 secs	60.9 secs
Travel Speed	39.5 km/h	39.5 km/h
Operating Cost (Total)	1924 $/h	1924 $/h
Fuel Consumption (Total)	597.1 L/h	
Carbon Dioxide (Total)	1494.0 kg/h	
Hydrocarbons (Total)	2.501 kg/h	
Carbon Monoxide (Total)	114.21 kg/h	
NOX (Total)	3.583 kg/h	

SIDRA SOLUTIONS

Site: Year 2015 Brentwood/Wye Rd
F:\Strathcona County\1149 - Wye Road\Traffic\Sidra Analysis\1149 Wye Road.aap
Processed Nov 21, 2006 09:39:45AM

A0682, Al-Terra Engineering Ltd., Small Office
Produced by SIDRA Intersection 3.2.0.1455
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www.sidrasolutions.com

SIDRA INTERSECTION

Movement Summary

Brentwood Dr / Wye Road

Year 2015 TRaffic

Roundabout

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Brentwood NB										
3L	L	223	1.8	0.725	61.0	LOS E	65	1.00	1.31	26.1
8T	T	835	2.0	1.020	93.4	LOS F	100	1.00	1.58	18.3
8R	R	324	1.9	0.564	17.9	LOS B	46	1.00	1.13	43.0
Approach		**1380**	**2.0**	**1.019**	**70.5**	**LOS E**	**100**	**1.00**	**1.43**	**22.3**
Wye WB										
1L	L	177	2.2	0.724	29.4	LOS C	48	0.91	1.14	37.8
6T	T	970	2.0	0.724	20.4	LOS C	53	0.92	1.12	41.7
6R	R	225	1.8	0.404	10.7	LOS B	23	0.83	0.93	49.8
Approach		**1372**	**2.0**	**0.724**	**20.0**	**LOS C**	**53**	**0.91**	**1.09**	**42.1**
Brentwood SB										
7L	L	149	2.0	0.248	15.3	LOS B	11	0.73	0.83	46.2
4T	T	477	2.1	0.240	6.7	LOS A	12	0.73	0.57	51.6
4R	R	355	2.0	0.390	6.5	LOS A	21	0.74	0.58	51.0
Approach		**982**	**2.0**	**0.390**	**7.9**	**LOS A**	**21**	**0.73**	**0.61**	**50.4**
Wye EB										
5L	L	663	2.0	0.469	13.8	LOS B	27	0.63	0.76	46.6
2T	T	2595	2.0	0.604	6.6	LOS A	36	0.68	0.61	52.0
2R	R	150	2.0	0.096	5.3	LOS A	4	0.44	0.46	53.3
Approach		**3408**	**2.0**	**0.604**	**7.9**	**LOS A**	**36**	**0.66**	**0.63**	**50.8**
All Vehicles		**7142**	**2.0**	**1.020**	**22.3**	**LOS C**	**100**	**0.78**	**0.87**	**39.5**

Symbols which may appear in this table:

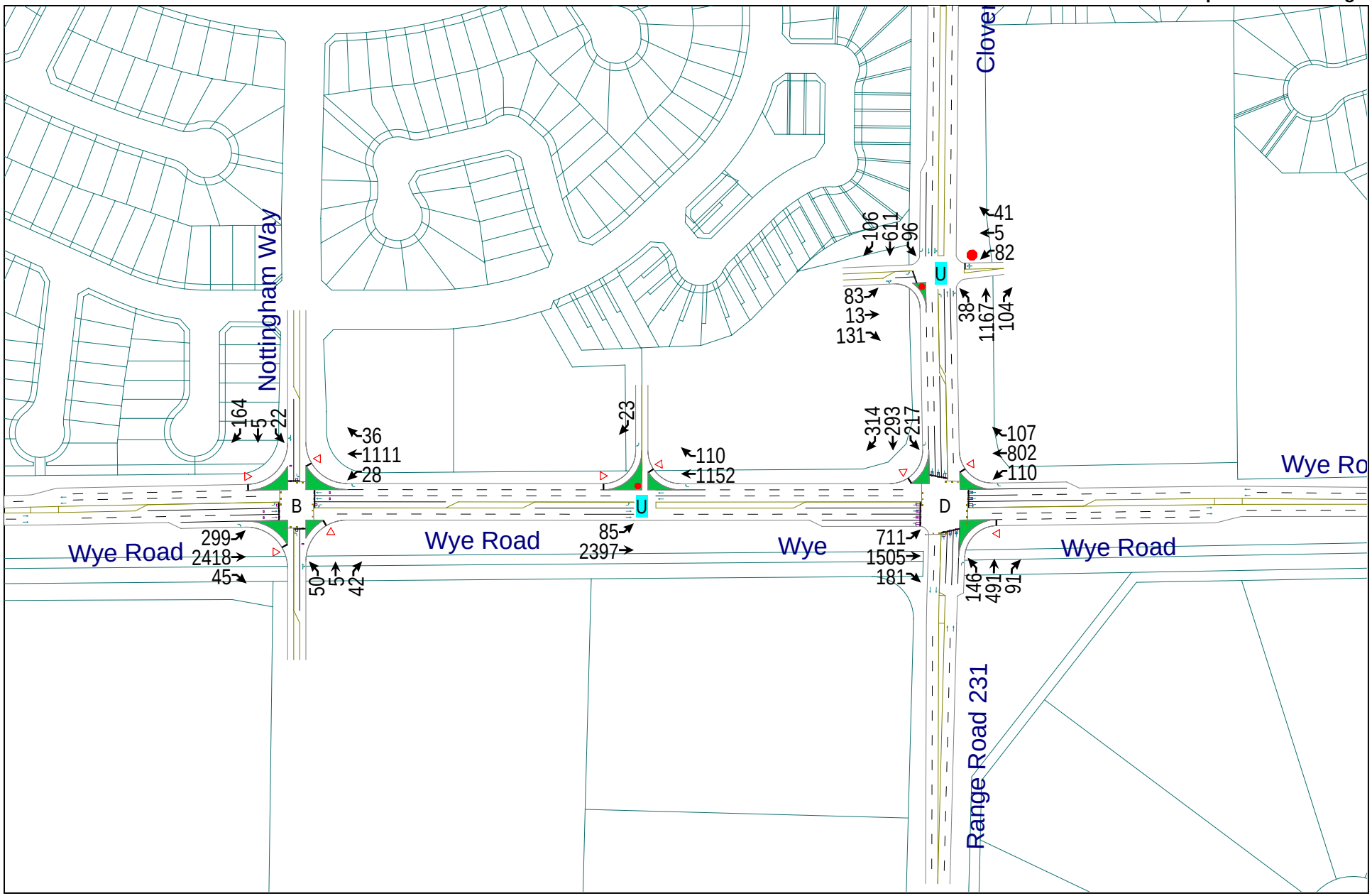
Following Degree of Saturation
x = 1.00 for Short Lane with resulting Excess Flow
* x = 1.00 due to minimum capacity

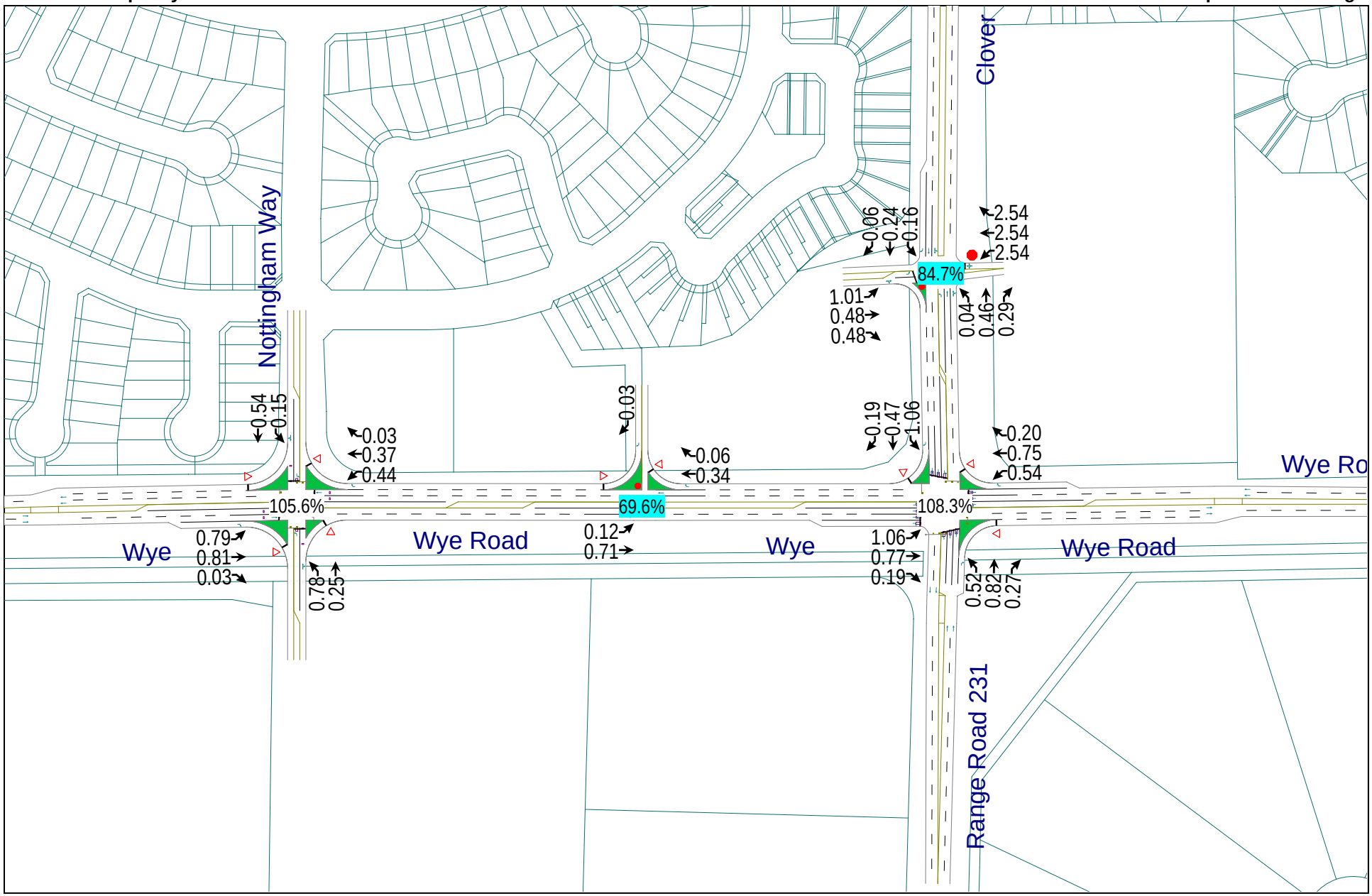
Following LOS
- Based on density for continuous movements

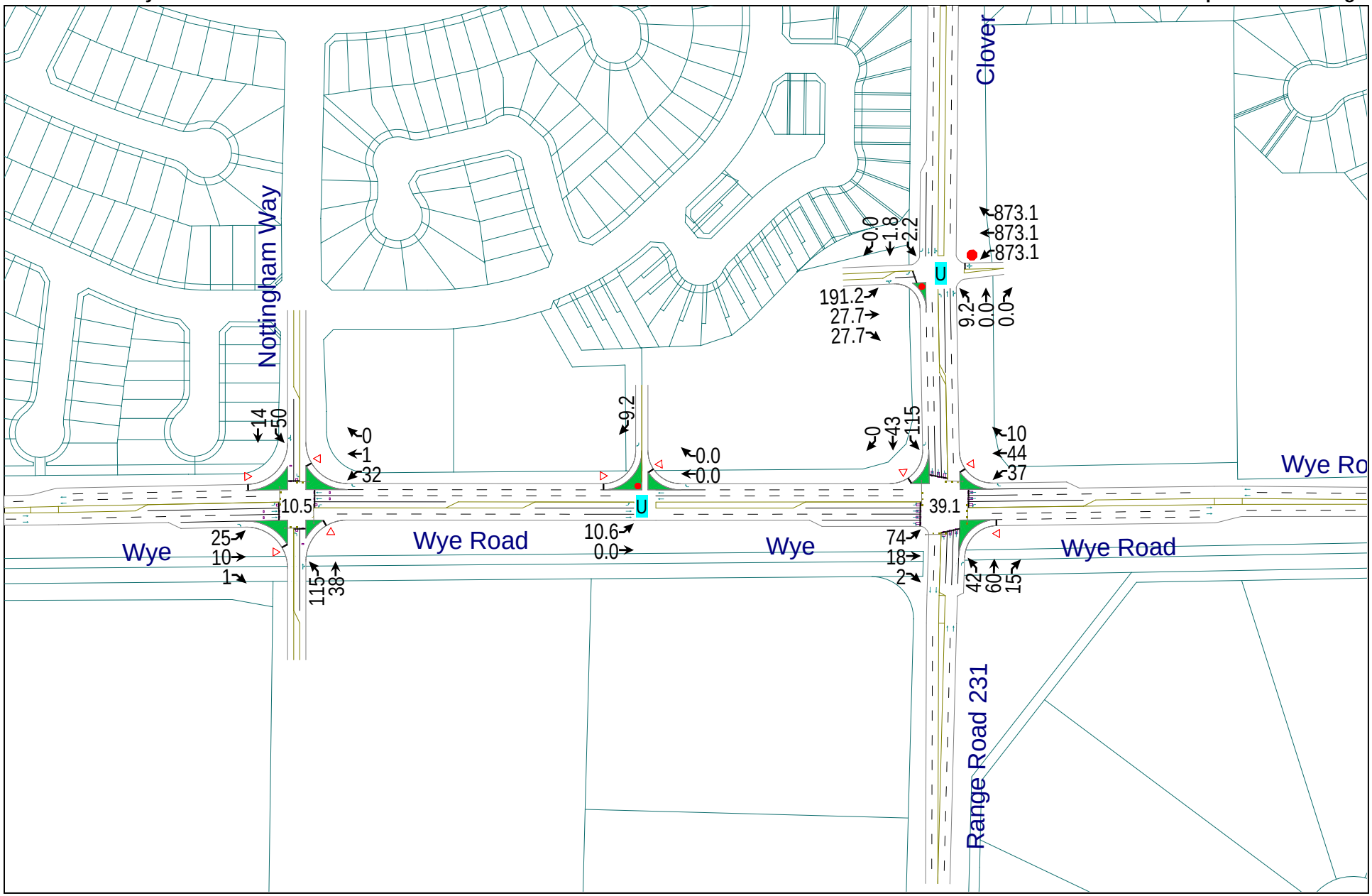
Following Queue

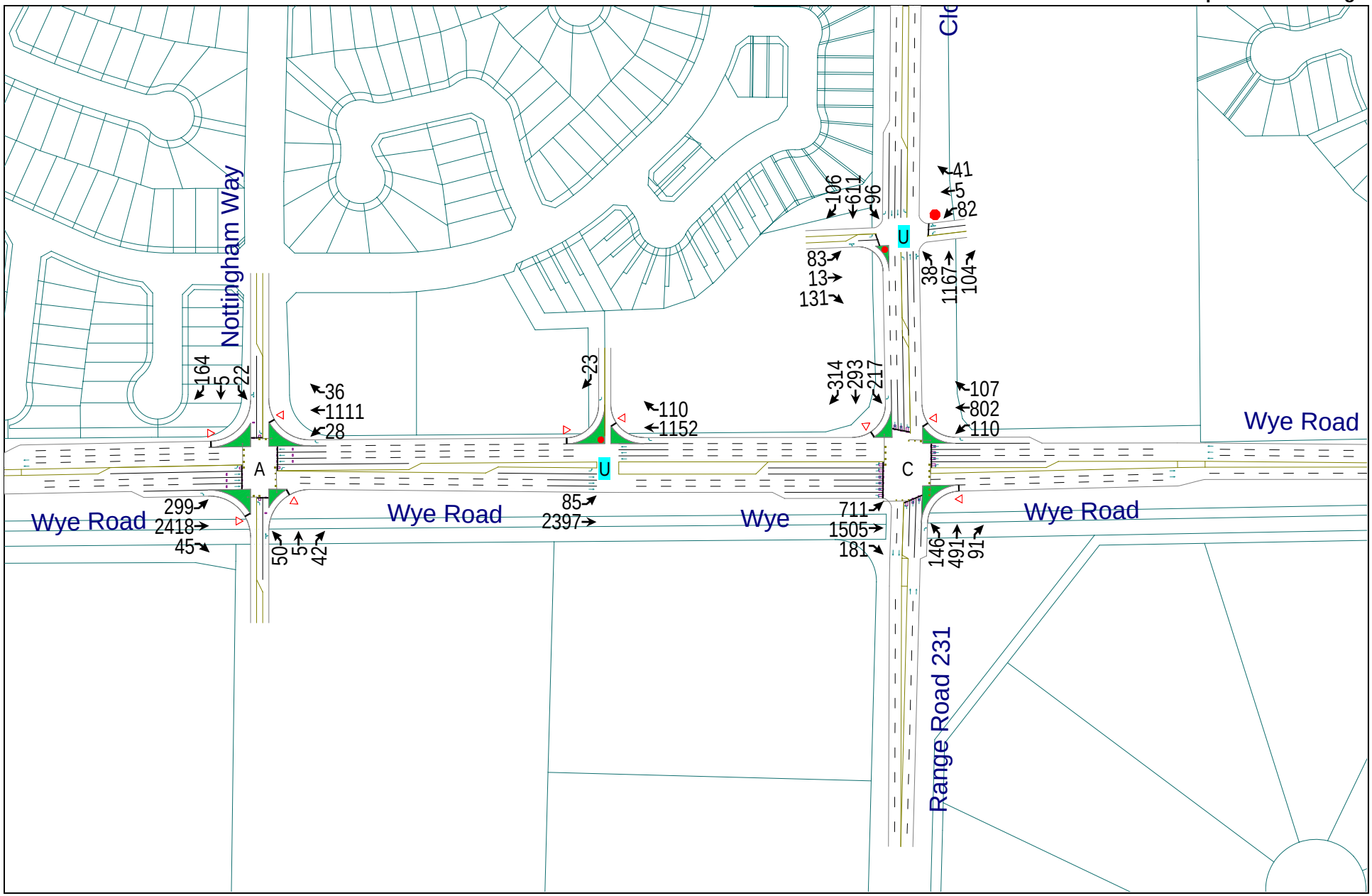
Wye Road/Clover Bar Road Intersection **Table 4.5**
Option Evaluation

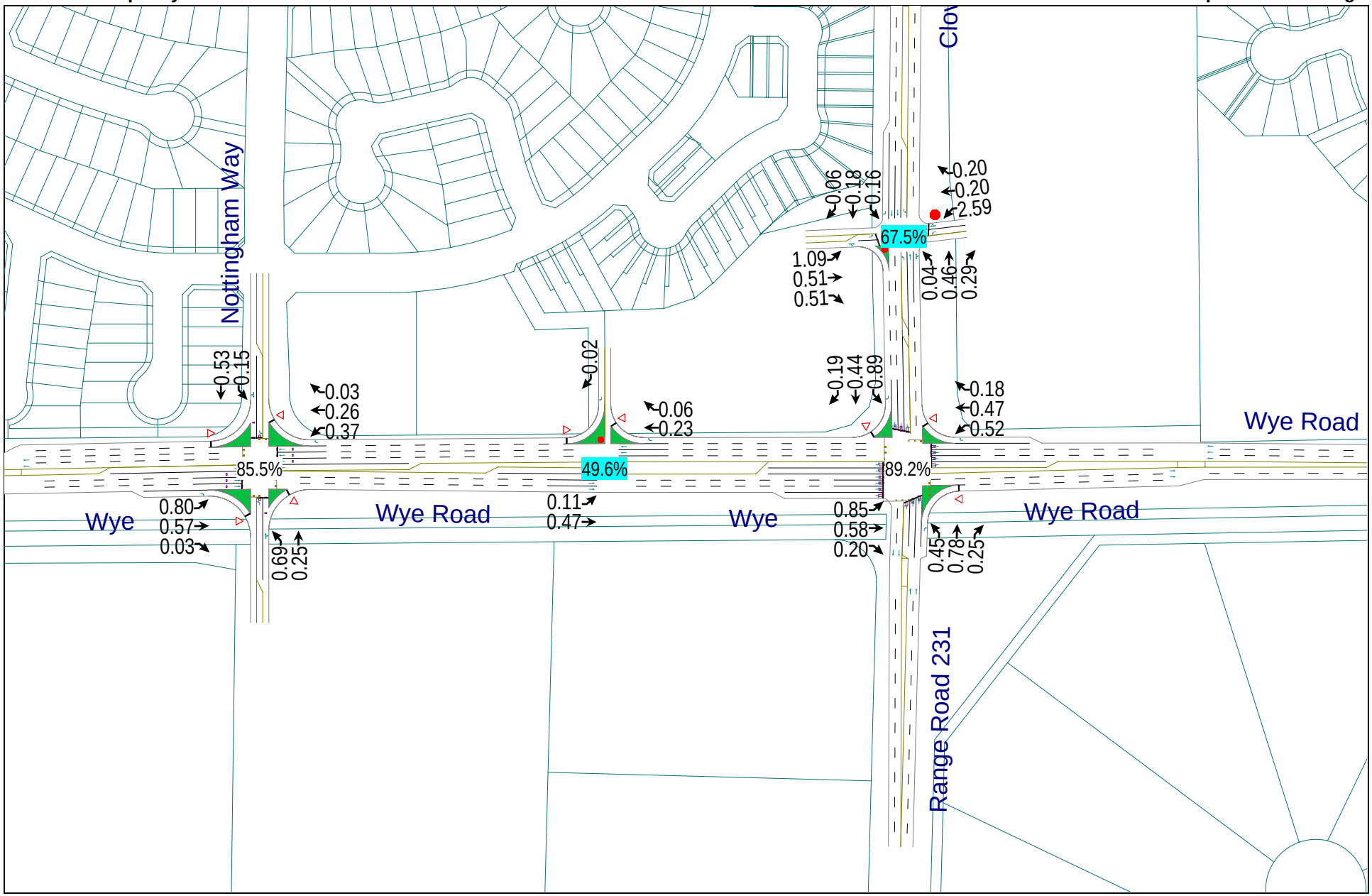
Option Year 2015 Traffic Volumes	**Level of Service**	**Operations** **Additional Requirements**
Do Nothing No improvements to existing intersection	**ICU 108.3 LOS G** EBL v/c = 1.06 SBL v/c = 1.06 **LOS D** Intersection Average Delay = 39.1 s/veh Critical Movement - SBL Average Delay = 115 s/veh (LOS F)	▪ Intersection over capacity and likely will experience congestion periods of 60 to 120 min, long queues ▪ Motorists would use different routs or time of travel. Unsignalized Intersections at Nottingham/Wye and Clover Bar/Christian Academy Access Fail
Option I Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes EBL – 2 lanes	**ICU 89.2% - ICU LOS E** SBL v/c = 0.89 **LOS C** Intersection Average Delay = 29.4 s/veh Critical Movement - SBL Average Delay = 68 s/veh (LOS E)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access
Option II Increased Number of Lanes SBT/NBT – 2 lanes WBT/EBT – 3 lanes EBL/SBL/NBL – 2 lanes	**ICU 83.4% - ICU LOS E** EBL v/c = 0.82 **LOS C** Intersection Average Delay = 26.6 s/veh Critical Movement - NBT Average Delay = 52 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access
Option III – Jughandle Option EB to NB Left Turn Remains Remaining Left Turn Movements Accommodated via Jughandle at SW quadrant of intersection	**ICU 76.9% - ICU LOS D** SBT v/c = 0.65 **LOS B** Intersection Average Delay = 14.6 s/veh Critical Movement - NBT Average Delay = 37.0 s/veh (LOS D)	▪ Intersection on the verge of congested condition. ▪ Minor traffic fluctuation, accidents, and lane closure can cause significant congestion Signalized Intersections at Wye/Nottingham and Clover Bar/Christian Academy Access

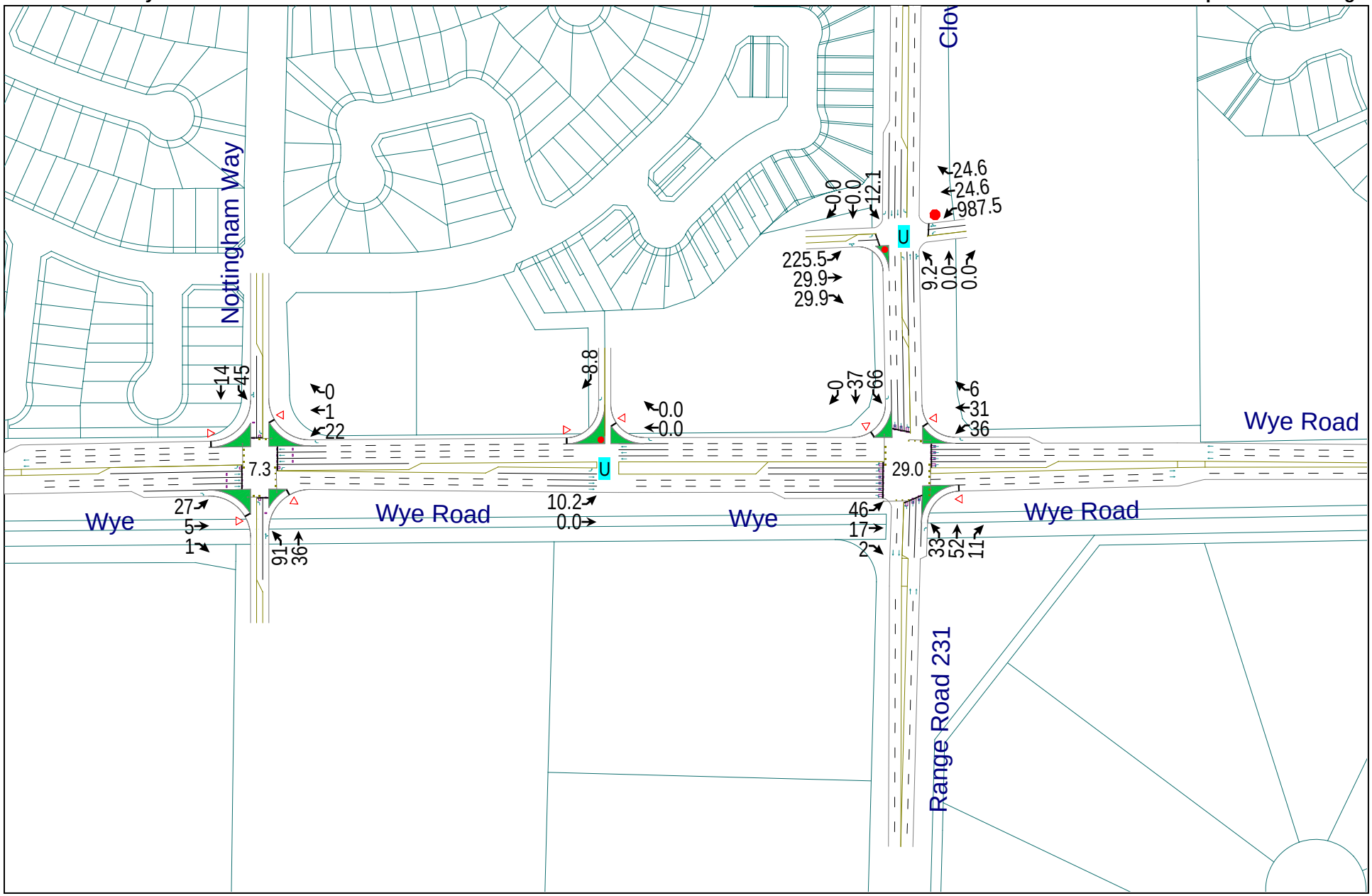

Nottingham Way
Wye Road
Wye Road
Wye
Wye Road
Wye Ro
Range Road 231
B
U
U
D
164
5
22
36
1111
28
23
110
1152
85
2397
106
611
96
41
5
82
83
13
131
38
1167
104
314
293
217
107
802
110
299
2418
45
50
5
42
711
1505
181
146
491
91

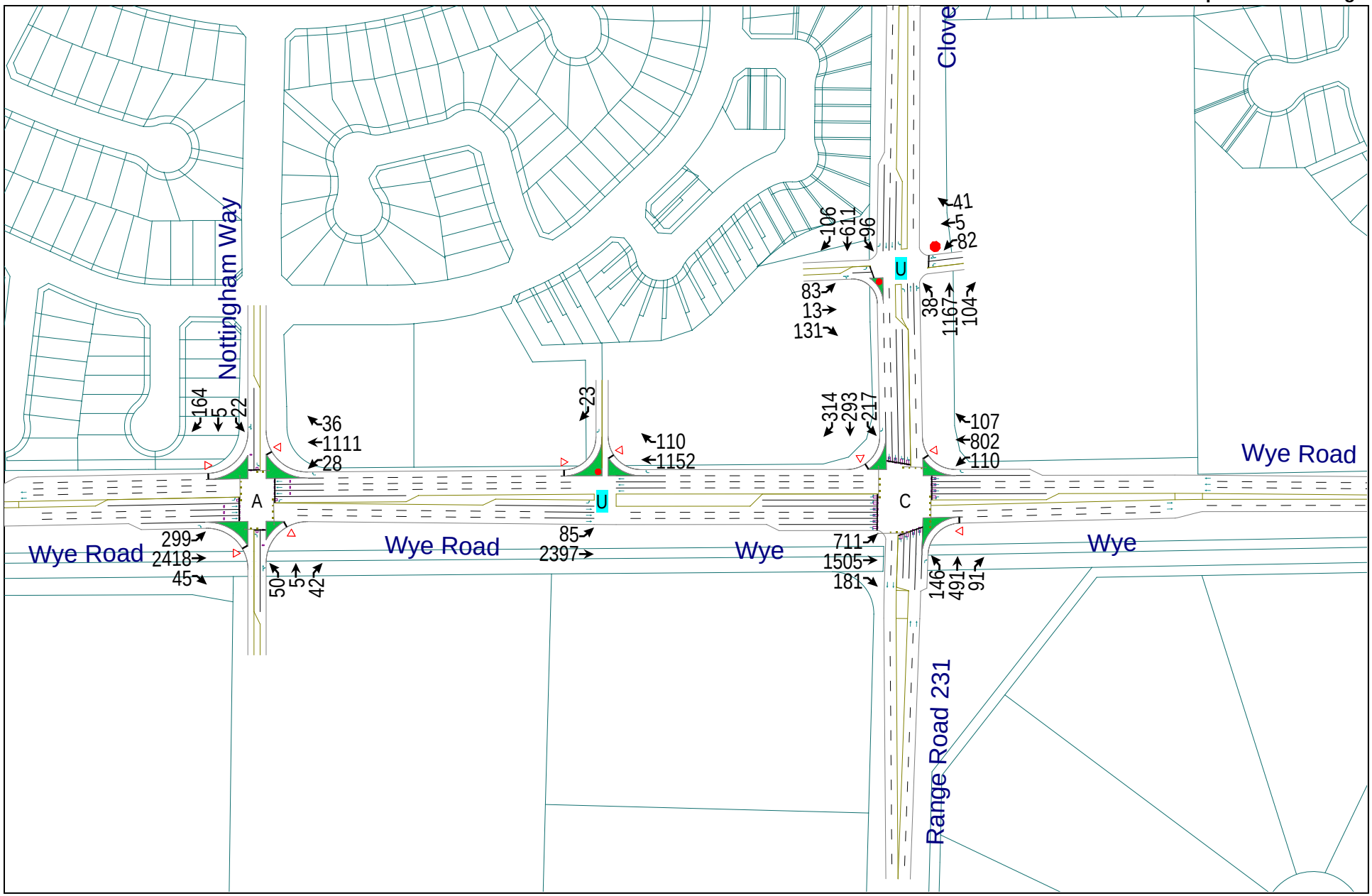

Nottingham Way
Clover
Wye Road
Wye
Wye Road
Wye
Wye Road
Range Road 231
105.6%
69.6%
84.7%
108.3%
0.54
0.15
0.03
0.37
0.44
0.03
0.06
0.34
0.06
0.24
0.16
2.54
2.54
2.54
1.01
0.48
0.48
0.04
0.46
0.29
0.19
0.47
1.06
0.20
0.75
0.54
0.79
0.81
0.03
0.78
0.25
0.12
0.71
1.06
0.77
0.19
0.52
0.82
0.27

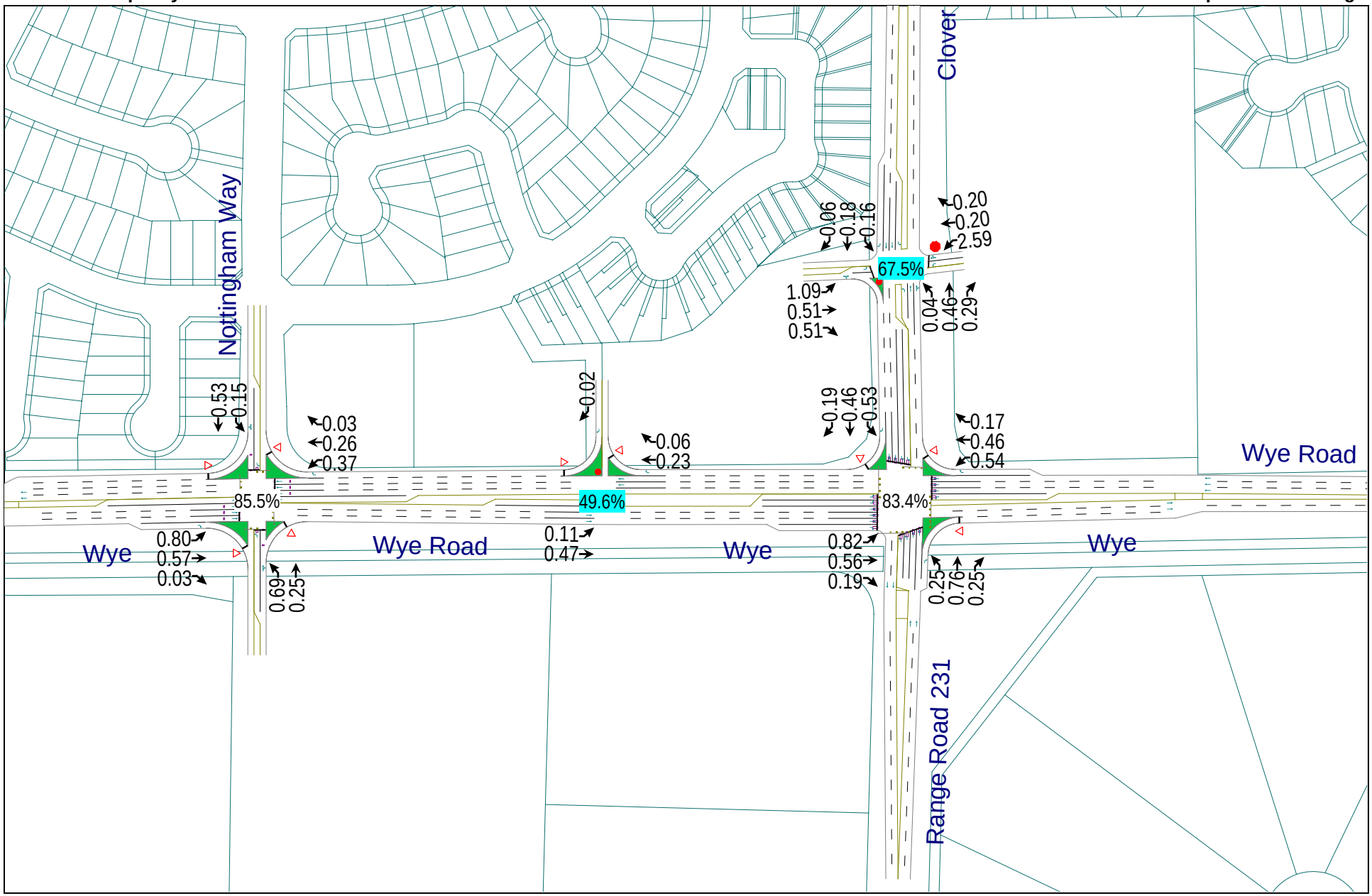

Nottingham Way
Clover
Wye Road
Wye
Wye Road
Wye
Wye Road
Range Road 231
U
U
873.1
873.1
873.1
191.2
27.7
27.7
0.0
1.8
2.2
9.2
0.0
0.0
14
50
0
1
32
9.2
0.0
0.0
0
43
115
10
44
37
10.5
39.1
25
10
1
115
38
10.6
0.0
74
18
2
42
60
15

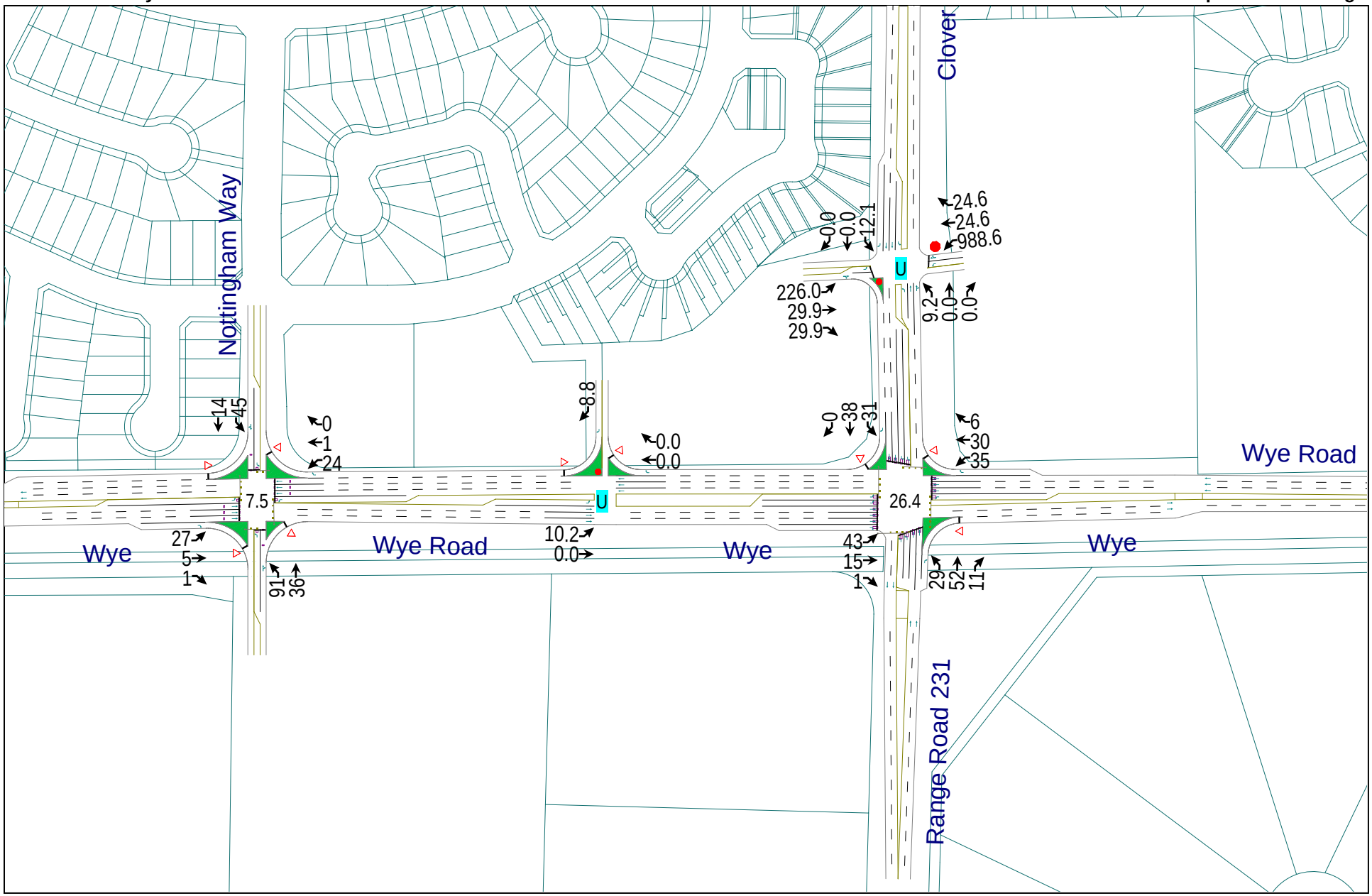

Nottingham Way
Wye Road
Wye Road
Wye
Wye Road
Range Road 231
A
U
C
U
164
5
22
36
1111
28
23
110
1152
106
611
96
83
13
131
41
5
82
38
1167
104
314
293
217
107
802
110
299
2418
45
50
5
42
85
2397
711
1505
181
146
491
91

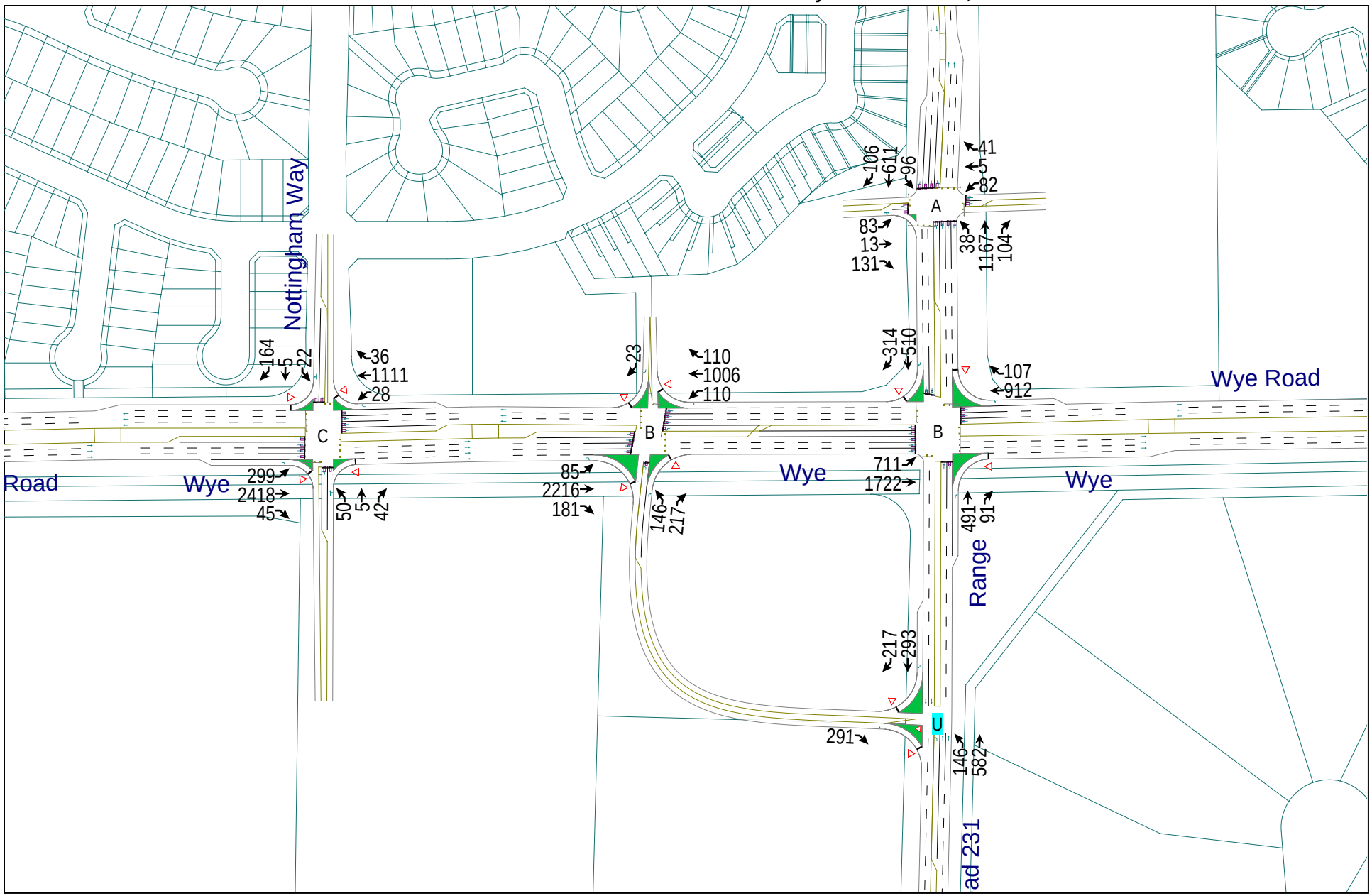

Nottingham Way
Wye Road
Wye
Wye Road
Wye
Wye Road
Range Road 231
67.5%
49.6%
85.5%
89.2%
0.53
0.15
0.03
0.26
0.37
0.02
0.06
0.23
0.19
0.44
0.89
0.18
0.47
0.52
0.06
0.18
0.16
0.20
0.20
2.59
1.09
0.51
0.51
0.04
0.46
0.29
0.80
0.57
0.03
0.69
0.25
0.11
0.47
0.85
0.58
0.20
0.45
0.78
0.25

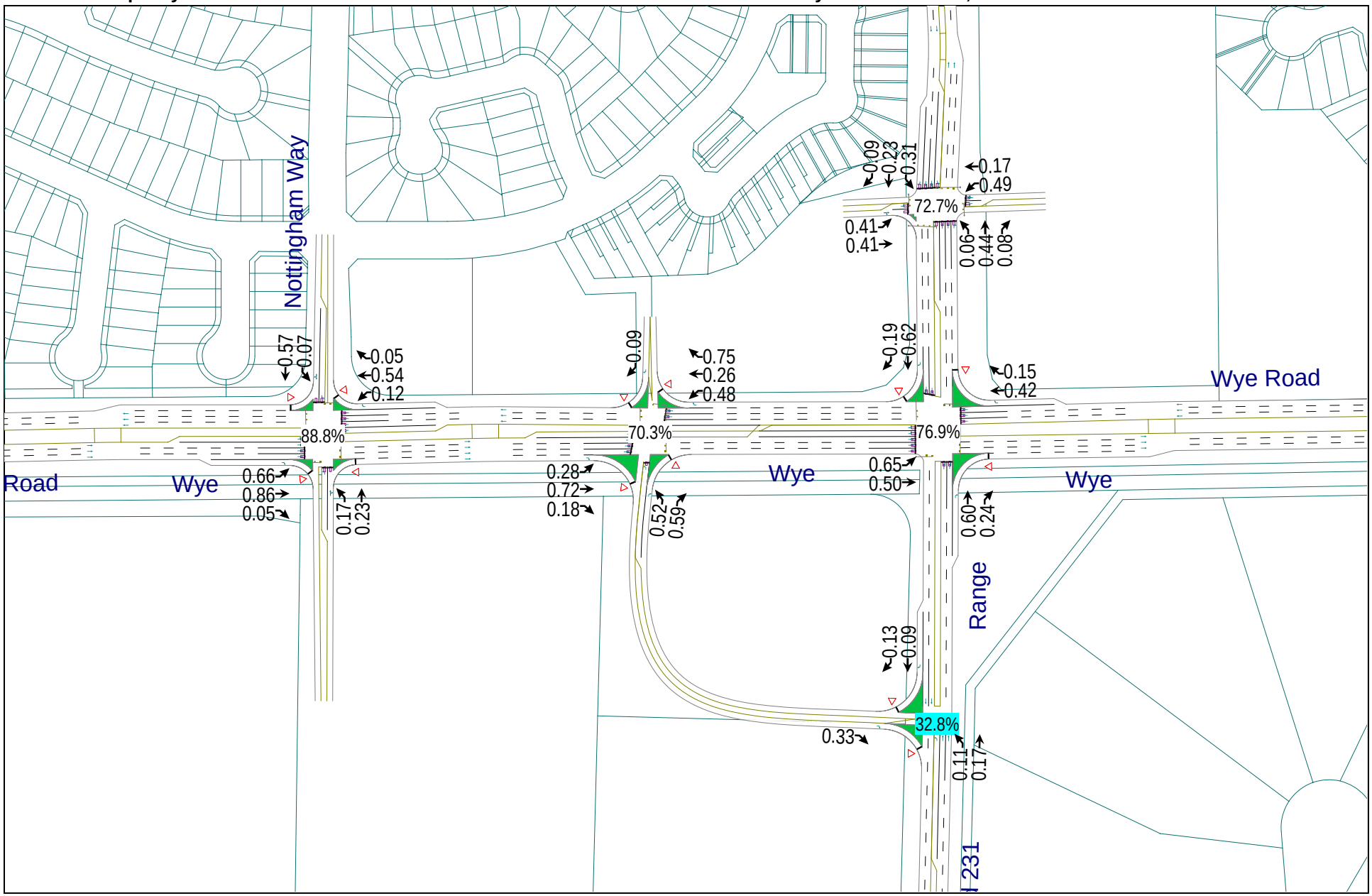

Nottingham Way
Wye Road
Wye
Wye Road
Wye
Wye Road
Range Road 231
U
U
14
45
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8.8
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36
10.2
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17
2
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52
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0.0
0.0
12.1
24.6
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987.5
225.5
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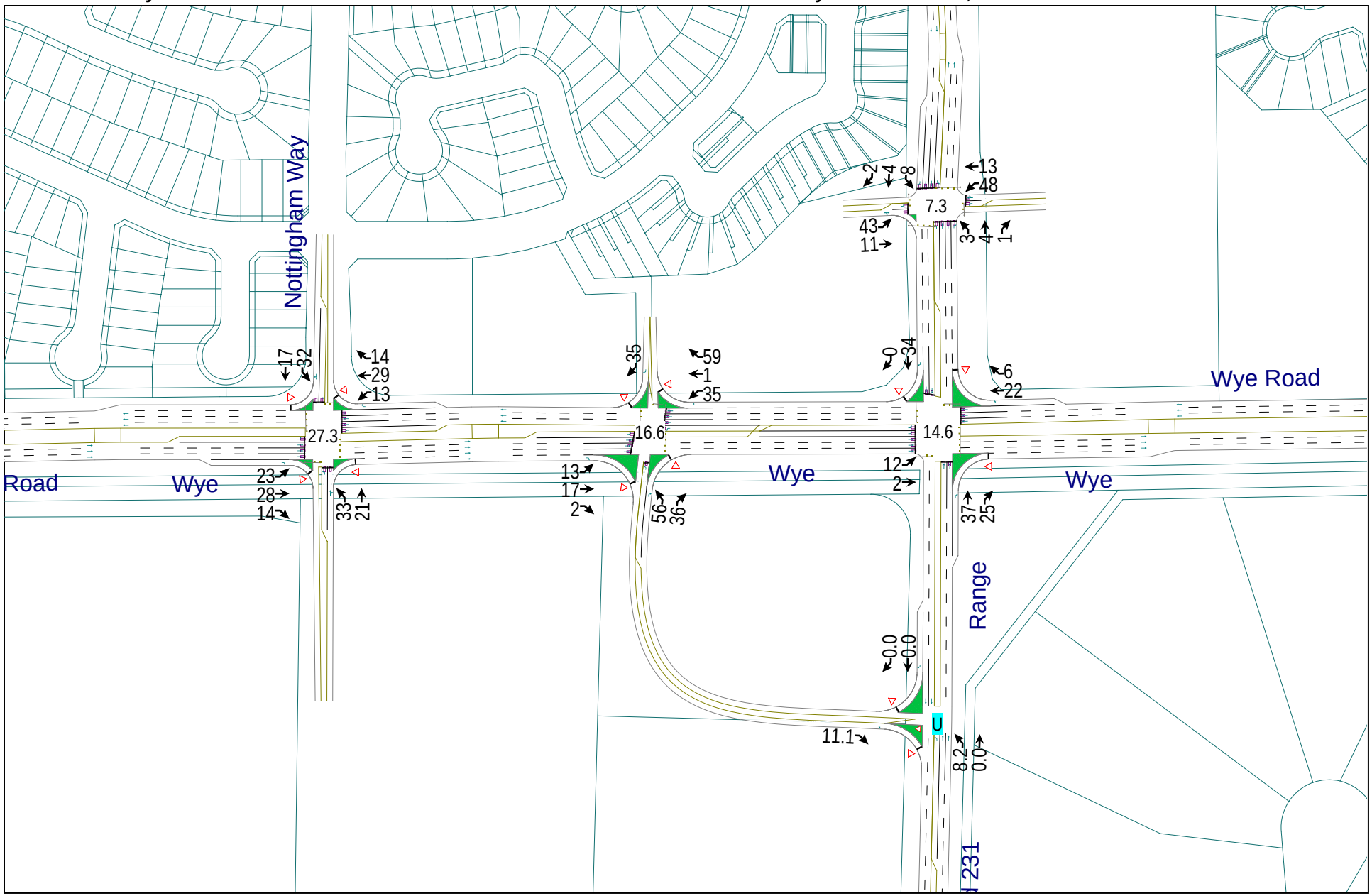

Nottingham Way
Clover
Wye Road
Wye Road
Wye Road
Wye
Range Road 231
A
U
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C
164
5
22
36
1111
28
23
110
1152
106
611
96
41
5
82
83
13
131
38
1167
104
314
293
217
107
802
110
299
2418
45
50
5
42
85
2397
711
1505
181
146
491
91


Clover
Nottingham Way
Wye Road
Wye
Wye Road
Wye
Wye
Range Road 231
67.5%
85.5%
49.6%
83.4%
0.06
0.18
0.16
0.20
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2.59
1.09
0.51
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0.11
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Clover
Nottingham Way
Wye Road
Wye
Wye Road
Wye
Wye
Range Road 231
24.6
24.6
988.6
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12.1
226.0
29.9
29.9
9.2
0.0
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1
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0.0
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38
31
6
30
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7.5
U
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27
5
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91
36
10.2
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43
15
1
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52
11


Nottingham Way
Wye Road
Wye
Road
Wye
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Range
ad 231
A
B
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C
106
611
96
41
82
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13
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1167
104
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5
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36
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28
23
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299
2418
45
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42
85
2216
181
146
217
711
1722
491
91
217
293
291
146
582


Nottingham Way
Wye Road
Road
Wye
Wye
Wye
Range
231
0.09
0.23
0.31
0.17
0.49
72.7%
0.41
0.41
0.06
0.44
0.08
0.57
0.07
0.05
0.54
0.12
0.09
0.75
0.26
0.48
0.19
0.62
0.15
0.42
88.8%
70.3%
76.9%
0.66
0.86
0.05
0.17
0.23
0.28
0.72
0.18
0.52
0.59
0.65
0.50
0.60
0.24
0.13
0.09
32.8%
0.33
0.11
0.17


Nottingham Way
Wye Road
Road
Wye
Wye
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Range
231
2 4 8
13
48
7.3
43
11
3 4 1
17 32
14
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23
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14
33 21
13
17
2
56 36
12
2
37 25
0.0 0.0
11.1
8.2
0.0

APPENDIX “C”

Pavement Evaluation / Design / Surfacing Strategy

J.R. Paine & Associates Ltd.
CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — PEACE RIVER — WHITEHORSE

17505 – 106 Avenue
Edmonton, Alberta
T5S 1E7

November 27, 2008
File No. 1229-296

AL-TERRA ENGINEERING LTD.
4010-76 Avenue
Edmonton, AB T6B 2P1

Attention: Dana Leithead, P. Eng.

Dear Madam:

Re: Surfacing Strategy – Pavement Rehabilitation and New Construction
Wye Road, Transportation Utility Corridor to Highway 21

As requested, we have carried out a preliminary surfacing strategy and basic structural design for the above noted project.

1.0 INTRODUCTION

The project consists of an ACP overlay and widening of Wye Road from the Transportation Utility Corridor to Highway 21. A pavement surfacing strategy is required for this section of Wye Road (5.75 kms in length).

The surfacing strategy and basic structure design has been carried out in accordance with Alberta Transportation's Pavement Design Manual, Edition 1, Published in June 1997.

2.0 EXISTING PAVEMENT STRUCTURE

2.1 Wye Road, Sherwood Drive to Highway 21 (4.90 kms)

Thirty probe holes were drilled with a truck mounted drilling rig on March 19, 2008 to determine the existing pavement structure thicknesses. The probehole locations were selected by J.R. Paine & Associates Ltd. and determined using a measuring wheel. Fifteen probe holes were drilled in the eastbound lanes (EBL) and fifteen probe holes were drilled in the westbound lanes (WBL). The approximate probehole locations and pavement structure layer thickness are shown on the attached probehole logs. All probe holes were situated on the outside lanes of the existing four lane divided road.

Review of the probehole logs indicates an existing pavement structure as follows:

- EBL ACP ranged from 140 to 330 mm in thickness (average of 245 mm).
- Below the EBL ACP was mostly loose oiled gravelly sand ranging from 140 to 350 mm in thickness (average of 269 mm). Below this material was clay.
- WBL ACP ranged from 310 to 370 mm in thickness (average of 341 mm). Below the ACP was clay.

2.2 Wye Road, Transportation Utility Corridor to Sherwood Drive (0.85 kms)

Sixteen probeholes were drilled with a truck mounted drilling rig on September 22, 2008 to determine the existing pavement structure thicknesses. The probehole locations were selected by J.R. Paine & Associates Ltd. and determined using a measuring wheel. Eight probeholes were drilled in the eastbound lanes (EBL) and eight probeholes were drilled in the westbound lanes (WBL). The approximate probehole locations and pavement structure layer thickness are shown on the attached probehole logs. The probeholes were situated either on the inside or outside lanes of the existing six lane divided road.

Review of the probehole logs indicates an existing pavement structure as follows:

- EBL ACP ranged from 100 to 320 mm in thickness (average of 250 mm).
- EBL outside lane ACP ranged from 100 to 320mm in thickness (average of 240 mm).
- EBL inside lane ACP ranged from 190 to 310mm in thickness (average of 260 mm).

- Below the EBL ACP was as following:
  - Clay at three locations
  - Concrete at one location
  - Sandy, oiled gravel at one location
  - 220 mm of sandy, oiled gravel then clay at one location
  - 120 mm of clay then 300 mm of sandy, oiled gravel then clay at one location
  - 300 mm of sandy gravel then clay at one location
- WBL ACP ranged from 180 to 550 mm in thickness (average of 354 mm).
- WBL ACP outside lane ranged from 180 to 310 mm in thickness (average of 260 mm).
- WBL ACP inside lane ranged from 300 to 550 mm in thickness (average of 448 mm).
- Below the WBL ACP was the following:
  - Clay at five locations
  - Sandy gravel at one location
  - Sandy, oily gravel at one location
  - 280 mm of sandy gravel then clay at one location

3.0 FIELD RECONNAISSANCE

A field reconnaissance was carried out on March 25, 2008 (Sherwood Drive to Highway 21) and on September 4, 2008 (Transportation Utility Corridor to Sherwood Drive) by J.R. Paine & Associates Ltd. to access the condition of the existing pavement. Summary of the observation made are as follows:

A) Wye Road (EBL), Sherwood Drive to Highway 21

- West to East.
- Curb and gutter; median.
- Minor to moderate rutting was observed.
- Numerous small patches.
- All of the existing ACP was visually aged.

- Some pot holes were observed. Many pot holes have been patched.
- Many cracks have reflected through the sealed cracks.
- Transverse and longitudinal cracking, block cracking, raveling, distress, old patches and alligator cracking.
- The outside lane is in worse condition than the inside lane.
- Outside curb ends at approximately km 1.83, starts again at km 2.09, ends again at km 2.32 and starts again at km 4.77.
- 122 transverse cracks exist between Sherwood Drive and Brentwood Blvd.
- 115 transverse cracks exist between Brentwood Blvd. and Clover Bar Road.
- 125 Transverse cracks exist between Clover Bar Road and Highway 21.
- The ride quality was considered poor to fair due to the roughness caused by the cracking, pot holes and old patches.
- Visually, the worst section of Wye Road (EBL) was from Brentwood Blvd. to Clover Bar Road.

B) <u>Wye Road (WBL), Highway 21 to Sherwood Drive</u>

- East to West.
- Curb and gutter; median.
- Minor to moderate rutting was observed.
- Numerous small patches.
- Some pot holes were observed. Many pot holes have been patched.
- Many cracks have reflected through the sealed cracks.
- Transverse and longitudinal cracking, block cracking, distress, old patches and alligator cracking.
- The outside lane is in worse condition than the inside lane.
- 37 Transverse cracks exist between Highway 21 and Clover Bar Road.
- 38 Transverse cracks exist between Clover Bar Road and Brentwood Blvd.
- 27 Transverse cracks exist between Brentwood Blvd. and Sherwood Drive.
- The ride quality was considered fair due to the roughness caused by the cracking, pot holes and old patch.

C) **Wye Road (WBL), Sherwood Drive to Transportation Utility Corridor**

- East to West.
- Curb and gutter; median.
- Minor to moderate rutting was observed.
- Non-continuous turning lanes.
- Some small patches.
- Pot holes have been patched.
- Some cracks have reflected through the sealed cracks.
- Transverse and longitudinal cracking, fatigue cracking and distress.
- 39 transverse cracks exist in this section.
- At the west end of this section was a noticeably different pavement.
- The ridge quality was considered fair due to the roughness cause by the cracking and small old patches.

D) **Wye Road (EBL), Sherwood Drive to Transportation Utility Corridor**

- East to West.
- Curb and gutter; median.
- Minor to moderate rutting was observed.
- Non-continuous turning lanes.
- Some small patches.
- Pot holes have been patched.
- Some cracks have reflected through the sealed cracks.
- Transverse and longitudinal cracking, and distress.
- 63 transverse cracks exist in this section.
- At the west end of this section was a noticeably different pavement.
- The ride quality was considered fair due to the roughness caused by the cracking and small old patches.

4.0 SURFACING STRATEGY – NEW CONSTRUCTION

The following design input valves were utilized for determination of the unstaged structural design:

A) Design ESALs

- AADT = 22140 (supplied by AL- Terra Engineering Ltd.)
- Design period = 20 years
- Traffic Growth Factor = 5%
- Lane distribution = 25:30:45
- Design ESALs = 1.7×10^6

B) Effective Roadbed Resilient Modulus = 30 MPa

C) Reliability

- A reliability of 85 % was used for the new construction pavement design (appropriate for 0.1×10^6 to 5.0×10^6 ESALs)

Based on the review of available information, discussions with Al-Terra Engineering Ltd., the review of the limited geotechnical investigation and engineering judgment, the following road structure is recommended for the new construction:

Asphaltic Concrete Pavement	Granular Base Course
160mm - 50mm ACO over 110mm ACB	**350mm** -2 lifts (maximum of 200mm thickness per lift) -20mm Crush

It should be noted that the ACP Mix Types and GBC are as per City of Edmonton Specifications.

Adjustments to the ACP and GBC thickness may be required to provide proper drainage to the adjoining existing road structure. This would be dependent on the Wye Road structure thickness encountered during construction. Also, the ACP Mix Type and thickness may have to be adjusted to coincide with the existing Wye Road overlay design and construction.

A 30 MPa subgrade modulus needs a very stiff clay subgrade with no deflection exhibited during a proof roll.

5.0 SURFACING STRATEGY - REHABILITATION

Strathcona County supplied the "Detailed Deflection Report(s)" for Wye Road within the project limits. The reports contained Dynaflect measurements obtained on July 17, 2007. J.R. Paine & Associates Ltd. utilized this Dynaflect data to analyse a design asphaltic concrete overlay for the existing pavement portion of the project.

Scott Sillers of Strathcona County informed J.R. Paine & Associates Ltd. that the Dynaflect sensor readings were temperature corrected. It was assumed by Mr. Sillers and J.R. Paine & Associates Ltd. that the readings are in thousandths of an inch.

The following formula were utilized to convert the S1 readings (D) to equivalent Benkleman Beam rebound values (D_B):

Full Depth AC $D_B = -7.4887 + 39.8501 \times D$

Granular Base $D_B = -7.8999 + 34.2494 \times D$

Based on the J.R. Paine & Associates Ltd. probehole results, the westbound lanes of Wye Road were mostly comprised of full-depth asphaltic concrete pavement type. The eastbound lane probeholes mostly contained gravelly sand with some oil below the asphaltic concrete pavement. The sand was noticeably soft. J.R. Paine & Associates Ltd. estimated that this sand base presence qualifies the pavement type as granular base for the Dynaflect/Benkleman Beam conversion formula.

A seasonal correction value of 1.2 was applied to the equivalent Benkleman Beam values, based on a formula given in, "Engineering Documentation for the Municipal Pavement Management System of the Province of Alberta" (November 1988).

The design overlay for Wye Road was determined using Figure 8-2 of the Asphalt Institute Manual Series No. 17. The following table provides the design overlay thickness for different sections of Wye Road.

The design overlay thicknesses for Sections 03014 and 03016 were less than the minimum thickness needed for paving. Therefore the recommended overlay thickness was set at the

minimum thickness of 40 millimeters required for paving. An overlay is recommended in these sections based on the visual assessment by JRP.

Section 02012 had the highest Dynaflect readings of the project area. JRP reviewed the readings and grouped them into two areas based on the values being relatively higher in one area versus the other. The first area starts from Brentwood Boulevard and heads eastbound to Station 1050. The second area starts at Station 1050 and goes eastbound to Clover Bar Road. It is assumed that the Station values are in meters.

Design and Recommended Overlay Thickness

Wye Road - Highway 21 to Transportation Utility Corridor

Road Section	Station	Section #	Direction	RRD	Design Overlay Thickness (mm)	Recommended Overlay Thickness (mm)
Hwy. 21 to Clover Bar Road	All	01011	WB	38.2	40	40
Clover Bar Road to Brentwood Blvd.	All	02011	WB	41.8	50	50
Brentwood Blvd. To Hawthorne Street	All	03011	WB	56	75	80
Hawthorne Street to Ash Street	All	03013	WB	39.1	45	50
Ash Street to Sherwood Drive	All	03015	WB	38.9	45	50
Sherwood Drive to Transport Utility Corridor	All	4011	WB	55.2	80	80
Hwy. 21 to Clover Bar Road	All	01012	EB	51.1	65	70
Clover Bar Road to Brentwood Blvd.	0 - 1050	02012	EB	93.7	135	140
Clover Bar Road to Brentwood Blvd.	1050-1650	02012	EB	50.1	65	70
Brentwood Blvd. To Hawthorne Street	All	03012	EB	44.4	60	60
Hawthorne Street to Ash Street	All	03014	EB	36.4	30	40
Ash Street to Sherwood Drive	All	03016	EB	31.6	10	40
Transport Utility Corridor to Sherwood Drive	All	4012	EB	50.4	70	70

Notes:

RRD - Representative Rebound Deflection (mean plus 2 standard deviations)

Design thickness based on County July 2007 Dynaflect data

The design ESALs for rehabilitation is 1.4 x 10^6 (Design Period of 20 years and a Traffic Growth Factor of 3%).

It should be noted that the ACP Mix Type ACO as per City of Edmonton specification is recommended for the overlay.

The EBL of Wye Road from Brentwood Blvd. to 1050m East of Brentwood Blvd. requires a 140 mm overlay. The ACP in this section of road should be placed in 2 lifts with ACB (City of Edmonton Specifications base asphalt type) used on the bottom lift of 90 mm. The top lift should be 50 mm of ACO. The remaining sections of Wye Road (EBL and WBL) may be placed in a single lift.

There are a few old patches, which exist throughout the Wye Road subject area. We recommend that all patches be inspected for structural distress prior to ACP overlay construction.

We recommend that the existing pavement in all areas exhibiting alligator cracking or structural distress be proof rolled. Any areas showing significant deflection during proof rolling should be inspected and repaired, prior to ACP overlay construction. Some failure areas may only require a minimum repair consisting of the removal and replacement of the existing ACP. We recommend that the existing pavement structure in all areas exhibiting major failures or structural distress be excavated to a minimum depth of 600 millimeters or as required below the existing subgrade surface. These areas would be backfilled with an appropriate granular material followed by a minimum of 140 millimeters of ACP (dependent on the existing ACP thickness and allowance for proper drainage). Proper excavation and backfill construction operations would apply for failure repair. It should be noted that the condition of the ACP below the existing patches is unknown. Cracking has reflected through some of the old patches.

Visually, the road exhibited minor to moderate rutting. All areas exhibiting moderate or severe rutting and structural distress should have an extra leveling course application prior to overlay construction.

There are numerous transverse and longitudinal cracks which exist throughout the project limits. Many of the transverse and longitudinal cracks that were previously sealed are now open. All longitudinal and transverse cracks which have a width greater then 10 millimeters should be repaired by spray patching. The crack repair should be completed a minimum of two weeks prior to ACP overlay construction.

A level course should be applied prior to overlay construction. The blade or paver laid leveling course would help address cracking, rutting, pot holes and any cross-sectional distortion.

6.0 CLOSURE

This report has been prepared for the exclusive and confidential use of Al-Terra Engineering Ltd. and Strathcona County. Use of this report is limited to the subject road upgrading only. The recommendations given are based on the subsurface soil conditions encountered during test boring, current construction techniques and generally accepted engineering practices. No other warranty, expressed or implied, is made. Due to geological randomness of many soils formations, no interpolation of soil conditions, other than those encountered has been made or implied. Soil conditions are known only at the test boring locations. Should other soils be encountered during construction or other information pertinent become available, the recommendations may be altered or modified in writing by the undersigned.

We trust this information is satisfactory. If you should have any questions or comments, please do not hesitate to contact our office.

Yours truly,

J.R. PAINE & ASSOCIATES LTD.



NOVEMBER 27, 2008

John Rakievich, P. Eng.

APEGGA Permit to Practice #P401

APPENDIX

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 1**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 180 m east of Sherwood Drive		

SAMPLE TYPE ☒ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	330 mm					
			CLAY FILL : sandy, some gravel, low to medium plastic, friable, black and brown					
		CL-CI	470 mm					
			CLAY : sandy, medium plastic, frozen, moist, green, traces of organic soil and gravel			23.9 (14.7 – 37.8)	P.L. = 14.7 L.L. = 37.8 M.C. = 23.9	
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 2**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 180 m east of Sherwood Drive		

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	360 mm					
			CLAY FILL : sandy, some gravel, medium plastic, very stiff, moist, brown			13.5		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 3**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 460 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			280 mm					
		CL-CI	**CLAY FILL** : sandy, some gravel, low to medium plastic, moist, black					
			470 mm					
		CI-CH	**CLAY FILL** : silty, medium to plastic, frozen, moist, yellowish green, traces of organic soil and gravel			13.5		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi
REVIEWED BY: J Rakievich

COMPLETION DEPTH: 0.76 m
COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 4**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 460 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			330 mm					
		CI	**CLAY FILL** : silty, medium plastic, frozen, moist, grey and brown, ,traces of gravel			14.8		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 5**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 900 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			320 mm					
			SAND : gravelly, oiled, medium grained, poorly graded, loose, black			8.3		
		SP						
			530 mm					
			CLAY FILL : silty, medium plastic, frozen, moist, greenish grey, traces of organic soil and gravel			13.9		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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LOGGED BY: J Tsoi | COMPLETION DEPTH: 0.76 m

REVIEWED BY: J Rakievich | COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 6**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 900 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			330 mm					
		CI	**CLAY FILL** : silty, medium plastic, very stiff, moist, greyish brown, traces of gravel			14.3		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 7**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 1100 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	260 mm					
			SAND : gravelly, oiled, medium grained, poorly graded, loose, black			3.4		
		SP	530 mm					
			CLAY : silty, medium to high plastic, frozen, moist, yellowish green, traces of organic soil and gravel			17.9		
		CI-CH	**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 8**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 1100 m east of Sherwood Drive		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			360 mm					
			CLAY : silty, medium plastic, very stiff, moist, brown and grey, traces of gravel			16.6		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 9**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 1370 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	310 mm					
			SAND : gravelly, oiled, medium grained, poorly graded, loose, moist, black					
		SP	540 mm			15.7		
			CLAY TILL : silty, medium plastic, frozen, moist, brown, traces of gravel					
		CI	**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 10**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 1370 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 320 mm					
		CI-CH	**CLAY FILL** : silty, medium to high plastic, very stiff, moist, grey and brown, traces of organic soil			16.7		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 11**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 2000 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	190 mm					
			SAND : oiled, medium grained, poorly graded, loose, black					
			Below 0.3 m - traces of gravel and cobble					
		SP						
			540 mm			16.5		
			CLAY : silty, medium plastic, frozen, moist, green, traces of gravel					
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 12**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 2000 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	360 mm					
			CLAY FILL : silty, medium plastic, very stiff, moist, brown, traces of gravel			15.3		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 13**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 2250 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	190 mm					
			SAND : gravelly, oiled, medium to coarse grained, poorly graded, loose, moist, black			5.5		
		SP						
			540 mm					
			CLAY : silty, medium plastic, very stiff, moist, green, traces of gravel			13		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 14**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 2250 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			310 mm					
			CLAY FILL : silty, medium plastic, very stiff, moist, grey and brown, traces of gravel					
		CI				14		
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 15**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 2450 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	210 mm					
			SAND : gravelly, some cobble, oiled, coarse grained, poorly graded, loose, black					
		SP	470 mm					
			CLAY : silty, medium plastic, frozen, moist, brownish grey, traces of gravel			20.7 (13.9 – 35.6)	P.L. = 13.9 L.L. = 35.6 M.C. = 20.7	
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 16**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 2450 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			350 mm					
			CLAY TILL : silty, medium plastic, very stiff, moist, brown, traces of gravel					
		CI				13.2		
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 17**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 2660 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 140 mm					
		SP	**SAND** : gravelly, some cobble, medium to coarse grained, poorly graded, loose, black 450 mm					
		CI	**CLAY** : silty, sandy, medium plastic, frozen, moist, greenish grey, traces of gravel			19.6		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 18**
CLIENT: Al-Terra Engineering Ltd.		DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:		LOCATION: WBL 2660 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			310 mm					
		CI	**CLAY FILL :** silty, sandy, medium plastic, very stiff, moist, brown, traces of organic soil					
			460 mm					
		CI	**CLAY :** silty, medium plastic, very stiff, moist, greyish brown, traces of gravel			13.4		
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 19**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 3060 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			200 mm					
		SP	**SAND** : gravelly, oiled, medium to coarse grained, moist, loose, black					
			480 mm					
		CI	**CLAY TILL** : silty, sandy, medium plastic, very stiff, moist, greenish grey, traces of gravel			14.2		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 20**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 3060 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			370 mm					
			CLAY : silty, medium plastic, very stiff, moist, greenish grey, traces of gravel			12.2		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 21**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 3440 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 250 mm					
		SP	**SAND** : gravelly, some cobble, oiled, medium to coarse grained, poorly graded, loose, black 480 mm					
		CI	**CLAY TILL** : silty, medium plastic, very stiff, moist, greyish brown			16.2		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 22**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 3440 m east of Sherwood Drive		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			320 mm					
			CLAY : silty, medium plastic, very stiff, moist, greenish grey, traces of gravel			12.8		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 23**
CLIENT: Al-Terra Engineering Ltd.		DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:		LOCATION: EBL 3660 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	250 mm					
			SAND : gravelly, some cobble, oiled, medium grained, poorly graded, loose, black			4.5		
		SP	500 mm					
			CLAY : silty, medium plastic, very stiff, moist, greenish grey, traces of gravel			13.8		
		CI	**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 24**
CLIENT: Al-Terra Engineering Ltd.		DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:		LOCATION: WBL 3660 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			360 mm					
		CI	**CLAY** : silty, some sand, medium plastic, very stiff, moist, greenish grey, traces of coal and gravel			14.5		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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REVIEWED BY: J Rakievich

COMPLETION DEPTH: 0.76 m
COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 25**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 3980 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 230 mm					
		SP	**SAND** : gravelly, some cobble, oiled, medium to coarse grained, poorly graded, loose, moist, black 540 mm					
		CI	**CLAY FILL** : silty, medium plastic, very stiff, moist, greenish grey, traces of coal and gravel			13.8		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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LOGGED BY: J Tsoi	COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich	COMPLETION DATE: 19/3/08
	Page 1 of 1

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 26**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 3980 m east of Sherwood Drive	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			370 mm					
			CLAY TILL : sandy, medium plastic, very stiff, moist, greyish brown, traces of gravel			16.3		
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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COMPLETION DATE: 19/3/08

JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 27**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 4350 m east of Sherwood Drive		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	POCKETPEN. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 190 mm					
		SP	**SAND** : gravelly, some cobble, oiled, medium to coarse grained, poorly graded, loose, black 520 mm					
		CI	**CLAY** : silty, medium plastic, very stiff, moist, greenish grey, traces of gravel and cobble			14.8		
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 28**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: WBL 4350 m east of Sherwood Drive	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			320 mm					
			CLAY TILL : sandy, medium plastic, very stiff, moist, greenish brown, traces of gravel			15.6 (12.4 – 34.7)	P.L. = 12.4 L.L. = 34.7 M.C. = 15.6	
		CI						
			TERMINATION AT 0.76 M **END OF @ 0.8 m.** No water and no slough on completion of .					
1								

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 29**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 4630 m east of Sherwood Drive		

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	320 mm					
			SAND : gravelly, some cobble, oiled, medium to coarse grained, poorly graded, loose, black					
		SP				18.1		
			640 mm					
		CI	**CLAY** : silty, medium plastic, very stiff, moist, greenish grey, traces of gravel and cobble					
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 30**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 4630 m east of Sherwood Drive		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH	350 mm					
			CLAY TILL : sandy, medium plastic, very stiff, moist, greyish brown, traces of coal, oxide and gravel			17.2		
		CI						
1			**TERMINATION AT 0.76 M** **END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD.GPJ JRPV2_3.GDT 23/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 31**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 820 m west of Sherwood Drive centre of outside lane		

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 320 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, very stiff, greenish grey and black, trace gravel					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 32**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 590 m west of Sherwood Drive centre of outside lane	

SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			280 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, very stiff, grey and black, trace gravel					
			END OF @ 0.8 m. No water and no slough on completion of .					
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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 33**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 380 m west of Sherwood Drive centre of outside lane	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			260 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, very stiff, dark grey, trace gravel					
			END OF @ 0.8 m. No water and no slough on completion of .					
1								

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PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 34**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 160 m west of Sherwood Drive centre of outside lane	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 100 mm					
		CONC	**CONCRETE**					
			END OF @ 0.2 m. No water and no slough on completion of .					
1								

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COMPLETION DEPTH: 0.20 m
COMPLETION DATE: 22/9/08

JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 35**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 820 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☐ SPT SAMPLE ■ GRAB SAMPLE ☐ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			270 mm					
		GP	**GRAVEL** : oiled, sandy, fine to coarse grained, moist, grey and black, poorly graded, likely cold mix asphalt					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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PROJECT: Wye Road between Sherwood Drive and Highway 21	PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 36**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:	LOCATION: EBL 590 m west of Sherwood Drive centre of inside lane	

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			270 mm					
		GP	**GRAVEL** : sandy, coarse grained, moist, black, slightly oiled, trace clay					
			490 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, very stiff, greyish brown, trace gravel					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 37**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 380 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 190 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, stiff, greyish brown 310 mm					
		GP	**GRAVEL** : oiled, sandy, fine to coarse grained, moist, black, likely cold mix or pit run 610 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, stiff, greyish brown			14		
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 38**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: EBL 160 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 310 mm					
		GP	**GRAVEL** : sandy, moist, brown, likely pit run 610 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, stiff, greyish brown					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 39**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 160 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			440 mm					
		GP	**GRAVEL** : sandy, damp, dark brown					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 40**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 380 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			300 mm					
		CI	**CLAY FILL** : silty, medium plastic, moist, very stiff, greenish brown, trace gravel			15.9		
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 41**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 590 m west of Sherwood Drive centre of inside lane		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			500 mm					
			CLAY FILL : silty, medium plastic, very moist, stiff, green					
		CI						
			END OF @ 0.8 m. No water and no slough on completion of .					
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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 42**
CLIENT: Al-Terra Engineering Ltd.		DRILL METHOD: Soild Stem Auger	ELEVATION:
OWNER:		LOCATION: WBL 820 m west of Sherwood Drive centre of inside lane	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			550 mm					
			GRAVEL : sandy, oiled, black, likely cold mix					
		GP						
			END OF @ 0.8 m. No water and no slough on completion of .					
1								

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 43**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 160 m west of Sherwood Drive centre of outside lane		

SAMPLE TYPE ☐ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			280 mm					
		CI	**CLAY FILL** : silty, sandy, medium plastic, moist, stiff to very stiff, brown					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 44**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 380 m west of Sherwood Drive centre of outside lane		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT** 180 mm					
		GP	**GRAVEL** : sandy, fine grained, moist, dark brown, likely pit run 460 mm					
		CI	**CLAY** : silty, medium plastic, moist to very moist, stiff, brown, trace coal					
1			**END OF @ 0.8 m.** No water and no slough on completion of .					

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LOGGED BY: J Tsoi | COMPLETION DEPTH: 0.76 m
REVIEWED BY: J Rakievich | COMPLETION DATE: 22/9/08

JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21		PROJECT NO: 1229 - 296	BOREHOLE NO: **08 - 45**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Soild Stem Auger		ELEVATION:
OWNER:	LOCATION: WBL 590 m west of Sherwood Drive centre of outside lane		

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0		ASPH	**ASPHALT**					
			270 mm **CLAY** : silty, medium plastic, moist, very stiff, greenish grey, trace gravel and organic soil					
		CI						
			END OF @ 0.8 m. No water and no slough on completion of .					
1								

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi
REVIEWED BY: J Rakievich

COMPLETION DEPTH: 0.76 m
COMPLETION DATE: 22/9/08

JRP WYEROAD2 GPJ JRPV2_3.GDT 14/10/08

PROJECT: Wye Road between Sherwood Drive and Highway 21 | PROJECT NO: 1229 - 296 | BOREHOLE NO: **08 - 46**

CLIENT: Al-Terra Engineering Ltd. | DRILL METHOD: Soild Stem Auger | ELEVATION:

OWNER: | LOCATION: WBL 820 m west of Sherwood Drive centre of outside lane

SAMPLE TYPE ☐ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ■ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲POCKETPEN. (kPa)▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	Elevation (m)
0			**ASPHALT**					
		ASPH						
			CLAY FILL : silty, medium plastic, moist, very stiff, greenish grey — 310 mm					
		CI				14.4 (12.5 – 34.8)	P.L. = 12.5 L.L. = 34.8 M.C. = 14.4	
			END OF @ 0.8 m. No water and no slough on completion of .					
1								

17505 - 106 Avenue
Edmonton, AB T5S 1E7
Phone: (780) 489-0700
Fax: (780) 489-0800

LOGGED BY: J Tsoi | COMPLETION DEPTH: 0.76 m

REVIEWED BY: J Rakievich | COMPLETION DATE: 22/9/08

JRP WYEROAD2.GPJ JRPV2_3.GDT 14/10/08

APPENDIX “D”

Storm Sewer Condition Assessment / Preliminary Design

Wye Road
Ordze Road to Brentwood Boulevard

BACKGROUND

The Functional Planning study for Wye Road identified roadway improvements required along Wye Road from Ordze Avenue to Highway 21. As Wye Road has an existing storm sewer system, the roadway improvements will necessitate storm sewer modifications, primarily catchbasin relocation and catchbasin lead extension. Some sections of the storm sewer on Wye Road were constructed as early as 1977 and the original design did not consider the widening of Wye Road to six lanes plus an auxiliary lane. Therefore, it is recommended that prior to any improvements along Wye Road, the storm sewer system should be reviewed for condition and capacity. The timely review of the system will identify any deficiencies and allow the system to be repaired, replaced or upgraded (as required) in conjunction with the roadway widening, reducing construction costs and disruption to the travelling public.

CONDITION ASSESSMENT

In preparation for the first phase of Wye Road widening and improvements between Sherwood Drive and Hawthorne Street, a video inspection of the storm sewer system (including catchbasin leads) was completed from Ordze Avenue to east of Brentwood Boulevard in March 2008. Overall plans for referencing locations are included in Attachment '1'.

In general, and as expected, the oldest sections reviewed showed the most deterioration; additionally there was some damage from third party shallow utility installations. The system section from Sherwood Drive to east of Hawthorne was identified as requiring the most replacement and repair. Due to the poor condition of the Wye Road system by Sherwood Drive a video inspection of the storm sewer on Sherwood Drive was undertaken to identify if any repairs and/or replacements should be coordinated with the Wye Road work.

A full review of the storm sewer tapes (completed by both Al-Terra Engineering and Strathcona County) are included in Attachment '2'.

CAPACITY ASSESSMENT

Using the Rational method, the functionality of the Wye Road storm sewer from Ordze Avenue to east of Brentwood was evaluated for the 2-year and 5-year storm event. A time of concentration of 8 minutes and 15 minutes were used for both storm events, although given the largely impervious area of the Wye Road right-of-way, the 8 minute time of concentration is generally felt to provide more accurate results.

The capacity analysis was undertaken as a supplement to the overall Sherwood Park Urban Area Drainage System Assessment completed by Sam-Eng in 2007. Wye Road is a very specific portion of the Gold Bar Creek Basin (as outlined in the Sam-Eng report) with a much higher run-off coefficient than the average used to identify capacity in the Sam-Eng Report . Table 3-13 Basin Percent Run-off Values from the report indicates the % Run-off used for Basin A, which encompasses Wye Road, was 39%. Table 3-13, Figure 3-8 and Figure 3-9 from the SamEng Report are included in Attachment '3' for reference.

The SamEng analysis of the Wye Road capacity did not consider the expansion of Wye Road; at the time of the report's completion, the functional planning study for Wye Road was not completed and at any rate, the Sam-Eng report was not intended to be specific enough to focus on individual characteristics of the various sections of the Basin. For example, the proposed 2008

construction will widen Wye Road between Sherwood Drive and Hawthorne to a six lane cross-section with a continuous auxiliary lane on the south side and double lefts. The Wye Road right-of-way, which is generally 80% impervious is calculated to have a run-off co-efficient of 0.70 – 0.80 using 95% run-off for the impervious surfaces and 10% for the grassed boulevards.

Using this rationale, the Wye Road storm sewer between Ordze Avenue to east of Brentwood has capacity for the two and five year storms as tabulated below:

WYE ROAD	2 – year event t_c = 8 min % Full Flow Capacity	2 – year event t_c = 15 min % Full Flow Capacity	5 – year event t_c = 8 min % Full Flow Capacity	5 – year event t_c = 15 min % Full Flow Capacity
West of Brentwood				
MH 10 – MH 9	57%	40%	85%	59%
MH 9 – MH 8	89%	65%	133%	97%
MH 8 – MH 7	69%	52%	103%	77%
Brentwood				
MH 7 – MH 6	52%	40%	78%	60%
MH 6 – MH 5	59%	46%	88%	69%
MH 5 – MH 4	65%	52%	97%	77%
East of Brentwood				
MH 4 – MH 1.1	41%	33%	60%	49%
East of Hawthorne				
MH 12 – MH 11	52%	37%	78%	55%
MH 11 – MH 10	138%	102%	205%	151%
Hawthorne				
MH 10 – MH 9	86%	65%	128%	97%
MH 9 – MH 8	93%	73%	138%	108%
MH 8 – MH 7	106%	84%	157%	125%
MH 7 – MH 6	70%	57%	105%	84%
MH 6 – MH 5	68%	55%	101%	81%
MH 5 – MH 4	72%	59%	106%	87%
MH 4 – MH 3	71%	58%	105%	86%
MH 3 – MH 2	70%	58%	104%	85%
Sherwood Drive				
MH 2 – MH 1	54%	44%	80%	66%
East of Sherwood Drive				
MH 5 – MH 4	28%	20%	42%	29%
MH 4 – MH 3	34%	24%	50%	36%
MH 3 – MH 2	44%	32%	65%	47%
Ordze Avenue				
MH 2 – MH 1	53%	39%	79%	58%

The storm sewer charts are attached in Appendix ‘4’.

The surcharge in the system was calculated for the 5-year storm using a time of concentration of 8 minutes. Generally, the surcharging does not rise above 0.50m below catchbasin rim elevation, with the exception being between east of Hawthorne at MH 11. STMH 11 is a sag manhole collecting drainage from approx 20m west of Hawthorne to 137m east of Hawthorne. Due to the larger catchment area, the analysis shows that surcharging of the system to over 1.0m could be

expected. However, the south boulevard of Wye Road drains south into an undeveloped parcel and a natural low area, therefore ponding at the location does not exceed 0.15m, the point at which the water overtops the curb and releases to the south. It should be noted that any development of the parcel to the south should not impede this overland drainage route, or significant flooding of Wye Road could be expected.

Table 1 – Attachment '4' tabulates the expected surcharge in the manholes along Wye Road from Ordze Avenue to east of Brentwood. It should be noted that the calculations for the storm system from Sherwood Drive to East of Hawthorne assumed that there was adequate capacity without surcharging the Sherwood Drive storm sewer downstream for the storm event. Losses in the manholes were not included.

CONCLUSIONS & RECOMMENDATIONS

The condition assessment of the Wye Road storm sewer was completed from Ordze Avenue to east of Brentwood Boulevard in preparation of the 2008 Wye Road widening improvements. As subsequent sections Wye Road are improved per the Functional Planning Study, a storm sewer analysis should be undertaken in conjunction with each project to ensure timely repair and replacement of the system.

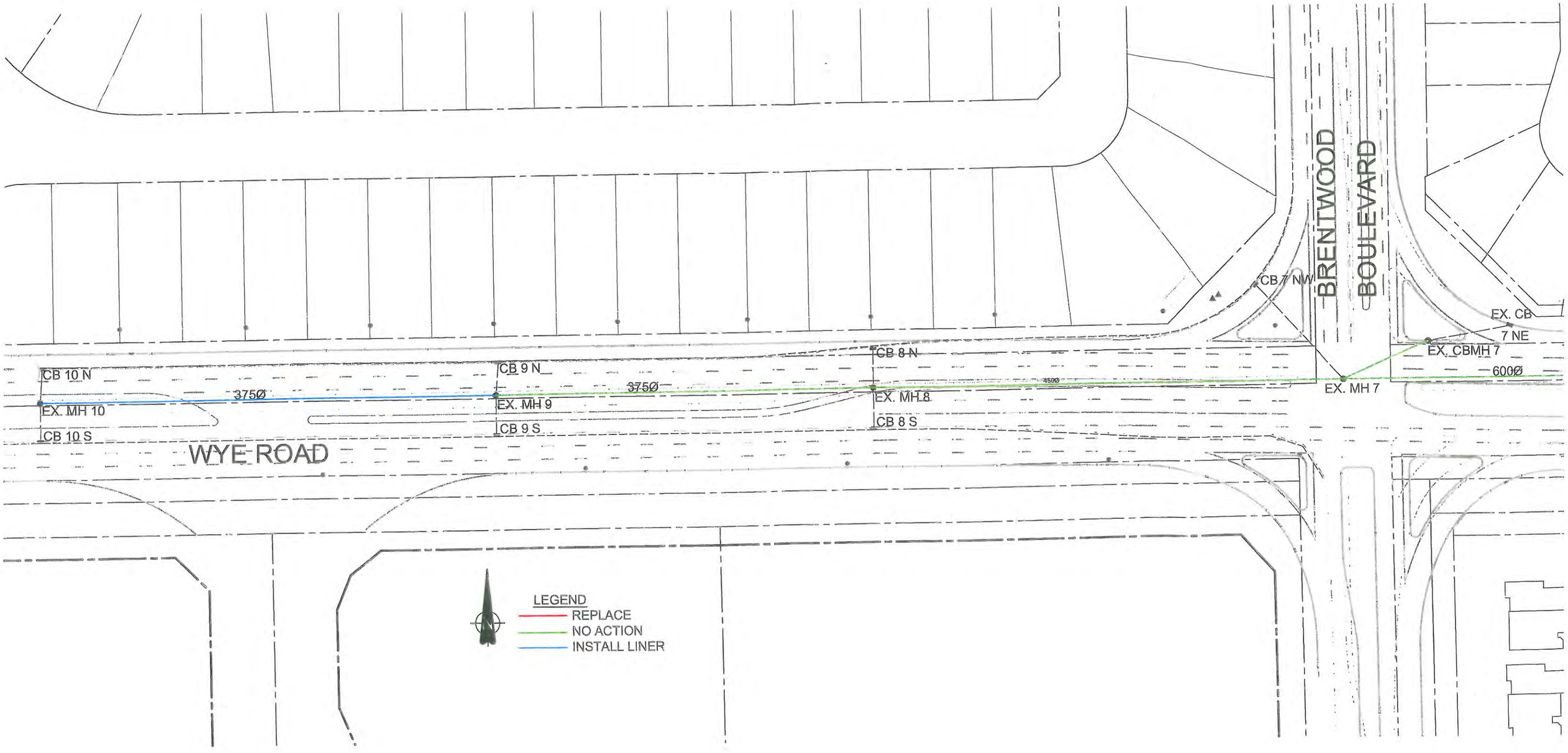
Recommendations are summarized below:

LOCATION	No Action	Install Liner	Replacement	Notes
West of Brentwood				Some catchbasin leads are damaged and require replacement/repair. See full report for details.
MH 10 – MH 9		✓		
MH 9 – MH 8	✓			
MH 8 – MH 7	✓			
Brentwood				
MH 7 – MH 6	✓			
MH 6 – MH 5	✓			
MH 5 – MH 4	✓			
East of Brentwood				
MH 4 – MH 1.1	✓			
East of Hawthorne				Some catchbasin leads are damaged and require replacement/repair. See full report for details
MH 12 – MH 11	✓			
MH 11 – MH 10			✓	
Hawthorne				
MH 10 – MH 9		✓		
MH 9 – MH 8		✓		
MH 8 – MH 7		✓		
MH 7 – MH 6		✓		
MH 6 – MH 5			✓	
MH 5 – MH 4		✓		
MH 4 – MH 3			✓	Replace with 525mm
MH 3 – MH 2	✓		✓	No Action in 2008. Replace with 525mm when Sherwood Drive storm sewer repaired/replaced.
Sherwood Drive				
MH 2 – MH 1 *	✓		✓	No Action in 2008. Replace with 525mm when Sherwood Drive storm sewer repaired/replaced.

	No Action	Install Liner	Replacement	Notes
Sherwood Drive North				
MH 20 – MH 21	✓			
MH 21 – MH 22			✓	
MH 22 – MH 23			✓	Lining would be adequate, but recommend replacement as pipes on both sides are being replaced
MH 22 – MH 24			✓	
MH 24 – MH 25	✓			
East of Sherwood Drive				Some catchbasin leads are damaged and require replacement/repair. See full report for details
MH 5 – MH 4	✓			
MH 4 – MH 3	✓			
MH 3 – MH 2	✓			
Ordze Avenue				
MH 2 – MH 1	✓			Repair required due to third party shallow utility damage

* The proposed increase in pipe size from SMHH 1 to STMH 4 is recommended to add some additional capacity to the storm sewer system, as well as provide additional clearance to underground utilities.

Prepared By:
Dana Leithead, P.Eng.
Al-Terra Engineering Ltd.


BRENTWOOD
BOULEVARD
WYE ROAD
CB 10 N
CB 9 N
CB 8 N
CB 7 NW
EX. CB
7 NE
EX. CBMH 7
600Ø
EX. MH 7
375Ø
4500
EX. MH 10
CB 10 S
EX. MH 9
CB 9 S
EX. MH 8
CB 8 S
LEGEND
REPLACE
NO ACTION
INSTALL LINER


BRENTWOOD
BOULEVARD
LEGEND
REPLACE
NO ACTION
INSTALL LINER
CB 7 NW
EX. CB
7 NE
EX. CBMH 7
600Ø
EX. MH 7
CB 6 N
EX. MH 6
600Ø
CB 5 N
EX. MH 5
600Ø
EX. MH 4
13.5m - 600Ø
EX. MH 1.1
CB 5 S
CB 6 S

Storm Sewer Video Inspection Analysis
Wye Road - West of Brentwood Boulevard to East of Brentwood Boulevard
March 2008

SUMMARY

EX. 10 – EX. 9 – Recommend lining
EX. 9 – EX. 8 – No action
EX. 8 – EX. 7 – No action
Ex. 7 – EX. CBMH 7 – No action
EX. 7 – EX. 6 – No action
EX. 6 – EX. 5 – No action
EX. 5 – EX. 4 – No action
EX. 4 – EX. 1.1 – No action

EX. 10 TO EX. 9 (Q248 to Q246)

375 Concrete – 118.70m

General

3.0m – crack along top of pipe
4.9m – chip at joint
13.3m – crack at 9 o'clock and 11 o'clock
14.6m – gap at joint (typical), chip at joint, minor debris in pipe (mortar?)
17.2m – hole in top of pipe (lifting hole – typical)
231.8m – gap at joint
25m – pipe has corregated look
37m – slight ponding 5mm
41.50m – gap a joint
49 – 52.2m slight ponding in pipe 15mm
50.7m – chip in joint
61.50m – slight gap at joint, chip at joint
79.5m – 85.2m – some ponding in pipe – 20mm, possible due to debris in pipe
91.5 – 99.5m – some ponding in pipe – 20 – 25mm, slight sag and debris in pipe
102.8m – chip at joint
105 – 113 slight ponding in pipe – 5 – 15 mm
106.7m – chip at joint
114.7 – sand in pipe
114.7 – sand cleared – ponding in pipe – likely due to debris in manhole downstream
117.3 – chip at joint, crack in pipe wall, both sides
(Note – additional crack noted and the crack identified at 117.3 is more correctly a fracture.)

Recommendation

Pipe is in generally good condition. Consider lining to reduce infiltration at joints.
(Agree – AS)

EX. 10 to CB 10 South (Q248 to Q248B)
250 Concrete Pipe – 8.4m
General

Recommendations
Pipe in is good condition
Extend lead as required
(Agree – AS)

EX. 10 to CB 10 North (Q248 to Q248A)
250 Concrete Pipe – 8.1m
General
Pipe has corregated look
Slight gap at joints
(Missed 2 short longitudinal cracks at a joint)
Recommendations
Pipe is generally in good condition.
Extend lead as required
(Agree – AS)

EX. 8 to EX. 9 (Q244 to Q246)
375 Concrete Pipe – 99m
General
0.0 – 10m ponding in pipe – 30 - 60mm
2.2m – (lifting) hole in top of pipe (typical)
3.0m – chip in joint
19 – 22.5m slight ponding 10mm
21.2m – chip at joint
35.8 – 37m – crack in pipe at 1 o'clock
43.7 – 44.6 – crack in pipe at 3 o'clock
75 – 79m - slight ponding 15mm
91.3m – large chunk of concrete in pipe
(Additional cracking at joint noted)
Recommendation
Pipe is in good condition
Some slight cracking noted throughout run at top of pipe and at 9 o'clock and 3 o'clock.
No action
(How will the construction impact those lines running in the median? At a minimum, all lines need to be re-inspected upon completion of the road work)

EX. 9 to CB 9 South (Q246 to Q246B)
250 Concrete Pipe – 9.0m
General
0.00m – 2.1m ponding 30mm depth
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 9 to CB 9 North (Q246 to Q246A)
250 Concrete Pipe – 8.0m
General
1.2m - crack along top of pipe 1 o'clock
Pipe has corregated look
4.40m – slight gap at joint, chip at joint
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 8 to CB 8 South (Q244 to Q244B)
250 Concrete Pipe – 8.4m
General
1.90m – slight gap in joint, chip in joint
3.10 – slight gap in joint
6.7m – slight gap in joint
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 8 to CB 8 North (Q244 to Q244A)
250 Concrete Pipe – 10.7m
General
0 – 2.1m – slight ponding 15mm
Pipe has corregated look
8.7m – slight gap at joint
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 8 to EX. 7 – downstream (Q244 to Q242)
450 Concrete Pipe – 124.4m
General
3.9m – (lifting) hole in top of pipe (typical)
8.8m – chip at joint
8.8m – 10.5 crack at 1 o'clock
13.8m – 15m – crack at 11 o'clock moving to 9 o'clock
32.3m – chip at joint
48.5m – chip at joint
50.5m – crack (0.3m long) extending from joint at 4 o'clock
57.6m – small chip at joint
63m – slight gap at joint
70.8 – 75m debris in pipe and water – 150mm reflushed
81.2 – 92.6 sand/sediment in pipe – ponding 70mm
92.6m - sediment too thick to go through – reflush
92.6m – ponding at zero with reflushing
109.9m – chip at joint
113.5m – chip at joint
122.6m – chip at joint
(Additional cracking noted as well as a fracture with a hole at the invert at 110.3 m)
Recommendation
Pipe is in good condition
No action
(Review the recommendation and consider liner to address the cracking along with the hole and fracture)

CB 7 NW to EX. 7 – downstream (Q242C to Q242)
300 Concrete Pipe – 34.8m
General
1.6m – slight gap at joint
Recommendation
Pipe is in good condition
No action
(Agree – AS)

EX. CBMH 7 to EX. 7 – downstream (Q242A to Q242)
300 Concrete Pipe – 23.7m
General
5.4m – chip at joint gasket showing
5.4 – 7.2m – crack along top of pipe (typical)
9.1m – gasket showing, top of connecting pipe looks offset
12.7m – gap at joint, cracking at edges
Recommendation
Pipe is in generally good condition
Some cracking noted throughout
Determine action regarding gaskets when location of pipe is determined.
(Agree – AS)

EX. CBMH 7 to CB 7 NE (Q242A to Q242B)
300 Concrete Pipe – 12.0m
General
4.2m – chip at joint, gasket showing
4.4 – 6.5m – (concrete) debris in pipe
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 6 to EX 7 – upstream (Q236 to Q242)
600 Concrete Pipe – 103.8m
General
2.0m – (lifting) hole in top of pipe – typical (CL at crown)
24.6 – 27m sand/sediment debris in pipe
27 – 30m – slight ponding 15mm
65.4m – chip at joint
74.5m – chip at joint
Recommendation
Pipe is in good condition
No action
(Agree – AS)

EX. 6 to EX. 5 (Q236 to Q230)
600 Concrete Pipe – 87.5m
General
2.7m – (lifting) hole in top of pipe (typical)
9.2m – slight gap at joint

11.1m – slight gap at joint, infiltration evident
14.8m – slight gap at joint
27.7m – very slight gap at joint
36m – 44.5m slight ponding 15 – 30mm sand/sediment/concrete in pipe
38.7m – slight gap at joint, very small chip
40.5 – slight gap at joint, very small chip
44.5m – concrete debris in pipe, difficult to pass
51.6m – chip at joint
55.1m – chip at joint
60.6m – slight gap/chip at joint
62.4m – chip at joint
66.10m – chip at joint
71.7m – chip at joint
73.5.m – chip at joint
73.5m – end - slight cracks at 9 and 3 o'clock

Recommendation

Pipe is in good condition
Joints show some signs of infiltration. No action.
(Agree – AS)

EX. 6 to CB 6 South (Q236 to Q236A)

250 Concrete Pipe – 11.6m

General

Crack along top of pipe
1.3m – slight gap at joint
2.5m – slight gap at joint
4.9m – slight gap at joint
6.3m – slight gap at joint
7.4m – slight gap at joint
11.1m – last pipe section appears offset from rest of run
Last pipe cracked at 3, 6 and 9 o'clock (Fracture not cracks – also at 12)
(Additional cracking noted at 1 to 3.5 and at 5.7 along crown)

Recommendation

Pipe is in generally good condition
Remove last section of pipe and extend.
(How will the depth of the road work impact this pipe with the cracking at 12? Must ensure that is CCTV'd after roadwork. If depth of work will impact, may want to consider liner to the last section that will be removed to extend)

EX. 6 to CB 6 North (Q236 to Q238)
250 Concrete Pipe – 11.2m
General
Appears to be another catchbasin lead entering the catchbasin
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 5 to CB 5 South (Q230 to Q230A)
250 Concrete Pipe – 8.5m (approx. cannot pass broken pipe)
General
7.4m – Pipe broken
Recommendation
Pipe is in good condition
Remove last two sections of pipe (to past broken pipe)
Extend lead as required
(Ensure entire segment with the broken pipe is replaced along with the next one – do not cut the pipe just past the break)

EX. 5 to CB 5 North (Q230 to Q232)
250 Concrete Pipe – 11.3m
General
8.1m – slight gap at joint
Recommendation
Pipe is in good condition
Extend lead as required
(Agree – AS)

EX. 4 to EX 5 – upstream (Q228 to Q230)
600 Concrete Pipe – 88.5m
General
0.00m – ponding (possible debris at manhole 4?) - 70mm
3.6m – (lifting) hole in top of pipe (typical)
6.3m – chip at joint
7.7m – ponding reduced to 50mm
17.2m – slight gap at joint
25m – ponding ends
44.5 – 52m slight ponding 15 – 25mm
53.8m – slight gap at joint
66.9m – ship at joint
73.5m – 80m slight ponding in pipe – 10 – 15mm

80 – 85.6m – slight ponding 25mm
83.6m – slight gap at joint
(2 additional circumferential cracks)

Recommendation

Pipe is in good condition
No action
(Agree – AS)

EX. 4 to EX. 1.1 downstream (Q228 to Q226)

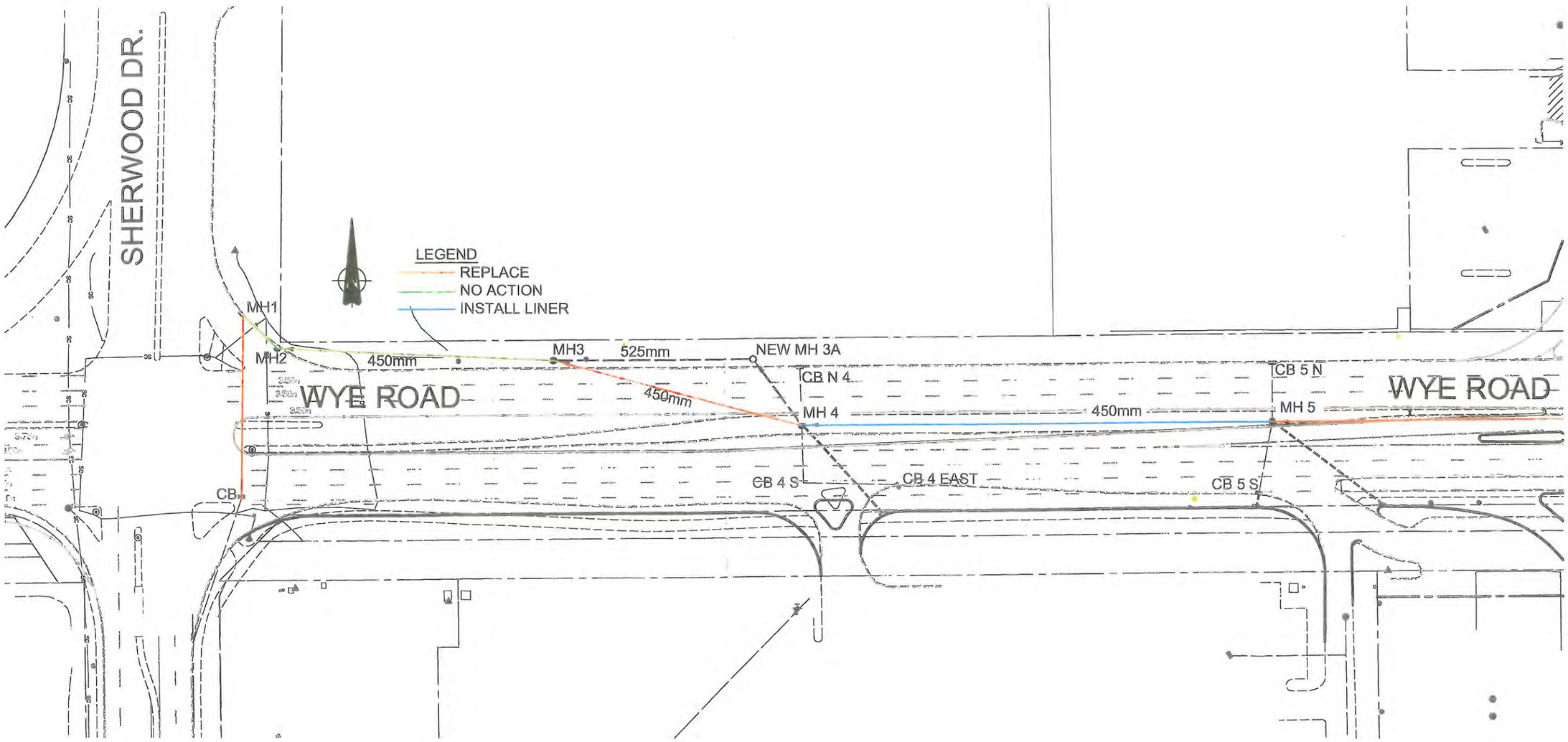
600 Concrete Pipe – 11.2m

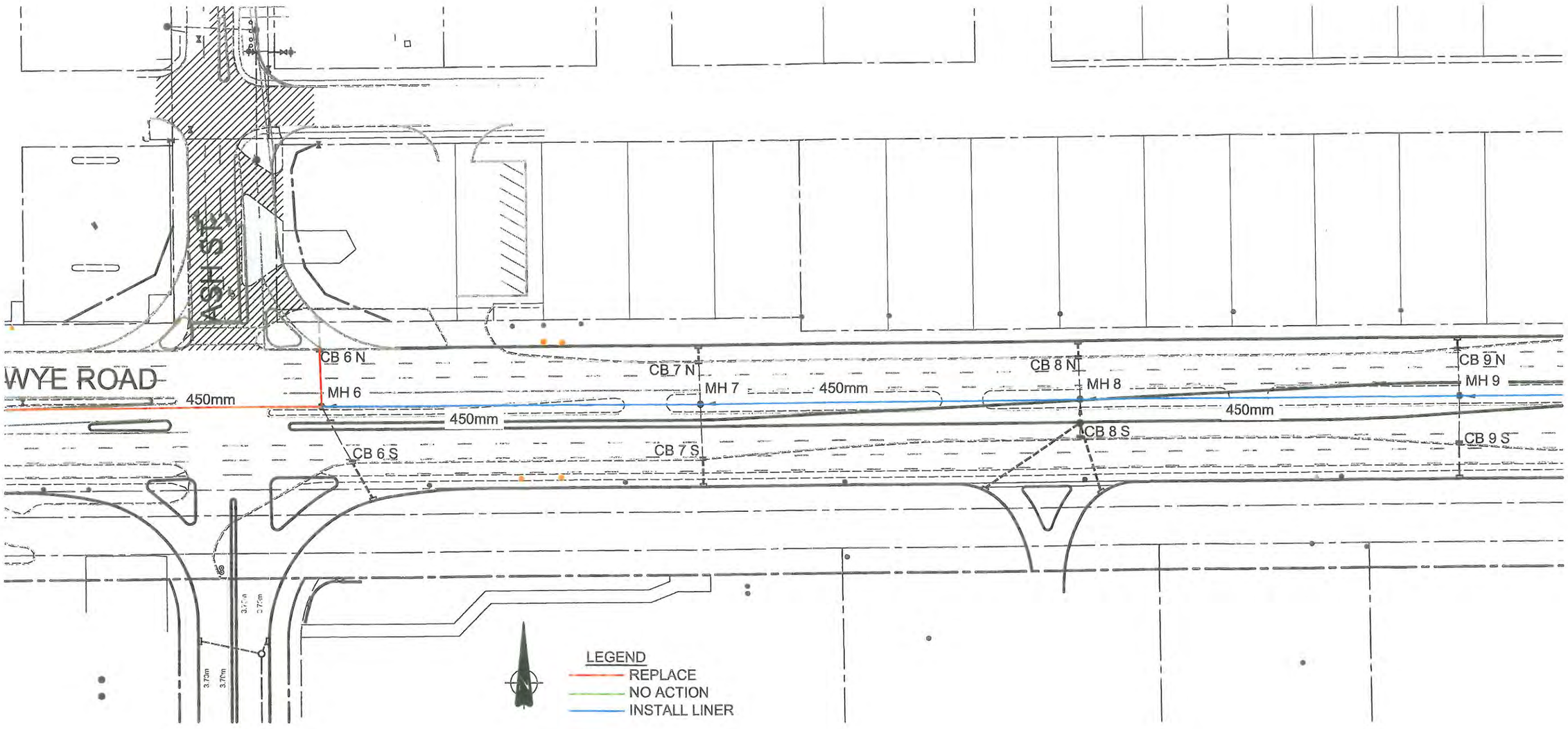
General

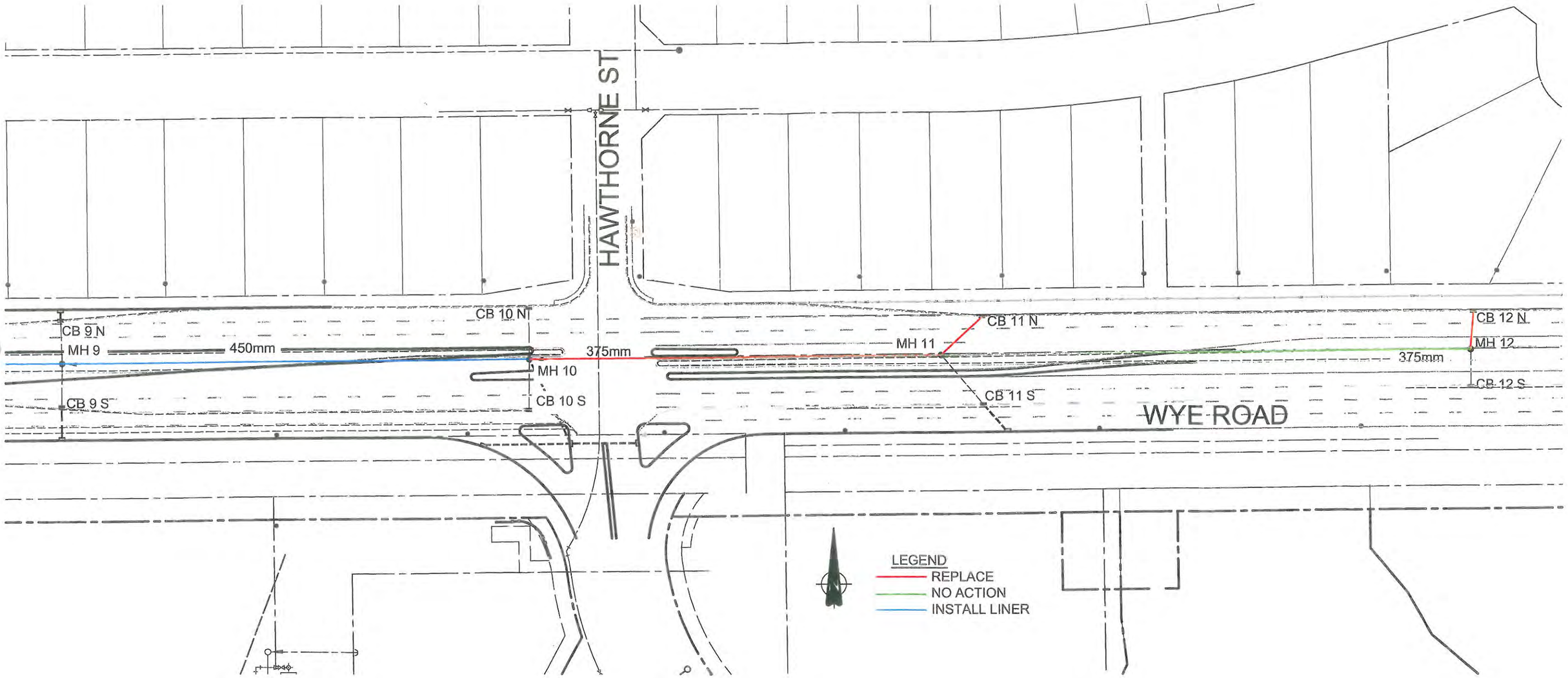
0 – 11.8m ponding 25mm
6.9m slight gap at joint
11.8m – manhole and deflection in pipe alignment

Recommendation

Pipe is in good condition
No action
(Agree – AS)


SHERWOOD DR.
LEGEND
REPLACE
NO ACTION
INSTALL LINER
MH1
MH2
450mm
MH3
525mm
NEW MH 3A
CB N 4
MH 4
450mm
CB 5 N
MH 5
WYE ROAD
WYE ROAD
CB
CB 4 S
CB 4 EAST
CB 5 S


WYE ROAD
CB 6 N
MH 6
450mm
CB 6 S
CB 7 N
MH 7
450mm
CB 7 S
CB 8 N
MH 8
450mm
CB 8 S
CB 9 N
MH 9
450mm
CB 9 S
LEGEND
REPLACE
NO ACTION
INSTALL LINER


HAWTHORNE ST
CB 10 N
CB 9 N
MH 9
450mm
MH 10
CB 10 S
CB 9 S
375mm
MH 11
CB 11 N
CB 11 S
CB 12 N
MH 12
375mm
CB 12 S
WYE ROAD
LEGEND
REPLACE
NO ACTION
INSTALL LINER

SUMMARY

STMH 12 to STMH 11 - No Action
STMH 11 to STMH 10 –Replace
STMH 10 to STMH 9 –Install Liner
STMH 9 to STMH 8 –Install Liner
STMH 8 to STMH 7 –Install Liner
STMH 7 to STMH 6 –Install Liner
STMH 6 to STMH 5 –Replace
STMH 5 to STMH 4 –Install Liner
STMH 4 to STMH 3 – Replace with 525mm
STMH 3 to STMH 2 – No Action in 2008. Replace with 525mm when Sherwood Drive storm sewer is replaced / repaired.
STMH2 to STMH 1 - No Action in 2008. Replace with 525mm when Sherwood Drive storm sewer is replaced / repaired.

EX. 1 to CB (A217 to A217a)

300 CSP (Corrugated Steel Pipe) – 40.9m
General
Bottom half of pipe shows some rust
1.90m slight gap at joint
4.60m – 9.0m ponding – 80mm
14.5m – gap at joint
23.70m – slight gap at joint, rust present at bottom of pipe
32.90 – gap at joint – mortared?
Significant debris in CB. Leads exiting are also CSP

Recommendation

Replacement **(Agree – AS)**

EX. 2 to EX. 1 (A218 to A217)

450 Concrete Pipe – 9.5m
General
Every pipe has (lifting) hole on top of pipe
6.30m – chip at joint
7.0 – 8.5m - some ponding

Recommendations

Pipe in is good condition
Action only required in MH 3 to MH 4 is lowered **(How does lowering 4 to 3 (A220 To A220) impact the grade farther downstream - otherwise Agree – AS)**

EX. 3 to EX. 2 (A219 to A218)

450 Concrete Pipe - 62.0m
General
0 – 5m build up at joints, some debris in bottom of channel

Every pipe has (lifting) hole at top
Hairline crack at top of pipe (likely whole run)
20.6m - chip at joint
40.5m – chip at joint
42.5m – hairline crack at 9 o'clock
54.8m – cracks at joint 9 o'clock
(more cracking than that shown or reported in this line)

Recommendations

Pipe is generally in good condition.
Action only required if upstream run must be lowered to avoid utility conflicts. **(How does lowering 4 to 3 (A220 To A220) impact the grade farther downstream - due to the cracking, will construction impact this area – if so may want to consider a Liner - AS)**

EX. 4 to EX. 3 & EX. 3 to EX. 4 (A220 to A219)

450 Concrete Pipe – 38.4m+17m

General

Spider cracking at top of pipe – some leakage
Pipe is cracked at 6, 9, 12, and 3 o'clock, the length of the run
4.40m pipe has oblong appearance, may be buckling
Every pipe has (lifting) hole at top of pipe
Utility through pipe 38m from MH #3
(Note – fractures not cracks for most of the line with deformation ranging up to 15% - broken pipe along the invert at locations and of course the pipe running through the line with associated hole and large cavity)

Recommendation

Replacement. **(Agree – AS)**
Investigate lowering of line to avoid shallow utility conflicts. **(How will lowering this line impact the flows downstream – need to investigate as you say. May need to determine usage of the pipe going through and consider alternate solutions.)**

EX. MH4 – to CB4 North (A220 to A220b)

250 Concrete Pipe – 11.9m

General

Pipe looks in good condition
3.90m – chip at joint, some separation
11.2 – chip at joint, some separation
Significant debris in catchbasin
(2 additional longitudinal cracks noted)

Recommendation

CB4 North is not proposed to be relocated at this time.
No action. **(Agree – AS)**

EX. MH4 – to CB4 South (Concern with this lead, plans indicate the lead should be 21m in length – camera indicates 12.2m) (Agree – could the original CB been covered over and an additional extension put on the line when they did the entrance into Wal-Mart? May need to determine once roadwork has started)
250 Concrete Pipe – 12.5m
General
Pipe looks in good condition.
7.8m - Hairline crack at top of pipe – no seepage visible.
11.8m - Material Change – concrete to CSP – debris in pipe at joint
Significant debris in catchbasin
Recommendation
CB4 South to be relocated to new curb.
Recommend Removing CSP Pipe Extend lead with 250mm concrete. **(Agree but would also include the last segment of concrete due to the condition of the pipe end – AS)**

CBMH 4A to CB 4 East (extension from CB4 south to catchbasin on curb of the Wal-Mart site)
250mm Concrete – 19.6m
General
6.3m – longitudinal crack at 7 o'clock
13.0m – slight separation at joint.. chip at 6 o'clock
19.0m – separation at joint
19.6m – CB 4 East
Recommendation
Pipe looks to be in good condition. No visible cracks or deflection. No action.

EX. MH 4 to EX. MH5 (A220 to A221)
450mm Concrete Pipe – 107.1m
General
Every pipe has a (lifting) hole in top of pipe
5.4 – 8.4m – debris causing ponding in pipe
Pipe has build-up at joints and silt / debris at bottom
Hairline crack at top of pipe (likely whole run) **(confirmed for most of line)**
91.8m - scrape on pipe 10 o'clock– crack visible at top of pipe
98.1m – short joint. Joint shows some separation
105.1 – alligator cracking at top of pipe.
(Significant additional cracking noted along invert as well)
Recommendations
Pipe is in good condition. Thorough cleaning should eliminate all ponding.
No action **(How does the construction impact the mains running in the median? Due the presence of cracking both at the invert and along the top of the pipe – recommend Liner)**

EX. MH 5 to CB 5 North (A221 to A221b)
250mm Concrete Pipe – 12.0m
General
3.90m – crack at joint
9.4m – scrapes on pipe wall – 11 o'clock
11.3m – crack at joint
Significant debris in catchbasin
Recommendations
No action **(Agree – AS)**

EX. MH 5 to CB 5 South
300mm Concrete Pipe - 16.0m
General
0.80m – some debris in bottom of pipe
6.1m – crack in pipe at joint 7 o'clock
8.6m – joint cracked, 6 - 10 o'clock **(fracture not crack)**
10.7m – bend in line 45 degrees
Recommendations
CB5 South to be relocated to new curb
Extend existing lead **(Agree – AS)**

EX. MH 5 to EX. MH 6 (A221 to A222)
450 Concrete Pipe – 101.10m
General
1.20m – hairline crack along top of pipe
Every pipe has a (lifting) hole at top
12.5m – crack in top of pipe **(fractures not crack)**
19.8m – crack in bottom of pipe **(fractures not crack)**
23.1m – crack in bottom of pipe – pipe heaving
26.5 – crack along sides of pipe
27.2m – crack at joint
32.4m – crack along bottom of pipe – pipe heaving
37.2m – large crack and chip at bottom, pipe heaving **(would be considered a broken)**
41.4m – crack on sides of pipe (9 o'clock)
45.6m – crack on side of pipe and bottom, pipe heaving
47.2m – crack in bottom of pipe, crack in top of pipe "u" shaped at joint
55.4m - concrete spalling. Small chips in pipe
50.0m – onwards Pipe in better condition, few to no visible cracks
83.5m – joint has some build-up
87.3m - entire run has 5 – 10mm of water in bottom of pipe joints have some build-up
87.3 – 91.10m – some ponding 25 – 30mm
96.10 – joint has some build-up
96.10 – 98.5m – some ponding 25 – 30mm

(coding by the contractor leaves a lot to be desired)

Recommendations

Pipe is in fair condition with longitudinal cracking at top, bottom and sides for the majority of the run. Some bottom cracks show heaving
Recommend replacement **(Agree – AS)**

EX. MH 6 to CB6 North (A222 to A222b)

250 Concrete Pipe – m

General

2.3m – separation and chips at joint, debris in channel
6.3m – separation at joint, gasket visible
8.3m pipe cracked at 9 o'clock
8.7m – separation at joint, chip at joint 8 o'clock

Recommendations

Pipe in fair condition, Pipe has rough appearance and looks corrugated.
Remove and replace. **(Agree – AS)**

EX. MH 6 to CB6 South (A222 to A222a)

250 Concrete Pipe – 13.8m

General

Slight periodic ponding in run 5mm
12.3m – joint broken.
12.3 – 12.7m short pipe section, appears corrugated.
12.8m – separation at joint
Significant debris in catchbasin

Recommendations

Pipe is in good condition. Remove catchbasin and 1.5m of pipe to broken joint. Extend lead as required. **(Agree – AS)**
Otherwise no action.

EX. MH 7 to EX. MH 6 (A223 to A222)

450 Concrete Pipe – 88.4m

General

0.80m crack along top of pipe – some alligator cracking visible
9.7m – build up at joint
18.9m – piece of concrete in pipe
20.9m – build up at joint
23.0m – alligator cracking at top of pipe no longer visible
28.5m – 33.5m Some ponding 5 – 10mm
Every pipe has a (lifting) hole at the top.
43.6m – scrape at 3 o'clock
Other than initial alligator cracking pipe is in better condition that EX. MH 7 to 8
54.5m crack in top of pipe

79.9m – scrape at 9 o'clock
84.2m – some build up at joint
85.9m – some ponding 15 – 25mm
86.5m – chip in joint

Recommendations

Other than the alligator cracking of the pipe at start of run, pipe is in good condition. Joints show build-up, but only minimal chips and separation.
Recommend lining. **(Agree – AS)**

EX. MH 7 to CB7 North (A223 to A223b)

250 Concrete Pipe – m

General

4.2m – slight separation at joint (typical)
6.6m – slight separation at joint, gasket visible
7.9m – slight separation at joint, gasket visible
Significant debris in catchbasin

Recommendations

Pipe is generally in good condition. Sections appear corrugated. Extend lead as required. Otherwise no action. **(Agree – AS)**

EX. MH 7 to CB7 South (A223 to A223a)

250 Concrete Pipe – 10.5m

General

Joints show some separation

Recommendations

Pipe is generally in good condition. Joints show some separation. Extend lead as required. Otherwise no action. **(Agree – AS)**

EX. MH 8 to EX. MH 7 (A224 to A223)

450 Concrete Pipe – 88.7m

General

1.4m Hairline crack at top of pipe
7.1m joint chipped, gasket showing
Every pipe has a (lifting) hole
10.0m chip in pipe wall at 9 o'clock– no apparent cracking around hole
14.3 – crack at bottom of pipe at 4 and 6 o'clock
19.8m large chip at joint 6 o'clock
18m – 29.0m - Some ponding 5mm
25.2 large chip in joint 9 o'clock
41.4m – hairline crack at 8 o'clock
41.7m - Some ponding water 15mm – 20mm
52.4m – ponding increases 30mm
57.0m ponding is gone

63.0m – 80.0m build up at joints
(several instances where a fracture has been noted as a crack)
Recommendations
Generally pipe is in fair to good condition. Joints show signs of cracking and some separation. Recommend lining. **(Agree – AS)**

EX. MH 8 to CB8 North (A224 to A224b)
250 Concrete Pipe – 7.8m
General
1.0m – slight separation at joint
2.3m – slight separation at joint, gasket is visible
3.5m – slight separation at joint, gasket is visible
6.0m cracks along pipe at 9 and 3 o'clock
Significant debris in catchbasin
Recommendations
Pipe is in fair condition. Some sections appear corrugated. Extend lead as required. Otherwise no action. **(Agree – AS)**

EX. MH 8 to CB8 South (A224 to A224a)
250 Concrete Pipe – 8.2m
General
1.6m – separation at joint
5.3m – separation at joint, chip at joint at 4 o'clock
6.5m – slight separation at joint, chip in joint at 3 o'clock
Catchbasin filled with debris to overflowing.
Recommendations
Pipe is in good condition. Extend lead as required.
No action. **(when extend lead, replace last pipe segment to reestablish grade)**

EX. MH 9 to EX. MH 8 (A225 to A224)
450 Concrete Pipe – 89.6m
General
1m poor joint – cracking in pipe wall(top of pipe), some infiltration present
Crack along bottom of pipe
Every pipe has (lifting) hole in top
10.0m U shaped crack at top of pipe
13.6m chips in joint
22.7m chips in joint
26.4m cracks in top show some alligator
46 – 51.8 pipe is alligator cracked
53.7 joint is chipped, gasket showing (typical)
(continuous fractures incorrectly identified as cracking)
Recommendations

Pipe is in fair to good condition. Joints are generally chipped, cracked and show some sign of separation. Recommend lining. **(Agree – AS)**

EX. MH 9 to CB9 North (A225 to A225b)
250 Concrete Pipe – 9.5m
General
0.80m – chip at joint 9 o'clock
5.1m – slight separation at joint, some build-up
7.5m – slight separation at joint.
8.7m – circumferential crack in pipe – 1 – 8 o'clock **(fracture)**
Significant debris in catchbasin
Recommendations
Pipe is in good condition. Sections of pipe look corrugated. Extend lead as required.
No action. **(when extend lead, replace last pipe segment to reestablish grade)**

EX. MH 9 to CB9 South (A225 to A225a)
250 Concrete Pipe – 10.2m
General
1.7m – slight separation at joint
2.8m – very slight separation at joint
10.0m – separation at joint
Recommendations
Pipe is in good condition. Extend lead as required. Remove catchbasin and last pipe section. Otherwise no action. **(Agree – AS)**

EX. MH 10 TO EX. MH 9 (A226 to A225)
450mm Concrete Pipe – 118.7m
General
Every pipe has a (lifting) hole at the top of the pipe
1.5m – small crack visible at the top of the pipe (likely continues length of run)
9.2m – separation at joint, gasket visible
14.7m – slight separation at joint. Chip in pipe at 3 o'clock
23.6m - slight separation at joint, small chip in joint at 9 o'clock
57.8m – build-up at joint
70.4m – slight separation at joint
79.7m – very slight separation at joint
108.4m – slight separation at joint
(additional fracture noted and cracking that is confirmed as continuous)
Recommendations
Pipe is in good condition. Suggest lining to prevent infiltration at the joints.
Otherwise no action **(Agree – AS)**

EX. MH 10 to CB10 North (A226 to A226b)

250 Concrete Pipe – 11.1m
General
0.80m – very slight separation at joint
3.3m – slight separation at joint
4.5m – slight separation at joint
5.5m – slight separation at joint
6.9m – very slight separation at joint
10.6m - separation at joint
Significant debris in catchbasin
Recommendation
Pipe is generally in good condition. Pipe has corrugated look, although there are no cracks visible. No action **(may be dependent on the roadwork – how deep are they going and how deep is the lead – may need to be reviewed at that time but MUST be looked at after the roadwork is done)**

EX. MH 10 to CB10 South (A226 to A226a)
250 Concrete Pipe – 11.7m
General
1.4m – very slight separation at joint
Recommendation
Pipe is in good condition. Extend lead as required. **(Agree – AS)**

EX. MH 10 TO EX. MH 11 (A226 to A227)
375mm Concrete Pipe – 105m
General
Every pipe has a (lifting) hole in the top of the pipe
Pipe has corrugated appearance
9.4m – separation at joint, chip at joint
12.5m – crack at 7 o'clock
19.8m – longitudinal crack on top of pipe **(continuous fractures – not cracks)**
20.90m – longitudinal crack along bottom of pipe
21.8m – longitudinal cracks at 9 and 3 o'clock
34.0 - cracking less visible – although likely still present especially on top
44.0 – crack along top and bottom.
52.8m - chip in joint at 9 o'clock. Separation at joint
67.5m - slight separation and chip in joint
93.5m - 104.3– some alligator cracking along top of pipe
Recommendations
Pipe is in fair to good condition. Borderline between lining and replacement. Middle section is good, end sections are not.
Replace. **(Agree – AS)**

EX. MH 11 to CB11 Northeast **(A227 to A227b)**
250 Concrete Pipe – 12.1m
General
1.20m – crack at joint, 3 o'clock, joint slightly separated, can see gasket
2.4m – joint separated, can see gasket
3.7m – crack at joint, 3 o'clock, joint slightly separated, can see gasket
3.7m, debris at 7 o'clock extending in 50mm wide line upstream.
4.8m – circumferential crack at joint, 2 – 6 o'clock
6.10m – joint slightly separated
7.3m circumferential crack at joint, pipe broken, 3 o'clock to 9 o'clock
7.3m – pipe seems to have formed channel bottom……possible ice build-up
9.7m – joint separated, crack at joint, pipe broken 6 o'clock to 11 o'clock
10.9m – joint separated, crack in pipe 1 o'clock
(several instances where fractures were incorrectly identified as cracking)
Recommendations
Poor pipe quality. Pipe has corrugated look. All joints are separated.
Replace. **(Agree – AS)**

EX. MH 11 to CB11 Southeast **(A227 to A227a)**
250 Concrete Pipe – 14.8m
General
Pipe looks in good condition
3.4 – 4.7m - Minor ponding 5 – 15mm
11.2m - joint has some separation
Recommendation
CB 11 SE to be relocated to new curb
Extend existing lead with new 250mm Conc. Lead. **(Agree – AS)**

EX. MH 12 to EX. MH 11 **(A228 to A227)**
XXXX – Concrete Pipe – 134.3m
General
Every pipe has a (lifting) hole at top of pipe
2.8m - Crack along top of pipe (likely whole run)
16.8m - slight separation at joint
18.6m – slight separation at joint, gasket showing
29.5m – circumferential crack at joint 3 – 6 o'clock
40.4m – slight separation at joint, gasket showing
Some minor ponding 5 – 10mm present throughout run
74.8m - chip at joint 10 o'clock
88.3m – slight concrete spalling, small chips in pipe, 10 o'clock
(additional cracking identified)
Recommendations
Pipe is in good condition.

No action. **(Agree – AS)**

EX. MH 12 to CB12 North (A228 to A228b)
250mm Concrete Pipe – 7.8m
General
1.80m – slight separation at joint
2.6m – slight separation at joint
4.2m - slight separation at joint
5.4m – slight separation at joint
6.6m – slight separation at joint
Recommendation
Poor pipe quality. Pipe has corrugated look. All joints are separated.
Replace. **(Agree – AS)**

EX. MH 12 to CB12 South (A228 to A228a)
250 Concrete Pipe – 7.2m
General
0.80m – slight separation at joint
1.7m – slight separation at joint, some build-up
2.9m – slight separation at joint
4.1m – slight separation at joint
5.3m – slight separation at joint
5.3m – debris in channel – possible ice build-up
6.6m – slight separation at joint, crack in pipe wall at 3 o'clock
Significant debris in catchbasin
Recommendation
Pipe generally looks in good condition, joints are slightly separated. Catchbasin is at top end of system. No action. **(Replace last section of pipe and CB)**

CCTV INSPECTION
WYE ROAD & SHERWOOD DR.
NOT TO SCALE



SUMMARY

EX.MH 21 to EX. MH 20 – No action
EX. MH 21 TO Ex. MH 22 – Replace
EX. MH 22 – EX. MH 23 – Line or replace. Recommend replacement (pipes on either side are being replaced)
EX. MH. 23 to EX. MH 24 – Replace
EX. MH 24 – EX. MH 25 – No action

MH 21 to MH 20 (A268 to A217)

525mm CSP Corrugated Steel Pipe - 14.0m (Video Inspection list at 375mm – however as the Wye Road storm sewer connecting is 425mm and downstream pipe is 600mm so it is assumed this is a misprint)

General

1.0m – some ponding 30mm
7.2m – some rusting present at bottom of pipe. Pipe appears to have been filled with debris ½ full regularly.
11.0m – rock in pipe
(3.0m rock in pipe from other direction)

Recommendation

Pipe looks to be in good condition. No action. **(Agree – AS)**

MH 22 to MH 21 (A216 to A268)

600mm Concrete -

General

1.0m – crack at top of pipe
3.8m – longitudinal crack at 3 o'clock
5.0m longitudinal crack at 11 o'clock
7.6m – separated joint
9.2m – chip in joint, crack some separation
12.6m – joint chipped at 3 o'clock, some separation
14.1m – roots starting through joint
14.9m – roots at top of joint
18.4m – chip and crack at joint 10 o'clock
20.4m – chip at joint, roots at joint
24.7m – roots at joint
26.10m – chip at 2 o'clock in joint
36.8m – hole in pipe at 9 o'clock. Utility pipe running parallel looks to have caused damage. Significant concrete in pipe. Appears as though utility pipe caused damage for two or more pipe lengths.

Concrete at joints appears darker than rest of pipe. Possibly due to presence of roots. Gives pipe the appearance that it has been subjected to fire.

Recommendation

Replacement due to significant root infiltration and damage to pipe from utility.
(Agree to a point – AS – replacement due to damaged pipe, not for roots)

MH 22 to MH 23(A216 to A215)

600mm Concrete – 56.1m

General

10.1m –
11.1m – roots at joint
14.4m – ponding in bottom of pipe 30mm
15.0m – roots at joint
16.6m – chip in joint at 4 o'clock
18.5m – roots in joint 8 o'clock
Snow and ice remain in bottom of pipe
56.2m – Catchbasin / manhole – placed directly on pipe (possibly 2 – 3 grade rings)

Recommendation

Pipe looks to be in good condition other than root infiltration. Should be lined or replaced. **(Agree – AS)**

MH 24 to MH 23 (A214 to A215)

600mm – CSP Corrugated Steel Pipe – 25.7

General

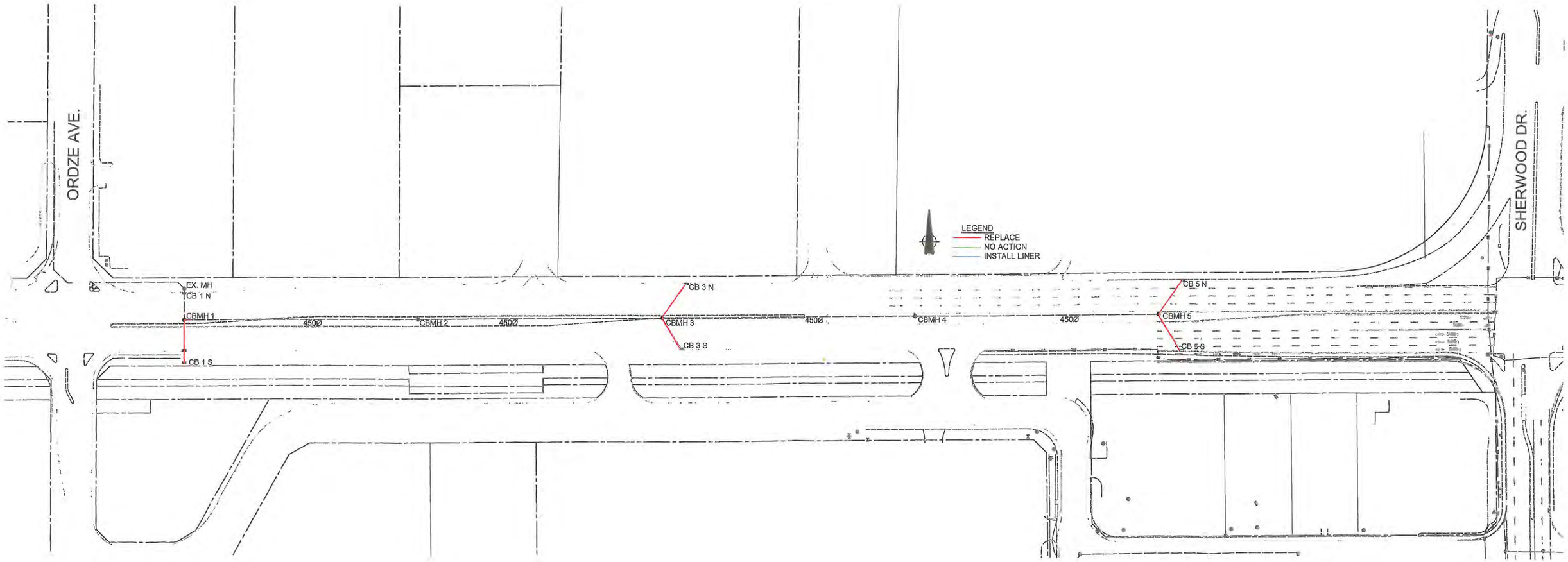
0.0m – ponding 100mm
1.9m – pipe switches to concrete CSP shows through at 12 o'clock **(suggest that piece of CSP was used to cover what I suspect was an abandoned CB)**
3.8m – abandoned manhole
4.7m – longitudinal cracks at 9, 12, 3 and 6 o'clock pipe oval – collapsing **(Fractures and cracks with Deformation up to 10 % - early stages in the process of collapse)**
11.5m – significant ponding 150mm
13.1m – chip in joint 1 o'clock
14.7m – longitudinal cracks stop
16.5m – abandoned manhole
19.0m – hole in pipe
25.7m - in line catchbasin / manhole

Recommendation

Replace **(Agree – AS)**

MH 24 to MH 25 (A214 to A213)
600mm Steel. Joint are approximately 9 – 10m apart.
General
Pipe has obviously stood half full of debris for a significant time
95.0m – ponding 25mm
186.8m – out of cable. Cannot camera farther
Recommendation
Pipe looks to be in good condition. No visible cracks or deflection. No action.
(Agree – AS)

MH 25 to MH 24 (A213 to A214)
600mm Steel. Joint are approximately 9 – 10m apart.
General
50.0m past survey from MH 24
Recommendation
Pipe looks to be in good condition. No visible cracks or deflection. No action.
(Agree – AS)


ORDZE AVE.
SHERWOOD DR.
LEGEND
REPLACE
NO ACTION
INSTALL LINER
EX. MH
CB 1 N
CBMH 1
CB 1 S
450Ø
CBMH 2
450Ø
CB 3 N
CBMH 3
CB 3 S
450Ø
CBMH 4
450Ø
CB 5 N
CBMH 5
CB 5 S

SUMMARY

EX. CBMH 5 – EX. CBMH 4 – No action
EX. CBMH 4 – EX. CBMH 3 – No action
EX. CBMH 3 – EX. CBMH 2 – No action
EX. CBMH 2 – EX. CBMH 1 – No action

EX. CBMH 5 to CB 5 NE (B44 to B44b)
300 CSP – 17.3m
General
Bottom ¼ of pipe shows significant rusting
Bottom half of pipe shows rust to the point of full deterioration
3.7 to 6.4 – several small holes in the culvert ribs
13.8m – joint coupler (missing one bolt) pipe extending past this point seems newer, less rust
Recommendation
Majority of pipe is in poor condition. Recommend replacement.
Should be lined or replaced. - AS

EX. CBMH 5 to CB 5 SE (B44 to B44a)
300 CSP – 18.1m
General
Bottom ¼ of pipe shows significant rusting
Bottom half of pipe shows rust to the point of full deterioration
0.0m – 1.1m – ponding 20mm depth
11.2 to 13.1 – several small holes in the culvert ribs
11.6m – hole in bottom of pipe (pipe has rusted through)
15.9m – joint coupler, pipe extending past this point seems newer, little to no rust
17.3 – debris 5%
Recommendations
Majority of pipe is in poor condition. Recommend replacement
Should be lined or replaced. - AS

EX. CBMH 5 to EX. CBMH 4 (B44 to B45)
450mm CSP – 111.5m
General
Bottom of pipe shows little to no rust **(Bottom half of pipe shows rust to varying degrees.)**
2.0m – gap at joint **possible infiltration (direction of camera travel is downstream and water appears to be flowing back to camera)**
20.1m – 24m slight ponding 50mm
101.1m – dent in pipe at 1 o'clock (no rusting) **Water being held back by debris – several attempts to clean line.**
Recommendations
Pipe is in good condition.

No action **Reinspect to confirm infiltration. If confirmed – liner point repair (minimum 1 meter in length centered over that point). If not determined to be infiltration, no action required. - AS**

EX. CBMH 4 to CB 4 E (A220a to A220c)
250 concrete – 19.6m
General
Minor encrustation.
6.5m - longitudinal crack at 7 o'clock
13m – slight chipping at joint
18.8m – slight separation at joint
Recommendations
Pipe is in good condition
Extend lead as required **(Pipe looks to be in good condition. No visible cracks or deflection. No action. – AS)**

EX. CBMH 4 to EX.CBMH 3 (B45 to B46)
450 CSP – 111.5m (Video inspection labels pipe as 375mm, as-builts indicate 450mm)
General
Bottom of the pipe shows little to no rust **(Bottom half of pipe shows rust to varying degrees.)**
Debris remaining in line.
6.7m – joint has separated at bottom **/joint edge pealed up across invert**
15.4 – 20.0m slight ponding 50 – 80mm
31.2m – joint is bent/separated at bottom **/joint edge pealed up across invert**
31.2 – 33.5m - slight ponding 50mm
36.2 – 38.4m – slight ponding 50mm
74.2 – 79.2m – slight ponding 50mm (seems to be less after reflush and camera restart)
Recommendation
Pipe is in good condition
No action **(Pipe looks to be in good condition. No visible cracks or major deflection with some minor deformation at 2 joints. No action. – AS)**

EX. CBMH 3 to CB 3 SE(B46 to B46a)
300 CSP – 15.5m
General
Bottom ¼ of pipe shows significant rusting
Bottom half of pipe shows rust to the varying degrees.
Debris remaining in line
Recommendation
Pipe is in fair to poor condition. Recommend replacement
(Should be lined or replaced. – AS)

EX. CBMH 3 to CB 3 NE (B46 to B46b)
300 CMP/Concrete – 18.0m
General
Bottom half of pipe shows rust to the varying degrees.
Debris remaining in line.
0m - 8.7m – bottom ¼ of pipe is filled with sand/silt debris, condition indeterminate.
12.9m – hole in top of pipe **at crown**
13.3m – material changes to concrete
14.9m – sand/silt debris ends
15.9m – small chip at joint
Recommendation
Condition of CSP Pipe indeterminate, although based on other lead camera's of the CSP pipe, replacement is likely.
Concrete pipe is in good condition. Clean and recamera to determine CSP condition.
(Should be lined or replaced. – AS)

EX. CBMH 3 to EX. CBMH 2 (B46 to B47)
450 CSP – 111.8m (Video inspection labels as 375mm, as-builts indicate 450mm)
General
Bottom of pipe shows little to no rust
Bottom half of pipe shows rust.
Debris still remaining in line.
28.1m – connection **from north** (150mm dia approx.) **¼ full of gravel**
29.8m – 31.7 slight ponding 50mm
51.1m – wire in pipe extending from joint
51.9m – 53.4m – slight ponding 50mm (likely due to sand/silt debris downstream)
85.5m – 88.2m - slight ponding 50mm, some rust present at bottom of pipe, may hold water frequently
93.5 – 96.8m – slight ponding 50mm (likely due to sand/silt debris downstream)
Recommendation
Pipe is in good condition
No action
(Determine start point of connection, clean and inspect if still active and provide recommended actions.
Pipe looks to be in good condition. No visible cracks or deflection. No action. – AS)

EX. CBMH 2 to EX. CBMH 1(B47 to B48)
450 CSP – 108m (Video inspection labels as 375mm, as-builts indicate 450mm)
General
Bottom of pipe shows little to no rust
Bottom half of pipe shows rust to varying degrees.
Water being held back by debris – several attempts to clean line.
11.2 – 13.3m – slight ponding 50mm
25 – 30.1m – slight ponding 50mm
70.5m – slight separation / bend at joint

90.1m – 91.4m – multiple dents at 1 o'clock (no apparent holes)
102.0m – slice in rib at crown and evidence of external forces being exerted on exterior of pipe causing minor deformation.
105.9m – hole ripped in pipe with cables coming through
105.9m – power line (2 orange conduit) through pipe

EX. CBMH 1 to EX. CBMH 2
450 CMP – (Video inspection labels as 375mm, as-builts indicate 450mm)
General
Reversal of previously abandoned survey.
0.80m – connection (150mm diameter approx.)
2.10m – power line (2 orange conduit) through pipe
Recommendation
Pipe is in good condition
Third party (owner of power line) to repair damage to pipe to County's satisfaction
(Replace from MH 1 to a point past the area with the slice (cables to be rerouted by owner). No action on remaining portion of the line. – AS)

EX. CBMH 1 to CB 1 S(B48 to B48a & B48a to B48b)
1200mm elliptical CSP – 19.8m
1200 by 600mm – Arched CSP (Corrugated Steel Pipe) – total length 19.8m (as the middle catch inlet has been identified as a node point, there is actually 2 runs – B48 to B48a (identified in the report as a connection) and B48a to B48b (connection to end of run)
General
Bottom of pipe shows some rusting
Bottom half of pipe shows rust to the point of full deterioration.
Debris remaining in line
12.8m – catchbasin in Wye Road
16.1m - bottom of pipe damaged - **hole at invert – 2 sections of ribs broken and sticking upwards and another is split**
18.5m – invert of pipe changes to concrete
19.8m – Catchbasin (south of Wye Road)
Recommendation
Pipe is in fair to poor condition
Recommend replacement **(Replacement. – AS)**

EX. CBMH 1 to CB 1 N (B48 to B50 & B50 to B51)
1200mm elliptical CSP – 14.3m
1200 by 600mm – Arched CSP (Corrugated Steel Pipe) – total length 14.3m (as the middle catch inlet has been identified as a node point, there is actually 2 runs – B48

to B50 (identified in the report as a connection) and B50 to B51 (connection to end of run)

General

Bottom half of pipe shows rust.

Debris still in line.

10.7m – catchbasin in Wye Road

14.3m – catchbasin manhole connection (north of Wye Road)

Recommendation

Pipe is in fair to good condition

Adjust catchbasin connections as required for widening **(Pipe looks to be in good condition. No visible cracks or deflection. No action. – AS)**

These inverts should be confirmed by field survey and the model should be updated accordingly. Additionally, the stage-surface area for the Davidson Creek Pond was estimated for the model and should be confirmed.

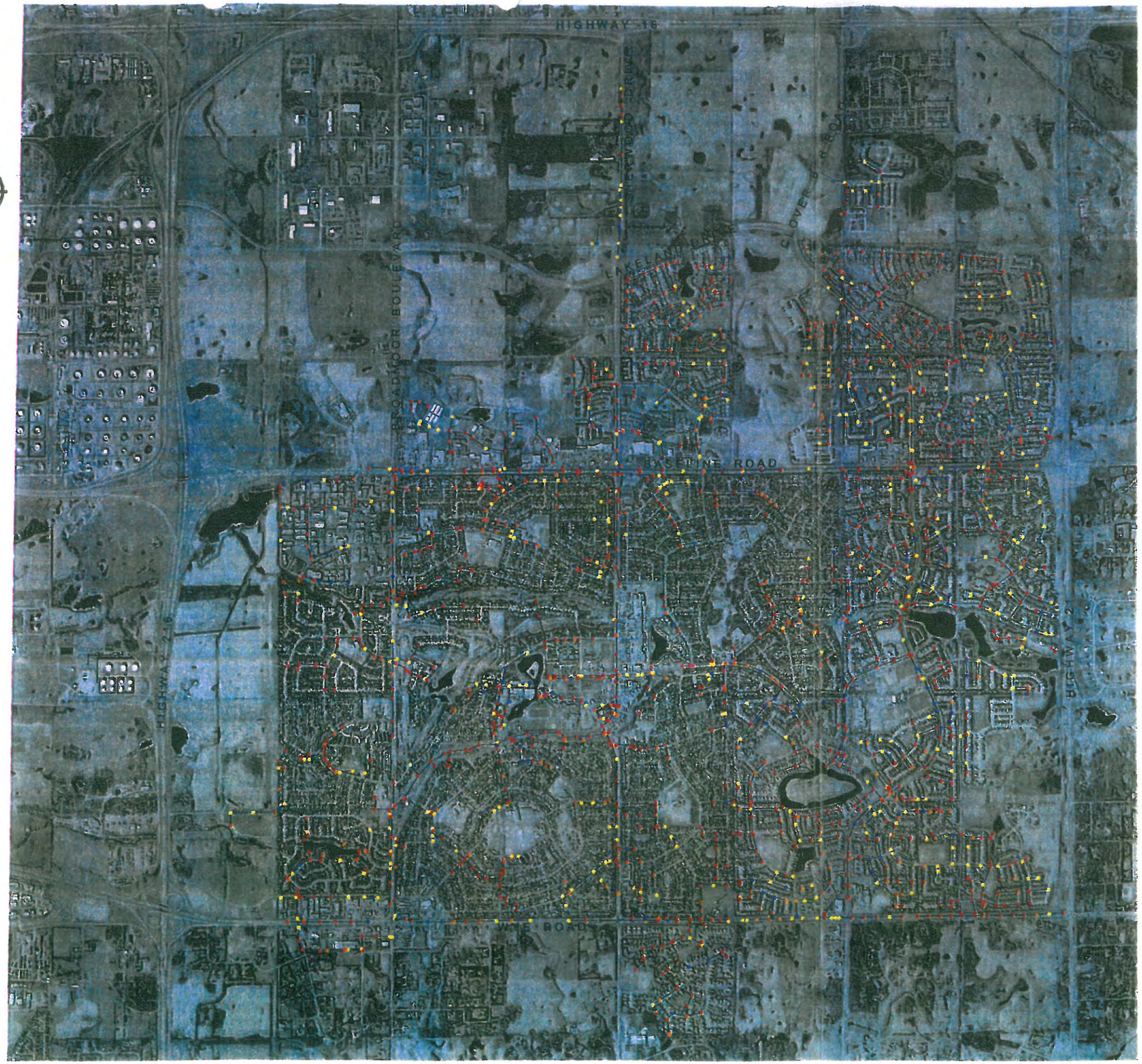
3.2.3 Model Verification

In the absence of flow monitoring data to calibrate the model, the percent runoff (runoff coefficient) was checked for each basin. These results are outlined in Table 3-13.

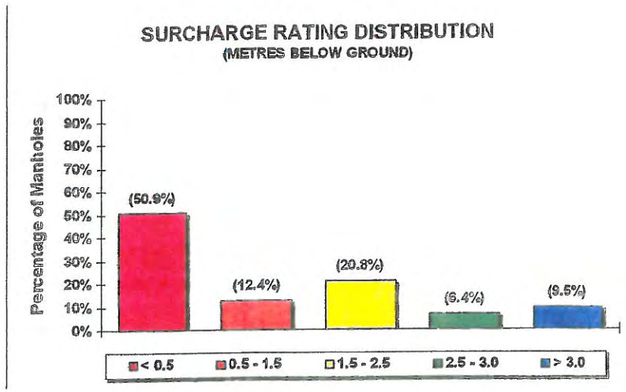
Table 3-13 Basin Percent Runoff Values

Basin	1:5 Year 4-hr Chicago Distribution			1:100 Year 24-hr Huff Distribution		
	Rainfall Depth (mm)	Runoff (mm)	% Runoff	Rainfall Depth (mm)	Runoff (mm)	% Runoff
A	37.3	14.6	39	126.6	81.4	64
B	37.3	19.3	52	126.6	91.2	72
BL	37.3	28.5	77	126.6	110.3	87
C	37.3	13.6	37	126.6	79.0	62
D	37.3	11.0	29	126.6	73.2	58
E	37.3	25.1	67	126.6	103.3	82
F	37.3	14.4	39	126.6	80.9	64
G	37.3	14.1	38	126.6	80.1	63
H	37.3	13.7	35	126.6	79.0	62
I	37.3	15.3	41	126.6	82.4	65
J	37.3	15.2	41	126.6	82.0	65
K	37.3	18.6	50	126.6	89.1	70
L	37.3	13.5	36	126.6	78.4	62
M	37.3	16.3	44	126.6	84.0	66
N	37.3	18.5	50	126.6	89.0	70
O	37.3	21.3	57	126.6	94.8	75
P	37.3	18.2	49	126.6	88.2	70
Q	37.3	16.8	45	126.6	85.5	68
R	37.3	14.8	40	126.6	81.3	64
S	37.3	15.9	43	126.6	83.1	66
T	37.3	11.6	31	126.6	74.6	59
U	37.3	17.5	47	126.6	86.7	68
W	37.3	14.5	39	126.6	80.5	64

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Scale: 1:30,000



Client:

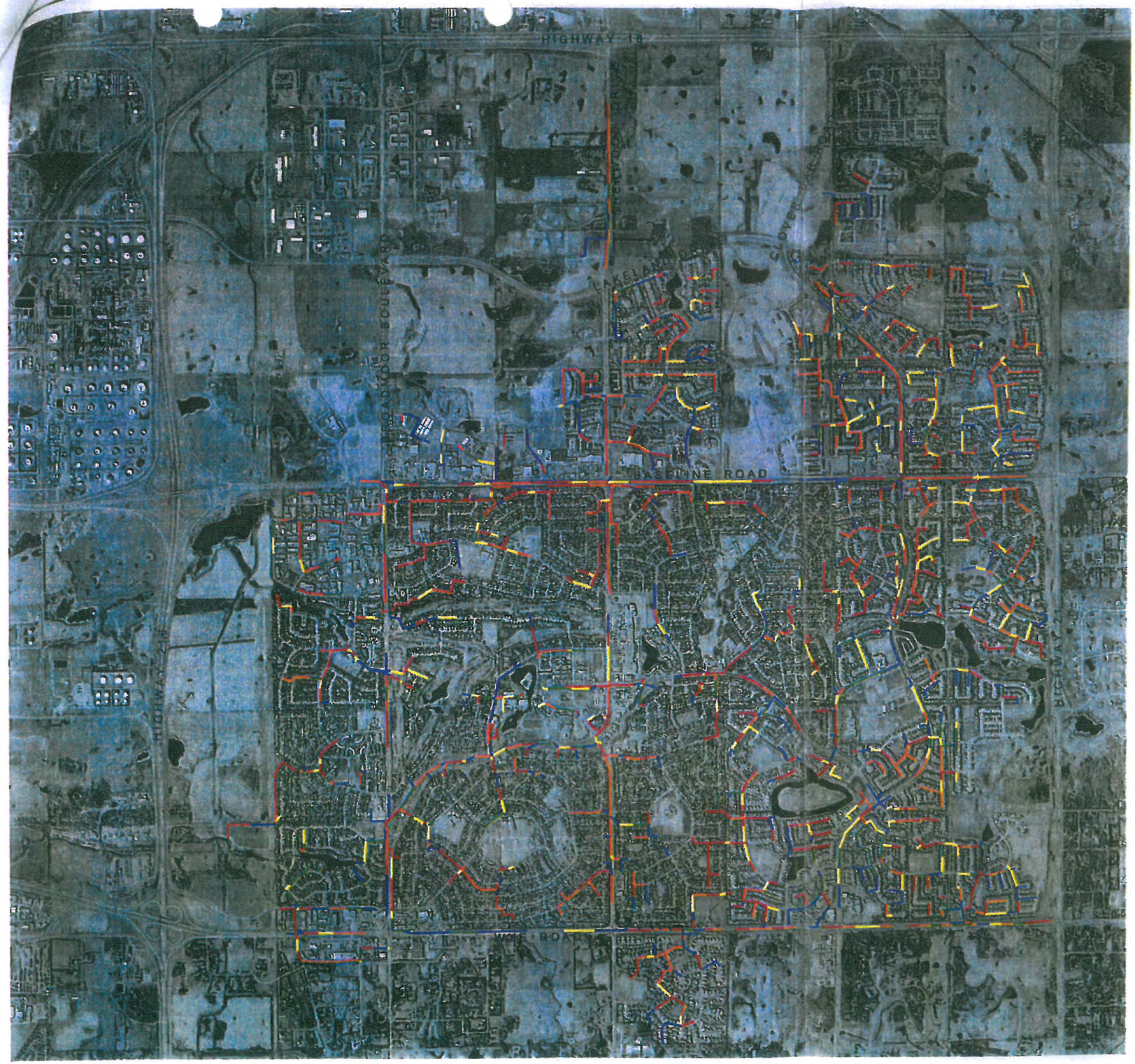
Strathcona County

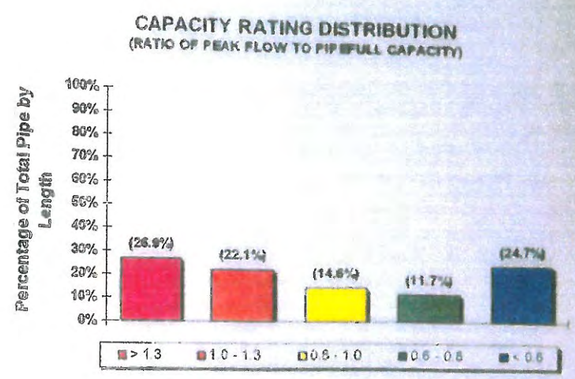
sameng inc.
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1500 Baker Centre, Edmonton, Alberta T5J 1G3
Ph: (780)482-2557, Fax: (780)482-2538

Urban Area Drainage System Assessment

Figure 3-8: Storm Manhole Surcharge 1:5 Chicago Distribution





Scale: 1:30,000

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Urban Area Drainage System Assessment

Figure 3-9: Storm Sewer Capacity Rating 1:5 Chicago Distribution

STRATHCONA COUNTY
STORM SEWER DESIGN SHEET

AL-TERRA ENGINEERING
4010 - 76 Avenue, Edmonton, Alberta, T6B 2P1
Tel: 780-440-4411 Fax: 780-440-2585

PROJECT: Wye 2008
JOB NO.: 1154
DATE: November 17, 2008

2 YEAR RETURN PERIOD IDF PARAMETERS:
a = 221.51
b = -0.647
c = 1.58

Location	From MH	To MH	DESIGN FLOW CALCULATIONS: Area, A (ha) Hard	Soft	Total	C	C*A	Cumulative Area (ha)	Cumulative C*A	T_c (min)	I (mm/hr)	Required Design Capacity, Q_c (m^3/s)	SEWER DESIGN & ANALYSIS: Nominal Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Full Flow Capacity, Q_f (m^3/s)	Percent of Full Flow Q_c/Q_f (%)	Full Flow Velocity, V_f (m/s)	Time in Pipe (min)
WYE ROAD																			
West of Brentwood	10	9	0.5521	0.1459	0.6979	0.77	0.54	0.6979	0.5390	8.00	51.34	0.077	375	0.55%	118.7	0.136	57%	1.190	1.66
	9	8	0.4116	0.1058	0.5174	0.78	0.40	1.2153	0.9406	9.66	46.29	0.121	375	0.55%	99.0	0.136	89%	1.190	1.39
	8	7	0.3495	0.0929	0.4424	0.77	0.34	1.6577	1.2819	11.05	42.93	0.153	450	0.55%	124.4	0.221	69%	1.344	1.54
Brentwood	7	6	0.8108	0.2176	0.5933	0.64	0.38	2.2510	1.6605	12.59	39.85	0.184	600	0.30%	103.8	0.351	52%	1.202	1.44
	6	5	0.3757	0.0340	0.3729	0.87	0.33	2.6239	1.9859	14.03	37.43	0.206	600	0.30%	87.5	0.351	59%	1.202	1.21
	5	4	0.3390	0.0552	0.3941	0.83	0.33	3.0181	2.3123	15.24	35.66	0.229	600	0.30%	88.5	0.351	65%	1.202	1.23
East of Brentwood	4	1.1	0.3290	0.1109	0.4400	0.10	0.04	3.4580	2.3562	16.47	34.07	0.223	675	0.39%	11.2	0.548	41%	1.483	0.13
East of Hawthorne	12	11	0.4615	0.1260	0.5875	0.77	0.45	0.5875	0.4510	8.00	51.34	0.064	375	0.45%	137.0	0.123	52%	1.076	2.12
	11	10	0.9204	0.2184	1.1388	0.79	0.90	1.7263	1.3472	10.12	45.11	0.169	375	0.45%	107.0	0.123	138%	1.076	1.66
Hawthorne	10	9	0.1489	0.0338	0.1827	0.79	0.14	1.9090	1.4921	11.78	41.40	0.172	450	0.45%	121.0	0.200	86%	1.215	1.66
	9	8	0.2539	0.0668	0.3207	0.77	0.25	2.2297	1.7400	13.44	38.38	0.186	450	0.45%	91.0	0.200	93%	1.215	1.25
	8	7	0.3576	0.0786	0.4362	0.80	0.35	2.6659	2.0875	14.69	36.45	0.211	450	0.45%	91.0	0.200	106%	1.215	1.25
	7	6	0.2962	0.0767	0.3729	0.78	0.29	3.0388	2.3766	15.93	34.75	0.229	450	1.20%	91.0	0.326	70%	1.985	0.76
	6	5	0.3060	0.0914	0.3974	0.75	0.30	3.4362	2.6764	16.70	33.80	0.251	450	1.55%	104.0	0.370	68%	2.256	0.77
	5	4	0.3733	0.0837	0.4570	0.79	0.36	3.8932	3.0395	17.47	32.91	0.278	450	1.70%	109.0	0.388	72%	2.362	0.77
	4	3	0.4204	0.1720	0.5924	0.70	0.42	4.4856	3.4560	18.24	32.08	0.308	450	2.15%	58.0	0.436	71%	2.656	0.36
	3	2			0.0000		0.00	4.4856	3.4560	18.60	31.70	0.304	450	2.15%	64.5	0.436	70%	2.656	0.40
Sherwood Drive	2	1			0.0000		0.00	4.4856	3.4560	19.00	31.30	0.300	450	3.54%	9.3	0.560	54%	3.409	0.05
East of Sherwood Drive	5	4	0.6686	0.1143	0.7829	0.83	0.65	0.7829	0.6466	8.00	51.34	0.092	450	1.20%	118.7	0.326	28%	1.985	1.00
	4	3	0.2047	0.0567	0.2613	0.77	0.20	1.0443	0.8467	9.00	48.15	0.113	450	1.28%	99.0	0.337	34%	2.050	0.80
	3	2	0.6158	0.1617	0.7775	0.77	0.60	1.8217	1.4479	9.80	45.92	0.185	450	2.03%	124.4	0.424	44%	2.581	0.80
Ordze	2	1			0.0000	0.00	0.00	1.8217	1.4479	10.61	43.94	0.177	450	1.27%	103.8	0.335	53%	2.042	0.85
SHERWOOD DRIVE	1	NORTH	0.5711	0.2432	0.8143	0.70	0.57	5.2999	4.0229	19.05	31.26	0.349	450		20.0	0.000	#DIV/0!	0.000	#DIV/0!

Assumptions:

All medians considered hard surface area
South grassed catchment area only considered to north boundary of 9.0m ATCO right-of-way
Path area not included as hard surface area because path may not be within road right-of-way and may not drain towards roadway.

STRATHCONA COUNTY
STORM SEWER DESIGN SHEET

AL-TERRA ENGINEERING
4010 - 76 Avenue, Edmonton, Alberta, T6B 2P1
Tel: 780-440-4411 Fax: 780-440-2585

PROJECT: Wye 2008
JOB NO.: 1154
DATE: November 17, 2008

2 YEAR RETURN PERIOD IDF PARAMETERS:
a = 221.51
b = -0.647
c = 1.58

Location	From MH	To MH	DESIGN FLOW CALCULATIONS: Area, A (ha) Hard	Soft	Total	C	C*A	Cumulative Area (ha)	Cumulative C*A	T_c (min)	I (mm/hr)	Required Design Capacity, Q_c (m^3/s)	SEWER DESIGN & ANALYSIS: Nominal Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Full Flow Capacity, Q_f (m^3/s)	Percent of Full Flow Q_c/Q_f (%)	Full Flow Velocity, V_f (m/s)	Time in Pipe (min)
WYE ROAD																			
West of Brentwood	10	9	0.5521	0.1459	0.6979	0.77	0.54	0.6979	0.5390	15.00	36.00	0.054	375	0.55%	118.7	0.136	40%	1.190	1.66
	9	8	0.4116	0.1058	0.5174	0.78	0.40	1.2153	0.9406	16.66	33.84	0.088	375	0.55%	99.0	0.136	65%	1.190	1.39
	8	7	0.3495	0.0929	0.4424	0.77	0.34	1.6577	1.2819	18.05	32.28	0.115	450	0.55%	124.4	0.221	52%	1.344	1.54
Brentwood	7	6	0.8108	0.2176	0.5933	0.64	0.38	2.2510	1.6605	19.59	30.73	0.142	600	0.30%	103.8	0.351	40%	1.202	1.44
	6	5	0.3757	0.0340	0.3729	0.87	0.33	2.6239	1.9859	21.03	29.45	0.162	600	0.30%	87.5	0.351	46%	1.202	1.21
	5	4	0.3390	0.0552	0.3941	0.83	0.33	3.0181	2.3123	22.24	28.47	0.183	600	0.30%	88.5	0.351	52%	1.202	1.23
East of Brentwood	4	1.1	0.3290	0.1109	0.4400	0.10	0.04	3.4580	2.3562	23.47	27.56	0.180	675	0.39%	11.2	0.548	33%	1.483	0.13
East of Hawthorne	12	11	0.4615	0.1260	0.5875	0.77	0.45	0.5875	0.4510	15.00	36.00	0.045	375	0.45%	137.0	0.123	37%	1.076	2.12
	11	10	0.9204	0.2184	1.1388	0.79	0.90	1.7263	1.3472	17.12	33.30	0.125	375	0.45%	107.0	0.123	102%	1.076	1.66
Hawthorne	10	9	0.1489	0.0338	0.1827	0.79	0.14	1.9090	1.4921	18.78	31.52	0.131	450	0.45%	121.0	0.200	65%	1.215	1.66
	9	8	0.2539	0.0668	0.3207	0.77	0.25	2.2297	1.7400	20.44	29.97	0.145	450	0.45%	91.0	0.200	73%	1.215	1.25
	8	7	0.3576	0.0786	0.4362	0.80	0.35	2.6659	2.0875	21.69	28.92	0.168	450	0.45%	91.0	0.200	84%	1.215	1.25
	7	6	0.2962	0.0767	0.3729	0.78	0.29	3.0388	2.3766	22.93	27.95	0.185	450	1.20%	91.0	0.326	57%	1.985	0.76
	6	5	0.3060	0.0914	0.3974	0.75	0.30	3.4362	2.6764	23.70	27.40	0.204	450	1.55%	104.0	0.370	55%	2.256	0.77
	5	4	0.3733	0.0837	0.4570	0.79	0.36	3.8932	3.0395	24.47	26.88	0.227	450	1.70%	109.0	0.388	59%	2.362	0.77
	4	3	0.4204	0.1720	0.5924	0.70	0.42	4.4856	3.4560	25.24	26.38	0.253	450	2.15%	58.0	0.436	58%	2.656	0.36
	3	2			0.0000		0.00	4.4856	3.4560	25.60	26.15	0.251	450	2.15%	64.5	0.436	58%	2.656	0.40
Sherwood Drive	2	1			0.0000		0.00	4.4856	3.4560	26.00	25.90	0.249	450	3.54%	9.3	0.560	44%	3.409	0.05
East of Sherwood Drive	5	4	0.6686	0.1143	0.7829	0.83	0.65	0.7829	0.6466	15.00	36.00	0.065	450	1.20%	118.7	0.326	20%	1.985	1.00
	4	3	0.2047	0.0567	0.2613	0.77	0.20	1.0443	0.8467	16.00	34.67	0.082	450	1.28%	99.0	0.337	24%	2.050	0.80
	3	2	0.6158	0.1617	0.7775	0.77	0.60	1.8217	1.4479	16.80	33.68	0.135	450	2.03%	124.4	0.424	32%	2.581	0.80
Ordze	2	1			0.0000	0.00	0.00	1.8217	1.4479	17.61	32.76	0.132	450	1.27%	103.8	0.335	39%	2.042	0.85
SHERWOOD DRIVE	1	NORTH	0.5711	0.2432	0.8143	0.70	0.57	5.2999	4.0229	26.05	25.87	0.289	450		20.0	0.000	#DIV/0!	0.000	#DIV/0!

Assumptions:

All medians considered hard surface area
South grassed catchment area only considered to north boundary of 9.0m ATCO right-of-way
Path area not included as hard surface area because path may not be within road right-of-way and may not drain towards roadway.

STRATHCONA COUNTY
STORM SEWER DESIGN SHEET

AL-TERRA ENGINEERING
4010 - 76 Avenue, Edmonton, Alberta, T6B 2P1
Tel: 780-440-4411 Fax: 780-440-2585

PROJECT: Wye 2008
JOB NO.: 1154
DATE: November 17, 2008

5 YEAR RETURN PERIOD IDF PARAMETERS:
a = 335.26
b = -0.654
c = 1.54

Location	From MH	To MH	DESIGN FLOW CALCULATIONS: Area, A (ha) Hard	Soft	Total	C	C*A	Cumulative Area (ha)	Cumulative C*A	T_c (min)	I (mm/hr)	Required Design Capacity, Q_c (m^3/s)	SEWER DESIGN & ANALYSIS: Nominal Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Full Flow Capacity, Q_f (m^3/s)	Percent of Full Flow Q_c/Q_f (%)	Full Flow Velocity, V_f (m/s)	Time in Pipe (min)
WYE ROAD																			
West of Brentwood	10	9	0.5521	0.1459	0.6979	0.77	0.54	0.6979	0.5390	8.00	76.68	0.115	375	0.55%	118.7	0.136	85%	1.190	1.66
	9	8	0.4116	0.1058	0.5174	0.78	0.40	1.2153	0.9406	9.66	69.04	0.180	375	0.55%	99.0	0.136	133%	1.190	1.39
	8	7	0.3495	0.0929	0.4424	0.77	0.34	1.6577	1.2819	11.05	63.96	0.228	450	0.55%	124.4	0.221	103%	1.344	1.54
	7	6	0.8108	0.2176	0.5933	0.64	0.38	2.2510	1.6605	12.59	59.31	0.274	600	0.30%	103.8	0.351	78%	1.202	1.44
	6	5	0.3757	0.0340	0.3729	0.87	0.33	2.6239	1.9859	14.03	55.66	0.307	600	0.30%	87.5	0.351	88%	1.202	1.21
	5	4	0.3390	0.0552	0.3941	0.83	0.33	3.0181	2.3123	15.24	53.00	0.340	600	0.30%	88.5	0.351	97%	1.202	1.23
East of Brentwood	4	1.1	0.3290	0.1109	0.4400	0.10	0.04	3.4580	2.3562	16.47	50.61	0.331	675	0.39%	11.2	0.548	60%	1.483	0.13
East of Hawthorne	12	11	0.4615	0.1260	0.5875	0.77	0.45	0.5875	0.4510	8.00	76.68	0.096	375	0.45%	137.0	0.123	78%	1.076	2.12
	11	10	0.9204	0.2184	1.1388	0.79	0.90	1.7263	1.3472	10.12	67.25	0.252	375	0.45%	107.0	0.123	205%	1.076	1.66
	10	9	0.1489	0.0338	0.1827	0.79	0.14	1.9090	1.4921	11.78	61.65	0.256	450	0.45%	121.0	0.200	128%	1.215	1.66
	9	8	0.2539	0.0668	0.3207	0.77	0.25	2.2297	1.7400	13.44	57.09	0.276	450	0.45%	91.0	0.200	138%	1.215	1.25
	8	7	0.3576	0.0786	0.4362	0.80	0.35	2.6659	2.0875	14.69	54.18	0.314	450	0.45%	91.0	0.200	157%	1.215	1.25
	7	6	0.2962	0.0767	0.3729	0.78	0.29	3.0388	2.3766	15.93	51.62	0.341	450	1.20%	91.0	0.326	105%	1.985	0.76
	6	5	0.3060	0.0914	0.3974	0.75	0.30	3.4362	2.6764	16.70	50.20	0.373	450	1.55%	104.0	0.370	101%	2.256	0.77
	5	4	0.3733	0.0837	0.4570	0.79	0.36	3.8932	3.0395	17.47	48.86	0.413	450	1.70%	109.0	0.388	106%	2.362	0.77
	4	3	0.4204	0.1720	0.5924	0.70	0.42	4.4856	3.4560	18.24	47.61	0.457	450	2.15%	58.0	0.436	105%	2.656	0.36
	3	2			0.0000		0.00	4.4856	3.4560	18.60	47.04	0.452	450	2.15%	64.5	0.436	104%	2.656	0.40
Sherwood Drive	2	1			0.0000		0.00	4.4856	3.4560	19.00	46.44	0.446	450	3.54%	9.3	0.560	80%	3.409	0.05
East of Sherwood Drive	5	4	0.6686	0.1143	0.7829	0.83	0.65	0.7829	0.6466	8.00	76.68	0.138	450	1.20%	111.5	0.326	42%	1.985	0.94
	4	3	0.2047	0.0567	0.2613	0.77	0.20	1.0443	0.8467	8.94	72.13	0.170	450	1.28%	111.5	0.337	50%	2.050	0.91
	3	2	0.6158	0.1617	0.7775	0.77	0.60	1.8217	1.4479	9.84	68.32	0.275	450	2.03%	111.8	0.424	65%	2.581	0.72
Ordze	2	1			0.0000	0.00	0.00	1.8217	1.4479	10.56	65.63	0.264	450	1.27%	108.0	0.335	79%	2.042	0.88
SHERWOOD DRIVE	1	21	0.5711	0.2432	0.8143	0.70	0.57	5.2999	4.0229	19.05	46.37	0.518	450		20.0	0.000	#DIV/0!	0.000	#DIV/0!

Assumptions:

All medians considered hard surface area
South grassed catchment area only considered to north boundary of 9.0m ATCO right-of-way
Path area not included as hard surface area because path may not be within road right-of-way and may not drain towards roadway.

STRATHCONA COUNTY
STORM SEWER DESIGN SHEET

AL-TERRA ENGINEERING
4010 - 76 Avenue, Edmonton, Alberta, T6B 2P1
Tel: 780-440-4411 Fax: 780-440-2585

PROJECT: Wye 2008
JOB NO.: 1154
DATE: November 17, 2008

5 YEAR RETURN PERIOD IDF PARAMETERS:
a = 335.26
b = -0.654
c = 1.54

Location	From MH	To MH	DESIGN FLOW CALCULATIONS: Area, A (ha) Hard	Soft	Total	C	C*A	Cumulative Area (ha)	Cumulative C*A	T_c (min)	I (mm/hr)	Required Design Capacity, Q_c (m^3/s)	SEWER DESIGN & ANALYSIS: Nominal Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Full Flow Capacity, Q_f (m^3/s)	Percent of Full Flow Q_c/Q_f (%)	Full Flow Velocity, V_f (m/s)	Time in Pipe (min)
WYE ROAD																			
West of Brentwood	10	9	0.5521	0.1459	0.6979	0.77	0.54	0.6979	0.5390	15.00	53.51	0.080	375	0.55%	118.7	0.136	59%	1.190	1.66
	9	8	0.4116	0.1058	0.5174	0.78	0.40	1.2153	0.9406	16.66	50.26	0.131	375	0.55%	99.0	0.136	97%	1.190	1.39
	8	7	0.3495	0.0929	0.4424	0.77	0.34	1.6577	1.2819	18.05	47.90	0.171	450	0.55%	124.4	0.221	77%	1.344	1.54
	7	6	0.8108	0.2176	0.5933	0.64	0.38	2.2510	1.6605	19.59	45.59	0.210	600	0.30%	103.8	0.351	60%	1.202	1.44
	6	5	0.3757	0.0340	0.3729	0.87	0.33	2.6239	1.9859	21.03	43.66	0.241	600	0.30%	87.5	0.351	69%	1.202	1.21
	5	4	0.3390	0.0552	0.3941	0.83	0.33	3.0181	2.3123	22.24	42.19	0.271	600	0.30%	88.5	0.351	77%	1.202	1.23
East of Brentwood	4	1.1	0.3290	0.1109	0.4400	0.10	0.04	3.4580	2.3562	23.47	40.83	0.267	675	0.39%	11.2	0.548	49%	1.483	0.13
East of Hawthorne	12	11	0.4615	0.1260	0.5875	0.77	0.45	0.5875	0.4510	15.00	53.51	0.067	375	0.45%	137.0	0.123	55%	1.076	2.12
	11	10	0.9204	0.2184	1.1388	0.79	0.90	1.7263	1.3472	17.12	49.45	0.185	375	0.45%	107.0	0.123	151%	1.076	1.66
	10	9	0.1489	0.0338	0.1827	0.79	0.14	1.9090	1.4921	18.78	46.77	0.194	450	0.45%	121.0	0.200	97%	1.215	1.66
	9	8	0.2539	0.0668	0.3207	0.77	0.25	2.2297	1.7400	20.44	44.43	0.215	450	0.45%	91.0	0.200	108%	1.215	1.25
	8	7	0.3576	0.0786	0.4362	0.80	0.35	2.6659	2.0875	21.69	42.86	0.249	450	0.45%	91.0	0.200	125%	1.215	1.25
	7	6	0.2962	0.0767	0.3729	0.78	0.29	3.0388	2.3766	22.93	41.41	0.273	450	1.20%	91.0	0.326	84%	1.985	0.76
	6	5	0.3060	0.0914	0.3974	0.75	0.30	3.4362	2.6764	23.70	40.59	0.302	450	1.55%	104.0	0.370	81%	2.256	0.77
	5	4	0.3733	0.0837	0.4570	0.79	0.36	3.8932	3.0395	24.47	39.80	0.336	450	1.70%	109.0	0.388	87%	2.362	0.77
	4	3	0.4204	0.1720	0.5924	0.70	0.42	4.4856	3.4560	25.24	39.05	0.375	450	2.15%	58.0	0.436	86%	2.656	0.36
	3	2			0.0000		0.00	4.4856	3.4560	25.60	38.71	0.372	450	2.15%	64.5	0.436	85%	2.656	0.40
Sherwood Drive	2	1			0.0000		0.00	4.4856	3.4560	26.00	38.33	0.368	450	3.54%	9.3	0.560	66%	3.409	0.05
East of Sherwood Drive	5	4	0.6686	0.1143	0.7829	0.83	0.65	0.7829	0.6466	15.00	53.51	0.096	450	1.20%	111.5	0.326	29%	1.985	0.94
	4	3	0.2047	0.0567	0.2613	0.77	0.20	1.0443	0.8467	15.94	51.62	0.121	450	1.28%	111.5	0.337	36%	2.050	0.91
	3	2	0.6158	0.1617	0.7775	0.77	0.60	1.8217	1.4479	16.84	49.94	0.201	450	2.03%	111.8	0.424	47%	2.581	0.72
Ordze	2	1			0.0000	0.00	0.00	1.8217	1.4479	17.56	48.69	0.196	450	1.27%	108.0	0.335	58%	2.042	0.88
SHERWOOD DRIVE	1	21	0.5711	0.2432	0.8143	0.70	0.57	5.2999	4.0229	26.05	38.29	0.428	450		20.0	0.000	#DIV/0!	0.000	#DIV/0!

Assumptions:

All medians considered hard surface area
South grassed catchment area only considered to north boundary of 9.0m ATCO right-of-way
Path area not included as hard surface area because path may not be within road right-of-way and may not drain towards roadway.

TABLE 1 - SUMMARY OF SURCHARGE

	Q_{REQ} (m^3/s)	EX. PIPE	EX. SLOPE (%)	REQ. SLOPE (%)	SURCHARGE IN UPSTREAM MH ABOVE INVERT (m)	DEPTH OF SURCHARGE BELOW ROAD (m)
WYE ROAD - WEST OF BRENTWOOD TO EAST OF BRENTWOOD						
STMH 7 to STMH 8	0.228	450	0.55	0.6	0.497	2.487
STMH 8 to STMH 9	0.18	375	0.55	1.0	0.849	1.936
STMH 9 to STMH 10 (Check)	0.115	375	0.55	0.55	0.83	1.371
WYE ROAD - SHERWOOD DRIVE TO EAST OF HAWTHORNE						
STMH 3 to STMH 2	0.452	450	2.15	2.3	0.54	1.18
STMH 4 to STMH 3	0.457	450	2.15	2.38	0.6	1.85
STMH 5 to STMH 4	0.413	450	1.7	1.93	0.86	0.93
STMH 6 to STMH 5	0.373	450	1.55	1.55	0.86	0.68
STMH 7 to STMH 6	0.341	450	1.2	1.3	0.95	0.73
STMH 8 to STMH 7	0.314	450	0.45	1.12	1.57	0.86
STMH 9 to STMH 8	0.276	450	0.45	0.86	1.94	1.18
STMH 10 to STMH 9	0.256	375	0.45	0.75	2.3	0.61
STMH 11 to STMH 10	0.252	375	0.45	1.9	FAIL	FAIL

APPENDIX “E”

Wye Road Widening

Evaluation of Guardrail Requirements

To: Ross Etches, P.Eng., M.Eng., PTOE

From: Dana Leithead, P.Eng.
Al-Terra Engineering Ltd.

Date: April 21, 2008

Re: Wye Road Widening
Evaluation of Guardrail Requirements

As part of the detailed design of the Wye Road widening project, we have completed an analysis of the requirement for guardrail along the north side of Wye Road between the traveled lanes and the existing noise wall.

Background:

Currently there is a W-beam guardrail installed along the length of the noise wall. The guardrail is installed at 1.5m south of the noise wall, resulting in a separation from the traveled lanes of 1.8m within the limits of the acceleration and deceleration lanes of Wye Road, and 5.3m from the traveled lane elsewhere. The currently installed guardrail has a maximum deflection of approximately 2.5m, meaning that in an accident, the guardrail would deflect into the existing noise wall.

Strathcona County records indicate that there have been 3 or 4 collisions of vehicles with the noise wall in the last 15 years.

The widening of Wye Road will result in the traveled lane of Wye Road being 3.3m from the noise wall. Utility installation (primary power and streetlights) will prompt the removal of the existing guardrail. Al-Terra completed the following attached analysis to evaluate whether guardrail should be re-installed once the Wye Road widening is complete.

Procedure:

The Alberta Infrastructure and Transportation 2007 Roadside Design Guide provides guiding principles for determining the requirement for roadside barrier systems and analysis of cost/benefit ratios.

Per the guidelines, roadside barriers are not recommended along curbed roadways, especially those with posted speeds of 60km/hr or greater. Barrier curb along roadways can cause a vehicle exiting the roadway to be projected upwards, resulting in the bumper of the vehicle being higher than the normal bumper height above the curb top. This higher trajectory may result in the

bumper of the vehicle not connecting with the barrier system, thus rendering it ineffective.

A further consideration is that barrier systems, especially those installed close to the traveled lanes can impede snow removal. Barrier systems such as W-beam guardrail or concrete barriers placed close to the traveled lanes can trap snow and prevent snow removal from the boulevard prolonging spring thaw and icing across the adjacent traveled lane.

Al-Terra completed the analysis for three options of barrier systems along Wye Road using Roadside Safety Analysis Program (RSAP) Version 2.0.3 which was developed under the Sponsorship of NCHRP Project 22-9 and is based on the same principles as the AIT Roadside Design Guide.

Assumptions:
The existing noise wall is modeled as a barrier. It was assumed that damage to a vehicle and/or occupant striking the noise wall would be equivalent to a vehicular impact with a concrete TL-2 barrier. Thus, the noise wall was input to the RSAP program as a concrete TL-2 barrier.

The cost to repair the noise wall was assumed at $10,000 per impact. At an estimated 2 impacts per year, the annual maintenance cost for the noise wall was input at $20,000.

Although there is no guarantee that the noise wall would not collapse, it was assumed that the noise wall will not fully collapse into adjacent residents property if impacted. Prior vehicular impacts with the wall have not initiated full collapse.

Analysis:
Three alternatives were evaluated.
In all three alternative streetlight poles are not included as they are standard in all three alternatives, 2.75m from traveled lane edge, installed on break away bases.

Alternative #1 – Do nothing.

This alternative evaluated the cost/benefit associated with widening Wye Road, without installing a barrier system.

Alternative #2 – Install cable system (TL-4) guardrail to protect the noise wall

This alternative evaluated the cost/benefit associated with widening Wye Road and installing a cable system barrier at 0.50m from the edge of the traveled lane. This is the location recommended in the Alberta Infrastructure and Transportation Roadside Design Guide. As well, installing the barrier system close to the traveled lane provides adequate separation between the barrier system and the

buried streetlighting cable / primary power. The analysis only included crash, repair costs and standard maintenance costs. It did not included any evaluation of difficulties arising from snow removal or risk associated with icing.

Alternative #3

This alternative evaluated the cost/benefit associated with widening Wye Road and installing a concrete barrier system (TL-2) 0.50m away from the noise wall. The concrete barrier system could be placed anywhere within the boulevard as it does not penetrate the ground, and would therefore not conflict with the buried streetlight cable / primary power. In this scenario, the barrier was placed close to the wall to facilitate snow removal and storage within the boulevard.

The results from the three alternatives are attached.

Conclusions and Recommendations:

The analysis shows that the greatest cost/benefit is achieved in Alternative #1 – Do nothing. The analysis shows that the fewest number of collision occur when the noise wall is unprotected; the farther away the obstacle is from the traveled lane edge, the fewer the number of accidents are likely to occur. Implementation of either the high tension cable barrier system or concrete barriers has high initial costs as well as increased maintenance costs each year because of the higher number of crashes.

The second best option would be to protect the noise wall with concrete barriers placed close to the wall. The concrete barriers provide better cost/benefit than the cable barrier system.

Based on the finding of the analysis we do not support the installation of a barrier system between the noise wall and the traveled lanes of Wye Road. Any barrier between the noise wall and Wye Road will increase the number of crashes per year, impede snow removal and result in increased project and maintenance costs to Strathcona County. Our recommendation is to implement Alternative #1 – Do nothing.

It should be noted that because a barrier system is currently in place, there may be public pressure to re-install a barrier system after the widening is complete. If public pressure or other influence instigates the installation of a barrier system an evaluation of the cost benefits specific to the various barrier systems as well as compliance with the Wye Road Beautification principles would be required.

Please call with any questions.

Sincerely,
Dana Leithead, P.Eng.
Al-Terra Engineering Ltd.

Enclosures.

1) April 14, 2008 email from Stuart Smith regarding structural stability of the noise wall
2) RSAP Benefit Cost Ratio Report – instructions for interpretation
3) April 21, 2008 RSAP Analysis Results of Wye Road Alternatives
   - Benefit/Cost Ratio Report
   - Alternative Cost Report
   - Feature Cost Report – Alternative #1
   - Feature Cost Report – Alternative #2
   - Feature Cost Report – Alternative #3
   - Input Data Report – Alternative #1
   - Input Data Report – Alternative #2
   - Input Data Report – Alternative #3
4) Capital Costs for Roadside/Median Barrier Systems
5) Applicable Reference Pages from the Alberta Infrastructure and Transportation Roadside Design Guide

Dana Leithead

From: Stuart Smith [stuart.smith@bptec-dnw.com]
Sent: Monday, April 14, 2008 11:34 AM
To: Dana Leithead
Subject: Re: Wye Road Noise Wall

Hi Dana
First off, there is NO WAY we can guarantee that the wall would not collapse if struck by a vehicle. The wall is for sound only and as far as we know , was not designed as a crash barrier. It is our opinion that if struck by a vehicle the wall would not totally collapse, but there is NO guarantee.
If the wall was struck and panels were damaged and removed, it would be some time before a replacement panel could be fabricated. I doubt that there are any replacement panels available for immediate use, so it could take a month or more to make new ones.

There should not be any problems with locating light poles next to the wall. The poles should not be placed next to the panel posts, rather they should go near the middle of the panel between posts.
Stuart

"Dana Leithead" <dleithead@al-terra.com> on April 14, 2008 at 11:04 AM -0700 wrote:
Hi Stuart,
We had talked about two weeks ago regarding whether or not the noise wall would fall over if a vehicle hit it, as well as whether dirt or planting could be placed against the wall.

We have completed the analysis of whether guard rail is required based on the assumption that the noise wall will not collapse and fall into the resident's back yard, potentially squashing their child or dog. Could you please confirm that this is the case? Some Strathcona County employees seem to recall that last time the wall was hit, there was panels missing for several weeks before they were replaced. Would this be because the panel was removed and then not re-installed promptly, or is it because the wall crumbled apart and fell into the resident's yard (suggested by Strathcona County)?

As well, we are proposing the light poles to be 1.0m from the noise wall. The light poles will be installed on breakaway bases. Other than damage to the wall if the light pole is broken off and hits the wall, can you think of any other problems (as pertaining to the noise wall) with installing the light poles in this location?

I look forward to hearing from you.
Thanks,
Dana Leithead, P.Eng.
Al-Terra Engineering Ltd.
Ph. (780) 440-4411
Fax (780) 440-2585

BENEFIT COST RATIO REPORT

The B/C RATIO report, an example of which is shown in Figure 39, is a one-page report, presenting the incremental benefit/cost (B/C) ratios associated with the alternatives in a tabular format. The following information is provided in B/C RATIO report:

- Date and time of the report.
- Project identification, including the file name and project description.
- Alternatives and descriptions
- Table showing the pairwise B/C ratios among the alternatives.

The number at row 1 and column 2 is the B/C ratio of Alternative 2 to Alternative 1. Similarly, the B/C ratio of Alternative 3 to Alternative 1 is the number at row 1 and column 3 and the B/C ratio of Alternative 3 to Alternative 2 is the number at row 2 and column 3. Note that the numbering of the rows and columns may not always be sequential, i.e., 1, 2, 3, etc., but can be out of order, e.g., 1, 3 and 2. The reason is that, other than Alternative 1, which must have the lowest direct cost, the other alternatives are automatically arranged in ascending order of direct costs. This assures that the denominator of the B/C ratio will always be positive.

Also, note that the B/C ratio may be positive or negative. The B/C ratio is the ratio of benefits, measured in terms of reduction in crash costs, over costs, which are the direct costs associated with the safety improvement. The denominator, direct costs, is purposely kept positive by arranging the alternatives in an ascending order of direct costs. The sign of the B/C ratio is, therefore, a function of the benefits. If the benefits are positive, i.e., a reduction in crash costs, the B/C ratio is positive. If the benefits are negative, i.e., an increase in crash costs, the B/C ratio is negative. Needless to say, a safety improvement with a negative B/C ratio is not a prime candidate for implementation.

It should be emphasized that the B/C ratios by themselves could be misleading. For example, if the difference in direct costs between two alternatives is very small, any change in the benefits could result in a huge swing in the B/C ratio. Users should also examine the crash and direct costs for the individual alternatives and features to make sure that the B/C ratio is not an artifact of some other factors.

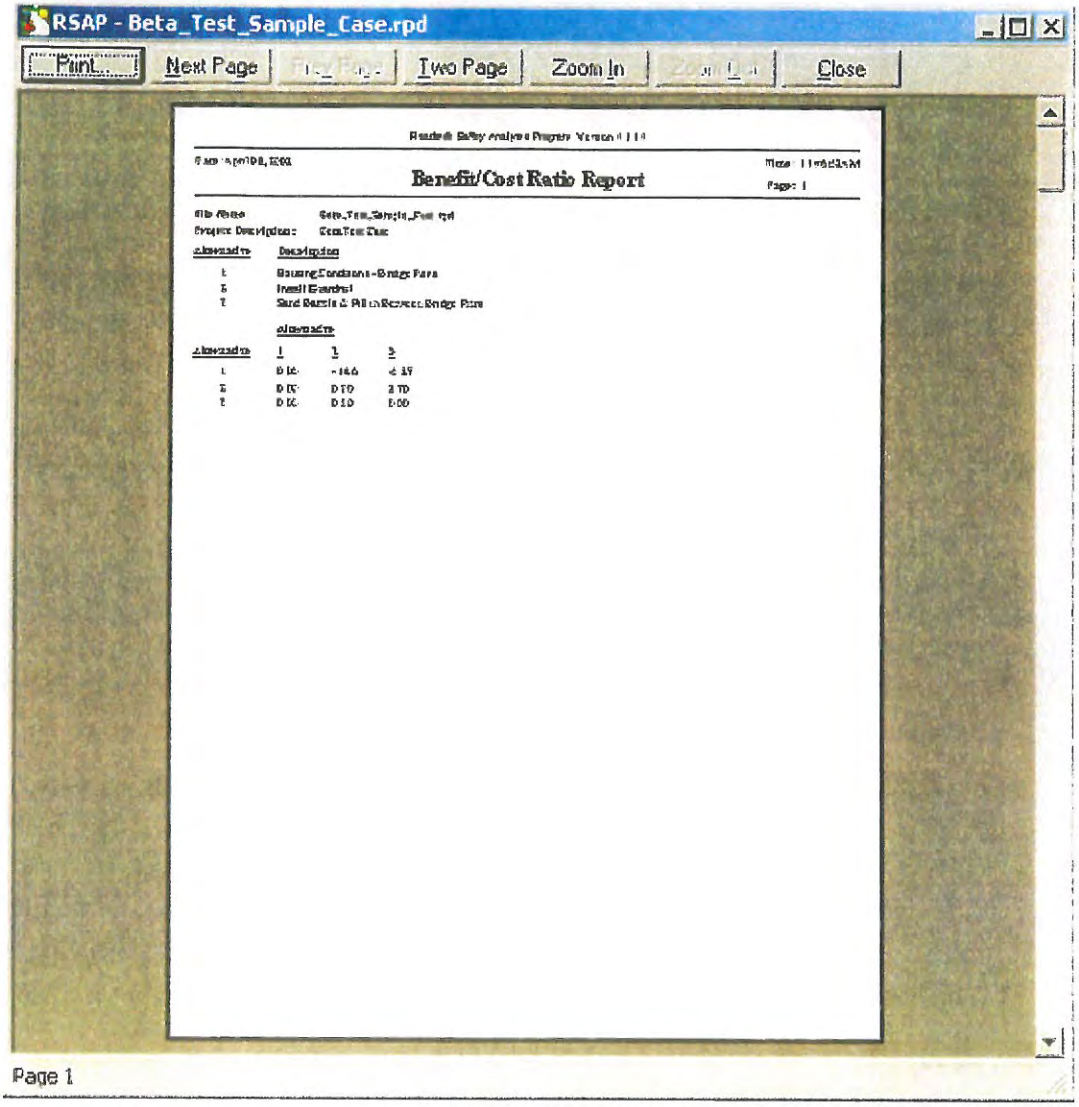


Figure 38. BENEFIT COST RATIO Report

Date: April 21, 2008

Time: 17:38:24PM

Benefit/Cost Ratio Report

File Name: noise wall opt3.rpd

Project Description: Wye Road Noise Wall

Alternative	Description
1	No action
2	Add High Tension Cable Barrier to protect noise wall
3	Concrete Barrier to Protect Wall

	Alternative		
Alternative	2	1	3
2	0.00	4.88	2.85
1	0.00	0.00	-5.31
3	0.00	0.00	0.00

Date: April 21, 2008

Time: 17:38:24PM

Alternative Cost Report

Name: noise wall opt3.rpd

Project Description: Wye Road Noise Wall

Alternative	Description
1	No action
2	Add High Tension Cable Barrier to protect noise wall
3	Concrete Barrier to Protect Wall

Alternative	Expected Crash Frequency (Acc/Yr)	Annual Crash Cost ($)	Annual Installation Cost ($)	Annual Maintenance Cost ($)	Annual Repair Cost ($)
1	1.944041	99122.60	0.00	20000.00	38.44
2	3.562255	137529.50	7873.47	500.00	3795.61
3	2.657559	109541.38	20803.89	500.00	697.34

Date: April 21, 200[illegible]

Feature Cost Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative: 1
Description: No action

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
1	0.0	1.944041	2.24	99122.60	Longitudinal Barriers	TL-2 Portable Concrete Barrier

Feature Cost Report

File Name: noise wall opt3.rpd

Project Description: Wye Road Noise Wall

Alternative: 2

Description: **Add High Tension Cable Barrier to protect noise wall**

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
.1	0.0	0.257315	2.72	738.29	User-Defined Feature	Noise Wall
.1	25.0	0.022914	2.28	2077.33	Longitudinal Barriers	TL-4 Guardrail
.1	32.0	3.268319	2.22	134555.41	Longitudinal Barriers	TL-4 Guardrail
.1	992.0	0.013707	0.53	158.48	Longitudinal Barriers	TL-4 Guardrail

Date: April 21, 2008

Feature Cost Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative: 3
Description: **Concrete Barrier to Protect Wall**

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
.1	0.0	0.653462	2.74	628.63	User-Defined Feature	Noise Wall
.1	25.0	0.003351	2.13	131.35	User-Defined Feature	Concrete barrier Flared and tapered Down End Treatment
.1	27.0	2.000746	2.23	108781.41	Longitudinal Barriers	TL-2 Portable Concrete Barrier

Date: April 21, 2008

Time: 17:38:24PM

Input Data Report

Fi ame: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternavtive 1[Baseline(Existing)Condition]

Description	No action
Life(years)	25
Total Installation Cost ($)	0.00
Annual Maintenance Cost ($)	20000.00
Discount Rate	4.00
Area Type	Urban
Functional Class	Principal Arterial
Highway Type	Two-Way, Divided
Number of Lanes	6
Lane Width(m)	3.5
Right Shoulder Width(m)	0.3
Left Shoulder Width(m)	0.3
Speed Limit(km/h)	70.0
Nominal Percent Truck(%)	2.0
ADT	35000
Traffic Growth Factor(%)	1.1
Encroachment Rate Adjustment Factor	1
Random Seed Number	12987000 (User Specified)

Segment	Length(m)	Median Width(m)	Percent Grade(%)	Curvature Direction	Curvature Radius(m)
1	1000.0	5.5	1.5	None	

Date: April 21, 20

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 1 [Baseline(Existing) Conditions]

Feature	Category	Type
1	Longitudinal Barriers	TL-2 Portable Concrete Barrier

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 1 [Baseline(Existing) Conditions]

Feature	Length(m)	Width(m)	Flare Rate	Location	Offset(m)	Distance(m)	Repetitions	Spacing(m)
1	1000.0	1.0	0.000	Right	3.3	0.0		

Date: April 21, 2008

Input Data Report

Fi ame: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternavtive 2

Description	Add High Tension Cable Barrier to protect noise wall
Life(years)	25
Total Installation Cost ($)	123000.00
Annual Maintenance Cost ($)	500.00
Discount Rate	4.00
Area Type	Urban
Functional Class	Principal Arterial
Highway Type	Two-Way, Divided
Number of Lanes	6
Lane Width(m)	3.5
Right Shoulder Width(m)	0.3
Left Shoulder Width(m)	0.3
Speed Limit(km/h)	70.0
Nominal Percent Truck(%)	2.0
ADT	35000
Traffic Growth Factor(%)	1.1
Encroachment Rate Adjustment Factor	1
Random Seed Number	12987000 (User Specified)

Segment	Length(m)	Median Width(m)	Percent Grade(%)	Curvature Direction	Curvature Radius(m)
1	1000.0	5.5	1.5	None	

Date: April 21, 20

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 2

Feature	Category	Type
1	User-Defined Feature	Noise Wall
2	Longitudinal Barriers	TL-4 Guardrail
3	Longitudinal Barriers	TL-4 Guardrail
4	Longitudinal Barriers	TL-4 Guardrail

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 2

Feature	Length(m)	Width(m)	Flare Rate	Location	Offset(m)	Distance(m)	Repetitions	Spacing(m)
1	1000.0	1.0	0.000	Right	3.3	0.0		
2	8.0	0.3	0.000	Right	0.5	25.0		
3	967.0	0.3	0.000	Right	0.5	32.0		
4	8.0	0.3	0.000	Right	0.5	992.0		

Date: April 21, 2008

Time: 17:38:24PM

Input Data Report

Fi ıme: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternavtive 3

Description	Concrete Barrier to Protect Wall
Life(years)	25
Total Installation Cost ($)	325000.00
Annual Maintenance Cost ($)	500.00
Discount Rate	4.00
Area Type	Urban
Functional Class	Principal Arterial
Highway Type	Two-Way, Divided
Number of Lanes	6
Lane Width(m)	3.5
Right Shoulder Width(m)	0.3
Left Shoulder Width(m)	0.3
Speed Limit(km/h)	70.0
Nominal Percent Truck(%)	2.0
ADT	35000
Traffic Growth Factor(%)	1.1
Encroachment Rate Adjustment Factor	1
Random Seed Number	12987000 (User Specified)

Segment	Length(m)	Median Width(m)	Percent Grade(%)	Curvature Direction	Curvature Radius(m)
1	1000.0	5.5	1.5	None	

Date: April 21, 20

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 3

Feature	Category	Type
1	User-Defined Feature	Noise Wall
2	User-Defined Feature	Concrete barrier Flared and tapered Down End Treatment
3	Longitudinal Barriers	TL-2 Portable Concrete Barrier

Date: April 21, 20

Time: 17:38:24PM

Input Data Report

File Name: noise wall opt3.rpd
Project Description: Wye Road Noise Wall

Alternative 3

Feature	Length(m)	Width(m)	Flare Rate	Location	Offset(m)	Distance(m)	Repetitions	Spacing(m)
1	1000.0	1.0	0.000	Right	3.3	0.0		
2	2.0	0.6	0.000	Right	2.5	25.0		
3	973.0	0.6	0.000	Right	2.5	27.0		

Capital Costs for Roadside/Median Barrier Systems

The following basic costs for different roadside barrier systems were developed for use with Alberta Infrastructure and Transportation's new Roadside Design Guide. These costs can be used by designers to compare costs and to do cost-benefit-analysis of different roadside barrier systems, and for budget purposes.

The costs are presented in two sets of tables (one set for post-mounted barrier systems and one set for concrete barrier systems). The tables show a base cost per metre and modification cost for site/job specific features such as soil condition, short-runs and remoteness of location. Separate costs are provided for end treatments of the different barrier systems.

The costs were determined using both average unit prices from past contracts and cost estimates provided by contractors specializing in the installation of barrier systems. For the post-mounted systems, a contractor provided current (2007 dollars) estimates for the four post-mounted barrier systems. For the weak post W-beam and the strong post W-beam, there was sufficient AIT contract unit price data to compare with the estimate received from the contractor. Allowing for inflation, the contractor estimated unit price is fairly consistent with the contract unit price data. For the Modified Thrie beam and High Tension Cable Systems, there was practically no AIT contract unit price data. The contractor's estimates for these systems were compared with some earlier estimates of these systems and a discussion was carried with a contractor that recently installed a High Tension Cable System. Using a combination of this information and data received, unit prices were arrived at for the Modified Thrie Beam and High Tension Cable Systems.

For the concrete barrier systems, a contractor specializing in installation of concrete barriers provided current (2007 dollars) estimate for six concrete barrier systems (two pre-cast and four slip-formed shapes). Recent AIT contract unit price data on concrete barrier was very limited. However, there was some older contract data on the F-Shape Barrier. This information was adjusted for inflation to 2007 dollars and compared to the contractor's estimate for the F-Shape Barrier. Using a combination of contractor's and AIT's unit price contract data, unit cost were arrived at for the F-Shape Barrier. The unit costs for the other shapes were adjusted to be proportional to the prices received from the contractor.

These unit costs are believed to be relatively accurate for comparison of the different systems and for cost-benefit analysis. These costs should be revised as more contract price data become available on future projects.

Capital Cost Comparison of Alterative POST-MOUNTED Barrier Systems for use on Alberta Transportation Projects (Pricing in 2007 dollars)

Barrier System:	**Weak Post W-Beam** Barrier	**Strong Post W-Beam** Barrier		**Modified Thrie Beam** Barrier		**High Tension Cable** Barrier
Drawing Reference:	*(TEB-3.12)*	*(TEB-3.09)*	*(no RDG dwg)*	*(TEB 3.70)*	*(no RDG dwg)*	*(See note 3)*
Application[2]:	Roadside	Roadside	Median	Roadside	Median	Roadside/Median
NCHRP Report 350 Test Level:	TL - 3	TL - 3	TL - 3	TL - 4	TL - 4	TL - 4 system
Base Rate[1]:	**$ 90/ m**	**$ 135/ m**	**$165/ m**	**$ 225/ m**	**$300/ m**	**$ 110/ m**[4]
Premium for Rocky Soil Conditions	*add $20/ m*	*add $30/ m*	*add $30/ m*	*add $30/ m*	*add $30/ m*	*add $30/ m*
Premium for Short Run (less than 200 m of barrier)	*add $25/ m*	*add $35/ m*	*add $35/ m*	*add $45/ m*	*add $45/ m*	*add $65/ m*
Premium for Semi-Remote Installation (based on 4 hour commute one-way)	*add $10/ m*	*add $10/ m*	*add $10/ m*	*add $10/ m*	*add $10/ m*	*add $10/ m*
Premium for Remote Installation (based on 6 hour commute one-way)	*add $15/ m*	*add $15/ m*	*add $15/ m*	*add $15/ m*	*add $15/ m*	*add $15/ m*

[1]Note: "Base Rate" is based on the following conditions:
- Barrier system installed in engineered backfill material (granular base course) along edge of pavement.
- Pavement road structure already in place.
- Runs of at least 200 m in length.
- Installation site within a 2 hour commute from Contractor's office/yard (one-way travel).
- Cost of barrier end treatments (such as energy or non-energy barrier terminal) not included.
-Traffic Accommodation not included.

[2]Note: Roadside application is an application where the barrier is intended for impact from one side only. On divided highways, these barriers are normally used on the right side of the roadway or on the left (median) side of the roadway for wide medians where the barrier is located outside of the clear zone for opposing direction of traffic.

Median application is an application where the barrier is intended for impact from both sides. These barriers are normally used for application on the median side of divided highways with narrow medians. For Strong Post W-Beam and Thrie Beam barriers, a median application has guardrail on both sides of the post.

[3]Note: AIT has currently approved the following three proprietary High Tension Cable Barrier Systems for use on Alberta highways: 1) Brifen, 2) Gibraltar, and 3) Trinity CASS. Drawings may be downloaded from the proprietor's website.

[4]Note: AIT has tendered one 10 km long job for a High Tension Cable System. The price for this job was $61.25/m plus $20,000 per end anchor. However, this price is not considered typical.

Capital Cost Comparison of Alterative End Treatments for POST-MOUNTED Barriers for use on Alberta Transportation Projects
(Pricing in 2007 dollars)

	Non-Energy Absorbing End Treatments		
End Treatment:	**W-Beam Cable Anchor[3]**	**Thrie Beam Cable Anchor[3]**	**High Tension Cable End**
Barrier System:	(W-Beam Barrier)	(Thrie Beam Barrier)	(High Tension Cable Barrier)
Drawing Reference:	*(RDG-B1.1)*	*(RDG-B5.1)*	*(Refer to Proprietor's Dwgs)*
Application[2]:	Roadside/Median	Roadside/Median	Roadside/Median
NCHRP Report 350 Test Level:	N/A	N/A	TL-3
Base Rate[1] (Per End):	**$2,500**	**$3,500**	**$6,500**

	Energy Absorbing End Treatments[4]					
End Treatment:	**ET PLUS / ET 2000**	**FLEAT 350**	**FLEAT MT**	**SKT 350**	**CAT 350**	**Thrie Beam Bullnose**
Barrier System:	(W-Beam Barrier)	(W-Beam Barrier)	(W-Beam Barrier)	(W-Beam Barrier)	(W-Beam Barrier)	(Thrie Beam Barrier)
Drawing Reference:	*(RDG-B1.4)*	*(RDG-B1.5)*	*(RDG-B1.6)*	*(see note 5)*	*(RDG-B1.7)*	*(TEB-3.60 sheets 1 to 9)*
Application[2]:	Roadside	Roadside	Median	Roadside	Roadside/Median	Roadside/Median
NCHRP Report 350 Test Level:	TL-3	TL-3	TL-3	TL-3	TL-3	TL-3
Base Rate[1] (Per End):	**$6,500**	**$6,500**	**$7,900**	**$8,500**	**$16,500**	**$15,000**

[1]Note: "Base Rate" is based on the following conditions:
- Pavement road structure already in place.
- Installation site within a 2 hour commute from Contractor's office/yard (one-way travel).
- The contractor who installed the barrier system is the same contractor installing the barrier end treatment.
- Therefore, premium for travel cost to remote and semi-remote locations covered in premium for barrier installation.
- Traffic Accommodation cost not included.

[2]Note: Roadside application is an application where the barrier is intended for impact from one side only. On divided highways, these barriers are normally used on the right side of the roadway or on the left (median) side of the roadway for wide medians where the barrier is located outside of the clear zone for opposing direction of traffic.

Median application is an application where the barrier is intended for impact from both sides. These barriers are normally used for application on the median side of divided highways with narrow medians. For Strong Post W-Beam and Thrie Beam barriers, a median application has guardrail on both sides of the post.

[3]Note: For use on the leaving end of a W-Beam/Thrie Beam barrier only or on the approach end when installed at or beyond the clear zone.

[4]Note: For use on the approach end of a W-Beam/Thrie Beam barrier when installed inside the clear zone.

[5]Note: Details of the Sequential Kinking Terminal (SKT) are available on the proprietor's website for Road Systems, Inc.

Capital Cost Comparison of Alterative CONCRETE Barrier Systems for use on Alberta Transportation Projects
(Pricing in 2007 dollars)

Barrier System:	**PRECAST** Concrete **"F-Shape"** Barrier (810 mm high)	**PRECAST** Concrete **"Single Slope"** Barrier (910 mm high)	**Slip-Formed** Concrete **"F-Shape"** Barrier (810 mm high)	**Slip-Formed** Concrete **"Single Slope"** Barrier (900 mm high)	**Slip-Formed** Concrete **"Tall Wall"** Barrier (1050 mm high)
Drawing Reference:	*(CB6-4.2M16)*	*(see note 3)*	*(CB6-4.3M3)*	*(RDG-B6.1)*	*(see note 4)*
Application[2]:	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median
NCHRP Report 350 Test Level:	TL - 3	TL - 3	TL - 4	TL - 4	TL - 5
Base Rate[1&5]:	**$ 335/ m**	**$ 375/ m**	**$ 275/ m**	**$ 310/ m**	**$ 345/ m**
Premium for Short Run (less than 200 m of barrier)	*add $30/ m*	*add $30/ m*	*add $120/ m*	*add $120/ m*	*add $120/ m*
Premium for Semi-Remote Installation (based on 4 hour commute one-way)	*add $25/ m*	*add $30/ m*	*add $25/ m*	*add $30/ m*	*add $35/ m*
Premium for Remote Installation (based on 6 hour commute one-way)	*add $40/ m*	*add $45/ m*	*add $40/ m*	*add $45/ m*	*add $55/ m*

[1]Note: "Base Rate" is based on the following conditions:
- Pre-grading already in place. Barriers supported on existing granular base course of road structure or placed directly on the finished wearing surface.
- Runs of at least 200 m in length.
- Installation site within a 2 hour commute from Contractor's office/yard (one-way travel).
- Cost of barrier end treatments (such as tapered end or crash cushion) not included.
- Traffic Accommodation not included.
- Cost does not include initial cost of forms.

[2]Note: Roadside application is an application where the barrier is intended for impact from one side only. On divided highways, these barriers are normally used on the right side of the roadway or on the left (median) side of the roadway for wide medians where the barrier is located outside of the clear zone for opposing direction of traffic.

Median application is an application where the barrier is intended for impact from both sides. These barriers are normally used for application on the median side of divided highways with narrow medians. For Strong Post W-Beam and Thrie Beam barriers, a median application has guardrail on both sides of the post.

[3]Note: Alberta Infrastructure and Tranpsortation does not currently have a typical barrier drawing for the precast concrete single slope barrier. Details of this portable barrier may be found on the California Department of Transportation website under the standard plan titled "Portable Concrete Barrier (Type 60K)". This reinforced barrier comes in 4.0 m long precast segments 'connected together using two 31.8 mm diameter steel pins 760 mm long at each joint. The FHWA has approved this barrier as meeting the requirements of TL - 3.

[4]Note: The Tall Wall barrier was developed by the Ministry of Transportation of Ontario (MTO) and has been approved by the FHWA as meeting the requirements of TL - 5. Details of this unreinforced barrier are available on the MTO's website as standard drawing OPSD-911.132 Type TW.

[5]Note: Consideration should be given to the lower maintenance cost of concrete barrier systems when evaluating life cycle costing.

Capital Cost Comparison of Alterative End Treatments for CONCRETE Barriers[3] for use on Alberta Transportation Projects
(Pricing in 2007 dollars)

Energy Absorbing End Treatments[4]

End Treatment:	QuadTrend 350	Quadguard CZ	Quadguard HS/Elite	Quadguard LMC	TRACC	TAU II	CAT 350	Sand Barrel System
Drawing Reference:	*(RDG-B6.9)*	*(RDG-B6.9)*	*(RDG-B6.9)*	*(RDG-B6.9)*	*(RDG-B6.8)*	*(no RDG dwg)*	*(RDG-B1.7 & RDG-B6.12)*	*(TEB-3.19)*
Application[2]:	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median	Roadside/Median
RP Report 350 Test Level:	TL - 3	TL - 3	TL - 3	TL - 3	TL - 3	TL - 3	TL - 3	TL - 3
Base Rate[1](Per End):	**$24,000**	**$56,000**	**$73,000**	**$116,000**	**$57,500**	**$41,300**	**$16,500**	**$11,500**

[1]Note: "Base Rate" is based on the following conditions:
- Installation is for the end of a concrete **median** barrier.
- Pre-grading of granular base course of road structure already in place.
- Installation site within a 2 hour commute from Contractor's office/yard (one-way travel).
- The contractor who installed the barrier system is the same contractor installing the barrier end treatment.
- Therefore, premium for travel cost to remote and semi-remote locations covered in premium for barrier installation.
- Traffic Accommodation cost not included.
- Test level ratings greater than TL-3 are available for some energy absorbing end treatments. Refer to proprietor drawings.

[2]Note: Roadside application is an application where the barrier is intended for impact from one side only. On divided highways, these barriers are normally used on the right side of the roadway or on the left (median) side of the roadway for wide medians where the barrier is located outside of the clear zone for opposing direction of traffic.

Median application is an application where the barrier is intended for impact from both sides. These barriers are normally used for application on the median side of divided highways with narrow medians. For Strong Post W-Beam and Thrie Beam barriers, a median application has guardrail on both sides of the post.

[3]Note: Roadside concrete barriers may be terminated using post-mounted energy absorbing barrier end treatments if a transition to a Thrie Beam and then a Strong Post W-beam is provided. Refer to drawings RDG-B6.12, RDG-B6.13 and RDG-B6.15.

[4]Note: For use on the approach end of a concrete barrier system. Concrete barriers may be terminated with a blunt end on the leaving end for roadside applications. Terminating with a blunt end on the leaving end may also be used for median applications when installed at or beyond the clear zone for the opposing direction of traffic.

For the selection of the appropriate barrier systems, refer to **Section H3.2.3.1.**

Table H5.1 provides a summary of the key dimensions and characteristics of barrier systems used on Alberta highways:

TABLE H5.1 Roadside Barrier Systems Characteristics Summary

Barrier System	Post Type	Category	NCHRP Report 350 Test Level	Design Deflection (m)	Minimum System Length (m)
High Tension Cable System	Steel Post	Flexible	TL-4	Depends on post spacing and choice of system, refer to manufacturer's information (2.1 to 2.4)	Refer to manufacturer's information (varies up to 35 m)
Alberta Weak Post W-Beam[1]	Plastic or Wood	Flexible	N/A	2.5	22.86 (≤ 70 km/h)[1] 45.72 (≥ 80 km/h)[1]
Weak Post Box Beam	Steel Post	Semi-Rigid	TL-3	1.5	100
Strong Post W-Beam	Plastic Post	Semi-Rigid	TL-3	1.5	50
	Wood or Steel Post	Semi-Rigid	TL-3	0.9	50
Standard Thrie Beam	Steel Post	Semi-Rigid	TL-3	0.6	50
Modified Thrie Beam	Steel Post	Semi-Rigid	TL-4	0.9	50
Precast Concrete Barrier – F-Shape or other approved shape (Temporary installation or special purpose permanent)	N/A	Semi-Rigid (must use crash tested joint between units)	TL-3	0.075 to 1.8	45
Cast-in-place or Extruded Concrete Barrier	N/A	Rigid	TL-4 or TL-5	0.0	30

[1] Minimum length for weak post w-beam does not include length of end treatments. The corresponding speeds are based on design speed.

Drawings for approved roadside barrier systems, including transition information, are provided in **Appendix B** of this guide.

Consult the recommended products list to confirm that the selected end treatments may be used in Alberta. The recommended products list may be accessed on INFTRA's website.

mitigation measures cannot be made to work.

The Length of Need and the selection of the appropriate longitudinal traffic barrier system, end treatments, and crash cushions need to be determined to shield the hazard properly.

H3.2.3.1 Longitudinal Traffic Barrier System Selection

The choice of longitudinal traffic barrier system is generally governed by the traffic volume (AADT), traffic speed (posted and/or design), facility type, and design deflection requirements (working area of the system). Other considerations include the stiffness required for connections to other features (such as bridges and retaining walls), severity of the hazard, aesthetics, special maintenance conditions (such as prevailing snow drifting problems) and other constraints or considerations.

All longitudinal traffic barrier systems must meet the test levels as specified in *NCHRP Report 350*. The six *NCHRP Report 350* performance test levels (TL-1 to TL-6) are discussed in **Section H1.3**.

The following table provides the minimum test level requirements for longitudinal traffic barriers:

TABLE H3.3
Barrier Test Level Requirements

Design Speed (km/h)	Test Level
> 70	TL-3
> 50 to ≤ 70	TL-2
≤ 50	TL-1

Test Level TL-3 is the basic level of performance desired for roadside hardware. Lower test levels are generally cost-effective for lower speed, lower volume highways. Higher test levels (TL-4, TL-5, or TL-6) are desirable for median applications and where the hazard is very severe and/or the exposure is very high.

Longitudinal traffic barrier systems that are more forgiving are preferred because they may reduce injuries and fatalities when crashes occur, provided that suitable operating space is, or can be made, available.

In general, the longitudinal traffic barrier systems listed below may be used on Alberta highways. The list is presented in order of most forgiving to the most rigid and indicates the *NCHRP Report 350* test level (TL):

- High Tension Cable System* (TL-4)
- Alberta Weak Post W-Beam** (Not tested under *NCHRP Report 350*, but assumed to be functionally equivalent to TL-3)
- Weak Post Box Beam (TL-3)
- Strong Post W-Beam with Plastic posts (TL-3)
- Strong Post W-Beam with Wood or Steel posts (TL-3)
- Modified Thrie Beam (TL-4)
- Precast Single Slope or F-Shape Concrete Barrier (TL-3)
- Cast-in-place or extruded F-Shape or Single Slope Concrete Barrier (TL-4 or TL-5).

* At the time of writing, "High Tension Cable Barrier" systems are considered "Introductory" by INFTRA because their use on Alberta highways has just commenced. Products are normally evaluated under in-service conditions for a period of two years prior to being accepted as "Approved Products". Consequently, although this product may be identified as the preferred product for many applications, permission to use it must still be obtained from INFTRA.

** The Alberta Weak Post W-Beam system has exhibited satisfactory in-service performance over many years and will continue to be used, where appropriate.

The New Jersey Concrete Barrier (TL-4) may only be used when connecting to or replacing a small segment of existing New Jersey Concrete Barrier.

recent investigation of the safety implications of combining curbs with adjacent longitudinal W-Beam Strong Post traffic barrier systems.

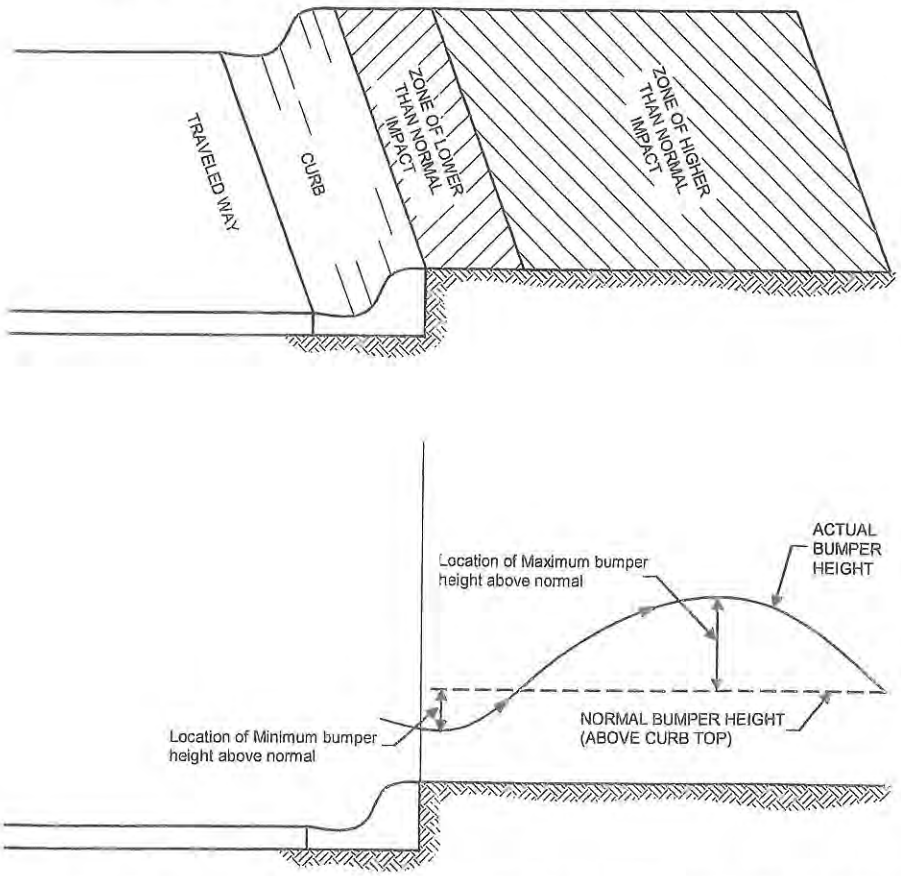
The primary goal of the study was to develop design guidelines for using curbs and curb–barrier combinations on highways with operating speeds greater than 60 km/h.

From this study, the trajectory of the vehicle after contact with the curb was determined.

Figure H4.1 illustrates the vehicle trajectory based on the bumper height of the vehicle.

In general, a barrier curb should not be installed on highways with posted speeds greater than 60 km/h. For a curb installation in an area with posted speeds greater than 60 km/h, use a mountable curb.

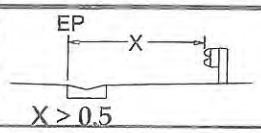
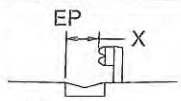
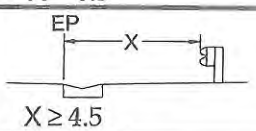
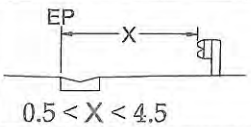
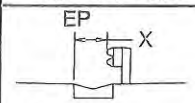
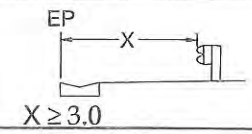
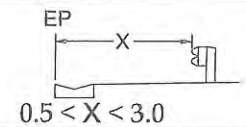
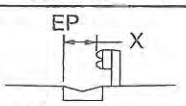
FIGURE H4.1 Vehicle Trajectory after Contact with Curb



Standard drawings for typical curbs used in Alberta are provided on the INFTRA website under the Highway Design & Construction subsection of the Technical Resources for Roads, Bridges, & Water section.

Acceptable combinations of curb and barrier systems are dependent on the design speed of the highway, the cross-sectional shape of the curb, and the lateral offset of the curb from the barrier system. The desirable combinations of curb and barrier systems based on design speed and lateral offset, adapted from *NCHRP Report 537*, are shown in **Table H4.1**.

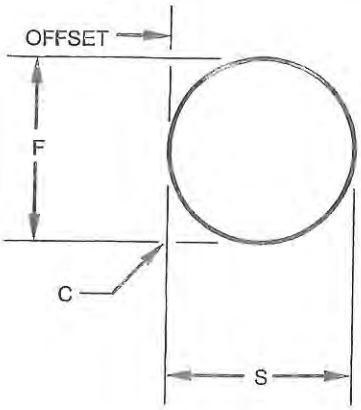
TABLE H4.1 Appropriate Curb and Barrier System Combinations (Barrier System Behind Curb)

Posted Speed (km/h) [4]	Allowable Offsets to Barrier Systems (m)	Acceptable Curb Types	Barrier Systems [1]					
			Cable	W-Beam Weak Post	Weak Post Box Beam	W-Beam Strong Post	Modified Thrie Beam	Concrete Barrier
> 100	Any Offsets	Mountable	Installation of curb in conjunction with barrier system not recommended.					
		Semi-mountable						
		Barrier						
> 85 to 100	 X > 0.5	Mountable	Installation of curb in conjunction with barrier system not recommended.					
		Semi-mountable						
		Barrier						
	 X = 0.5	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	×	×	×	×	×	×
		Barrier	×	×	×	×	×	×
> 70 to 85	 X ≥ 4.5	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	✓	✓	✓	✓	✓	×
		Barrier	×	×	×	×	×	×
	 0.5 < X < 4.5	Mountable	Installation of curb in conjunction with barrier system not recommended.					
		Semi-mountable						
		Barrier						
	 X = 0.5	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	×	×	×	×	×	×
		Barrier	×	×	×	×	×	×
> 60 to 70	 X ≥ 3.0	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	✓	✓	✓	✓	✓	×
		Barrier	×	×	×	×	×	×
	 0.5 < X < 3.0	Mountable	Installation of curb in conjunction with barrier system not recommended.					
		Semi-mountable						
		Barrier						
	 X = 0.5	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	×	×	×	×	×	×
		Barrier	×	×	×	×	×	×
≤ 60	No Restriction	Mountable	✓	✓	✓	✓	✓	✓
		Semi-mountable	✓	✓	✓	✓	✓	×
		Barrier	✓	✓	✓	✓	✓	×

Note: (1) Excludes application of barrier curbs on structures
(2) EP = Edge of Driving Lane
(3) Adopted from *NCHRP Report 537*
(4) For posted speeds greater than 70 km/h, the suggested minimum offset between the edge of travelled lane and the face of curb is the shy line offset as described in **Section H5.4.1.**

✓ Permitted
× Not Permitted

TABLE HA.9 Suggested Severity Indices
Fixed Objects

Object Type and Characteristics		Object Surface (*)	Severity Index							
			Design Speed – km/h							
			50	60	70	80	90	100	110	120
Round Fixed Object: 	Diameter equal to 0.5 m	S	3.0	3.4	3.8	4.3	4.8	5.4	6.0	6.5
		C	3.4	3.8	4.2	4.7	5.2	5.8	6.5	7.2
		F	2.6	3.0	3.4	3.9	4.4	4.9	5.3	5.7
	Diameter equal to 1 m	S	2.8	3.3	3.8	4.3	4.8	5.3	5.9	6.4
		C	3.3	3.7	4.1	4.6	5.1	5.7	6.4	7.1
		F	2.5	2.9	3.3	3.8	4.3	4.7	5.0	5.3
	Diameter equal to or greater than 2 m	S	2.7	3.2	3.7	4.2	4.7	5.3	5.9	6.4
		C	3.2	3.6	4.0	4.5	5.0	5.6	6.3	7.0
		F	2.6	2.9	3.3	3.7	4.2	4.7	5.2	5.7
Rectangular Fixed Object: Width of approach side equal to 0.5m Face parallel to roadway, sides are perpendicular.	Height = 0.15 m	S	0.2	0.3	0.5	0.6	0.7	0.8	0.9	0.9
		C	0.2	0.3	0.5	0.6	0.7	0.8	0.9	0.9
		F	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.5
	Height = 0.3 m	S	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		C	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height = 0.5 m	S	3.2	3.6	4.0	4.5	5.1	5.7	6.3	6.8
		C	3.2	3.6	4.0	4.5	5.1	5.7	6.3	6.8
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height = 0.6 m	S	3.4	3.8	4.2	4.7	5.2	5.8	6.5	7.2
		C	3.4	3.8	4.2	4.7	5.2	5.8	6.5	7.2
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height > 1.0 m	S	3.4	3.9	4.4	4.9	5.4	6.0	6.7	7.4
		C	3.4	3.9	4.4	4.9	5.4	6.0	6.7	7.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2

* S = Approach Side, C = Corner, F= Traffic Face, A = S, C, and F

TABLE HA.9 Suggested Severity Indices
Fixed Objects (continued)

Object Type and Characteristics		Object Surface (*)	Severity Index							
			Design Speed – km/h							
			50	60	70	80	90	100	110	120
Rectangular Fixed Object: Width of approach side is 1.25 m. Face is parallel to roadway, sides are perpendicular.	Height = 0.15 m	S	0.5	0.6	0.8	0.9	1.1	1.3	1.5	1.8
		C	0.5	0.6	0.8	0.9	1.1	1.3	1.5	1.8
		F	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.5
	Height = 0.3 m	S	2.6	3.2	3.7	4.3	4.8	5.3	5.8	6.3
		C	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height = 0.5 m	S	3.0	3.5	4.0	4.5	5.0	5.6	6.2	6.7
		C	3.2	3.6	4.0	4.5	5.1	5.7	6.3	6.8
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height = 0.6 m	S	3.1	3.6	4.1	4.6	5.1	5.7	6.4	7.1
		C	3.4	3.8	4.2	4.7	5.2	5.8	6.5	7.2
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
	Height > 1.0 m	S	3.3	3.8	4.3	4.8	5.3	5.9	6.6	7.3
		C	3.4	3.9	4.4	4.9	5.4	6.0	6.7	7.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.2
Rectangular Fixed Object: Width of approach side is 2 m or greater. Face is parallel to traffic and sides are perpendicular.	Height = 0.15 m	S	0.5	0.7	0.9	1.1	1.3	1.6	1.9	2.2
		C	0.5	0.7	0.9	1.1	1.3	1.6	1.9	2.2
		F	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.5
	Height = 0.3 m	S	2.5	3.1	3.6	4.2	4.7	5.3	5.8	6.3
		C	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	3.0	3.3
	Height = 0.5 m	S	2.9	3.4	3.9	4.4	4.9	5.5	6.1	6.6
		C	3.2	3.6	4.0	4.5	5.1	5.7	6.3	6.8
		F	1.9	2.0	2.2	2.3	2.5	2.7	3.0	3.3
	Height = 0.6 m	S	2.8	3.4	4.1	4.7	5.1	5.6	6.3	7.0
		C	3.5	3.8	4.2	4.6	5.2	5.8	6.5	7.2
		F	1.9	2.0	2.2	2.3	2.5	2.7	3.0	3.3
	Height > 1.0 m	S	3.2	3.7	4.2	4.7	5.2	5.8	6.5	7.2
		C	3.4	3.9	4.4	4.9	5.4	6.0	6.7	7.4
		F	1.9	2.0	2.2	2.3	2.5	2.7	2.9	3.3

* S = Approach Side, C = Corner, F= Traffic Face, A = S, C, and F

TABLE HA.3 Suggested Severity Indices
Backslopes (continued)

Object Type and Characteristics			Object Surface	Severity Index, SI							
Slope (H:V)	Height (m)	Surface Condition		Design Speed – km/h							
				50	60	70	80	90	100	110	120
Backslope Vertical (cont.)	0.6	A	F	0.7	1.0	1.3	1.6	2.0	2.4	3.0	3.7
		B	F	1.1	1.4	1.7	2.0	2.3	2.7	3.3	4.0
		C	F	1.6	1.9	2.2	2.5	2.8	3.2	3.8	4.3
		D	F	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		E	F	3.2	3.6	4.0	4.5	5.1	5.7	6.3	7.0
	≥1.0	A	F	0.6	0.9	1.2	1.5	1.9	2.3	2.9	3.6
		B	F	1.0	1.3	1.6	1.9	2.2	2.6	3.2	3.9
		C	F	1.5	1.8	2.1	2.4	2.7	3.1	3.7	4.2
		D	F	2.8	3.3	3.8	4.3	4.8	5.4	5.9	6.4
		E	F	3.2	3.6	4.0	4.5	5.1	5.7	6.3	7.0

*S = Approach Side, C = Corner, F= Traffic Face, A = S, C, and F

APPENDIX “F”

Noise Monitoring / Modeling

Noise Modeling
Existing and 2015 Traffic

Environmental Noise Survey and Computer Modeling
Estates Residential – Sherwood Park
(ACI Acoustical Consultants Ltd.)

Wye Road
AHD to Highway 21
Functional Planning Study
Noise Modeling

Location	Site	Existing Road/ Existing Traffic		Existing Road/ Year 2015 Traffic		Future Road/ Year 2015 Traffic	
		Noise Level		Noise Level		Noise Level	
		PM Peak	24h Equivalent	PM Peak	24h Equivalent	PM Peak	24h Equivalent
Lot 117, Estates of Sherwood Park (S. of Wye Rd.)	A	57.6	55.0	62.9	59.5	65.5	61.7
Lot 111, Estates of Sherwood Park (S. of Wye Rd.)	B	54.6	52.4	60	57.0	62.4	59.0
Lot 109, Maplewood at Rosewood Drive (N. of Wye Rd.)	C	55	52.8	60.7	57.6	56.8	58.9

Notes:

Site A and B - Existing 1.8m noise barrier (double boarded fence)

Site C - Existing 3.0m noise wall

No Noise Barrier at location a or B

Lot 117, Estates of Sherwood Park (S. of Wye Rd.)	A	62.2	58.9	67.3	63.2	70.3	65.8
Lot 111, Estates of Sherwood Park (S. of Wye Rd.)	B	62.1	58.8	67.2	63.1	70.1	65.6

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Environmental Noise Survey and Computer Modelling
For

Estates Residential Development in Sherwood Park, AB

DRAFT

Prepared for:
County of Strathcona

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aci Project #: 08-082
December 1, 2008

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the County of Strathcona to conduct an environmental noise survey for the Estates of Sherwood Park residential development in Sherwood Park, AB. The purpose of the work was to determine the current noise climate in the area and generate a computer noise model to illustrate the noise contours under current conditions and future conditions with the proposed modifications to Wye Rd. Site work was conducted for aci on November 4-5, 2008 by P. Froment, B.Sc., B.Ed. under the supervision of S. Bilawchuk, M.Sc., P.Eng.

As part of the study, a total of three (3) baseline noise monitorings were conducted in residential backyards directly adjacent to Wye Road. The overnight monitoring resulted in adjusted **$L_{eq}24$[1] levels of 57.8 dBA, 58.2 dBA and 56.8 dBA, respectively.** The results were adjusted to remove "non-typical" sounds near the monitors. It was found that the dominant noise source in this area was Wye Road.

The results of the baseline noise modeling confirmed the measured results and, as such, they were used to calibrate the model for future conditions. The modeling results for future conditions indicated that the noise levels at all receptors within the study area would increase by approximately 3 dBA (related to the approximate proposed doubling of traffic) and would remain below Outdoor Trigger Criterion Sound Level $L_{eq}24$ of 65 dBA. However, in order to ensure that these predicted levels are maintained into the future it is recommended that all fences be verified and repaired to be in good condition.

DRAFT

[1] The term L_{eq} represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the County of Strathcona to conduct an environmental noise survey for the Estates of Sherwood Park residential development in Sherwood Park, AB. The purpose of the work was to determine the current noise climate in the area and generate a computer noise model to illustrate the noise contours under current conditions and future conditions with the proposed modifications to Wye Rd. Site work was conducted for aci on November 4-5, 2008 by P. Froment, B.Sc., B.Ed. under the supervision of S. Bilawchuk, M.Sc., P.Eng.

2.0 Location Description

The study area is located on the South side of Sherwood Park as seen in Fig.1. The study area is bounded on the north by Wye Road, on the east and south by low density housing and on the west by Brentwood Blvd. The Estates of Sherwood Park development is comprised of single and multiple family dwellings.

Topographically the land in the area is relatively flat, particularly, the buffer between Wye Road and the residential lots. Periodically, there are sparse trees and bushes within this buffer however they are neither deep, nor dense enough to provide vegetative sound absorption for any of the monitoring locations.

3.0 Measurement & Modeling Methods

3.1. Environmental Noise Monitoring

As part of the study, a total of three (3) baseline noise monitorings were conducted in residential backyards directly adjacent to Wye Road as seen in Fig. 1. These were used to assess the existing environmental noise climate in the study area.

Noise Monitor #1 was located at house #8 in the Estates Village. This location is east of Brentwood Blvd and south of Wye Road, as shown in Fig. 2. The microphone was placed at a height of 1.5 m, approximately 15.0 m NW of the house. At this location, there was a 2.13 m tall fence between the monitor and Wye Road, however there were several large gaps between the fence and the ground. The noise monitor was started at 12:40 on Tuesday November 4, 2008 and ran for 24-hours until 12:40 on Wednesday November 5, 2008.

Noise Monitor #2 was located at 273 Estates Drive. This location was west of the entrance to the Estates of Sherwood Park development and south of Wye Road, as shown in Fig. 3. The microphone was placed at a height of 1.5 m, approximately 15.0 m NE of the house. At this location, there was a 1.83 m tall fence between the monitor and Wye Road. The noise monitor was started at 13:15 on Tuesday November 4, 2008 and ran for 24-hours until 13:15 on Wednesday November 5, 2008.

Noise Monitor #3 was located at 301 Estates Drive. This location was east of the entrance to the Estates of Sherwood Park development and south of Wye Road, as shown in Fig. 4. The microphone was placed at a height of 1.5 m, approximately 15.0 m NW of the house. At this location, there was a 1.83 m tall fence between the monitor and Wye Road. The noise monitor was started at 13:55 on Tuesday November 4, 2008 and ran for 24-hours until 13:55 on Wednesday November 5, 2008.

Appendix I includes a detailed description of the measurement equipment used, Appendix II includes a description of the acoustical terminology, and Appendix III includes a list of common noise sources. All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been no calibration drift over the duration of the measurements.

3.2. Computer Noise Modeling

The computer noise modeling was conducted using the CADNA/A (version 3.7.123) software package. CADNA/A allows for the modeling of various noise sources such as road, rail, and various stationary sources. In addition, topographical features such as land contours, vegetation, and bodies of water can be included. Finally, meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction can be included in the calculations.

The calculation method used for noise propagation follows the ISO standard 9613-2. All receiver locations were assumed as being downwind from the source(s). In particular, as stated in Section 5 of the ISO document:

> "Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely
>
> - wind direction within an angle of $\pm 45^0$ of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and
> - wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.
>
> The equations for calculating the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.
>
> These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights".

Due to the small amount of vegetation, and thus relative ineffectiveness to mitigate the noise climate, no vegetation was included in the model. Similarly, no snow cover was included since there can be variation in absorption/reflection caused by different snow conditions. As a result, all sound level propagation calculations are considered representative of summertime conditions for all surrounding residents.

Note that not every residential house in the area was modeled. Only the first few rows of buildings (in relation to the major roadways) were included, since these are the ones which will have the highest sound levels and will result in the greatest impact from any roadway activity.

As part of the study, two scenarios were modeled including:

1) Current conditions with existing noise sources (traffic conditions) and buildings
2) Future conditions with existing noise sources (traffic conditions) and buildings as well as proposed noise sources (roadway orientation, traffic conditions).

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at specific receiver locations (i.e. residents). Next, the sound levels were calculated using a 2 m x 2 m grid over the entire study area. This provided color noise contours for easier visualization of the results.

Refer to Appendix IV for a list of the computer noise modeling parameters.

4.0 Permissible Sound Levels

Environmental noise levels from road are commonly described in terms of equivalent sound levels or L_{eq}. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. In addition, this energy averaged level is A–weighted to account for the reduced sensitivity of average human hearing to low frequency sounds. These L_{eq} in dBA, which are the most common environmental noise measure, are often given for day-time (07:00 to 22:00) L_{eq}Day and night-time (22:00 to 07:00) L_{eq}Night while other criteria use the entire 24-hour period as $L_{eq}24$. The criterion used to evaluate the road noise in the study area is the Strathcona County Traffic Noise Policy SER-009-027.

4.1. Strathcona County Noise Policy SER-009-027

The Strathcona County Noise Policy (SCNP) SER-009-027 is applicable to all existing or new residential neighbourhoods. This policy serves as a guideline to assess and, as necessary, to attenuate forecasted or actual traffic noise in these residential neighbourhoods. The sound level descriptor used in all assessments is an A-weighted $L_{eq}24$. As such, all sound levels in this policy are $L_{eq}24$. The following section, which is most applicable to this study, is taken directly from the SCNP:

Guideline

1) Attenuation of Traffic Noise for Existing Residential Areas
    a. No measures will be undertaken for residential neighbourhoods until the measured noise levels 5 metres from the rear facade of the dwelling and 1.5 metres above the ground elevation at that point, exceed **65 dBA**.
    b. No protection will be provided for second or subsequent storeys of houses unless such protection can be achieved by a maximum of a 2.5 metre wall on the existing grades at the road right-of-way limit.

Procedure

1. Attenuation of Traffic Noise for Existing Residential Areas
    a. In areas where the Outdoor Trigger Sound Level Criterion of **65 dBA** noise level is exceeded, Council will consider, on a priority and availability of funds basis, the construction of such noise attenuation measures that are determined by Administration to have the desired attenuating effect.

b. Where residents would prefer a more expensive attenuation measure than that proposed by the County, they may petition on a local improvement charge basis to pay the difference in cost for the enhanced facility.
c. Where residents would prefer a noise attenuation facility in advance of the County's ability to provide it, in accordance with the Municipal Government Act, RCA 2000, M-26, they may petition for the construction of such noise attenuation measures at any time on a 100% local improvement charge basis.
d. The residents will be assisted by Engineering and Environmental Planning staff in the determination of the design and estimated cost of such noise attenuation measures. In conjunction with the petition process, all residents adjacent to the property line on which the facility will be constructed must sign a working easement agreement prior to implementation of the project.

In summary, as described in the SCNP, the Outdoor Criterion Sound Level for the exiting residential development is 65 dBA $L_{eq}24$ of for all dwellings.

5.0 Results and Discussion

5.1. Environmental Monitoring

The results of the environmental noise monitoring are presented in Table 1 and Fig. 5 – 10. Note that the sound levels have been adjusted by removing "non-typical" noises associated with sirens, birds chirping nearby, etc.

Table 1. Measured Sound Levels

Location	$L_{eq}24$ (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
Monitor 1	57.8	59.4	51.3
Monitor 2	58.2	59.9	51.3
Monitor 3	56.8	58.6	49.6

For the all noise monitoring locations the dominant noise source was, as expected, Wye Road. In analyzing the data and the audio files it was found that the traffic was fairly consistent throughout the day-time with rises during the morning and evening rush hour periods and, as anticipated, the noise levels lowered during night-time period. The elevated noise levels can be attributed to the volume of traffic as well as the high percentage of heavy vehicles on Wye Road. Subjectively, this was confirmed during the set-up and take-down. During this time the traffic along Wye Road was continual with a large number of heavy trucks. The 1/3 octave band data collected throughout the entire 24-hour monitoring period for the second monitoring location is presented in Figs. 6, 8 and 10. It can be seen that in all measurements, the sound pressure level is fairly consistent throughout the lower frequencies eventually tapering off at higher frequencies. The dominant frequency ranges are near 80 Hz (engine and exhaust noise) and 1000 Hz (tire noise). These results are typical of traffic noise which confirms the contribution of Wye Road for this study area. In addition, it can be seen that the measured sound levels are currently well below the Outdoor Trigger Criterion Sound Level $L_{eq}24$ of 65 dBA.

5.2. Weather Conditions

Subjectively the weather conditions were cloudy with slight wind from the north during the setup. The weather was overcast with calm conditions during the take-down. At no point was the weather considered detrimental to the results obtained from the environmental noise monitorings. In particular, given the relatively low wind speeds and close proximity of the noise monitors to Wye Road, the weather was determined to have a minimal contribution to the noise climate. Weather data for the duration of the environmental noise monitoring, are presented in Appendix V.

5.3. Computer Noise Modelling

5.3.1. Current Conditions Without Wye Road Expansion

The noise model results for current conditions without the proposed future Wye Road expansion are presented in Table 2 and Fig. 11. The $L_{eq}24$ and day-time L_{eq} modeled results for all three monitors match quite well with those obtained from the noise monitors. The modeled night-time L_{eq} levels are all higher than the measured night-time L_{eq} levels, however, this is considered conservative and as such no other adjustment will have been made.

Table 2. Modeled Sound Levels Under Current Conditions

Location	$L_{eq}24$ (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Location	$L_{eq}24$ (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
M1	58.1 (+0.3)	59.7 (+0.3)	52.3 (+1.0)		**R10**	57.4	59.0	51.6
M2	58.9 (+0.7)	60.4 (+0.5)	53.1 (+1.8)		**R11**	57.0	58.6	51.2
M3	57.0 (+0.2)	58.5 (+0.1)	51.2 (+1.6)		**R12**	56.8	58.4	51.0
R1	58.2	59.8	52.5		**R13**	56.8	58.4	51.0
R2	58.4	60.0	52.6		**R14**	56.7	58.3	50.9
R3	58.5	60.1	52.7		**R15**	55.9	57.5	50.1
R4	58.7	60.2	52.9		**R16**	55.3	56.8	49.5
R5	58.8	60.3	53.0		**R17**	55.5	57.1	49.7
R6	58.9	60.5	53.1		**R18**	55.6	57.1	49.8
R7	58.9	60.5	53.2		**R19**	55.6	57.1	49.8
R8	58.5	60.1	52.7		**R20**	55.2	56.8	49.5
R9	58.0	59.6	52.2		**R21**	54.5	56.0	48.7

Note: (xx) = comparison to monitored sound levels

It can be seen in Table 2 and Figure 11 that all modeled receptors fall below the Outdoor Trigger Criterion Sound Level $L_{eq}24$ of 65 dBA which is consistent with the environmental monitoring results.

5.3.2. Future Conditions With Wye Road Expansion

The noise model results for future conditions with the proposed future Wye Road expansion are presented in Table 3 and Fig. 12.

Table 3. Modeled Sound Levels Under Future Conditions

Location	$L_{eq}24$ (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Location	$L_{eq}24$ (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
M1	60.9	62.4	55.1		R10	60.5	62.1	54.7
M2	61.6	63.1	55.8		R11	60.3	61.9	54.5
M3	60.1	61.7	54.4		R12	60.1	61.7	54.3
R1	61.0	62.6	55.2		R13	60.1	61.6	54.3
R2	61.1	62.6	55.3		R14	60.0	61.6	54.2
R3	61.2	62.8	55.4		R15	59.0	60.6	53.3
R4	61.4	63.0	55.7		R16	57.2	58.8	51.4
R5	61.4	63.0	55.7		R17	57.5	59.1	51.8
R6	61.6	63.2	55.8		R18	57.6	59.2	51.9
R7	61.7	63.3	55.9		R19	57.6	59.2	51.8
R8	61.5	63.1	55.7		R20	57.5	59.1	51.7
R9	61.1	62.7	55.3		R21	57.0	58.6	51.3

It can be seen in Table 3 and Figure 12 that all modeled receptors fall below the Outdoor Trigger Criterion Sound Level $L_{eq}24$ of 65 dBA. On average, the noise levels increased by 3 dBA from the current conditions to the future conditions with the expansion of Wye Road. This increase in level is consistent with the proposed increase in traffic volumes (essentially double).

In order to ensure that these predicted levels are maintained into the future it is recommended that all fences be verified and repaired to be in good condition. During the setup and take-down it was found that certain portions of the fence had small gaps between it and the ground and/or vertical sections. Even small holes and gaps can introduce areas where the sound can penetrate into the backyard amenity space. It was found in model that all current fence heights provide sufficient attenuation.

6.0 Conclusion

As part of the study, a total of three (3) baseline noise monitorings were conducted in residential backyards directly adjacent to Wye Road. The overnight monitoring resulted in adjusted **L_{eq}24 levels of 57.8 dBA, 58.2 dBA and 56.8 dBA, respectively.** The results were adjusted to remove "non-typical" sounds near the monitors. It was found that the dominant noise source in this area was Wye Road.

The results of the baseline noise modeling confirmed the measured results and as such, they were used to calibrate the model for future conditions. The modeling results for future conditions indicated that the noise levels at all receptors within the study area would increase by approximately 3 dBA (related to the approximate proposed doubling of traffic) and would remain below Outdoor Trigger Criterion Sound Level L_{eq}24 of 65 dBA. However, in order to ensure that these predicted levels are maintained into the future it is recommended that all fences be verified an repaired to be in good condition.

7.0 References

- Strathcona County Traffic Noise Policy SER-009-027, 2007
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.

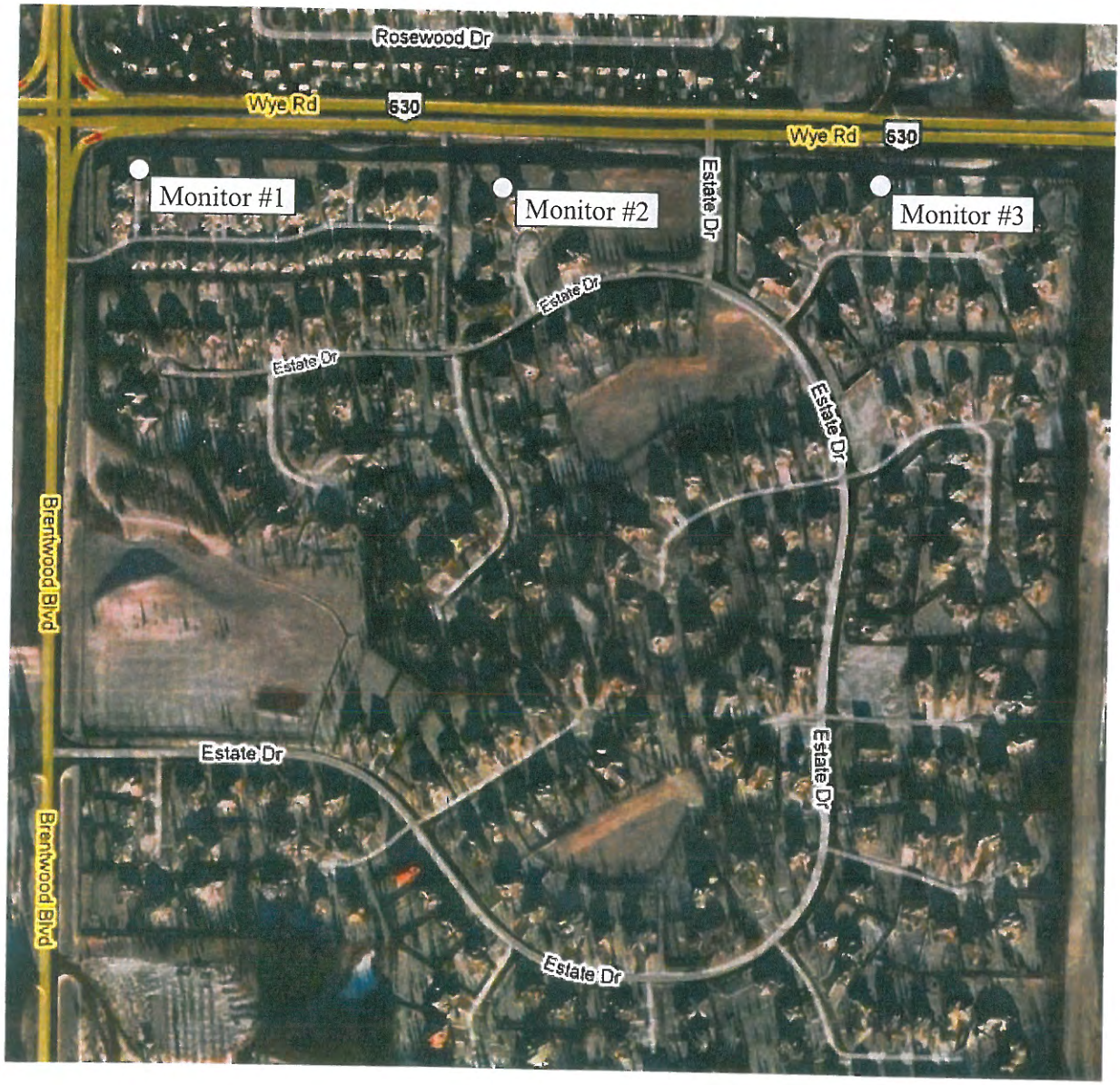


Figure 1. Study Area



Figure 2. Noise Monitor #1 Used for Environmental Noise Study



Figure 3. Noise Monitor #2 Used for Environmental Noise Study



Figure 4. Noise Monitor #3 Used for Environmental Noise Study

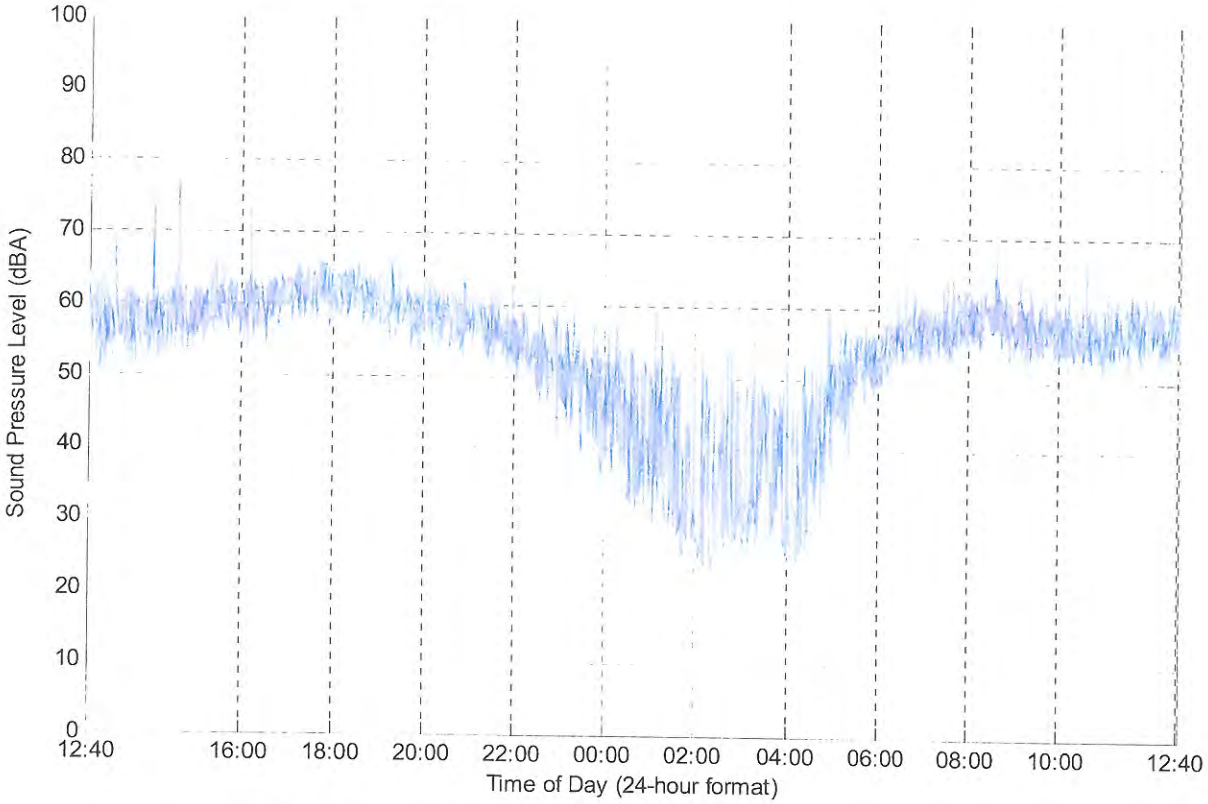


Figure 5. 15-Second L_{eq} Sound Levels For Monitor Location #1

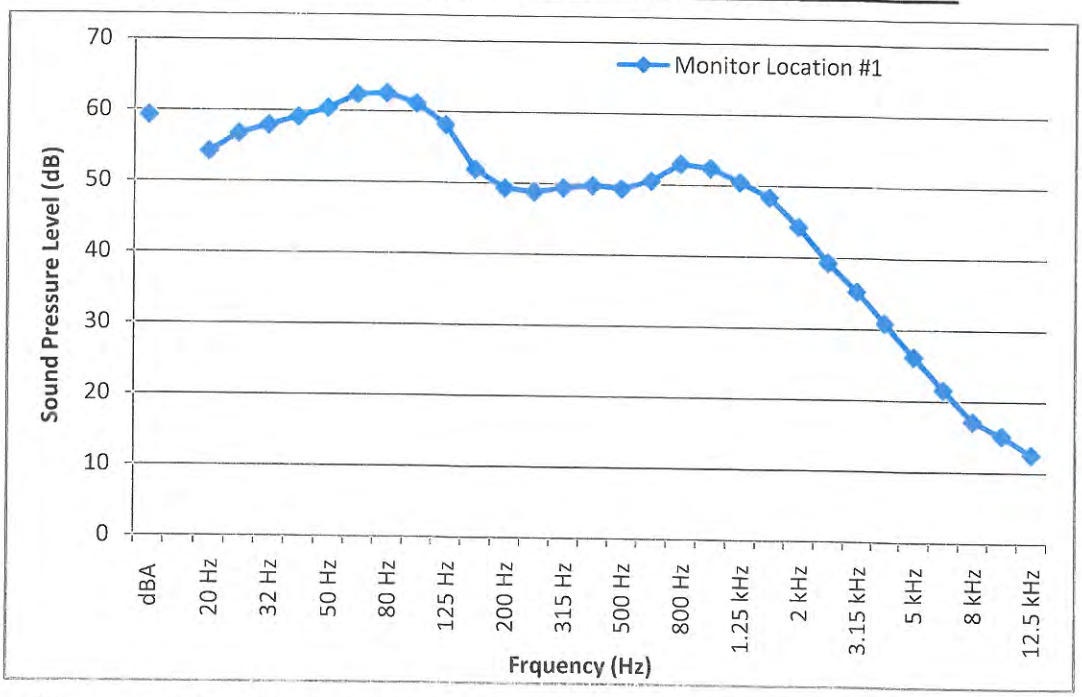


Figure 6. A-Weighted 1/3 Octave L_{eq}24 Sound Levels For Monitor Location #1

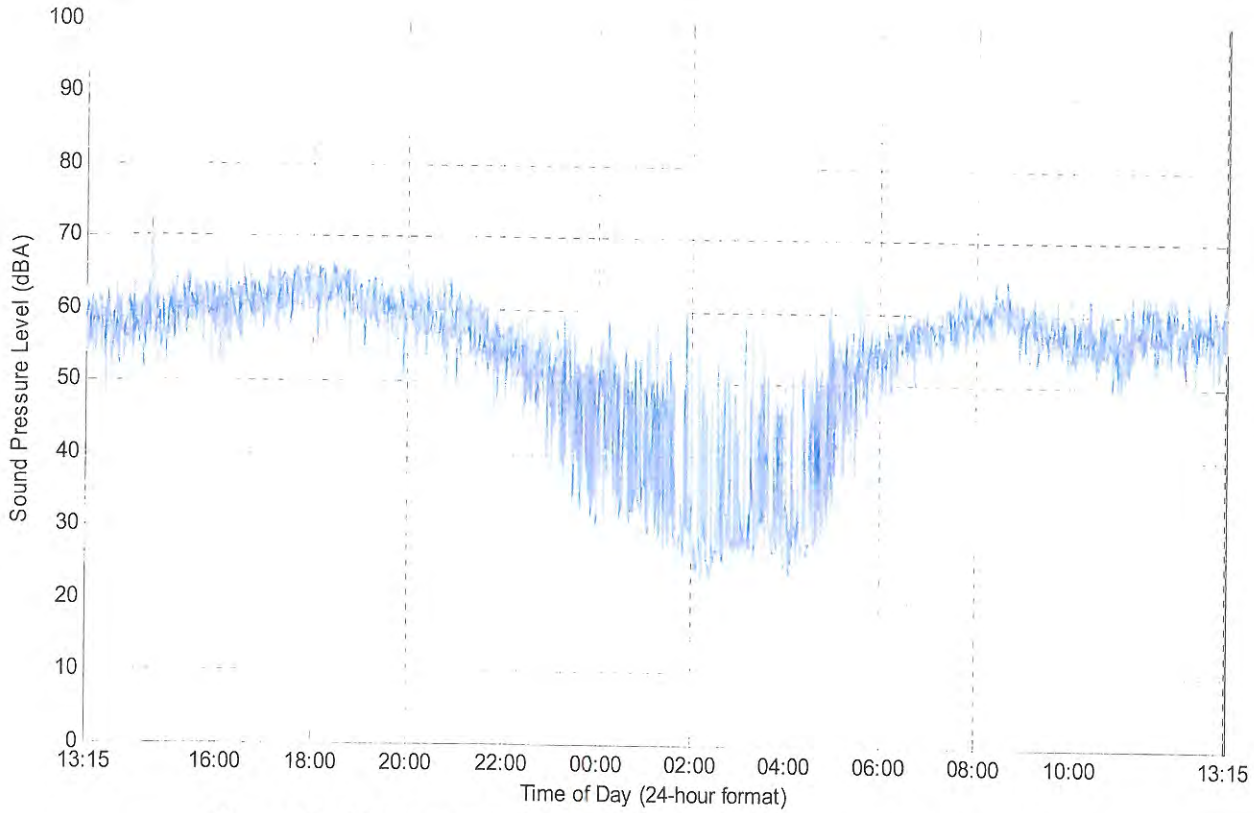


Figure 7. 15-Second L_{eq} Sound Levels For Monitor Location #2

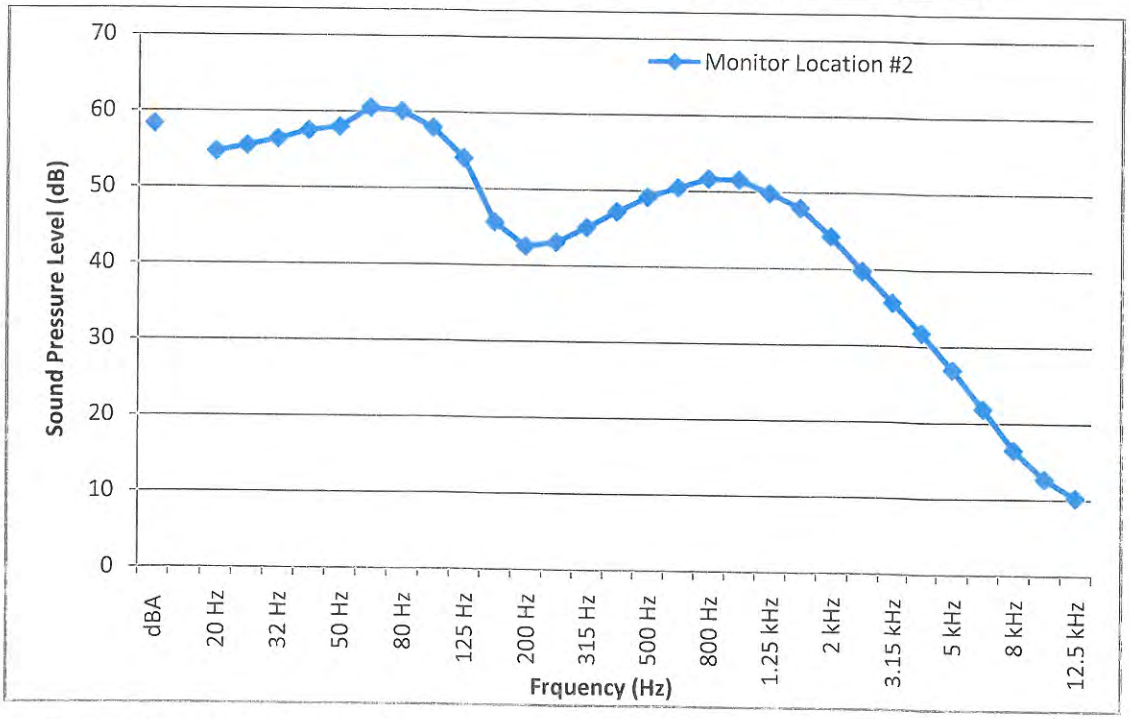


Figure 8. A-Weighted 1/3 Octave $L_{eq}24$ Sound Levels For Monitor Location #2

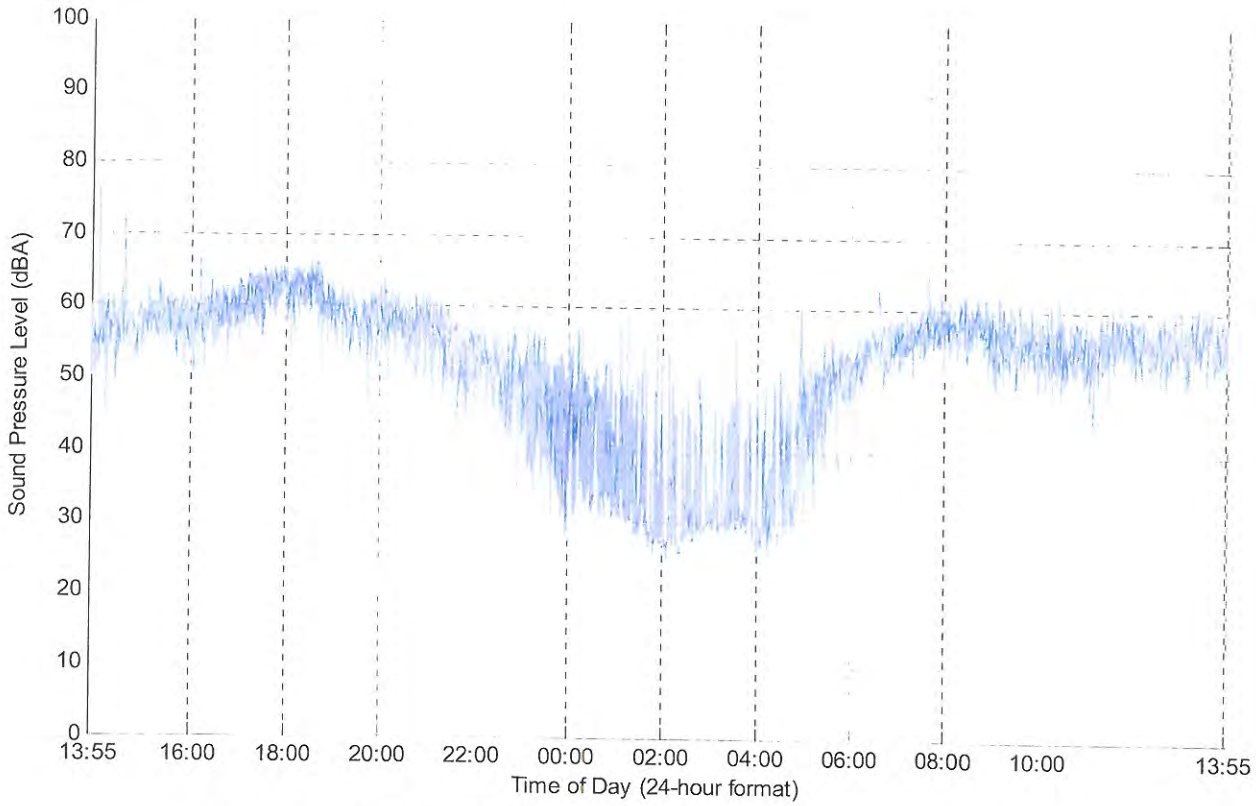


Figure 9. 15-Second L_{eq} Sound Levels For Monitor Location #3

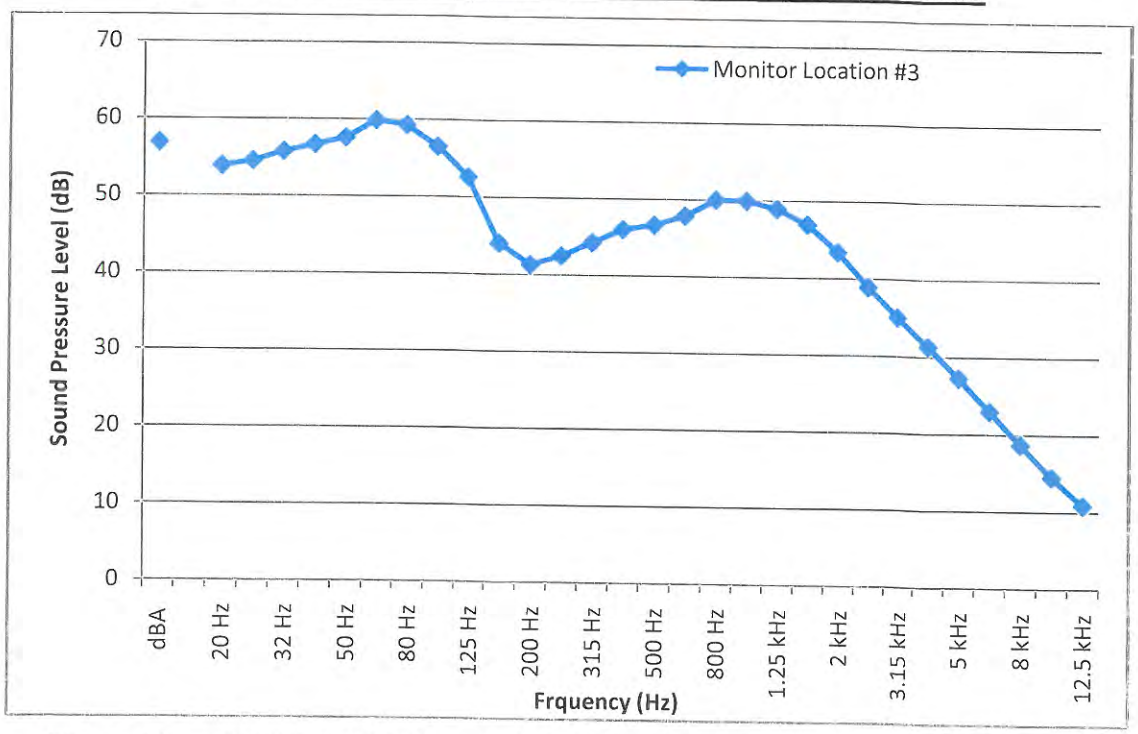


Figure 10. A-Weighted 1/3 Octave L_{eq}24 Sound Levels For Monitor Location #3

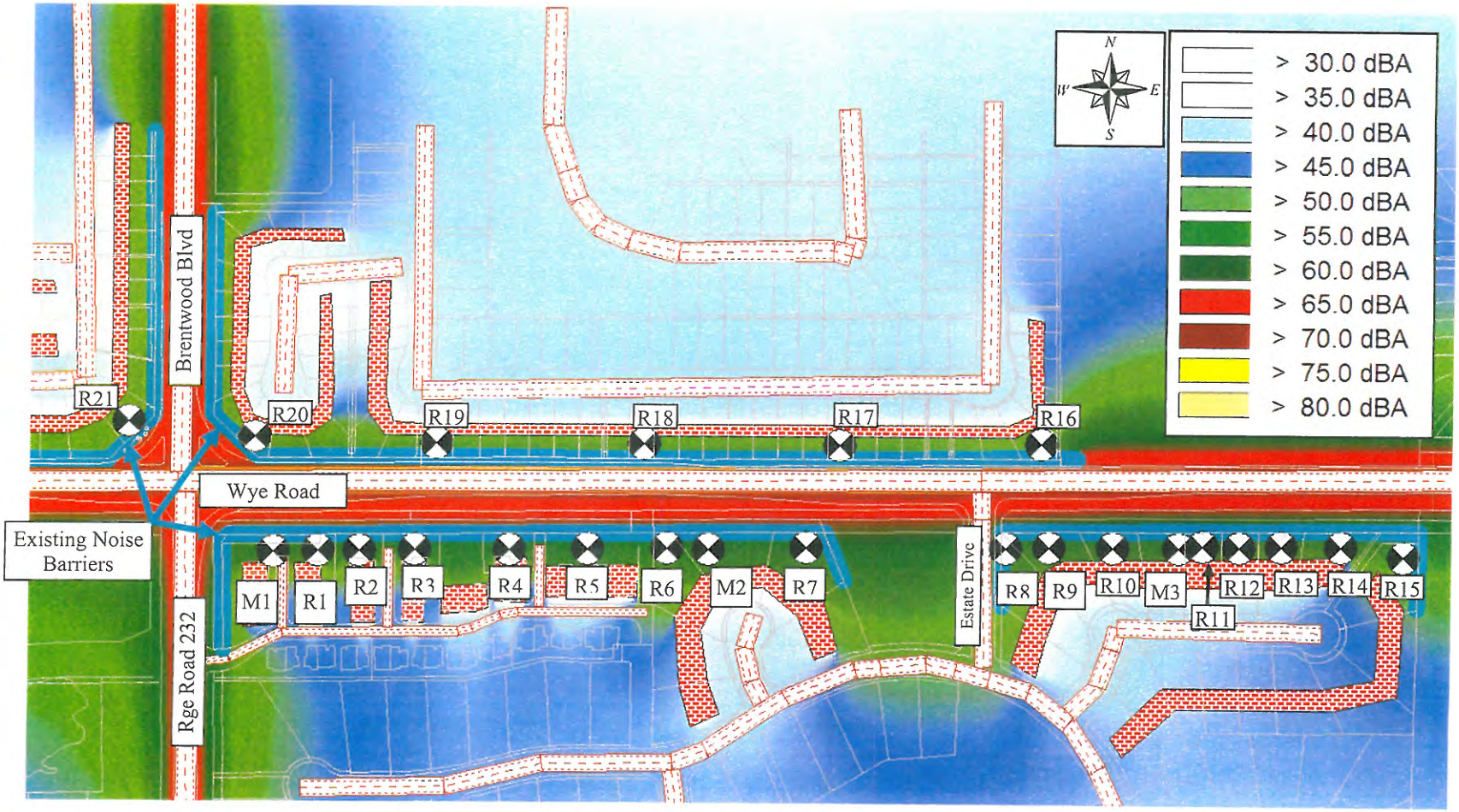


Figure 11. $L_{eq}24$ Noise Levels under Current Conditions

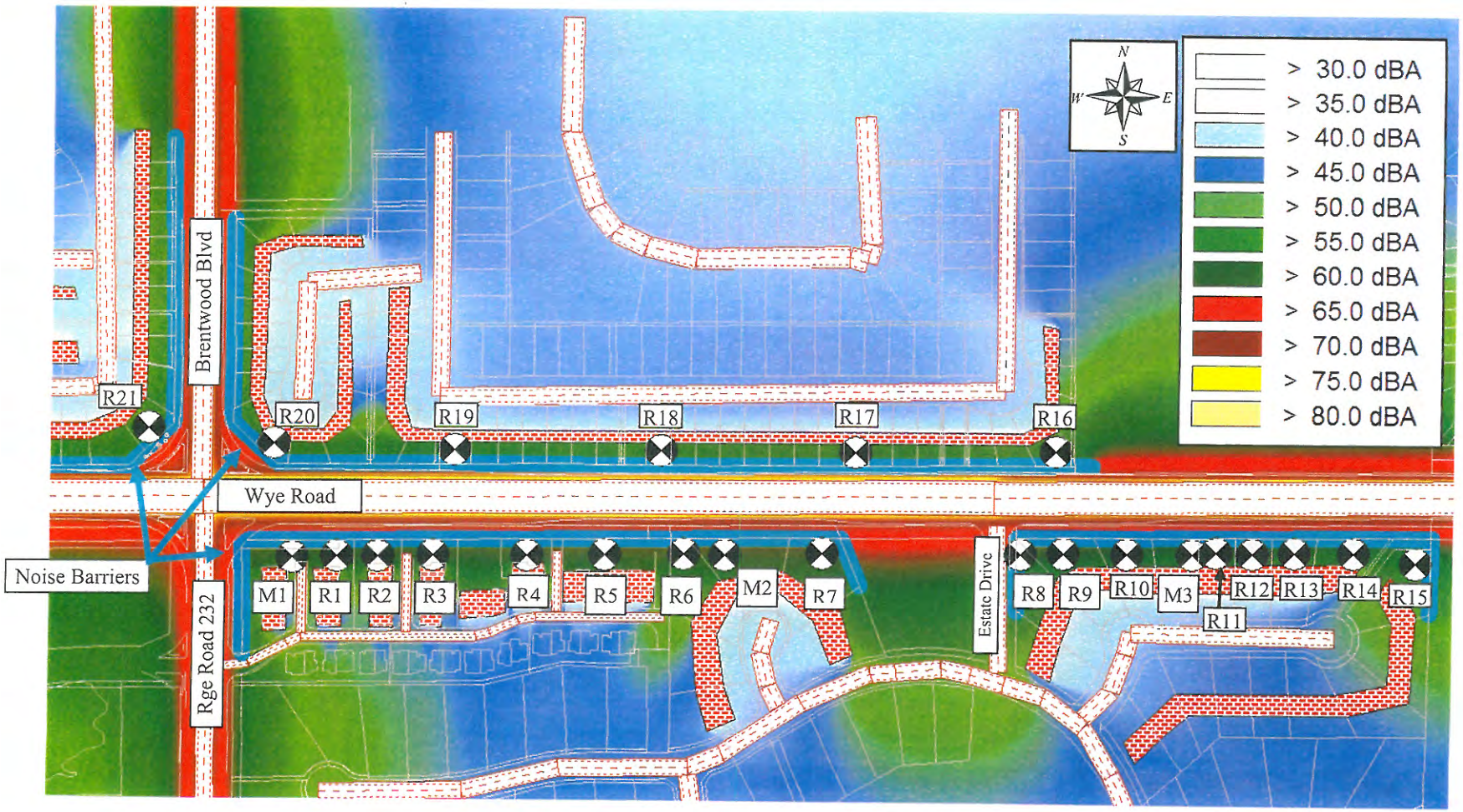


Figure 12. $L_{eq}24$ Noise Levels under Future Conditions

Appendix I

MEASUREMENT EQUIPMENT USED

Brüel and Kjær 2250/2270 (Unit 1 / Unit 2/ Unit 3/)

The environmental noise monitoring equipment used for the three monitoring locations consisted of a Brüel and Kjær Type 2250 Precision Integrating Sound Level Meter enclosed in an environmental case, a tripod, a weather protective microphone hood, and an external battery. The system acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meter conforms to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meter, pre-amplifier and microphone were certified on May 23, 2007 / February 26, 2007 / September 24, 2007 and the calibrator (type B&K 4231) was certified on May 30, 2008 / May 30, 2008 / September 23, 2007 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. Simultaneous digital audio was recorded directly on the sound level meter using a 3.3 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitor

The weather monitoring equipment used for the study consisted of a NovaLynx 110-WS-16D data acquisition box, with a 200-WS-02E wind-speed and wind-direction sensor, a 110-WS-16TH temperature and relative humidity sensor and a 110-WS-16THS solar radiation shield. The data acquisition box and a battery were located in a weather protective case. The sensors were mounted on a tripod at approximately 4.5m above ground. The system was set up to record data in 5-minute averages obtaining average wind-speed, peak wind-speed, wind-direction, temperature and relative humidity.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
On-site Spot	November 4 2008	12:40	Pre	93.9 dBA	B&K 4231	2478139
On-site Spot	November 5 2008	14:25	Post	93.8 dBA	B&K 4231	2478139
On-site Spot	November 4 2008	13:15	Pre	93.9 dBA	B&K 4231	2575493
On-site Spot	November 5 2008	14:10	Post	93.8 dBA	B&K 4231	2575493
On-site Spot	November 4 2008	13:45	Pre	93.9 dBA	B&K 4231	2594693
On-site Spot	November 5 2008	13:55	Post	93.8 dBA	B&K 4231	2594693

B&K 2250/2270 Unit #1 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 1999, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.16239

Instrument:	**Sound Level Meter**	*Date Calibrated:*	**5/23/2007**
Model:	**2250**	*Status*	**Received / Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance*	**X / X**
Serial number:	**2488495**	*Out of tolerance*	
Tested with:	**Microphone 4189 s/n 2471133** **Preamplifier ZC 0032 s/n 3271**	*See comments*	
Type (class):	**1**	*Contains non-accredited tests:*	**__Yes X No**
		Calibration service:	**__ Basic X Standard**
Customer:	**Acoustical Consultants, Inc.**	*Address:*	**Suite 107, 9920-63 Ave** **Edmonton, Alberta, Canada T6E 0G9**
Tel/Fax:	**780-414-6373/ -6376**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal date	Traceability evidence Cal. Lab / Accreditation
483B-Norsonic	SME Cal Unit	25747	Dec 12, 2006	Scantek, Inc.
DS-360-SRS	Function Generator	33584	Dec 12, 2006	Scantek, Inc.
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 3, 2006	Transcat / NVLAP
DPI140-Druck	Pressure Indicator	790/00	Nov 9, 2006	Transcat / A2LA
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Oct 26, 2006	Transcat / A2LA
PC Program 1019 Norsonic	Calibration software	v.46	Validated Dec 2006	-
1253-Norsonic	Calibrator	25726	Jan 29, 2007	Scantek, Inc.

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.1 °C	101.588 kPa	39.5 %RH

Calibrated by	Valentin Buzduga	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/23/2007	Date	5/23/07

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory. This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
Document stored as: C:\Nor1504\SlmCal\2007\BNK2250_2488495_M1.doc
Page 1 of 2

B&K 2250/2270 Unit #1 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 1999, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.16237

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2471133**

Date Calibrated: **5/22/2007**

Status	Received	Sent
In tolerance	X	X
Out of tolerance		
See comments		

Contains non-accredited tests: X Yes __ No

Customer: **Acoustical Consultants, Inc.**
Tel/Fax: **780-414-6373/ -6376**
Address: **Suite 107, 9920-63 Ave Edmonton, Alberta, Canada T6E 0G9**

Tested in accordance with the following procedures and standards:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal date	Traceability evidence Cal. Lab / Accreditation
483B-Norsonic	SME Cal Unit	25747	Dec 12, 2006	Scantek, Inc.
DS-360-SRS	Function Generator	33584	Dec 12, 2006	Scantek, Inc.
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 3, 2006	Transcat / NVLAP
DPI140-Druck	Pressure Indicator	790/00	Nov 9, 2006	Transcat / A2LA
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Oct 26, 2006	Vaisala / A2LA
PC Program 1017 Norsonic	Calibration software	v.46	Validated Feb 2006	-
1253-Norsonic	Calibrator	22909	Dec 4, 2006	NPL (UK) / UKAS
1203-Norsonic	Preamplifier	14059	Jan 2, 2007	Scantek, Inc./ NVLAP
4180-Bruel&Kjaer	Microphone	2246115	Dec 6, 2006	NPL (UK) / UKAS

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by	Valentin Buzduga	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/22/2007	Date	5/23/07

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Page 1 of 2

B&K 2250/2270 Unit #1 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.17999

Instrument:	**Acoustical Calibrator**	*Date Calibrated:*	**5/30/2008**
Model:	**4231**	*Status.*	**Received** / **Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance*	X / X
Serial number:	**2478139**	*Out of tolerance:*	
Class (IEC 60942):	**1**	*See comments:*	
Barometer type:		*Contains non-accredited tests:*	__Yes _X_ No
Barometer s/n:			

Customer:	**Acoustical Consultants, Inc**	*Address:*	**9920 63rd Avenue, Suite 107 Edmonton AB T6E 0G9**
Tel/Fax:	**780-414-6373/-6376**		

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., 06/06/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal date	Traceability evidence Cal.Lab / Accreditation
483B-Norsonic	SME Cal Unit	25747	Jan 15, 2008	Scantek, Inc./NVLAP
DS-360-SRS	Function Generator	61646	Nov 19, 2007	Davis Inotek / AClass
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 13, 2007	Transcat / NVLAP
DPI 141-Druck	Pressure Indicator	790/00	Nov 9, 2006	Transcat / A2LA
8903A-HP	Audio Analyzer	2514A05691	Jan 2, 2008	Transcat/ NVLAP
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	May 7, 2008	Transcat/ NVLAP
PC Program 1018 Norsonic	Calibration software	v.44	Validated May 2006	-
1253-Norsonic	Calibrator	28326	Mar 3, 2008	NPL (UK) / UKAS
1203-Norsonic	Preamplifier	14059	Jan 4, 2008	Scantek, Inc./ NVLAP
4180-Bruel&Kjaer	Microphone	2246115	Mar 3, 2008	NPL (UK) / UKAS

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/30/08	Date	5/30/08

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B&K 2250/2270 Unit #2 Calibration Certificate(s)

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær -2250--- Serial No 2575774 has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2000 assuring that all calibration data for test equipment are retained on file and are available for inspection upon request.

Nærum 26-feb-2007

Torben Bjørn
Vice President
Operations

Please note that this document is not a calibration certificate, for information on our calibration services please contact your nearest Brüel & Kjær Service Center.

EA 02 13 - 15

WORLD HEADQUARTERS. DK-2850 Nærum Denmark
Telephone: +45 45 80 05 00 Fax: +45 45 80 14 05 http://www.bksv.com e-mail: info@bksv.dk

Brüel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Bruel & Kjær **Calibration Chart**

Serial No: 2573766

Open-circuit Sensitivity*, S_0:	***-26.8***	dB re 1V/Pa
Equivalent to:	***45.5***	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	13.3	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.8 kPa 24 °C 53 % RH

Procedure: 7042:5 **Date:** 6. Feb. 2007 **Signature:** B\K

*K_0 = −26 S_0 Example: $K_0 = -26 - (-26.2) = +0.2$ dB
DC0224 - 12

B&K 2250/2270 Unit #2 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.17998

Instrument: **Acoustical Calibrator**
Model: 4231
Manufacturer: **Brüel and Kjær**
Serial number: 2575493
Class (IEC 60942): 1
Barometer type:
Barometer s/n:

Date Calibrated: 5/30/2008

Status:	Received	Sent
In tolerance	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **Acoustical Consultants, Inc**
Tel/Fax: **780-414-6373/-6376**
Address: **9920 63rd Avenue, Suite 107 Edmonton AB T6E 0G9**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., 06/06/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal date	Traceability evidence Cal.Lab / Accreditation
483B-Norsonic	SME Cal Unit	25747	Jan 15, 2008	Scantek, Inc./NVLAP
DS-360-SRS	Function Generator	61646	Nov 19, 2007	Davis Inotek / AClass
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 13, 2007	Transcat / NVLAP
DPI 141-Druck	Pressure Indicator	790/00	Nov 9, 2006	Transcat / A2LA
8903A-HP	Audio Analyzer	2514A05691	Jan 2, 2008	Transcat/ NVLAP
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	May 7, 2008	Transcat/ NVLAP
PC Program 1018 Norsonic	Calibration software	v.44	Validated May 2006	-
1253-Norsonic	Calibrator	28326	Mar 3, 2008	NPL (UK) / UKAS
1203-Norsonic	Preamplifier	14059	Jan 4, 2008	Scantek, Inc./ NVLAP
4180-Bruel&Kjaer	Microphone	2246115	Mar 3, 2008	NPL (UK) / UKAS

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature		Signature	
Date	5/30/08	Date	5/30/08

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Page 1 of 2

B&K 2250/2270 Unit #3 Calibration Certificate(s)

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær -2250--- Serial No 2600498 has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2000 assuring that all calibration data for test equipment are retained on file and are available for inspection upon request.

Nærum 24-sep-2007

Torben Bjørn
Vice President
Operations

Please note that this document is not a calibration certificate, for information on our calibration services please contact your nearest Brüel & Kjær Service Center.

BA0238 - 15

WORLD HEADQUARTERS · DK-2850 Nærum · Denmark
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Brüel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Brüel & Kjær **Calibration Chart**

Serial No: **2595637**

Open-circuit Sensitivity*, S_o:	***-26.0***	dB re 1V/Pa
Equivalent to:	***50.0***	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	***13.0***	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
98.9 kPa 23 °C 50 % RH

Procedure: 704215 **Date:** 26. Jun. 2007 **Signature:**

*$K_o = -26 - S_o$ Example: $K_o = -26 - (-26.2) = +0.2$ dB

BC 0224 - 12

B&K 2250/2270 Unit #3 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.18780

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2594693**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **10/16/2008**

	Received	Sent
Status:		
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/ -6376**

Address: **9920 - 63 Ave. Suite 107**
Edmonton, Alberta,
Canada T6E 0G9

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., 06/06/2005

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Jan 15, 2008	Scantek, Inc.	Jan 15, 2009
DS-360-SRS	Function Generator	33584	Jan 3, 2008	Davis Calibration / AClass	Jan 3, 2009
34401A-Agilent	Digital Voltmeter	US36120731	Aug 19, 2008	ACR Env. / A2LA	Aug 14, 2009
HM30-Thommen	Meteo Station	1040170/39633	Dec 21, 2007	Transcat / A2LA	Jun 21, 2009
8903-HP	Audio Analyzer	2514A05691	Jan 2, 2008	Transcat / A2LA	Jan 2, 2010
PC Program 1018 Norsonic	Calibration software	v.44	Validated May 2006	-	-
1253-Norsonic	Calibrator	22909	Aug 14, 2008	Scantek, Inc.	Aug 14, 2009
1203-Norsonic	Preamplifier	14059	Jan 4, 2008	Scantek, Inc./ NVLAP	Jan 4, 2009
4180-Bruel&Kjaer	Microphone	2246115	Mar 3, 2008	NPL (UK) / UKAS	Mar 7, 2010

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature		Signature	
Date	10/16/2008	Date	10/16/08

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
Document stored as: C:\Nor1504\CalCal\2008\BNK4231_2594693_M2.doc

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Appendix II

THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

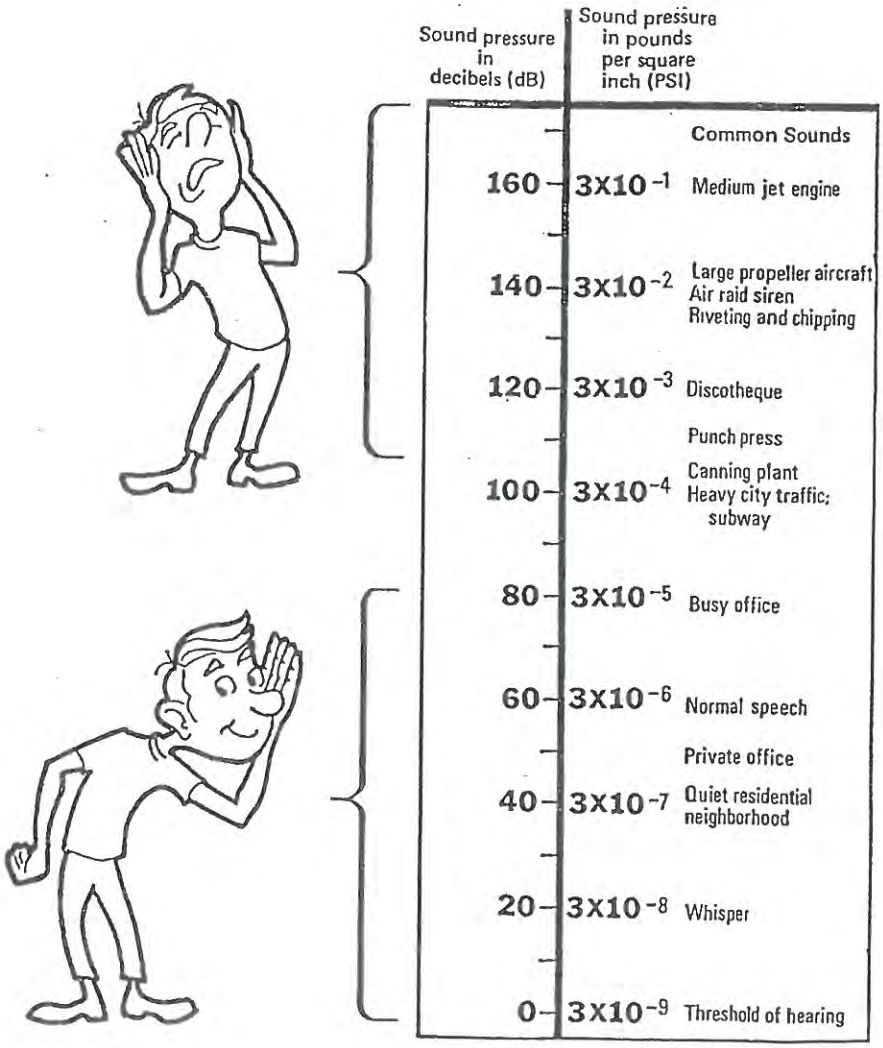
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^{2}}{P_{ref}^{2}}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2\text{x}10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160
3X10 -1
Medium jet engine
140
3X10 -2
Large propeller aircraft
Air raid siren
Riveting and chipping
120
3X10 -3
Discotheque
Punch press
100
3X10 -4
Canning plant
Heavy city traffic; subway
80
3X10 -5
Busy office
60
3X10 -6
Normal speech
Private office
40
3X10 -7
Quiet residential neighborhood
20
3X10 -8
Whisper
0
3X10 -9
Threshold of hearing

Frequency

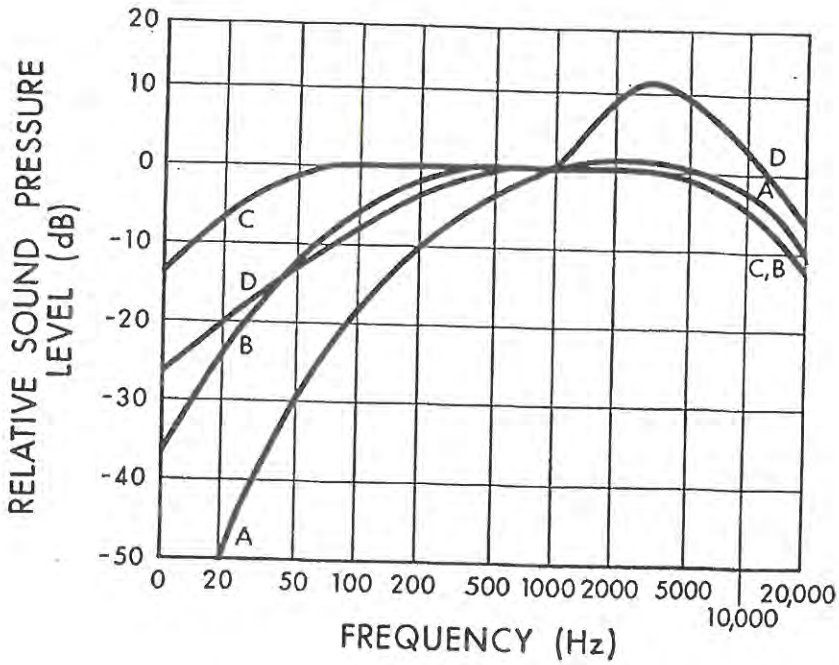
The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

Whole Octave		
Lower Band Limit	Center Frequency	Upper Band Limit
11	**16**	22
22	**31.5**	44
44	**63**	88
88	**125**	177
177	**250**	355
355	**500**	710
710	**1000**	1420
1420	**2000**	2840
2840	**4000**	5680
5680	**8000**	11360
11360	**16000**	22720

1/3 Octave		
Lower Band Limit	Center Frequency	Upper Band Limit
14.1	**16**	17.8
17.8	**20**	22.4
22.4	**25**	28.2
28.2	**31.5**	35.5
35.5	**40**	44.7
44.7	**50**	56.2
56.2	**63**	70.8
70.8	**80**	89.1
89.1	**100**	112
112	**125**	141
141	**160**	178
178	**200**	224
224	**250**	282
282	**315**	355
355	**400**	447
447	**500**	562
562	**630**	708
708	**800**	891
891	**1000**	1122
1122	**1250**	1413
1413	**1600**	1778
1778	**2000**	2239
2239	**2500**	2818
2818	**3150**	3548
3548	**4000**	4467
4467	**5000**	5623
5623	**6300**	7079
7079	**8000**	8913
8913	**10000**	11220
11220	**12500**	14130
14130	**16000**	17780
17780	**20000**	22390

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called "A-weighting". It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.



Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level (L_{eq}) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time. The L_{eq} is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\,dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\,dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc. **An L_{eq} is meaningless if there is no time period associated.**

In general there a few very common L_{eq} sample durations which are used in describing environmental noise measurements. These include:

- $L_{eq}24$ - Measured over a 24-hour period
- L_{eq}Night - Measured over the night-time (typically 22:00 – 07:00)
- L_{eq}Day - Measured over the day-time (typically 07:00 – 22:00)
- L_{DN} - Same as $L_{eq}24$ with a 10 dB penalty added to the night-time

Statistical Descriptor

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

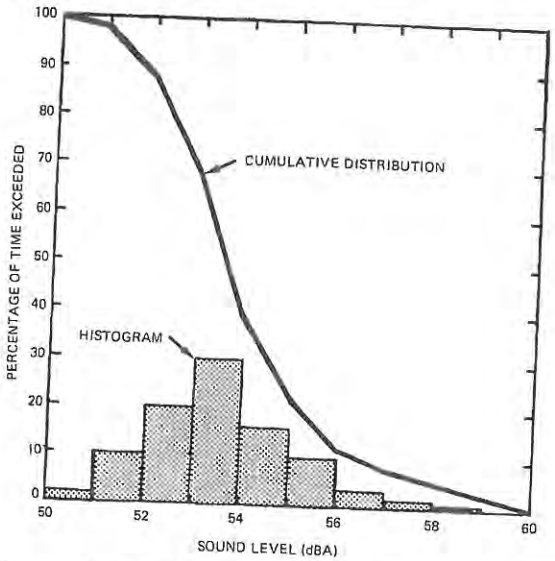


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994

The most common statistical descriptors are:

- L_{min} - minimum sound level measured
- L_{01} - sound level that was exceeded only 1% of the time
- L_{10} - sound level that was exceeded only 10% of the time.
  - Good measure of intermittent or intrusive noise
  - Good measure of Traffic Noise
- L_{50} - sound level that was exceeded 50% of the time (arithmetic average)
  - Good to compare to L_{eq} to determine steadiness of noise
- L_{90} - sound level that was exceeded 90% of the time
  - Good indicator of typical "ambient" noise levels
- L_{99} - sound level that was exceeded 99% of the time
- L_{max} - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the L_{eq} and the L_{50} (L_{eq} can never be any lower than the L_{50}) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the L_{10} and L_{90} is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: SPL_1 = sound pressure level at location 1, SPL_2 = sound pressure level at location 2
r_1 = distance from source to location 1, r_2 = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 44 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

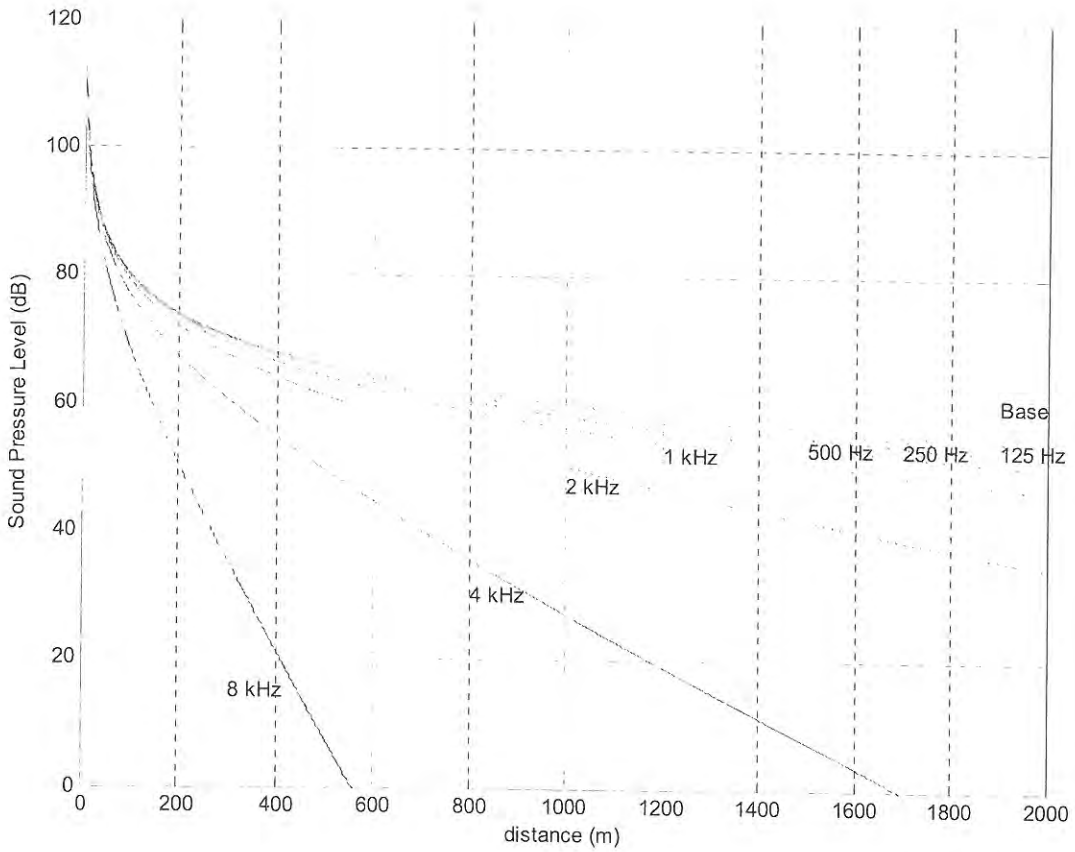
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

Temperature °C	Relative Humidity (%)	Frequency (Hz)					
		125	250	500	1000	2000	4000
30	20	0.06	0.18	0.37	0.64	1.40	4.40
	50	0.03	0.10	0.33	0.75	1.30	2.50
	90	0.02	0.06	0.24	0.70	1.50	2.60
20	20	0.07	0.15	0.27	0.62	1.90	6.70
	50	0.04	0.12	0.28	0.50	1.00	2.80
	90	0.02	0.08	0.26	0.56	0.99	2.10
10	20	0.06	0.11	0.29	0.94	3.20	9.00
	50	0.04	0.11	0.20	0.41	1.20	4.20
	90	0.03	0.10	0.21	0.38	0.81	2.50
0	20	0.05	0.15	0.50	1.60	3.70	5.70
	50	0.04	0.08	0.19	0.60	2.10	6.70
	90	0.03	0.08	0.15	0.36	1.10	4.10

- As frequency increases, absorption tends to increase
- As Relative Humidity increases, absorption tends to decrease
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**



Atmospheric Absorption at 10°C and 70% RH

Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind
- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a "bending" of the sound away from the earth's surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature
- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell's law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain
- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary
- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a "worst case" of downwind noise levels are desired.

Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

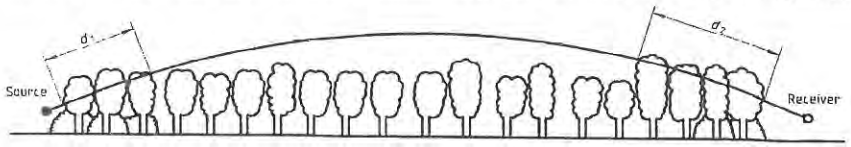
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \quad (dB/100m)$$

Where: A_g is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.



NOTE — $d_f = d_1 + d_2$

For calculating d_1 and d_2, the curved path radius may be assumed to be 5 km.

Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance d_f through the foliage

Table A.1 — Attenuation of an octave band of noise due to propagation a distance d_f through dense foliage

Propagation distance d_f	Nominal midband frequency Hz							
m	63	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can "carry" much further.

Snow

- Covers the ground for approximately 1/2 of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

Appendix III

SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from ERCB Guide 38: Noise Control Directive User Guide (February 2007)

Source[1]	Sound Level (dBA)
Bedroom of a country home	30
Soft whisper at 1.5 m	30
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy office	60
Noisy restaurant	70
Highway traffic at 15 m	75
Loud singing at 1 m	75
Tractor at 15 m	78-95
Busy traffic intersection	80
Electric typewriter	80
Bus or heavy truck at 15 m	88-94
Jackhammer	88-98
Loud shout	90
Freight train at 15 m	95
Modified motorcycle	95
Jet taking off at 600 m	100
Amplified rock music	110
Jet taking off at 60 m	120
Air-raid siren	130

[1] Cottrell, Tom, 1980, *Noise in Alberta*, Table 1, p.8, ECA80 - 16/1B4 (Edmonton: Environment Council of Alberta).

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from ERCB Guide 38: Noise Control Directive User Guide (February 2007)

Source[1]	Sound level at 3 feet (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	60-70
Food mixer	59-75
Electric knife	65-75
Electric knife sharpener	72
Sewing machine	70-74
Vacuum cleaner	65-80
Food blender	65-85
Coffee mill	75-79
Food waste disposer	69-90
Edger and trimmer	81
Home shop tools	64-95
Hedge clippers	85
Electric lawn mower	80-90

[1] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., *Noise in the Human Environment*, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Appendix IV

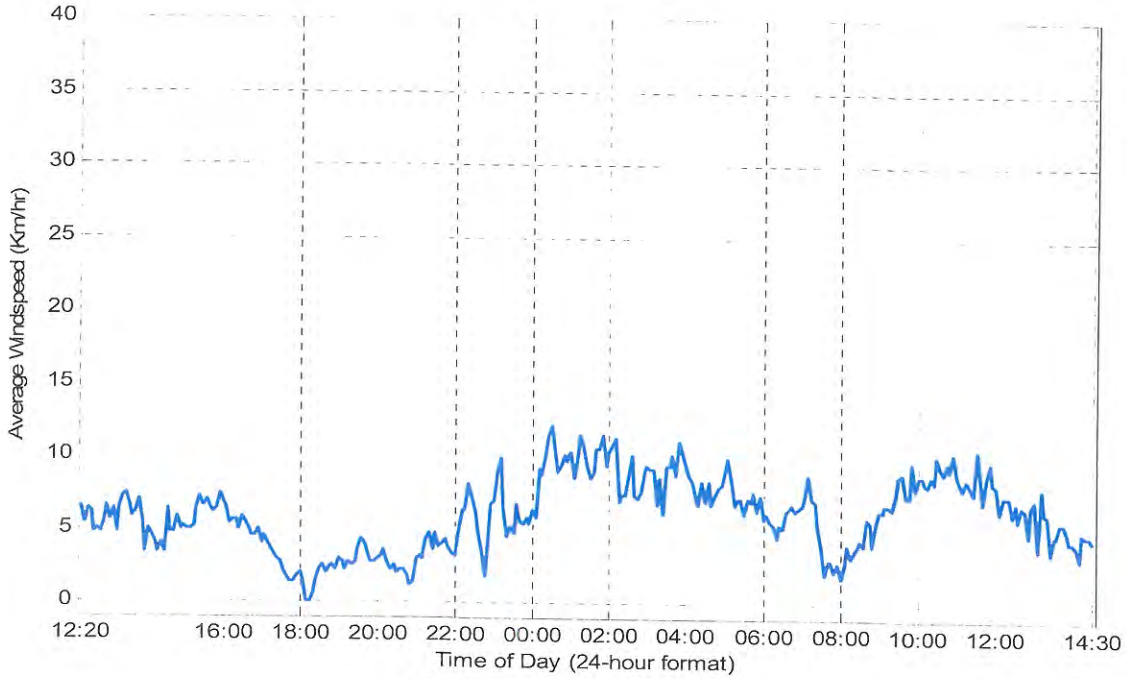
NOISE MODELING PARAMETERS

Vehicle Traffic (Baseline Case)					
Road	Day (Vehicles Per Hour)	Day % Heavy Trucks	Night (Vehicles Per Hour)	Night % Heavy Trucks	Speed (km/hr)
Wye Road (West of Rge Rd 232)	1506	4	276	4	70
Wye Road (Between Rge Rd 232 & Estates Drive)	1530	4	281	4	70
Wye Road (East of Estates Drive)	1500	4	275	4	70
Rge Rd 232 (South of Wye Rd)	438	3	80	3	60
Brentwood Blvd (North of Wye Rd)	707	3	130	3	60

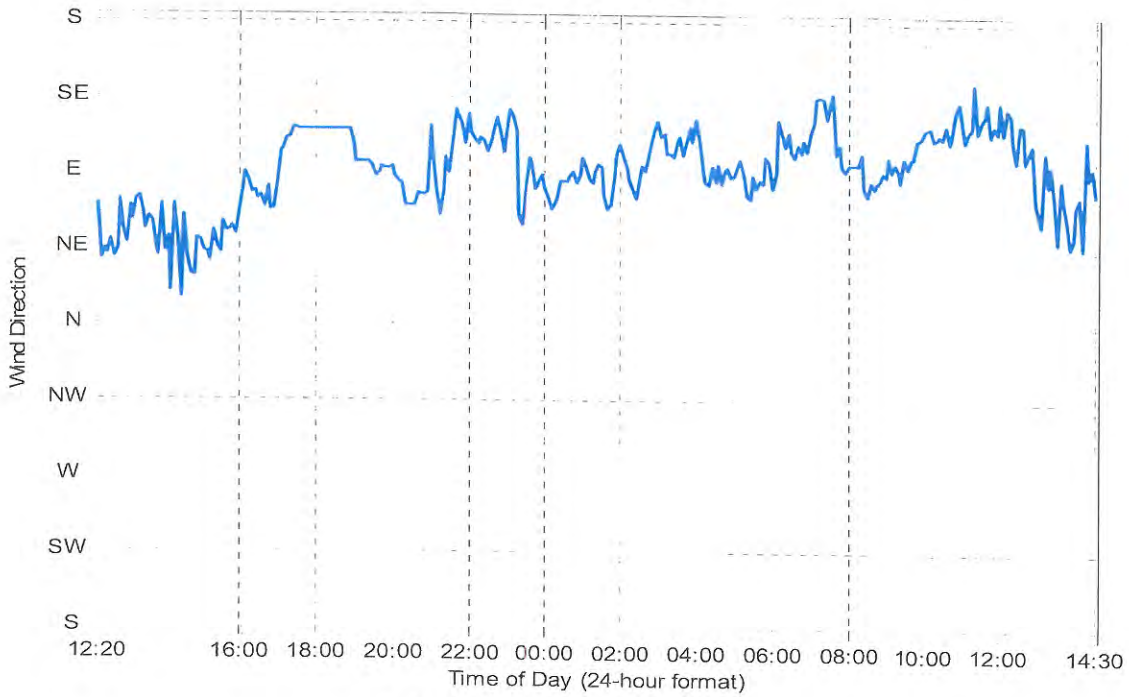
Vehicle Traffic (Future Case)					
Road	Day (Vehicles Per Hour)	Day % Heavy Trucks	Night (Vehicles Per Hour)	Night % Heavy Trucks	Speed (km/hr)
Wye Road (West of Rge Rd 232)	2752	4	505	4	70
Wye Road (Between Rge Rd 232 & Estates Drive)	2659	4	487	4	70
Wye Road (East of Estates Drive)	2644	4	485	4	70
Rge Rd 232 (South of Wye Rd)	1013	3	186	3	60
Brentwood Blvd (North of Wye Rd)	1477	3	271	3	60

Appendix V

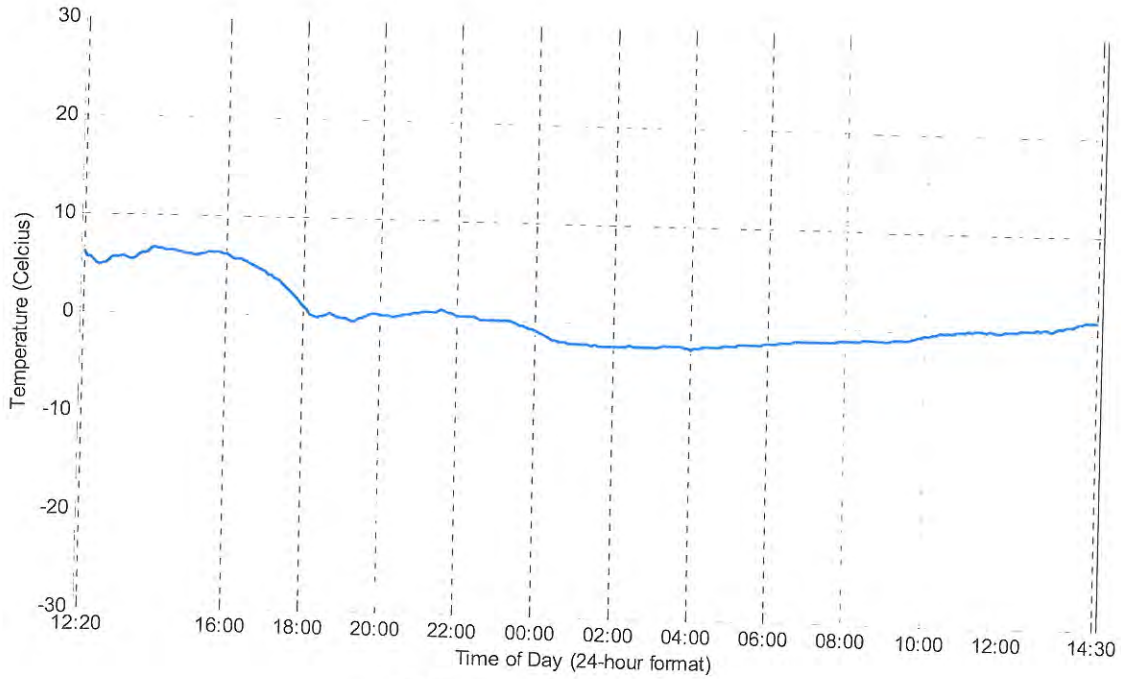
WEATHER DATA



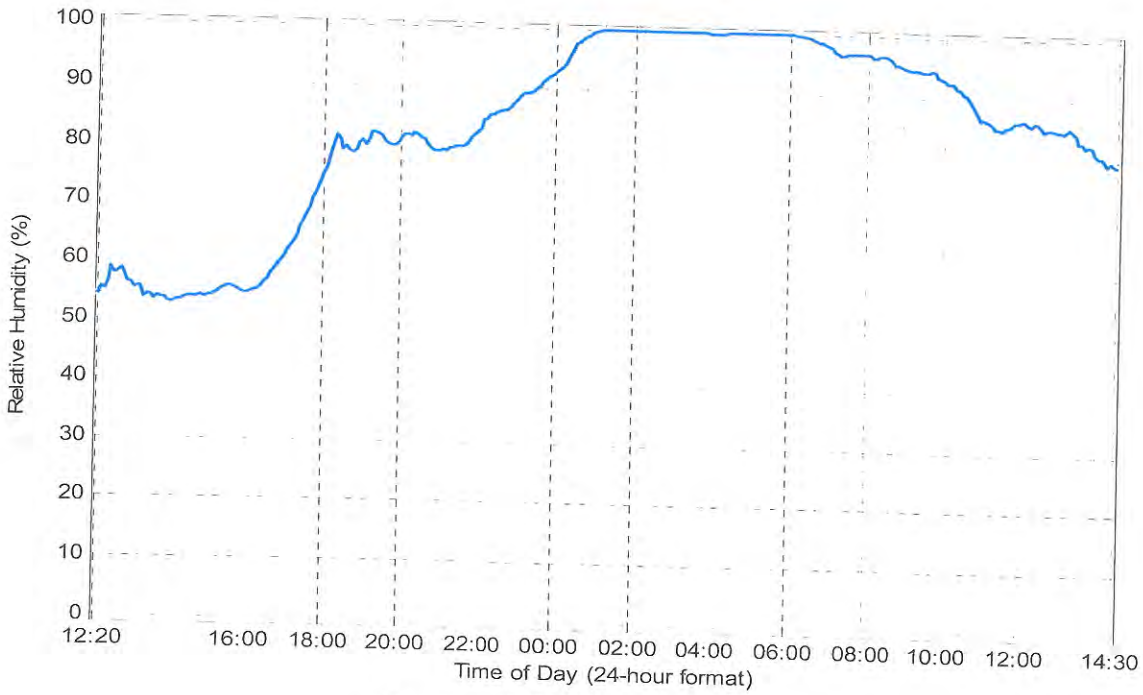
Monitored Wind Speed



Monitored Wind Direction



Monitored Temperature



Monitored Relative Humidity

AL-TERRA
ENGINEERING

Appendix A.3

Wye Road and Brentwood Boulevard Supplemental Intersection Analysis *(Al-Terra Engineering) – 2011*



AL-TERRA ENGINEERING

Strathcona County

Wye Road and Brentwood Boulevard

Supplementary Intersection Analysis

Appendix to:

Wye Road – Sherwood Park
Ordze Road to Highway 21
Functional Planning Study

May 2011

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1.0 INTRODUCTION

1.1 BACKGROUND

The original South Wye ASP was approved in 1990 and supported a range of low intensity commercial, business industrial and shopping centre uses. In 2007, the South Wye ASP was amended, and subsequently updated in 2009, to include a mix of commercial, residential and environmental land uses within three subareas:

- Wye Road Crossing – the west commercial portion;
- Salisbury Village West – the central mixed use portion;
- Salisbury Village East – the east portion formerly known as the Devco lands.

A Traffic Impact Assessment (TIA) was prepared in 2007/2008 by Bunt and Associates in support of the South Wye ASP with the final report being submitted to Strathcona County in February 2008. The TIA included the development of all the lands within the South Wye ASP, however, general land use assumptions were made with respect to Salisbury Village East as detailed planning for these lands had not been undertaken by the owners.

In 2010, the South Wye ASP was amended to allow for commercial office use with supporting hotel, retail, recreational and environmental land uses in Salisbury Village East. A TIA in support of the amendment was prepared by Bunt and Associates in September 2009.

1.2 OBJECTIVE

The objective of this addendum is to evaluate the traffic impact of the current version of the South Wye ASP and confirm the optimal approach for mitigating anticipated operational issues at the intersection of Wye Road and Brentwood Blvd.

1.3 SCOPE

This addendum is an assessment of 2015 PM peak hour operations - with and without the Wye & Brentwood jughandle - at the arterial intersections significantly impacted by the Salisbury Village land use amendment, including:

- Wye Road & Brentwood Boulevard;
- Wye Road & Mitchell Street;
- Range Road 232 & Jughandle;
- Range Road 232 & Salisbury Village East Parkway.

The primary focus of the assessment is the Wye Road corridor and specifically the two critical intersections of Wye Road & Brentwood Blvd and Wye Road and Mitchell Street.

2.0 2015 PROJECTED INTERSECTION TRAFFIC

2.1 Trip Generation and Distribution

Land use intensity in Salisbury Village East (formerly the Devco lands) is substantially higher than envisioned in the original ASP document. As a result, the number of trips generated by Salisbury Village East (SVE) is substantially more than originally anticipated by the original functional planning study.

Referencing the SVE TIA prepared Bunt & Associates and dated September 2009, traffic generated by the SVE in 2015 is expected to be 1052 vph in the PM peak period versus 563 vph originally estimated in Appendix A. This represents an 87% increase in traffic generation.

Additionally, the SVE TIA expects the percentage of pass-by trips to be considerably less since the current ASP proposes primarily business/office development as opposed to the low intensity business industrial and commercial uses originally identified for the lands. The pass-by rate anticipated in Appendix A is 40% versus 20% utilized in the SVE TIA. This reduction in pass-by trips increases the number of "new" vehicle trips on the road network.

Assumed primary trip distribution is similar as per the following table:

Table 1 - Primary Trip Distribution Comparison

	East Wye Road	West Wye Road	North Brentwood Blvd	South RgeRd 232	TOTAL
Bunt - SVE TIA	20%	35%	20%	25%	100%
Al-Terra - Appendix A	20%	30%	25%	25%	100%

2.2 2015 Background Traffic

Estimated 2015 background traffic is shown on Exhibit 4.2, which are the volumes utilized by the SVE TIA.

2.3 2015 Intersection Volumes

Appendix A projected PM peak hour intersection volumes are shown in detail on Exhibit G.1. Volumes projected by the SVE TIA are shown on Exhibit G.2. For comparative purposes, total projected intersection volumes are shown in Table 2.

Table 2 - Intersection Volume Comparison - Bunt TIA vs Appendix A

Intersection	Back Ground Traffic	Bunt				Al-Terra		Difference Bunt vs Al-Terra
		Site Traffic			Total Traffic	Site Traffic	Total Traffic	
		SVW	SVE	Total				
Wye & Brentwood	5064	1148	491	1639	6703	1394	6458	4%
Wye & Mitchell	3424	1167	545	1712	5136	1128	4552	13%
RR 232 & SVE Parkway	1318	511	534	1045	2363	1198	2516	-6%

SVW = Salisbury Village West + Wye Road Crossing; SVE = Salisbury Village East

Note that SVE TIA site traffic assigned to Wye & Brentwood is 18% higher than estimated by Appendix A; 52% higher at Wye & Mitchell; and 13% lower at RgeRd 232 & SVE Parkway.

3.0 2015 ROADWAY CAPACITY ANALYSIS & ASSESSMENT

3.1 GENERAL

The purpose of the following analysis is to evaluate intersection operations relative to capacity and to determine the measures-of-effectiveness (MOE's) to facilitate comparative assessment of four scenarios comprised of two proposed intersection control alternatives evaluated for two traffic volume regimes, as follows:

- Road Widening Alternative with Al-Terra Projected 2015 Traffic Volumes;
- Jughandle Alternative with Al-Terra Projected 2015 Traffic Volumes;
- Road Widening Alternative with Bunt Projected 2015 Traffic Volumes
- Jughandle Alternative with Bunt Projected 2015 Traffic Volumes.

The analysis that follows in this section focuses on the two critical intersections within the study area:

- Wye Road & Brentwood Boulevard;
- Wye Road & Mitchell Street.

Projected 2015 traffic volumes are shown on Exhibits G.1 and G.2 for the Al-Terra and Bunt estimates, respectively. Redistributed volumes reflecting the two jughandle scenarios are shown on are shown on Exhibits G.7 and G.8.

Overall summary exhibits illustrating select MOEs for the four analysis scenarios are attached at the end of this appendix.

3.2 METHODOLOGY

To evaluate intersection operating parameters and determine measures-of-effectiveness (MOE's), the Synchro / SimTraffic suite of analysis tools has been used. MOE's presented in this appendix are developed with Synchro's HCM tool.

For the purpose of this assessment, the following assumptions have been made:

- Saturation Flow Rate = 1900 vph;
- PHF = 1.00 (planning level value);
- Lane Utilization Factors = Synchro defaults (where applicable);
- Semi-actuated Coordinated Signal Operation;
- Signal Cycle Length = 140 seconds on Wye Road;
- Signal Cycle Length = 70 seconds at the intersection of Brentwood Blvd & Salisbury East Parkway.

Select MOEs for the study area are provided in the exhibits attached at end of this appendix along with detailed Synchro analyses for the intersections of Wye Road & Brentwood Boulevard & Wye Road & Mitchell Street.

3.3 INTERSECTION OF WYE ROAD & BRENTWOOD BOULEVARD

3.3.1 Lane Configuration and Signal Phasing

Road Widening Alternative

- *Eastbound on Wye Road*: dual left-turn lanes, three through lanes, right-turn lane developed as an added lane at Wye & Mitchell and further developed into an added lane on departure southbound;
- *Westbound on Wye Road*: dual left-turn lanes, three through lanes, right-turn bay & taper;
- *Northbound on Brentwood*: single left-turn lane, two through lanes, right-turn bay & taper including an acceleration bay & taper on departure;
- *Southbound on Brentwood*: dual left-turn lanes, two through lanes, right-turn bay & taper;
- *Signal Phasing*: protected-prohibited left-turn phasing east & westbound, protected-permissive left-turn phasing north & southbound.

Jughandle Alternative

- *Eastbound on Wye Road*: dual left-turn lanes, three through lanes, right-turn lane developed as an added lane at Wye & Mitchell;
- *Westbound on Wye Road*: left-turns prohibited, three through lanes, right-turn bay & taper;

- *Northbound on Brentwood*: left-turns prohibited, two through lanes, right-turn lane developed as an added lane at the Jughandle intersection including an acceleration bay & taper on departure;
- *Southbound on Brentwood*: left-turns prohibited, three through lanes, right-turn bay & taper;
- *Signal Phasing*: protected-prohibited left-turn phasing eastbound, no left turns allowed west, north & southbound.

3.3.2 Analysis with Al-Terra Projected 2015 Traffic Volumes

Intersection MOEs for both the road widening and jughandle alternatives are shown in Table 3.

Table 3 - Wye & Brentwood MOEs - Al-Terra Estimated 2015 PM Peak Volumes

	EB on Wye Rd			WB on Wye Rd			NB on Brentwood			SB on Brentwood		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Geometry	LL // TTT // R			LL // TTT // R			L // TT // R			LL // TT // R		
Road Widening Alternative												
2015 Volume (vph)	431	2467	149	289	797	198	156	611	279	327	552	202
v/c Ratio	0.80	0.92	0.16	0.91	0.34	0.22	0.79	0.81	0.65	0.90	0.73	0.41
Delay (s)	59.8	26.1	3.4	95.7	26.1	15.4	63.2	58.0	28.6	66.8	58.4	10.1
LOS	E	C	A	F	C	B	E	E	C	E	E	B
50th Queue (m)	57.3	242.7	8.9	43.8	55.4	25.6	31.8	91.8	30.0	37.5	79.8	2.6
95th Queue (m)	79.1	266.0	9.6	71.6	66.5	40.7	61.1	108.7	49.6	59.6	101.3	24.7
Approach LOS	C			D			D			D		
	Intersection Delay (s)			38.9			Intersection LOS			D		
Jughandle Alternative												
Geometry	LL // TTT // R			TTT // R			TT // R			TTT // R		
2015 Volume (vph)	411	2794	149	1086		198	641		279	914		202
v/c Ratio	0.73	0.74	0.13	0.40		0.23	0.79		0.82	0.79		0.41
Delay (s)	70.7	4.8	2.7	20.9		16.1	56.9		66.6	57.1		12.8
LOS	E	A	A	C		B	E		E	E		B
50th Queue (m)	54.0	39.1	5.2	68.4		25.0	82.1		66.2	92.8		7.7
95th Queue (m)	64.0	42.3	5.6	82.6		42.2	96.0		118.1	109.9		30.7
Approach LOS	B			C			E			D		
	Intersection Delay (s)			26.8			Intersection LOS			C		

Overall, intersection operations are improved by the jughandle alternative which has less intersection delay and improved intersection LOS relative to the road widening alternative. Of particular importance, the average delay on the critical eastbound approach is dramatically reduced from 29.7 to 12.8 seconds with the jughandle, and the approach LOS improves from LOS C to LOS B. In addition, the eastbound through movement v/c is reduced from 0.92 to 0.74 and the 95th queue is reduced from 266m to 42m which is conducive to the provision of excellent coordinated operation with the upstream signals at Mitchell Street.

3.3.3 Analysis With Bunt Projected 2015 Traffic Volumes

Intersection MOEs for both the road widening and jughandle alternatives are shown in Table 4.

Table 4 - Wye & Brentwood MOEs - Bunt Estimated 2015 PM Peak Volumes

	EB on Wye Rd			WB on Wye Rd			NB on Brentwood			SB on Brentwood		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Geometry	LL // TTT // R			LL // TTT // R			L // TT // R			LL // TT // R		
Road Widening Alternative												
2015 Volume (vph)	594	2479	103	145	928	197	183	650	323	327	415	359
v/c Ratio	0.81	0.90	0.10	0.55	0.46	0.24	0.73	0.86	0.79	0.90	0.55	0.58
Delay (s)	58.2	19.5	0.4	70.6	33.1	19.6	50.6	59.8	42.3	66.8	52.8	8.5
LOS	E	B	A	E	C	B	D	E	D	E	D	A
50th Queue (m)	75.7	211.3	0.3	21.3	73.8	28.7	36.1	94.7	48.9	37.8	57.4	0.0
95th Queue (m)	95.9	182.9	0.4	33.3	89.7	47.3	60.8	124.1	76.5	59.6	75.6	28.0
Approach LOS	C			D			D			D		
	Intersection Delay (s)			35.3			Intersection LOS			D		
Jughandle Alternative												
Geometry	LL // TTT // R			TTT // R			TT // R			TTT // R		
2015 Volume (vph)	594	2806	103	1073		197	650		323	742		359
v/c Ratio	0.79	0.75	0.09	0.44		0.25	0.80		0.94	0.64		0.56
Delay (s)	63.0	4.7	2.1	26.0		20.3	57.6		90.7	52.4		8.0
LOS	E	A	A	C		C	E		F	D		A
50th Queue (m)	77.2	44.5	2.8	75.3		28.0	82.4		88.2	72.4		0.0
95th Queue (m)	80.0	46.4	3.1	94.1		48.9	99.0		129.8	87.6		27.3
Approach LOS	B			C			E			D		
	Intersection Delay (s)			27.9			Intersection LOS			C		

Similar to the analysis with Al-Terra volumes, overall intersection operations are improved by the jughandle alternative with less intersection delay and improved intersection LOS relative to the road widening alternative. The average delay on the critical eastbound approach is reduced from 26.1 to 14.5 seconds with the jughandle, and the approach LOS improves from LOS C to LOS B. In addition, the eastbound through movement v/c is reduced from 0.90 to 0.75 and the 95th queue is reduced from 211m to 46m which again, is conducive to the provision of excellent coordinated operation with the upstream signals at Mitchell Street.

3.4 INTERSECTION OF WYE ROAD & MITCHELL STREET

3.4.1 Lane Configuration and Signal Phasing

Road Widening Alternative

- *Eastbound on Wye Road*: three through lanes, right-turn lane developed as an added lane at the upstream right-in / right-out access;
- *Westbound on Wye Road*: dual left-turn lanes, three through lanes;
- *Northbound on Mitchell Street*: dual left-turn lanes, right-turn bay & taper developed into an added lane on departure eastbound;
- *Signal Phasing*: protected-permitted phasing westbound.

Jughandle Alternative

The lane configuration and signal phasing remains unchanged from the road widening alternative.

3.4.2 Analysis with Al-Terra Projected 2015 Traffic Volumes

Intersection MOEs for both the road widening and jughandle alternatives are shown in Table 5.

Table 5 - Wye & Mitchell MOEs - Al-Terra Estimated 2015 PM Peak Volumes

	EB on Wye Rd		WB on Wye Rd		NB on Mitchell St	
Movement	T	R	L	T	L	R
Geometry	TTT // R		LL // TTT		LL // R	
Road Widening Alternative						
2015 Volume (vph)	2811	259	188	967	91	236
v/c Ratio	0.78	0.22	0.59	0.24	0.20	0.62
Delay (s)	17.3	2.2	29.3	3.6	55.1	55.0
LOS	B	A	C	A	E	D
50th Queue (m)	190.9	4.0	17.1	20.5	12.3	61.0
95th Queue (m)	218.6	13.8	25.5	23.8	21.2	89.4
Approach LOS	B		A		D	
Intersection Delay (s)	16.8		Intersection LOS		B	
Jughandle Alternative						
2015 Volume (vph)	2791	259	477	811	252	563
v/c Ratio	0.86	0.24	0.87	0.20	0.52	0.91
Delay (s)	26.0	4.2	57.0	4.2	60.7	51.7
LOS	C	A	E	A	E	D
50th Queue (m)	235.7	8.5	63.2	19.3	35.7	114.7
95th Queue (m)	257.9	20.5	80.3	21.9	50.5	186.6
Approach LOS	C		C		D	
Intersection Delay (s)	28.8		Intersection LOS		C	

Overall, intersection operations are degraded by the jughandle alternative which has higher intersection delay and lower intersection LOS relative to the road widening alternative.

With the jughandle, overall intersection delay at Mitchell increases from 16.8 seconds to 28.8 seconds and the LOS falls from LOS B to LOS C. Three movements will operate close to capacity:

- Eastbound through – v/c increases from 0.78 to 0.86;
- Westbound left – v/c increases from 0.59 to 0.87;
- Northbound right – v/c increases from 0.62 to 0.91.

3.4.3 Analysis With Bunt Projected 2015 Traffic Volumes

Intersection MOEs for both the road widening and jughandle alternatives are shown in Table 6.

Table 6 - Wye & Mitchell MOEs - Bunt Estimated 2015 PM Peak Volumes

	EB on Wye Rd		WB on Wye Rd		NB on Mitchell St	
Movement	T	R	L	T	L	R
Geometry	TTT // R		LL // TTT		LL // R	
Road Widening Alternative						
2015 Volume (vph)	2842	140	394	1075	349	334
v/c Ratio	0.84	0.13	0.87	0.26	0.73	0.74
Delay (s)	22.8	3.2	47.5	5.3	67.6	57.0
LOS	C	A	D	A	E	E
50th Queue (m)	224.7	3.5	42.2	23.9	51.0	88.2
95th Queue (m)	245.9	11.7	67.8	42.7	68.7	125.4
Approach LOS	C		B		E	
Intersection Delay (s)	25.8		Intersection LOS		C	
Jughandle Alternative						
2015 Volume (vph)	2842	140	539	892	532	661
v/c Ratio	0.92	0.14	0.96	0.23	0.96	0.99
Delay (s)	31.9	5.0	64.3	6.0	87.0	63.8
LOS	C	A	E	A	F	E
50th Queue (m)	260.1	5.5	70.5	24.9	80.3	147.1
95th Queue (m)	284.5	15.1	101.2	39.8	116.4	232.9
Approach LOS	C		C		E	
Intersection Delay (s)	39.2		Intersection LOS		D	

Similar to the analysis with Al-Terra volumes, overall intersection operations are degraded by the jughandle alternative which has higher intersection delay and lower intersection LOS relative to the road widening alternative.

With the jughandle, overall intersection delay at Mitchell increases from 25.8 seconds to 30.2 seconds and the LOS falls from LOS C to LOS D. Four movements will operate very close to capacity and have a high likelihood of failing:

- Eastbound through – v/c increases from 0.84 to 0.92;
- Westbound left – v/c increases from 0.87 to 0.96;
- Northbound left – v/c increases from 0.73 to 0.96;
- Northbound right – v/c increases from 0.74 to 0.99.

3.5 NETWORK EVALUATION

Network MOEs are shown in Table 7 for the two critical intersections in the study area: Wye Road & Brentwood Blvd and Wye Road & Mitchell Street.

Note that lower Performance Indexes are indicative of better performance. The Performance Index is calculated as:

PI = [D + (10 x St)] / 3600

PI = Performance Index
D = Total Delay (s)
St = Vehicle Stops

Table 7 - Network MOE Comparison

	Road Widening		Jughandle Alternative	
	Al-Terra Volumes	Bunt Volumes	Al-Terra Volumes	Bunt Volumes
Delay (s/veh)	30	31	28	33
Delay (hr)	91	102	91	114
Stops / Veh	0.69	0.72	0.61	0.62
Stops (#)	7610	8528	7186	7726
Average Speed (km/hr)	26	24	27	23
Dilemna Zone Vehicles (#)	290	331	270	286
Performance Index	112.2	126.2	110.9	135.6

For the Al-Terra volumes, which represent the original ASP land use and intensity, the jughandle alternative has the better MOEs and therefore offers the best solution. For the Bunt volumes, which are substantially higher reflecting the more intense land use of the recently amended ASP, the traditional road widening approach is superior to the jughandle treatment.

4.0 DISCUSSION AND CONCLUSION

4.1 GENERAL

The original South Wye ASP was approved in 1990 and supported a range of low intensity commercial, business industrial and shopping centre uses. For the Devco lands, the trip generation calculated in Appendix A of this report was based on this low density land use as detailed planning for these lands had not been undertaken by the owners.

The South Wye ASP has recently been amended to allow for commercial office use in the Devco lands with supporting hotel, retail, recreational and environmental land uses. A TIA in support of the amendment was prepared by Bunt and Associates in September 2009.

The character and intensity of development in the Devco lands (Salisbury Village East) is now significantly different than was originally anticipated in Appendix A. Projected PM peak trip generation levels for the lands have increased by 87% from 563 vph, estimated in Appendix A, to 1052 vph per the Bunt TIA.

Given that current traffic projections are significantly higher than initially anticipated by Appendix A, the remainder of this discussion will focus on analysis that utilizes the current traffic projections estimated in the Bunt TIA.

4.2 INTERSECTION OPERATIONS

As expected, operations at the intersection of Wye Road & Brentwood Blvd are improved by the jughandle treatment since three of the four left turn movements are eliminated thus permitting more allocation of green-time to the through movements. Overall intersection delay is reduced from 35 seconds to 28 seconds relative to a traditional intersection widening treatment and intersection LOS improves from LOS D to LOS C. The v/c ratio for the critical eastbound through movement improves from 0.90 to 0.75. Delays and queues are reduced substantially.

However, the improvement at Wye & Brentwood comes at the expense of operations at Wye & Mitchell which gains extra traffic from the jughandle treatment. With the jughandle, overall intersection delay at Mitchell increases from 26 seconds to 39 seconds and the LOS falls from LOS C to LOS D. Of particular significance is that there will be potential operational issues on all three approaches and signal phases:

- Eastbound through – v/c increases from 0.84 to 0.92;
- Westbound left – v/c increases from 0.87 to 0.96;
- Northbound left – v/c increases from 0.73 to 0.96;
- Northbound right – v/c increases from 0.74 to 0.99.

In effect, introducing the jughandle transfers operational issues from Wye & Brentwood to Wye & Mitchell, however the issues are magnified at Wye & Mitchell.

4.3 NETWORK CONSIDERATIONS

The two intersection alternatives under consideration involve trade-offs in operational metrics:

- the jughandle treatment significantly improves operations at Wye & Brentwood but degrades operations at Wye & Mitchell to the point of failure;
- a traditional road widening treatment results in near capacity operation at both intersections but slightly favours Wye & Mitchell.

A network evaluation of the two intersections together suggests that the road widening alternative is superior to the jughandle treatment. Network Performance Indices are 126 for the road widening alternative and 136 for the jughandle alternative (a lower Performance Index indicates better performance). Interestingly, the opposite is true for analysis utilizing the original Al-Terra projected traffic volumes: the jughandle treatment results in better network performance.

4.4 CONCLUSION

From a road network perspective, and considering the increase in projected level of traffic flow resulting from the recently amended South Wye ASP, a traditional road widening treatment at the intersection of Wye Road and Brentwood Boulevard is superior to a jughandle treatment.

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Approved by:
Al-Terra Engineering Ltd.

Corry G. Broks, P.Eng.

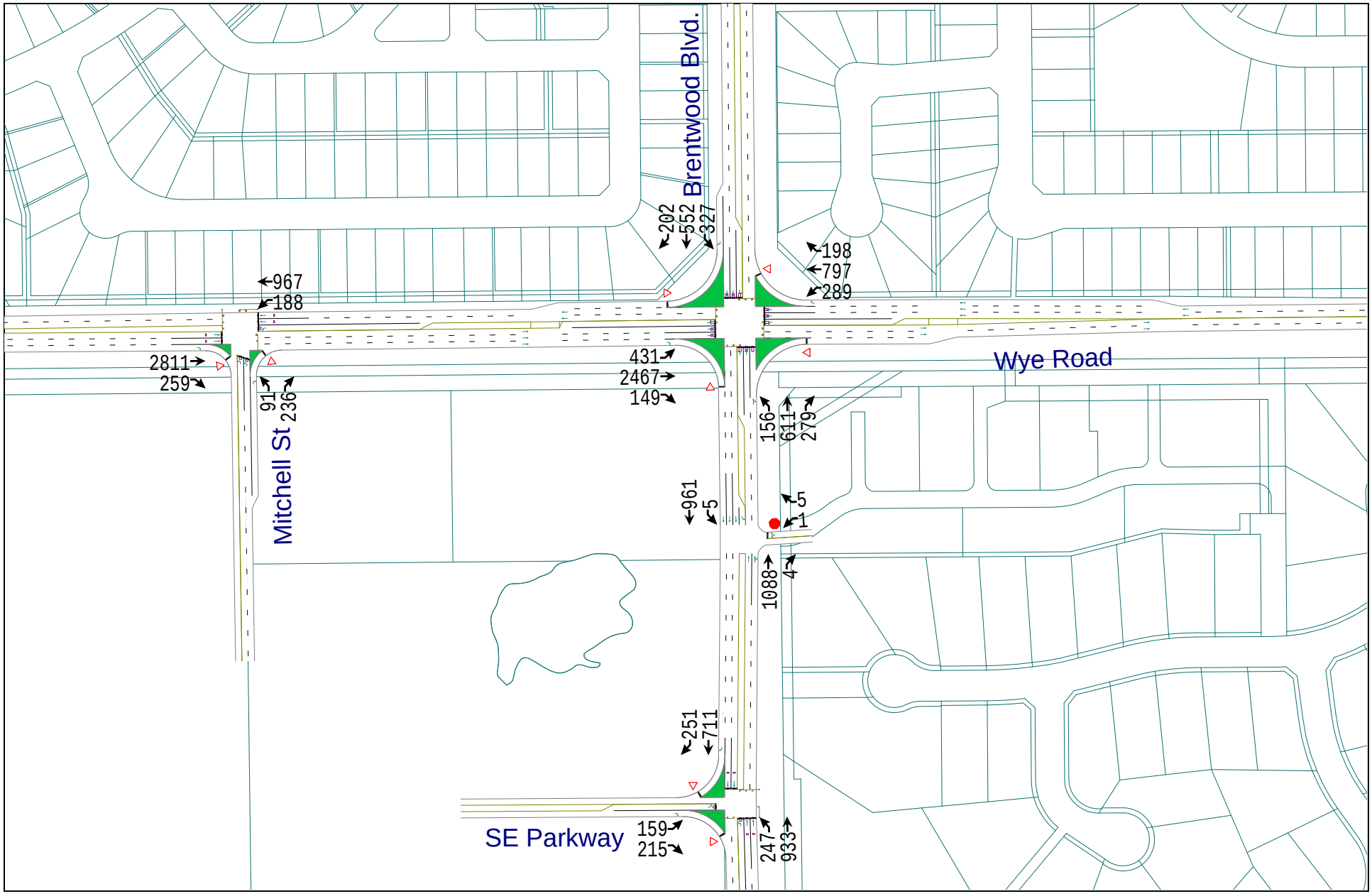


Exhibit G.1
2015 PM Peak Traffic Volumes - Al-Terra Estimate

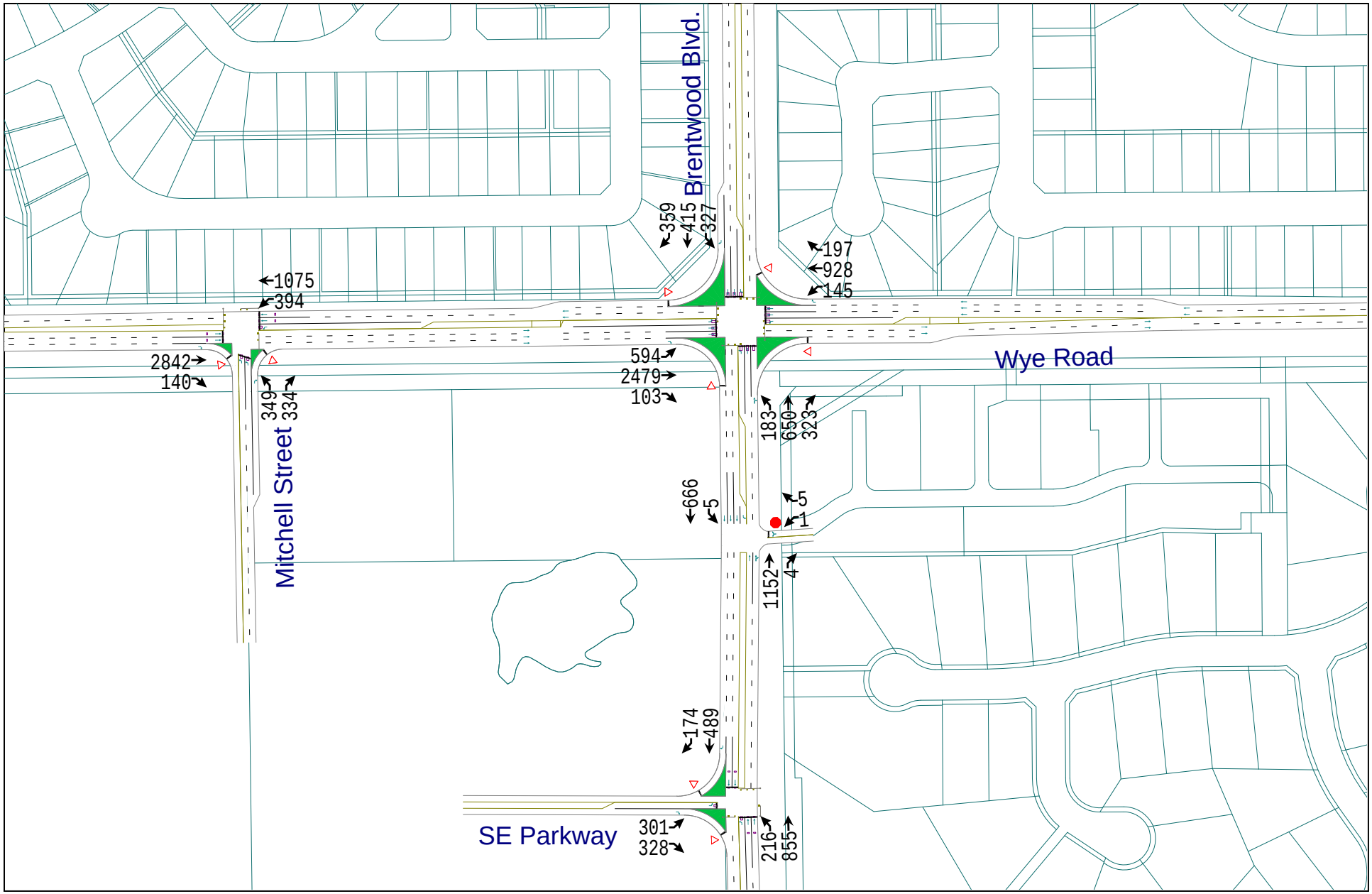


Exhibit G.2
2015 PM Peak Traffic Volumes - Bunt Estimate

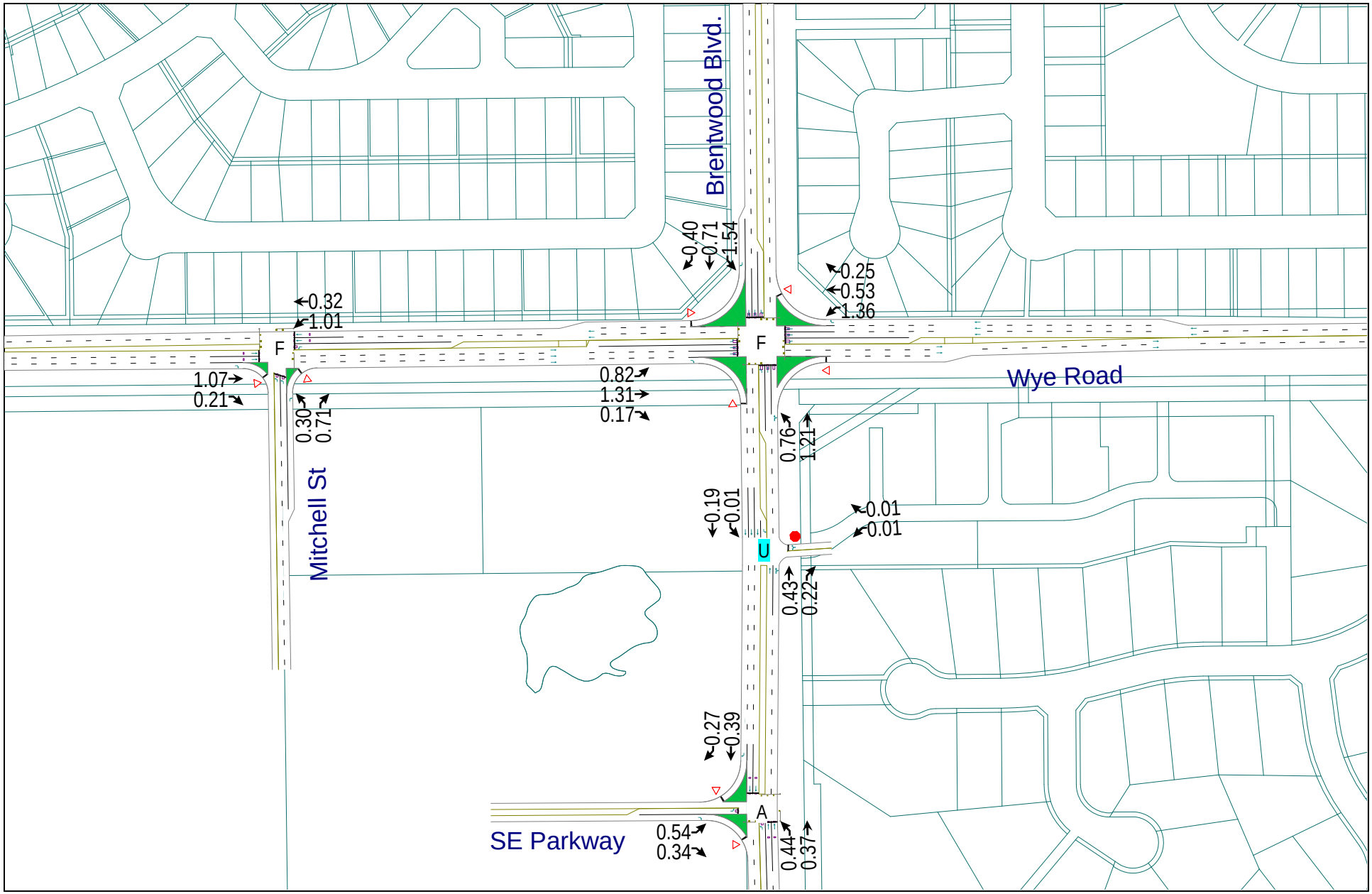


Exhibit G.3

Intersection LOS and Movement V/C Ratios - Al-Terra Volumes **No Improvements**

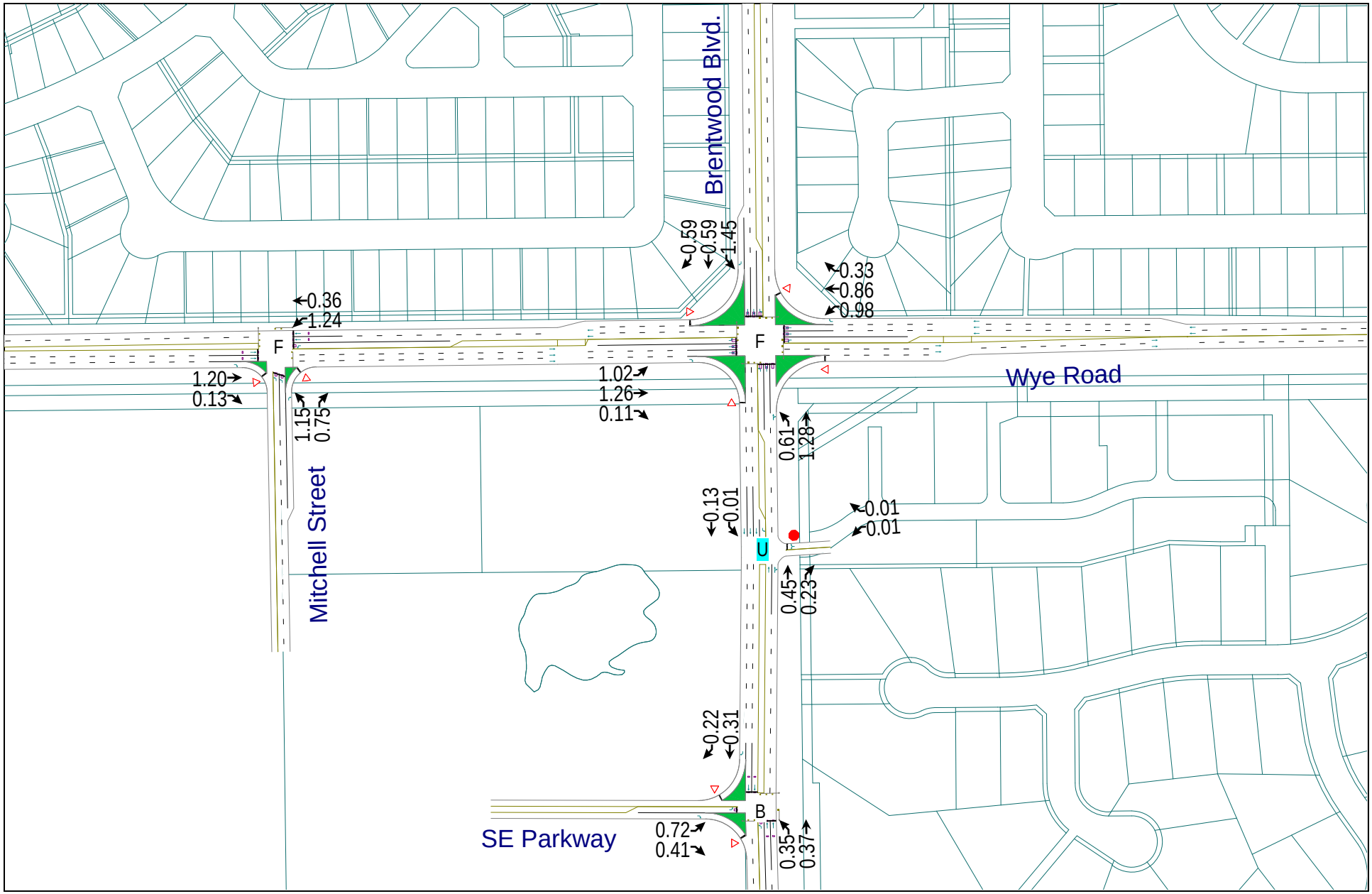


Exhibit G.4
Intersection LOS and Movement V/C Ratios - Bunt Volumes

No Improvements

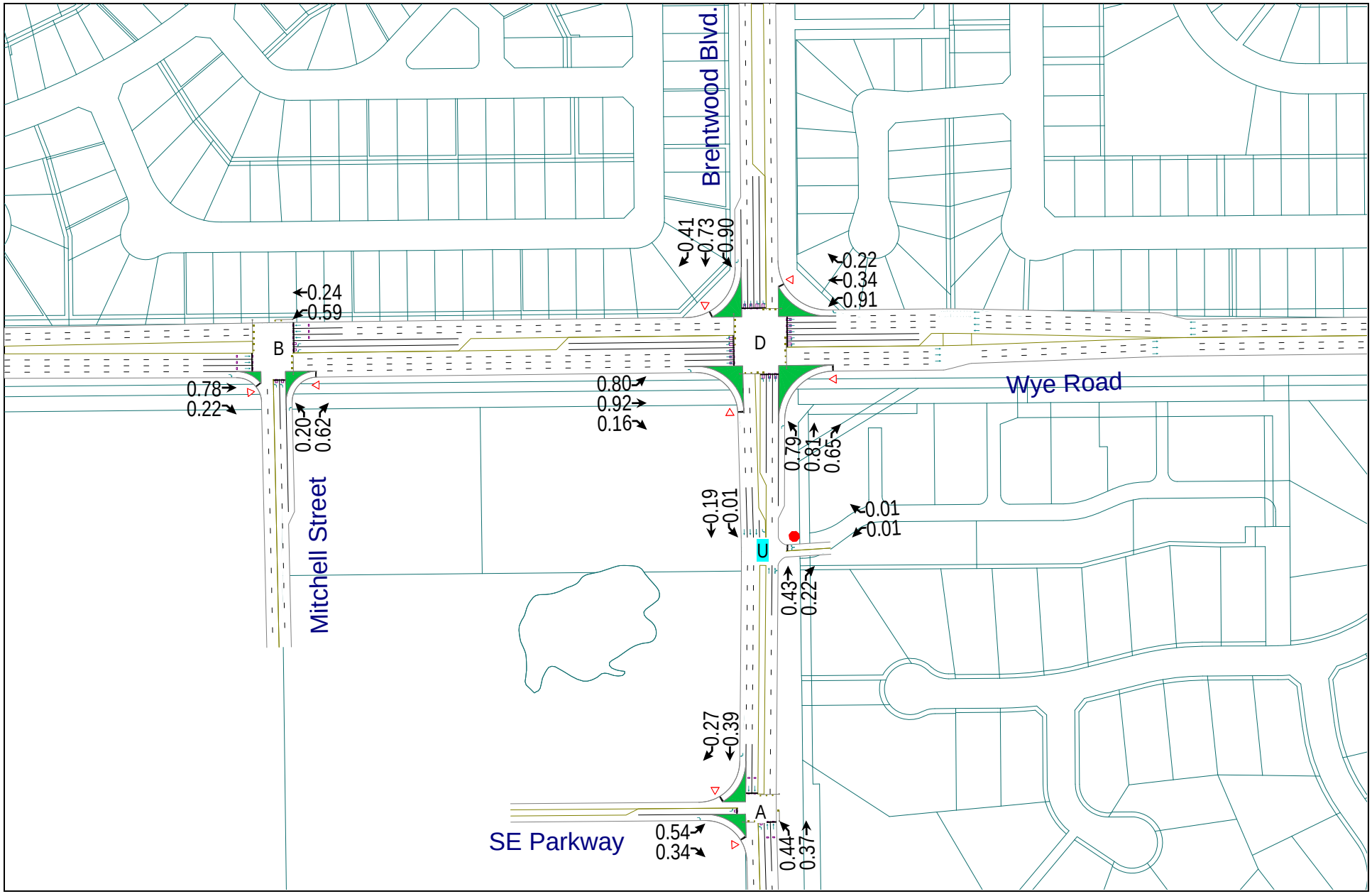


Exhibit G.5
Intersection LOS and Movement V/C Ratios - Al-Terra Volumes **Road Widening Treatment**

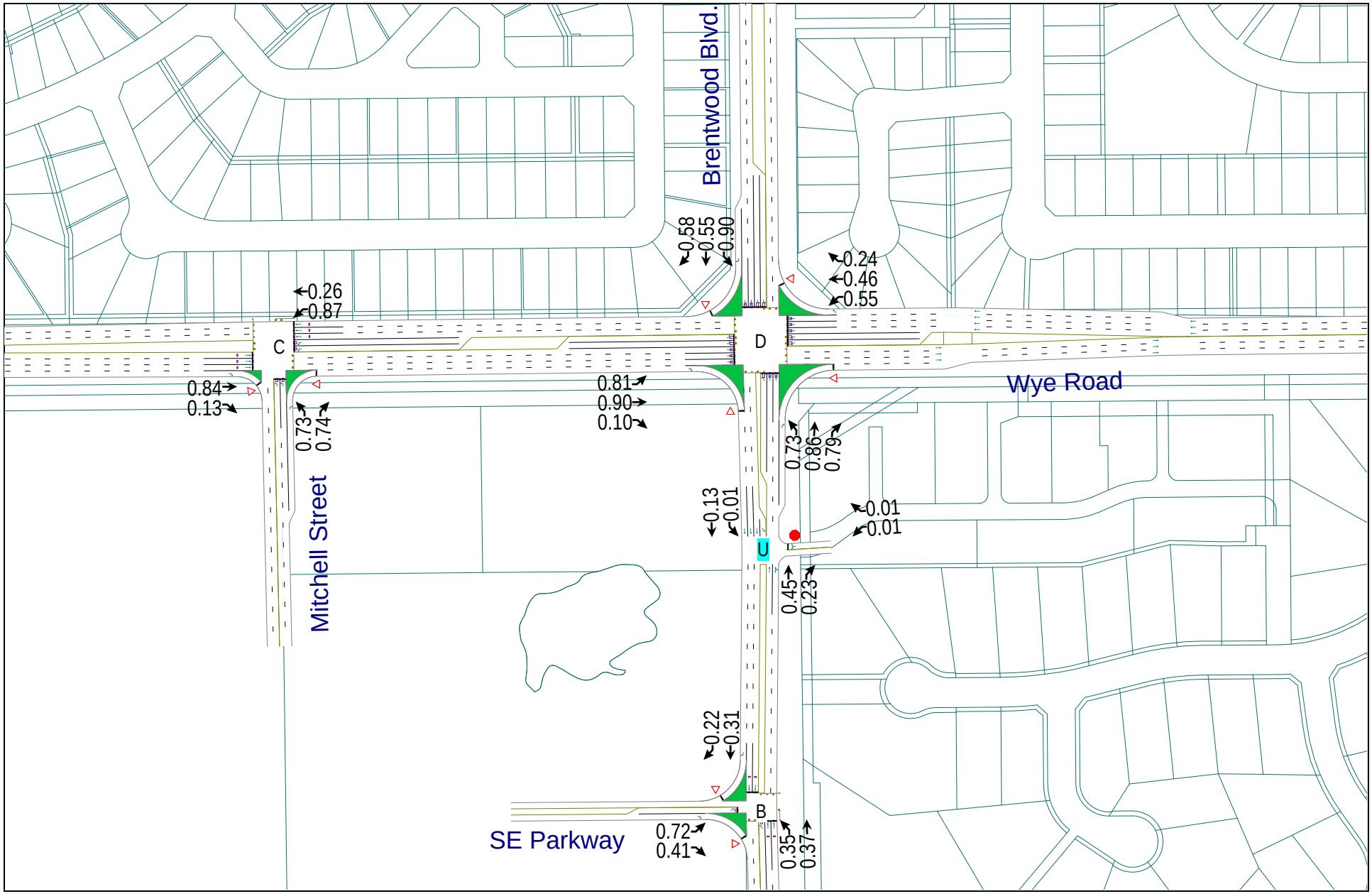


Exhibit G.6
Intersection LOS and Movement V/C Ratios - Bunt Volumes **Road Widening Treatment**

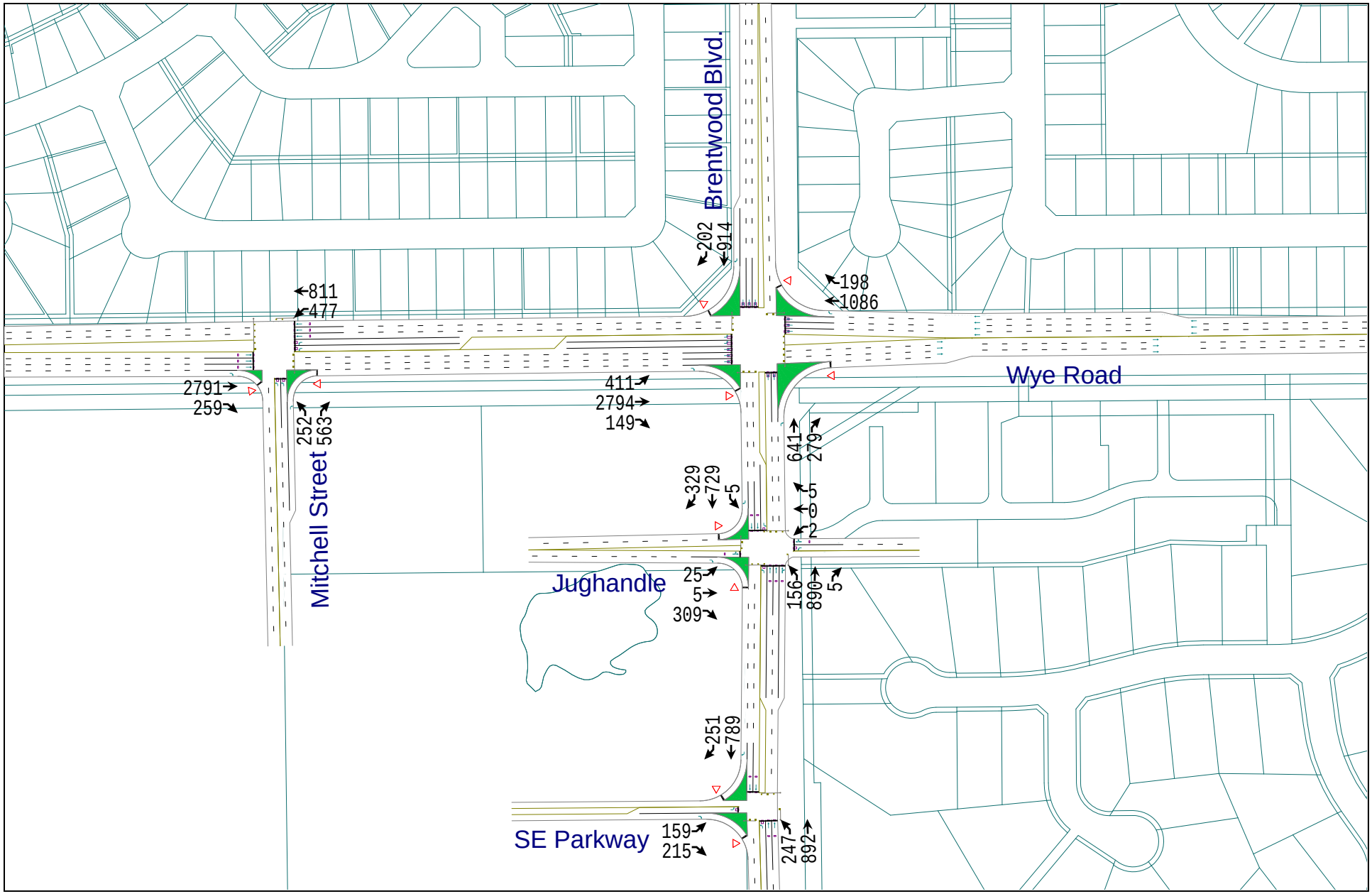


Exhibit G.7
2015 Traffic Redistribution with Jughandle - Al-Terra Estimate

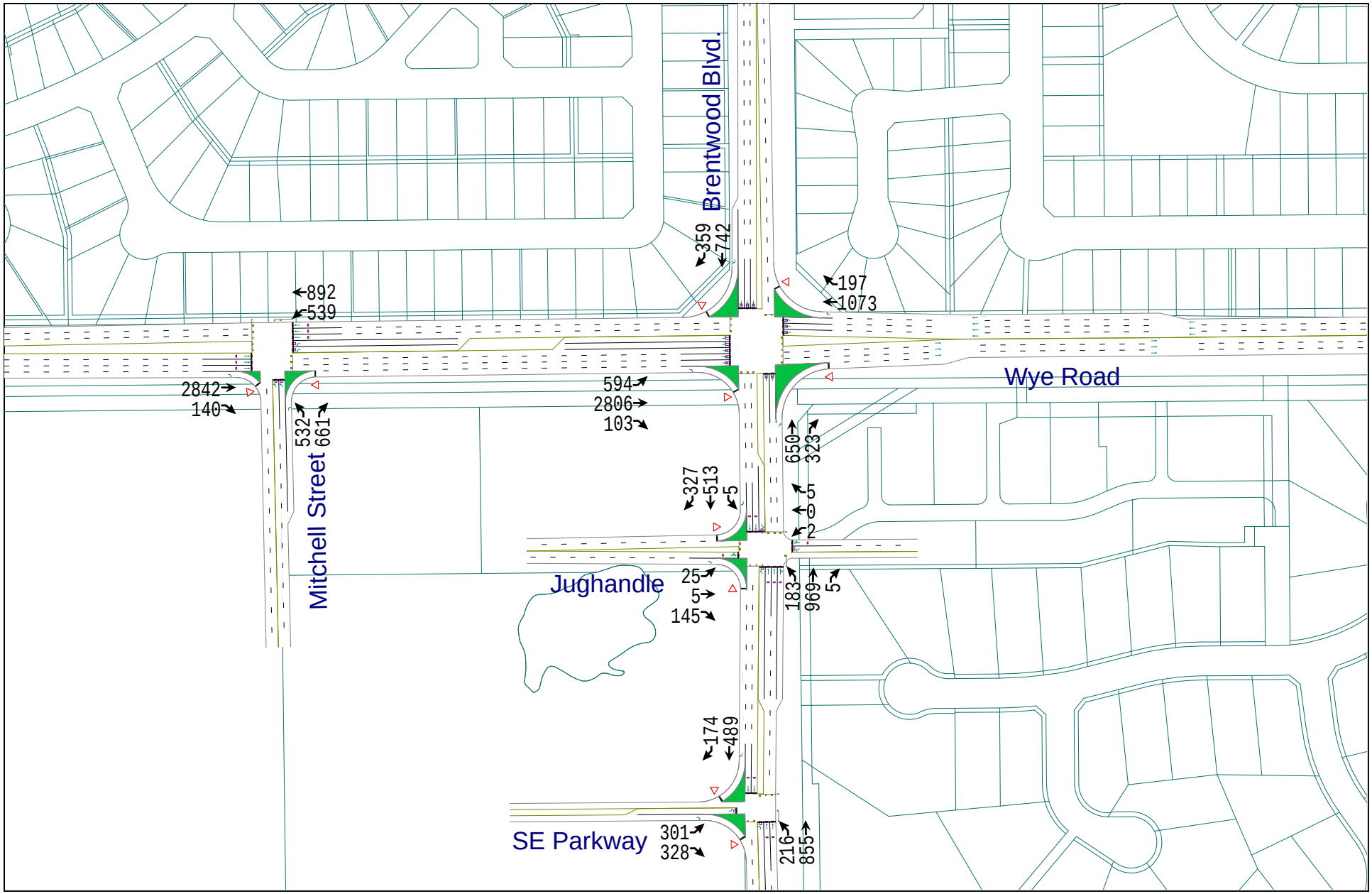


Exhibit G.8
2015 Traffic Redistribution with Jughandle - Derived From Bunt Volumes

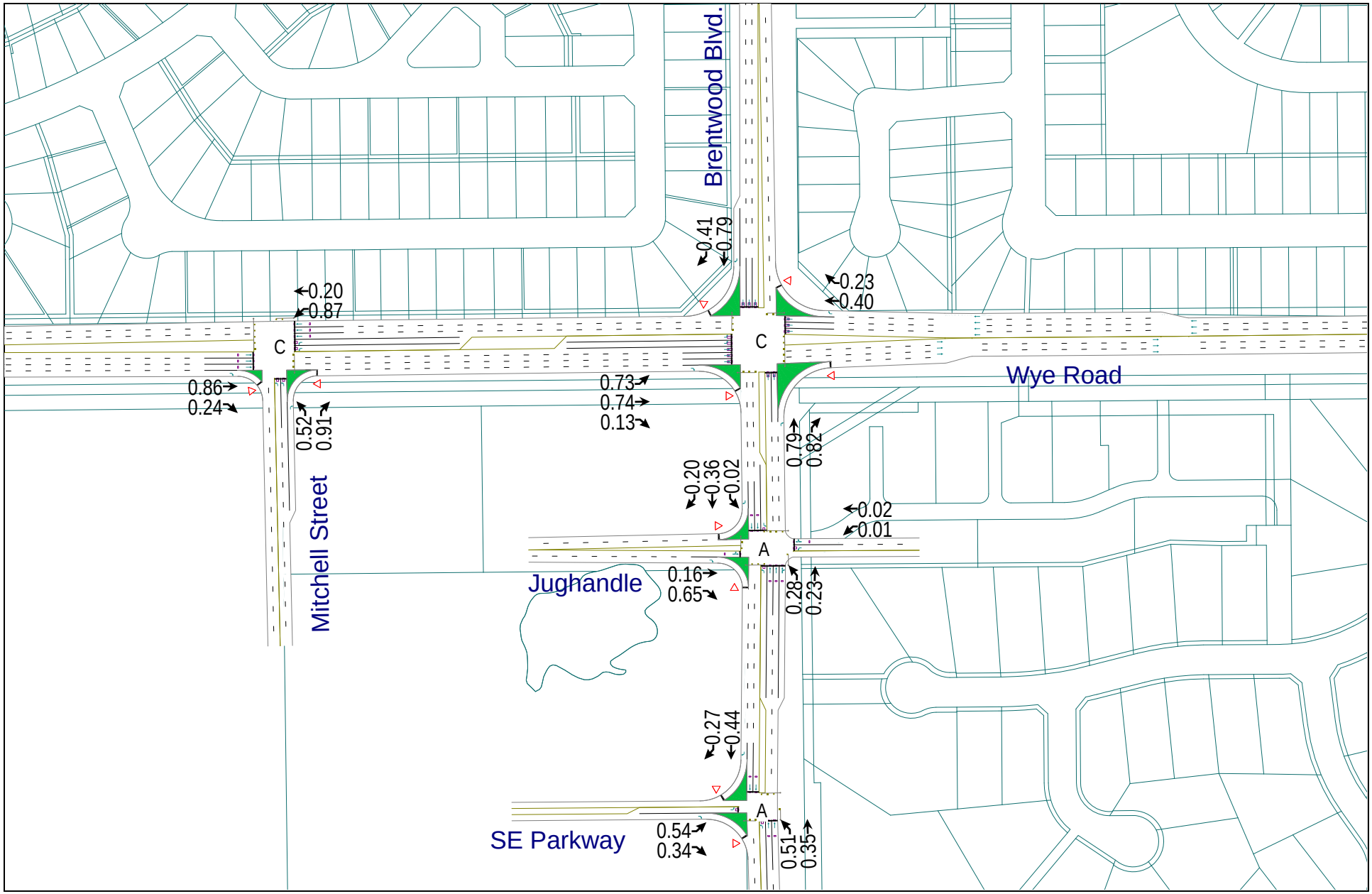


Exhibit G.9
Intersection LOS and Movement V/C Ratios - Al-Terra Volumes **Jughandle Treatment**

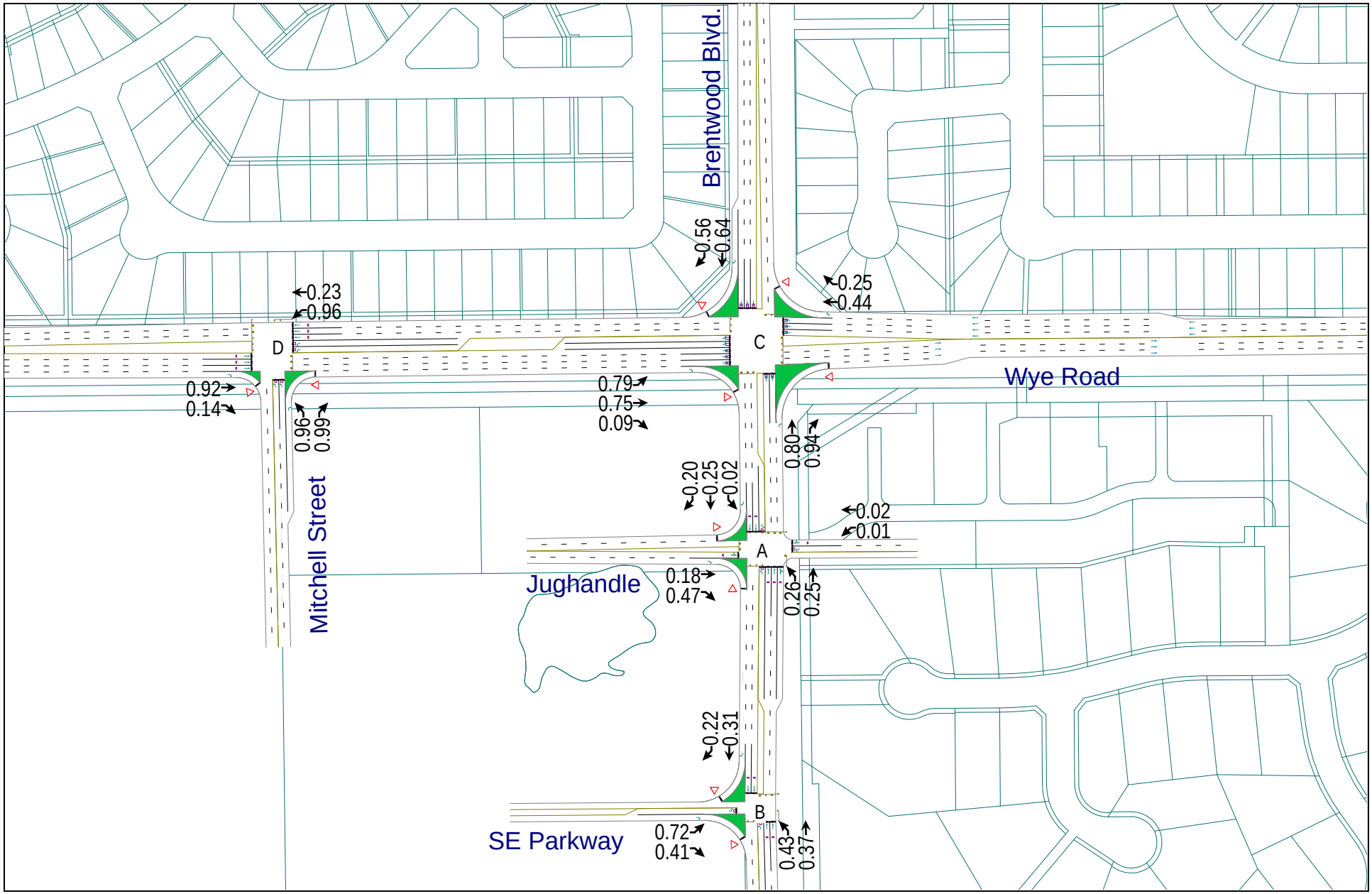
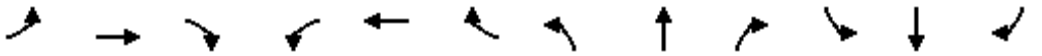


Exhibit G.10

Intersection LOS & Movement V/C Ratios - Volumes Derived from Bunt TIA **Jughandle Treatment**



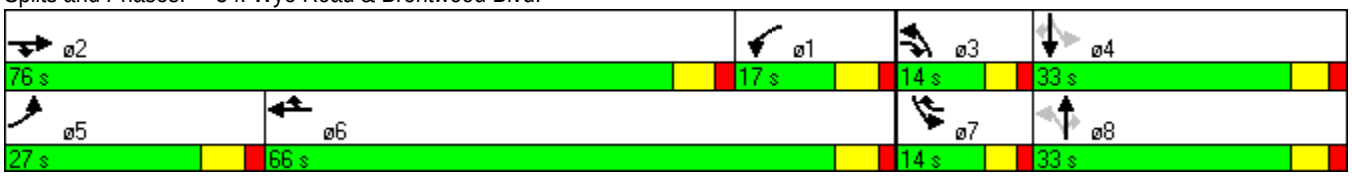
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	431	2467	149	289	797	198	156	611	279	327	552	202
Satd. Flow (prot)	3541	5245	1633	3541	5245	1633	1825	3650	1633	3541	3650	1633
Flt Permitted	0.950			0.950			0.169			0.143		
Satd. Flow (perm)	3541	5245	1633	3541	5245	1633	325	3650	1633	533	3650	1633
Satd. Flow (RTOR)			25			23			141			191
Lane Group Flow (vph)	431	2467	149	289	797	198	156	611	279	327	552	202
Turn Type	Prot		pt+ov	Prot		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2	2 3	1	6	6 7	3	8		7	4	
Permitted Phases						6	8		8	4		4
Detector Phase	5	2	2 3	1	6	6 7	3	8	8	7	4	4
Switch Phase												
Minimum Initial (s)	5.0	14.0		5.0	14.0		5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	11.5	27.5		11.5	27.5		10.0	33.0	33.0	10.0	33.0	33.0
Total Split (s)	27.0	76.0	90.0	17.0	66.0	80.0	14.0	33.0	33.0	14.0	33.0	33.0
Total Split (%)	19.3%	54.3%	64.3%	12.1%	47.1%	57.1%	10.0%	23.6%	23.6%	10.0%	23.6%	23.6%
Yellow Time (s)	4.5	4.5		4.5	4.5		3.5	4.0	4.0	3.5	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.5	2.0	2.0	1.5	2.0	2.0
Lost Time Adjust (s)	-1.5	-2.0	-2.0	-2.0	-2.0	-2.0	-1.0	-2.0	0.0	-1.0	-2.0	-2.0
Total Lost Time (s)	5.0	4.5	4.5	4.5	4.5	4.5	4.0	4.0	6.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	Min	C-Max		Min	C-Max		Min	Min	Min	Min	Min	Min
Act Effct Green (s)	21.2	71.5	81.0	12.5	62.3	76.3	39.0	29.0	27.0	39.0	29.0	29.0
Actuated g/C Ratio	0.15	0.51	0.58	0.09	0.44	0.54	0.28	0.21	0.19	0.28	0.21	0.21
v/c Ratio	0.80	0.92	0.16	0.91	0.34	0.22	0.79	0.81	0.65	0.90	0.73	0.41
Control Delay	59.8	25.8	3.4	95.7	26.1	15.4	63.2	58.0	28.6	66.8	58.4	10.1
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.8	26.1	3.4	95.7	26.1	15.4	63.2	58.0	28.6	66.8	58.4	10.1
LOS	E	C	A	F	C	B	E	E	C	E	E	B
Approach Delay		29.7			40.1			50.9			51.9	
Approach LOS		C			D			D			D	
Queue Length 50th (m)	57.3	242.7	8.9	43.8	55.4	25.6	31.8	91.8	30.0	37.5	79.8	2.6
Queue Length 95th (m)	79.1	266.0	m9.6	#71.6	66.5	40.7	#61.1	108.7	49.6	#59.6	101.3	24.7
Internal Link Dist (m)		267.1			94.9			101.8			227.5	
Turn Bay Length (m)	100.0			80.0			60.0		80.0	80.0		60.0
Base Capacity (vph)	556	2680	955	316	2334	900	198	756	429	363	756	490
Starvation Cap Reductn	0	24	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.93	0.16	0.91	0.34	0.22	0.79	0.81	0.65	0.90	0.73	0.41

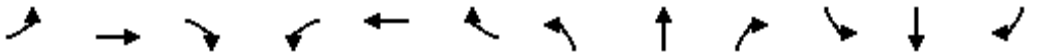
Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 115
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92

Intersection Signal Delay: 38.9	Intersection LOS: D
Intersection Capacity Utilization 96.3%	ICU Level of Service F
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 34: Wye Road & Brentwood Blvd.





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	411	2794	149	0	1086	198	0	641	279	0	914	202
Satd. Flow (prot)	3541	5245	1633	0	5245	1633	0	3650	1633	0	5245	1633
Flt Permitted	0.950											
Satd. Flow (perm)	3541	5245	1633	0	5245	1633	0	3650	1633	0	5245	1633
Satd. Flow (RTOR)			3			34			5			169
Lane Group Flow (vph)	411	2794	149	0	1086	198	0	641	279	0	914	202
Turn Type	Prot		Perm			Perm			Perm			Perm
Protected Phases	5	2			6			8			4	
Permitted Phases			2			6			8			4
Detector Phase	5	2	2		6	6		8	8		4	4
Switch Phase												
Minimum Initial (s)	5.0	14.0	14.0		14.0	14.0		15.0	15.0		15.0	15.0
Minimum Split (s)	11.5	27.5	27.5		27.5	27.5		33.0	33.0		33.0	33.0
Total Split (s)	30.0	105.0	105.0	0.0	75.0	75.0	0.0	35.0	35.0	0.0	35.0	35.0
Total Split (%)	21.4%	75.0%	75.0%	0.0%	53.6%	53.6%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%
Yellow Time (s)	4.5	4.5	4.5		4.5	4.5		4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lost Time Adjust (s)	-1.5	-2.0	-2.0	-2.0	-2.0	-2.0	-1.0	-2.0	0.0	-1.0	-2.0	-2.0
Total Lost Time (s)	5.0	4.5	4.5	2.0	4.5	4.5	3.0	4.0	6.0	3.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?												
Recall Mode	Min	C-Max	C-Max		C-Max	C-Max		Min	Min		Min	Min
Act Effct Green (s)	22.3	100.5	100.5		73.2	73.2		31.0	29.0		31.0	31.0
Actuated g/C Ratio	0.16	0.72	0.72		0.52	0.52		0.22	0.21		0.22	0.22
v/c Ratio	0.73	0.74	0.13		0.40	0.23		0.79	0.82		0.79	0.41
Control Delay	70.7	4.4	2.7		20.9	16.1		53.1	64.6		57.1	12.8
Queue Delay	0.0	0.4	0.0		0.0	0.0		3.8	2.0		0.0	0.0
Total Delay	70.7	4.8	2.7		20.9	16.1		56.9	66.6		57.1	12.8
LOS	E	A	A		C	B		E	E		E	B
Approach Delay		12.8			20.2			59.9			49.1	
Approach LOS		B			C			E			D	
Queue Length 50th (m)	54.0	39.1	5.2		68.4	25.0		82.1	66.2		92.8	7.7
Queue Length 95th (m)	m64.0	42.3	m5.6		82.6	42.2		96.0	#118.1		109.9	30.7
Internal Link Dist (m)		267.1			94.9			101.8			227.5	
Turn Bay Length (m)	100.0											60.0
Base Capacity (vph)	632	3765	1173		2742	870		808	342		1161	493
Starvation Cap Reductn	0	430	0		0	0		99	15		0	0
Spillback Cap Reductn	0	0	0		0	0		0	0		0	0
Storage Cap Reductn	0	0	0		0	0		0	0		0	0
Reduced v/c Ratio	0.65	0.84	0.13		0.40	0.23		0.90	0.85		0.79	0.41

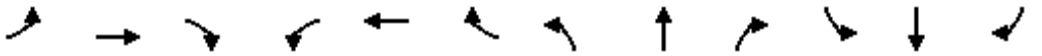
Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82

Intersection Signal Delay: 26.8	Intersection LOS: C
Intersection Capacity Utilization 80.0%	ICU Level of Service D
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 34: Wye Road & Brentwood Blvd.





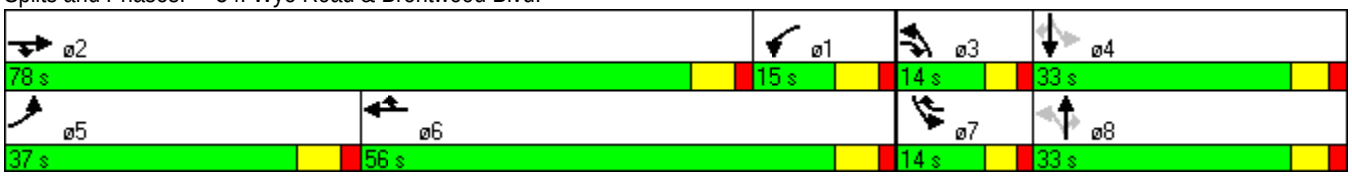
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	594	2479	103	145	928	197	183	650	323	327	415	359
Satd. Flow (prot)	3541	5245	1633	3541	5245	1633	1825	3650	1633	3541	3650	1633
Flt Permitted	0.950			0.950			0.303			0.143		
Satd. Flow (perm)	3541	5245	1633	3541	5245	1633	582	3650	1633	533	3650	1633
Satd. Flow (RTOR)			78			24			115			359
Lane Group Flow (vph)	594	2479	103	145	928	197	183	650	323	327	415	359
Turn Type	Prot		custom	Prot		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2	2 3	1	6	6 7	3	8		7	4	
Permitted Phases			2			6	8		8	4		4
Detector Phase	5	2	2 3	1	6	6 7	3	8	8	7	4	4
Switch Phase												
Minimum Initial (s)	5.0	14.0		5.0	14.0		5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	11.5	27.5		11.5	27.5		10.0	33.0	33.0	10.0	33.0	33.0
Total Split (s)	37.0	78.0	92.0	15.0	56.0	70.0	14.0	33.0	33.0	14.0	33.0	33.0
Total Split (%)	26.4%	55.7%	65.7%	10.7%	40.0%	50.0%	10.0%	23.6%	23.6%	10.0%	23.6%	23.6%
Yellow Time (s)	4.5	4.5		4.5	4.5		3.5	4.0	4.0	3.5	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.5	2.0	2.0	1.5	2.0	2.0
Lost Time Adjust (s)	-1.5	-2.0	-2.0	-2.0	-2.0	-2.0	-1.0	-2.0	0.0	-1.0	-2.0	-2.0
Total Lost Time (s)	5.0	4.5	4.5	4.5	4.5	4.5	4.0	4.0	6.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	Min	C-Max		Min	C-Max		Min	Min	Min	Min	Min	Min
Act Effct Green (s)	29.1	73.5	83.0	10.5	54.4	68.4	39.0	29.0	27.0	39.0	29.0	29.0
Actuated g/C Ratio	0.21	0.52	0.59	0.08	0.39	0.49	0.28	0.21	0.19	0.28	0.21	0.21
v/c Ratio	0.81	0.90	0.10	0.55	0.46	0.24	0.73	0.86	0.79	0.90	0.55	0.58
Control Delay	58.2	19.2	0.4	70.6	33.1	19.6	50.6	59.8	42.3	66.8	52.8	8.5
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.2	19.5	0.4	70.6	33.1	19.6	50.6	59.8	42.3	66.8	52.8	8.5
LOS	E	B	A	E	C	B	D	E	D	E	D	A
Approach Delay		26.1			35.3			53.5			42.5	
Approach LOS		C			D			D			D	
Queue Length 50th (m)	75.7	211.3	0.3	21.3	73.8	28.7	36.1	94.7	48.9	37.5	57.4	0.0
Queue Length 95th (m)	m95.9	182.6	m0.4	33.3	89.7	47.3	#60.8	#124.1	#76.5	#59.6	75.6	28.0
Internal Link Dist (m)		267.1			94.9			101.8			227.5	
Turn Bay Length (m)	100.0			80.0			60.0		80.0	80.0		60.0
Base Capacity (vph)	809	2754	1000	266	2037	810	251	756	408	363	756	623
Starvation Cap Reductn	0	44	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.91	0.10	0.55	0.46	0.24	0.73	0.86	0.79	0.90	0.55	0.58

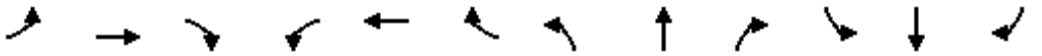
Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 105
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90

Intersection Signal Delay: 35.3	Intersection LOS: D
Intersection Capacity Utilization 93.5%	ICU Level of Service F
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 34: Wye Road & Brentwood Blvd.





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	594	2806	103	0	1073	197	0	650	323	0	742	359
Satd. Flow (prot)	3541	5245	1633	0	5245	1633	0	3650	1633	0	5245	1633
Flt Permitted	0.950											
Satd. Flow (perm)	3541	5245	1633	0	5245	1633	0	3650	1633	0	5245	1633
Satd. Flow (RTOR)			11			33			5			359
Lane Group Flow (vph)	594	2806	103	0	1073	197	0	650	323	0	742	359
Turn Type	Prot		Perm			Perm			Perm			Perm
Protected Phases	5	2			6			8			4	
Permitted Phases			2			6			8			4
Detector Phase	5	2	2		6	6		8	8		4	4
Switch Phase												
Minimum Initial (s)	5.0	14.0	14.0		14.0	14.0		15.0	15.0		15.0	15.0
Minimum Split (s)	11.5	27.5	27.5		27.5	27.5		33.0	33.0		33.0	33.0
Total Split (s)	40.0	105.0	105.0	0.0	65.0	65.0	0.0	35.0	35.0	0.0	35.0	35.0
Total Split (%)	28.6%	75.0%	75.0%	0.0%	46.4%	46.4%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%
Yellow Time (s)	4.5	4.5	4.5		4.5	4.5		4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lost Time Adjust (s)	-1.5	-2.0	-2.0	-2.0	-2.0	-2.0	-1.0	-2.0	0.0	-1.0	-2.0	-2.0
Total Lost Time (s)	5.0	4.5	4.5	2.0	4.5	4.5	3.0	4.0	6.0	3.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?												
Recall Mode	Min	C-Max	C-Max		C-Max	C-Max		Min	Min		Min	Min
Act Effct Green (s)	29.9	100.5	100.5		65.6	65.6		31.0	29.0		31.0	31.0
Actuated g/C Ratio	0.21	0.72	0.72		0.47	0.47		0.22	0.21		0.22	0.22
v/c Ratio	0.79	0.75	0.09		0.44	0.25		0.80	0.94		0.64	0.56
Control Delay	63.0	4.1	2.1		26.0	20.3		53.2	83.2		52.4	8.0
Queue Delay	0.0	0.5	0.0		0.0	0.0		4.4	7.5		0.0	0.0
Total Delay	63.0	4.7	2.1		26.0	20.3		57.6	90.7		52.4	8.0
LOS	E	A	A		C	C		E	F		D	A
Approach Delay		14.5			25.1			68.6			37.9	
Approach LOS		B			C			E			D	
Queue Length 50th (m)	77.2	44.5	2.8		75.3	28.0		82.4	88.2		72.4	0.0
Queue Length 95th (m)	m80.0	m46.4	m3.1		94.1	48.9		99.0	#129.8		87.6	27.3
Internal Link Dist (m)		267.1			94.9			101.8			227.5	
Turn Bay Length (m)	100.0											60.0
Base Capacity (vph)	885	3765	1175		2459	783		808	342		1161	641
Starvation Cap Reductn	0	479	0		0	0		99	14		0	0
Spillback Cap Reductn	0	0	0		0	0		0	0		0	0
Storage Cap Reductn	0	0	0		0	0		0	0		0	0
Reduced v/c Ratio	0.67	0.85	0.09		0.44	0.25		0.92	0.98		0.64	0.56

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.94

Intersection Signal Delay: 27.9	Intersection LOS: C
Intersection Capacity Utilization 83.0%	ICU Level of Service E
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 34: Wye Road & Brentwood Blvd.



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2811	259	188	967	91	236
Satd. Flow (prot)	5245	1633	3541	5245	3541	1633
Flt Permitted			0.040		0.950	
Satd. Flow (perm)	5245	1633	149	5245	3541	1633
Satd. Flow (RTOR)		214				3
Lane Group Flow (vph)	2811	259	188	967	91	236
Turn Type		Perm	pm+pt			pt+ov
Protected Phases	2		1	6	8	1 8
Permitted Phases		2	6			
Detector Phase	2	2	1	6	8	1 8
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	7.0	12.0	
Minimum Split (s)	23.5	23.5	12.0	13.5	18.0	
Total Split (s)	100.0	100.0	15.0	115.0	25.0	40.0
Total Split (%)	71.4%	71.4%	10.7%	82.1%	17.9%	28.6%
Yellow Time (s)	4.5	4.5	3.5	4.5	3.5	
All-Red Time (s)	2.0	2.0	1.5	2.0	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	5.0	6.5	6.0	5.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	C-Max	C-Max	Min	C-Max	Min	
Act Effct Green (s)	96.0	96.0	110.7	109.2	18.3	32.5
Actuated g/C Ratio	0.69	0.69	0.79	0.78	0.13	0.23
v/c Ratio	0.78	0.22	0.59	0.24	0.20	0.62
Control Delay	17.2	2.2	29.3	3.6	55.1	55.0
Queue Delay	0.1	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	2.2	29.3	3.6	55.1	55.0
LOS	B	A	C	A	E	D
Approach Delay	16.1			7.8	55.0	
Approach LOS	B			A	D	
Queue Length 50th (m)	190.9	4.0	17.1	20.5	12.3	61.0
Queue Length 95th (m)	218.6	13.8	m25.5	23.8	21.2	89.4
Internal Link Dist (m)	425.9			267.1	157.4	
Turn Bay Length (m)			100.0			80.0
Base Capacity (vph)	3597	1187	360	4091	481	399
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	91	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.22	0.52	0.24	0.19	0.59

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 79 (56%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78

Intersection Signal Delay: 16.8	Intersection LOS: B
Intersection Capacity Utilization 84.3%	ICU Level of Service E
Analysis Period (min) 15	

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Wye Road & Mitchell Street





Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2791	259	477	811	252	563
Satd. Flow (prot)	5245	1633	3541	5245	3541	1633
Flt Permitted			0.044		0.950	
Satd. Flow (perm)	5245	1633	164	5245	3541	1633
Satd. Flow (RTOR)		184				*180
Lane Group Flow (vph)	2791	259	477	811	252	563
Turn Type		Perm	pm+pt			custom
Protected Phases	2		1	6	8	1 8
Permitted Phases		2	6			8
Detector Phase	2	2	1	6	8	1 8
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	7.0	12.0	
Minimum Split (s)	23.5	23.5	12.0	13.5	18.0	
Total Split (s)	92.0	92.0	23.0	115.0	25.0	48.0
Total Split (%)	65.7%	65.7%	16.4%	82.1%	17.9%	34.3%
Yellow Time (s)	4.5	4.5	3.5	4.5	3.5	
All-Red Time (s)	2.0	2.0	1.5	2.0	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	5.0	6.5	6.0	5.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	C-Max	C-Max	Min	C-Max	Min	
Act Effct Green (s)	86.2	86.2	110.0	108.5	19.0	42.3
Actuated g/C Ratio	0.62	0.62	0.79	0.78	0.14	0.30
v/c Ratio	0.86	0.24	0.87	0.20	0.52	0.91
Control Delay	26.0	4.2	57.0	4.2	60.7	51.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	4.2	57.0	4.2	60.7	51.7
LOS	C	A	E	A	E	D
Approach Delay	24.1			23.7	54.5	
Approach LOS	C			C	D	
Queue Length 50th (m)	235.7	8.5	63.2	19.3	35.7	114.7
Queue Length 95th (m)	257.9	20.5	#80.3	21.9	50.5	#186.6
Internal Link Dist (m)	425.9			267.1	157.4	
Turn Bay Length (m)			100.0			80.0
Base Capacity (vph)	3230	1076	563	4065	481	626
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.24	0.85	0.20	0.52	0.90

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 101 (72%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91

Intersection Signal Delay: 28.8	Intersection LOS: C
Intersection Capacity Utilization 98.4%	ICU Level of Service F
Analysis Period (min) 15	

* User Entered Value

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Wye Road & Mitchell Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2842	140	394	1075	349	334
Satd. Flow (prot)	5245	1633	3541	5245	3541	1633
Flt Permitted			0.042		0.950	
Satd. Flow (perm)	5245	1633	157	5245	3541	1633
Satd. Flow (RTOR)		105				2
Lane Group Flow (vph)	2842	140	394	1075	349	334
Turn Type		Perm	pm+pt			pt+ov
Protected Phases	2		1	6	8	1 8
Permitted Phases		2	6			
Detector Phase	2	2	1	6	8	1 8
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	7.0	12.0	
Minimum Split (s)	23.5	23.5	12.0	13.5	18.0	
Total Split (s)	96.0	96.0	19.0	115.0	25.0	44.0
Total Split (%)	68.6%	68.6%	13.6%	82.1%	17.9%	31.4%
Yellow Time (s)	4.5	4.5	3.5	4.5	3.5	
All-Red Time (s)	2.0	2.0	1.5	2.0	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	5.0	6.5	6.0	5.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	C-Max	C-Max	Min	C-Max	Min	
Act Effct Green (s)	89.9	89.9	110.0	108.5	19.0	38.6
Actuated g/C Ratio	0.64	0.64	0.79	0.78	0.14	0.28
v/c Ratio	0.84	0.13	0.87	0.26	0.73	0.74
Control Delay	22.8	3.2	47.5	5.3	67.6	57.0
Queue Delay	0.1	0.0	0.0	0.0	0.0	0.0
Total Delay	22.8	3.2	47.5	5.3	67.6	57.0
LOS	C	A	D	A	E	E
Approach Delay	21.9			16.6	62.4	
Approach LOS	C			B	E	
Queue Length 50th (m)	224.7	3.5	42.2	23.9	51.0	88.2
Queue Length 95th (m)	245.9	11.7	#67.8	42.7	68.7	125.4
Internal Link Dist (m)	425.9			267.1	157.4	
Turn Bay Length (m)			100.0			80.0
Base Capacity (vph)	3369	1087	462	4065	481	456
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	31	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.13	0.85	0.26	0.73	0.73

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 83 (59%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87

Intersection Signal Delay: 25.8	Intersection LOS: C
Intersection Capacity Utilization 90.7%	ICU Level of Service E
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Wye Road & Mitchell Street





Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2842	140	539	892	532	661
Satd. Flow (prot)	5245	1633	3541	5245	3541	1633
Flt Permitted			0.046		0.950	
Satd. Flow (perm)	5245	1633	171	5245	3541	1633
Satd. Flow (RTOR)		93				*200
Lane Group Flow (vph)	2842	140	539	892	532	661
Turn Type		Perm	pm+pt			pt+ov
Protected Phases	2		1	6	8	1 8
Permitted Phases		2	6			
Detector Phase	2	2	1	6	8	1 8
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	7.0	12.0	
Minimum Split (s)	23.5	23.5	12.0	13.5	18.0	
Total Split (s)	89.0	89.0	23.0	112.0	28.0	51.0
Total Split (%)	63.6%	63.6%	16.4%	80.0%	20.0%	36.4%
Yellow Time (s)	4.5	4.5	3.5	4.5	3.5	
All-Red Time (s)	2.0	2.0	1.5	2.0	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	5.0	6.5	6.0	5.0
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Recall Mode	C-Max	C-Max	Min	C-Max	Min	
Act Effct Green (s)	82.5	82.5	107.0	105.5	22.0	46.0
Actuated g/C Ratio	0.59	0.59	0.76	0.75	0.16	0.33
v/c Ratio	0.92	0.14	0.96	0.23	0.96	0.99
Control Delay	31.9	5.0	64.3	6.0	87.0	63.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.9	5.0	64.3	6.0	87.0	63.8
LOS	C	A	E	A	F	E
Approach Delay	30.6			27.9	74.2	
Approach LOS	C			C	E	
Queue Length 50th (m)	260.1	5.5	70.5	24.9	80.3	147.1
Queue Length 95th (m)	284.5	15.1	#101.2	39.8	#116.4	#232.9
Internal Link Dist (m)	425.9			267.1	157.4	
Turn Bay Length (m)			100.0			80.0
Base Capacity (vph)	3091	1001	564	3952	556	671
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.14	0.96	0.23	0.96	0.99

Intersection Summary
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 93 (66%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.99

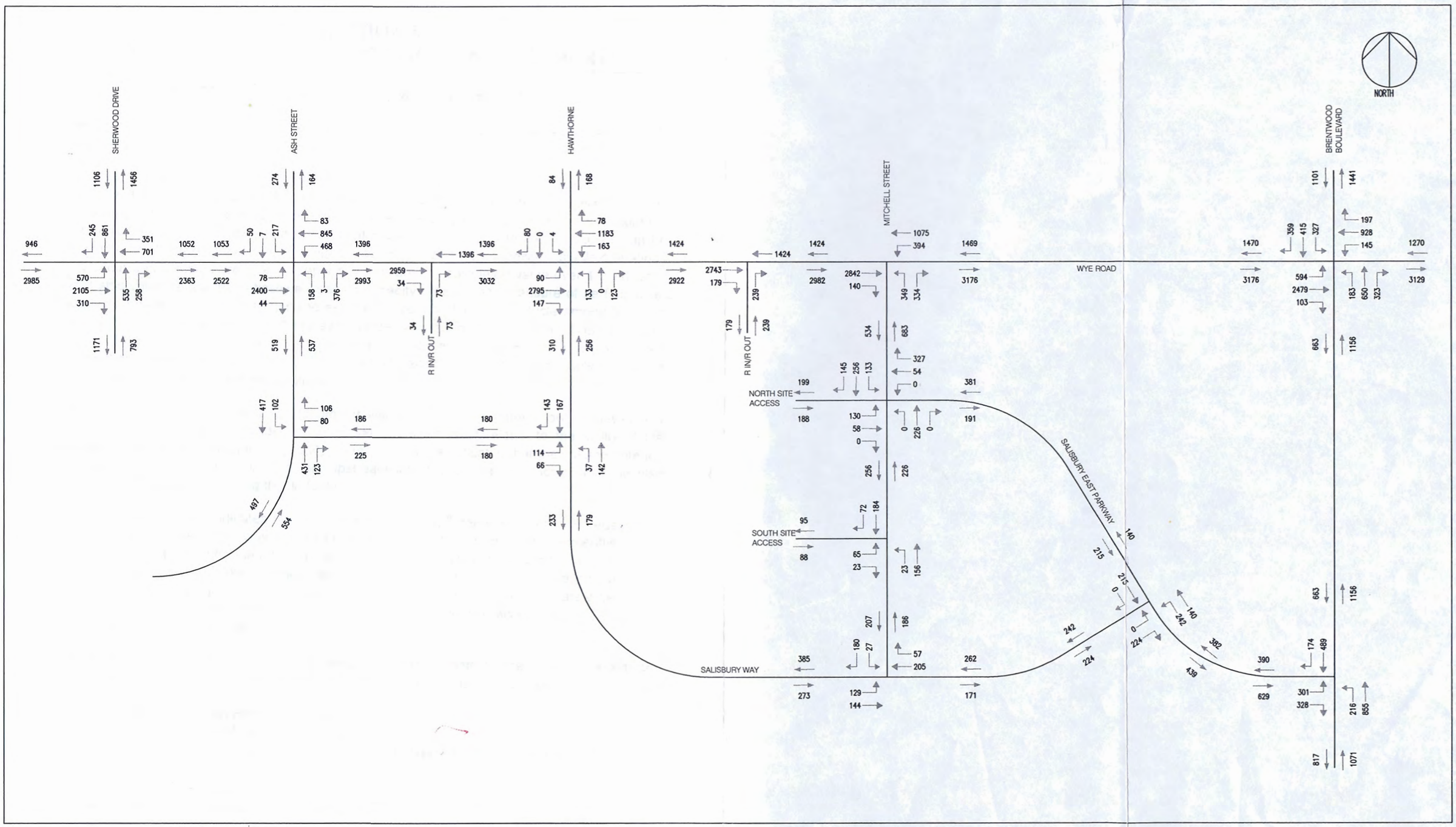
Intersection Signal Delay: 39.2	Intersection LOS: D
Intersection Capacity Utilization 105.4%	ICU Level of Service G
Analysis Period (min) 15	

* User Entered Value

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Wye Road & Mitchell Street





2015 PM PEAK HOUR TOTAL TRAFFIC VOLUME ESTIMATES

bunt &associates
TRANSPORTATION PLANNERS AND ENGINEERS

Exhibit 4-4
September 2009

AL-TERRA
ENGINEERING