Daytona Urban Development Corp.

APPENDIX A

Certificates of Title

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0034 386 847	4;22;8;22;NE	101 370 176

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 22
QUARTER NORTH EAST
CONTAINING 64.7 HECTARES(159.88 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	ACRES	MORE OR LESS
SUBDIVISION	0512218	32.374	80.00	
SUBDIVISION	0912705	2.037	5.03	
SUBDIVISION	1012738	16.187	40.00	

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 101 208 815 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
101 370 176	22/12/2010	TRANSFER OF LAND	$1,750,000	$1,750,000

OWNERS

DAYTONA URBAN DEVELOPMENT CORP..
OF 11504-170 STREET
EDMONTON
ALBERTA T5S 1J7

(CONTINUED)

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
751 004 557	17/01/1975	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
051 220 165	21/06/2005	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE CITY OF LETHBRIDGE. 910 - 4TH AVE. SOUTH, LETHBRIDGE ALBERTA
101 108 991	16/04/2010	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. AS TO PORTION OR PLAN:1011510
101 370 177	22/12/2010	MORTGAGE MORTGAGEE - HSBC BANK CANADA. 10250-101 ST EDMONTON ALBERTA T5J3P4 ORIGINAL PRINCIPAL AMOUNT: $2,625,000
101 370 178	22/12/2010	CAVEAT RE : ASSIGNMENT OF RENTS AND LEASES CAVEATOR - HSBC BANK CANADA. 10250-101 ST EDMONTON ALBERTA T5J3P4 AGENT - ROBERT P ASSALY

TOTAL INSTRUMENTS: 005

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 12 DAY OF JANUARY, 2012 AT 09:28 A.M.

ORDER NUMBER:20409975

CUSTOMER FILE NUMBER: 112944453500

END OF CERTIFICATE

(CONTINUED)

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0034 604 397	4;22;8;22;NW	101 357 063 +25

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 22
QUARTER NORTH WEST
CONTAINING 64.7 HECTARES(160 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	(ACRES) MORE OR LESS
SUBDIVISION	0512143	32.393	80.04
SUBDIVISION	0914592	0.517	1.28
SUBDIVISION	1013011	0.359	0.887
SUBDIVISION	1014671	1.338	3.31

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 101 236 800 +33

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
101 357 063	08/12/2010	SUBDIVISION PLAN		

OWNERS

DAYTONA URBAN DEVELOPMENT CORP..
OF 100, 10423 178 ST
EDMONTON
ALBERTA T5S 1R5

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT
751 006 968	27/01/1975	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
791 209 303	11/12/1979	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
981 102 147	09/04/1998	CAVEAT RE : SURFACE LEASE UNDER 20 ACRES CAVEATOR - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 (DATA UPDATED BY: TRANSFER OF CAVEAT 991026304) (DATA UPDATED BY: TRANSFER OF CAVEAT 011228042) (DATA UPDATED BY: TRANSFER OF CAVEAT 041186908)
981 102 148	09/04/1998	CAVEAT RE : RIGHT OF WAY AGREEMENT CAVEATOR - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 AGENT - DIANE VANDER VEEN (DATA UPDATED BY: TRANSFER OF CAVEAT 991026304) (DATA UPDATED BY: TRANSFER OF CAVEAT 011238126) (DATA UPDATED BY: TRANSFER OF CAVEAT 041187481)
981 356 450	16/11/1998	UTILITY RIGHT OF WAY GRANTEE - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 "RE-ENTERED 30/03/01 BY 011084942" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		OF WAY 011251218) (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 041220522)
011 085 073	30/03/2001	DISCHARGE OF UTILITY RIGHT OF WAY 981356450 PARTIAL SEE INSTRUMENT
051 213 775	16/06/2005	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE CITY OF LETHBRIDGE. 910 4 TH AVENUE SOUTH LETHRIDGE ALBERTA
101 236 803	11/08/2010	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. AS TO PORTION OR PLAN:1013012
101 357 065	08/12/2010	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. AS TO PORTION OR PLAN:1014672

TOTAL INSTRUMENTS: 010

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 12 DAY OF JANUARY, 2012 AT 09:28 A.M.

ORDER NUMBER:20409975

CUSTOMER FILE NUMBER: 112944453500

END OF CERTIFICATE

(CONTINUED)

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0034 386 855	1012738;101;2	101 208 848

LEGAL DESCRIPTION
PLAN 1012738
BLOCK 101
LOT 2
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 16.187 HECTARES (40 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;22;8;22;NE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 101 208 815

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
101 208 848	14/07/2010	TRANSFER OF LAND	$2,200,000	$2,200,000

OWNERS

DAYTONA URBAN DEVELOPMENT CORP..
OF 100, 10423 178 ST
EDMONTON
ALBERTA T5S 1R5

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
751 004 557	17/01/1975	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.

(CONTINUED)

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
051 220 165	21/06/2005	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE CITY OF LETHBRIDGE. 910 - 4TH AVE. SOUTH, LETHBRIDGE ALBERTA
101 108 991	16/04/2010	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. AS TO PORTION OR PLAN:1011510
101 370 177	22/12/2010	MORTGAGE MORTGAGEE - HSBC BANK CANADA. 10250-101 ST EDMONTON ALBERTA T5J3P4 ORIGINAL PRINCIPAL AMOUNT: $2,625,000
101 370 178	22/12/2010	CAVEAT RE : ASSIGNMENT OF RENTS AND LEASES CAVEATOR - HSBC BANK CANADA. 10250-101 ST EDMONTON ALBERTA T5J3P4 AGENT - ROBERT P ASSALY

TOTAL INSTRUMENTS: 005

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 18 DAY OF JANUARY, 2012 AT 02:27 P.M.

ORDER NUMBER:20450909

CUSTOMER FILE NUMBER: 112944453

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

(CONTINUED)

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0034 878 059	4;22;8;23;NW	111 186 538

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 23
QUARTER NORTH WEST
CONTAINING 64.7 HECTARES (160 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	ACRES	MORE OR LESS
SUBDIVISION	7710684		52.32	
REPLOTTING SCHEME	7710705		0.06	
REPLOTTING SCHEME	7710882		71.57	
REPLOTTTNG SCHEME	7810431		9.01	
SUBDIVISION	0814827	0.101	0.25	
ROAD	1112320	3.477	8.59	

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 081 411 298 +47

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
111 186 538	22/07/2011	ROAD PLAN		

OWNERS

THE CITY OF LETHBRIDGE.
OF 910 - 4TH AVENUE S., LETHBRIDGE
ALBERTA T1J 0P6

(CONTINUED)

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 003 252	10/01/1974	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE OLDMAN RIVER REGIONAL PLANNING COMMISSION.
771 055 709	04/05/1977	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE OLDMAN RIVER REGIONAL PLANNING COMMISSION.
071 444 489	05/09/2007	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. 910 - 4TH AVE. SOUTH, LETHBRIDGE ALBERTA AS TO PORTION OR PLAN:0714451 UR/W "C"

TOTAL INSTRUMENTS: 003

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 16 DAY OF JANUARY, 2012 AT 10:22 A.M.

ORDER NUMBER:20428968

CUSTOMER FILE NUMBER: 112944453

END OF CERTIFICATE

Daytona Urban Development Corp.

APPENDIX B

Transportation Impact Assessment

Stantec Consulting Ltd.
200 - 325 - 25th Street SE
Calgary AB T2A 7H8
Tel: (403) 716-8337
Fax: (403) 716-8129

August 27, 2012
File: 1129 44453

The City of Lethbridge
Infrastructure Services
City Hall, 910 – 4th Avenue South
Lethbridge, AB T1J 0P6

Attention: **Mr. Ahmed Ali, P. Eng., PTOE**

Dear Sir:

Reference: **Copperwood Stage 2 TIA – Comment Responses**

Please find enclosed an update to our report entitled "Copperwood Stage 2 Transportation Impact Assessment", originally dated March 15, 2012. The updated reported, entitled "Copperwood Stage 2 Updated Transportation Impact Assessment, August 2, 2012" addresses the comments provided by the City following its review of the original document. A copy of the comments received by Stantec on April 16, 2012 regarding the City's review of the original document has been added to the correspondence section in the updated report (see **Appendix 'A'**).

A brief review of the comments received and the means by which they were addressed follows:

1. *City's Comment: Figure 3.2: This refers to Coalbanks Gate being the only access currently, in practice the Coalbanks Links W connection to Metis Trail Gravel road does also exist as a second access point from Copperwood Stage-1.*

   Response: See the response to City's Comment #2, which addresses both comments.

2. *City's Comment: In the absence of counts on Coalbanks Link W / Metis Trail W access, Table 1 and Table 2 do not represent the reality, suggest moving these Tables and revising text.*

   Response: Agreed. Without count information for the second access there is potential that some of the existing Copperwood traffic was not included in Section 3.2. Because the access is gravel (i.e. less desirable), it is likely that the volumes using this road are considerably lower than the volumes counted at Coalbanks Gate W. These additional volumes may account for the discrepancy between the "Existing Volume Projected to 100% Occupancy" and the "Copperwood Stage 1 TIA Volumes", as shown in Table 3.2.

   Regardless, without the count information for this access, it is not possible to ensure the comparison between the "projected volumes" and the TIA volumes is accurate. Therefore we propose removing the text from section 3.2.

3. *City's Comment: Figure 3.1 to 3.8 – Traffic volumes do not add up at Whoop-up Dr / Metis trail (Intersection 70), please check.*

Response: Figures 3.1 to 3.10 include information obtained from other studies (specifically the Crossings TIA – iTrans, July 2007; and the original Copperwood TIA – UMA, December 2005). These studies did not include volumes at the intersection of Whoop Up Drive / Metis Trail (Intersection 70) and therefore Figures 3.1 to 3.10 also did not include volumes at this intersection.

In order analyze intersection 70, assumptions regarding the distribution of traffic to/from Metis Trail South and to/from Whoop-Up Drive West were required. Therefore, the combined traffic (from figures 3.1 through 3.10 as described in Section 3.1 of the report) approaching/leaving the intersection to/from the south and west was distributed according to the assumptions listed in Table 3.5.

Because of the interaction between the west and south legs of the intersection, and because both legs used some different information for developing combined traffic approaching/leaving the intersection, a small imbalance was left with on the west approach. The following differences in volumes were noted to the west of intersection 70 on Figures 3.11 and 3.12:

AM Peak Hour	PM Peak Hour
-37 vph EB	-10 vph EB
0 vph WB	+43 vph WB

These volumes have been added to the updated report and are reflected in Figures 3.11 and 3.12 (background traffic volume), as well as Figures 3.15 and 3.16 which use the volumes from Figures 3.11 and 3.12 as information. The analyses for the background and post-development horizons have also been updated to include these volumes.

4. *City's Comment: Label Copperwood Stage 1 Access to Metis Trail as "Coalbanks Link W"*

   Response: Acknowledged. References to this access have been changed in the figure as well as in the text of the updated report.

5. *City's Comment: Figure 4.2 –page 4.3: Please analyze Metis Trail/Coalbanks Link W as a 2 lane roundabout intersection.*

   Response: See the response to City's Comment #6, which addresses both comments.

6. *City's Comment: Figure 4.3: I consider the analysis on Copperwood Stage 2 Access/Coalbanks Blvd W (intersection 55) and Metis Trail/Simon Fraser Blvd (Copperwood Stage 2 Access) as interim, since both these intersections will be impacted from lands south of this OP area (not considered in your analysis). We would like roundabouts at these intersections. Please revise this section for Intersection 71 as a roundabout as well.*

   Response: The report has been updated to provide the results for all three intersections as both conventional intersections as well as roundabouts. Similar to the original report, the existing intersection (Metis Trail/Coalbanks Link W) has been analyzed for both the background and post-development horizons.

   Intersection 55 is now shown as a roundabout in the Outline Plan documents.

In order to ensure adequate capacity in the post-development scenario, Intersection 71 (Metis Trail/Coalbanks Link W) requires similar improvements for a roundabout as it would for a conventional intersection (specifically a designated southbound right turn lane). The other intersection will operate sufficiently as single lane roundabouts based on the post-development volumes analyzed.

7. *City's Comment: Figure 4.3: Make the daily volumes legible (make the dots smaller and may be text smaller or use schematic rather than the drawing as the background).*

   Response: Acknowledged. Figure 4.3 has been revised to more clearly illustrate the daily volumes.

8. *City's Comment: Figure 4.4: No need to show local roads, the colour confuses with the Super collector. The 30th ST W cannot be a minor collector (again your analysis is interim; there are lands to be developed west of this road). Do not show any classification for this road.*

   Response: Acknowledged. Figure 4.4 has been revised as recommended for the local roads and for 30 Street W.

9. *City's Comment: I would accept intersection 35 to be yield-controlled, but I have concerns that the section of the road between Intersection 25 – 45 may lead to speeding complaints. I would like to include a recommendation to consider traffic calming measures on this road. Please include this in the recommendations and revise the OP Figure 9.1.*

   Response: A recommendation has been added to Section 4.3 (post-development analysis) as well to Section 5 (conclusions). Figure 9.1 from the outline plan has also been revised to illustrate this.

Should you have any questions or require clarification, please contact the writer at 716-1462.

Sincerely,

STANTEC CONSULTING LTD.

Cole Piechotta, P.Eng.
Transportation Engineer
Tel: (403) 716-1462
Fax: (403) 716-8129
david.thatcher@stantec.com

c. Mr. D. Huber – Stantec Consulting Ltd.
Mr. B. Schmidtke – Stantec Consulting Ltd.
Mr. D. Thatcher – Stantec Consulting Ltd.

Copperwood Stage 2
Updated Transportation
Impact Assessment
August 27, 2012

Prepared for:
Daytona Urban Development Corp.

Prepared by:
Stantec Consulting Ltd.
200 - 325 - 25th Street SE
Calgary, AB T2A 7H8

and

Stantec Consulting Ltd.
290 – 220 – 4th Street S
Lethbridge, AB T1J 4J7

Project No. 1129 44453

August 27, 2012

Corporate Authorization

This document entitled "Copperwood Stage 2 Updated Transportation Impact Assessment – August 27, 2012" was prepared by Stantec Consulting Ltd. for the account of Daytona Urban Development Corp. The material in it reflects Stantec Consulting Ltd.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

PERMIT TO PRACTICE
STANTEC CONSULTING LTD.
Signature [signature]
Date August 27, 2012
PERMIT NUMBER: P 0258
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

CORPORATE AUTHORIZATION

PROFESSIONAL ENGINEER
COLE PIECHOTTA
ALBERTA
[signature]
8/27/12

RESPONSIBLE ENGINEER

Executive Summary

Daytona Urban Development Corp. proposes to develop Stage 2 of its Copperwood community. The proposed subdivision consists of approximately 62 hectares of land in West Lethbridge, and will include the development of 588 low density residential units and 302 medium density residential units. The proposed development is consistent with the intent and land uses proposed in West Lethbridge Phase 2 Area Structure Plan. The land owners have retained Stantec Consulting Ltd. to conduct a Transportation Impact Assessment (TIA) to evaluate transportation impacts of the Outline Plan application.

The development has been assessed for the full-build horizon (assumed to occur within ten years of approval). Four external intersections which provide access to the development off of Metis Trail and WhoopUp Drive (either directly or through Copperwood Stage 1) have been analyzed. In addition, 10 internal intersections located within either Stage 1 or Stage 2 of Copperwood have been analyzed.

The objectives of the analysis included estimating the impacts of vehicular traffic on the roadway system at the full-build horizon, and recommending appropriate improvements to accommodate the associated traffic volumes. The scope of the study was established through consultation with the City of Lethbridge Traffic Engineering and Transportation Planning Manager using the City of Lethbridge TIA guidelines as a reference.

The analysis contained within this TIA demonstrates that, with some conventional infrastructure modifications, the surrounding road network will be able to support the development of the Copperwood Stage 2 Outline Plan area.

Table of Contents

COPPERWOOD STAGE 2
TRANSPORTATION IMPACT ASSESSMENT

List of Figures

List of Tables

1.0 Introduction

1.1 BACKGROUND

Daytona Urban Development Corp. proposes to develop Stage 2 of its Copperwood community. The proposed subdivision consists of approximately 62 hectares of land in West Lethbridge, and will include the development of 588 low density residential units and 302 medium density residential units. The proposed development is consistent with the intent and land uses proposed in West Lethbridge Phase 2 Area Structure Plan.

Copperwood is bound to the north by Copperwood Stage 1, to the east by the future Métis Trail, to the south by future development located within the West Lethbridge Phase 2 ASP, and to the west by 30th Street. **Figure 1.1** illustrates the location of the development area. Daytona Urban Development Corp. has retained Stantec Consulting Ltd. (Stantec) to conduct a Transportation Impact Assessment (TIA) to evaluate transportation impacts resulting from the development proposed in the Outline Plan.

1.2 OBJECTIVES

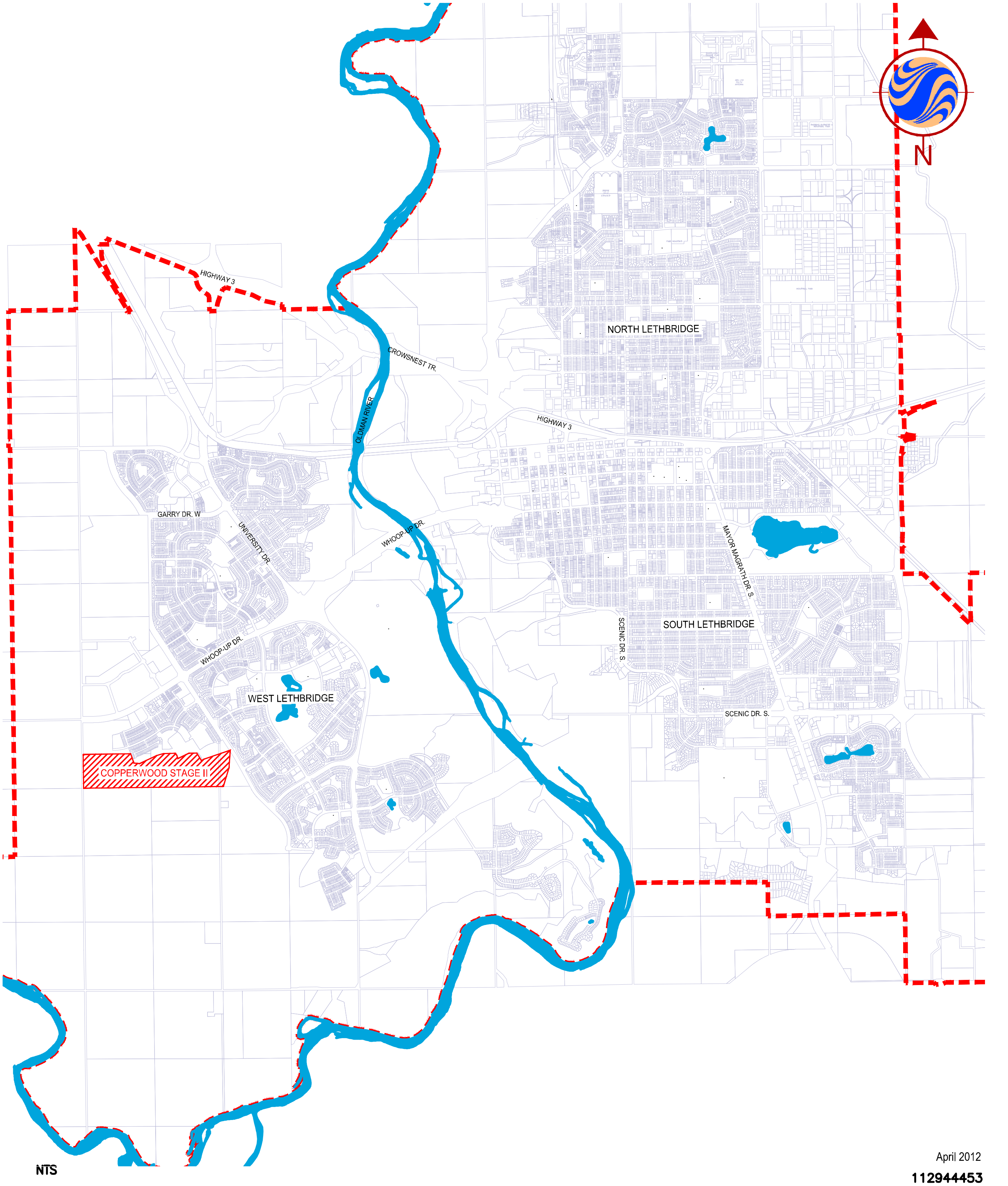
The City of Lethbridge TIA Guidelines were used as a reference in developing the scope for this TIA. Similar to what has been observed for Stage 1 of Copperwood, it is anticipated that Stage 2 will be developed entirely within ten years of approval, and therefore only a full-build horizon was selected for this study. The objectives of the study, as agreed to with the City of Lethbridge Infrastructure Services are to:

- Establish full-build background traffic conditions in the vicinity of the proposed development
- Estimate the magnitude and characteristics of peak hour traffic generated by the proposed development at the full-build horizon
- Evaluate the impacts of vehicular traffic generated by the proposed development on the roadway system at the full-build horizon
- Identify and recommend appropriate traffic operation and/or infrastructure improvements necessary to accommodate the full-build horizon traffic volumes
- Estimate the full-build daily traffic volumes to confirm the classification of the road network within the Copperwood Outline Plan area

1.3 STUDY AREA

The Study area as agreed to by the City of Lethbridge Infrastructure Services department is illustrated in **Figure 1.2**. Correspondence with Infrastructure Services regarding the scope of this study is documented in **Appendix A**. The intersections included in the study are as follows:

- Whoop Up Drive / Metis Trail W (Intersection 70)
- Whoop Up Drive / Coalbanks Gate W (Intersection 40)
- Whoop Up Drive / 30 Street W (Intersection 10)
- Metis Trail / Coalbanks Link W (Intersection 71)
- Coalbanks Link W / Coalbanks Boulevard W (Intersection 52)
- Coalbanks Gate W / Coalbanks Boulevard W (Intersection 42)
- Simon Fraser Boulevard / Copperwood Stage 2 Access / Metis Trail W (Intersection 75)
- Copperwood Stage 2 Access / Coalbanks Boulevard W (Intersection 55)
- Internal Intersections (labeled Intersections 12, 25, 33, 35, 45 & 54)



April 2012

112944453

Legend

City of Lethbridge Limits

Copperwood Stage II

Stantec

Client/Project

Daytona Urband Development Corp.

City of Lethbridge RELD

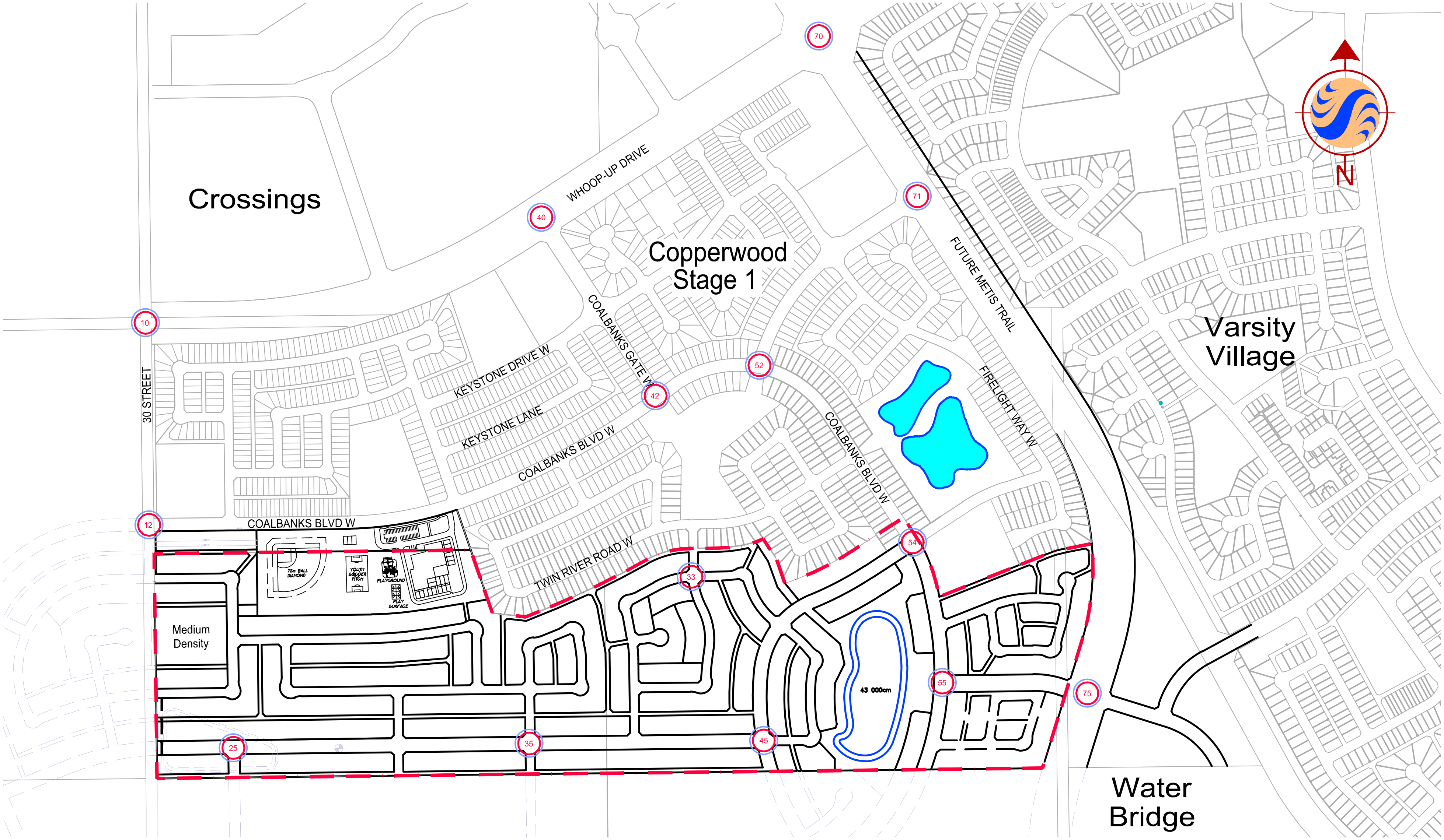
Copperwood Stage II TIA

Figure No.

1.1

Title

Site Context



NTS

April 2012
112944453

Legend

Copperwood Stage II Boundary

Intersection Evaluation

ORIGINAL SHEET - ANSI B

Stantec

Client/Project
DAYTONA URBAN DEVELOPMENT CORP.
City of Lethbridge RELD
COPPERWOOD STAGE II OUTLINE PLAN

Figure No.
1.2

Title
Transportation Impact
Assessment Study Area

2.0 Development Proposal

2.1 PROPOSED DEVELOPMENT

Daytona Urban Development Corp. proposes to develop an approximately 62 hectare site in West Lethbridge. After excluding the area for the proposed roadway network, the storm management facilities and reserve lands, the development yields approximately 36 hectares of developable land. **Outline Plan Figure 7.1** is included in **Appendix B** to illustrate the proposed land use designations for Copperwood Stage 2.

Table 2.1 summarizes the proposed composition of the community within the Outline Plan area. The development intensities shown in **Table 2.1** reflect the full build-out of the community. The development will consist of a mix of low and medium density residential uses.

Table 2.1 – Development Summary

Use	Intensity
Low Density Residential	588 units
Medium Density Residential	302 units

Areas designated as "Low Density R-CL" zoning have been included with an assumed density of 20 units per hectare. As stated in the outline plan, the R-CL zoning within Copperwood is anticipated to yield 588 units. These units have all been included as Low Density Residential.

Areas designated as "Medium Density R75" and "Mixed Density (R-M)" zoning have been included with assumed densities of 75 units per hectare and 37 units per hectare, respectively. As stated in the outline plan, the total number of units anticipated for the combined R75 and R-M zoned areas is 302.

The majority of traffic generated by the proposed development will use Intersection 75 for ingress and egress. Three other entrance points provide ingress/egress for Copperwood Stage 2, including Intersection 40 (Coalbanks Gate/Whoop Up Drive), Intersection 71 (future Stage 1 Metis Trail intersection), and Intersection 10 (30 Street W/Whoop Up Drive).

2.2 PLANNING HORIZONS AND PROPOSED DEVELOPMENT STAGING

As established in scope discussions with Infrastructure Services, the entire development is anticipated to be serviced within ten years of approval. Therefore only a "full-build" horizon has been analyzed.

3.0 Traffic Volumes

3.1 BACKGROUND TRAFFIC VOLUMES

A combination of the available information from approved outline plans and TIAs within West Lethbridge were used to establish the background traffic volumes. The “Full Build Out Horizon Traffic Volumes” established in the Crossings TIA (iTrans, July 2007) were used as the basis for the background traffic along Whoop Up Drive and Metis Trail. The volumes associated with Stage 1 of Copperwood were then removed and added back using the information from the Copperwood TIA (UMA, December 2005). Background volumes on Metis Trail related to the west accesses to Varsity Village were also added using the information from the Copperwood TIA.

A specific breakdown of the approach to developing the background traffic volumes for the analysis of Copperwood Stage 2 is summarized below.

1. Figure 4-4 from the Crossings TIA, which illustrates “full-build” volumes along Whoop Up Drive was used as the basis for developing the background traffic volumes. The east access to Copperwood from Whoop Up Drive was not shown on Figure 4-4. Therefore, the volumes shown at the intersection of Whoop Up Drive and Coalbanks Gate were calculated based on the volumes at the adjacent intersections.

   The volumes at the intersection of Whoop Up Drive / Metis Trail were also not shown on Figure 4-4 from the Crossings TIA. The volumes at this intersection were developed by applying the trip distribution agreed to for the Copperwood Stage 2 TIA (See Table 3.5) to the total background volumes on the Whoop Up Drive and Metis Trail approaches. This assumption is described in greater detail in point 6 below; however because this methodology would not provide volumes for the westbound right turn nor for the southbound left turn at this intersection, we have used the volumes shown on Figure 2-2 from the Crossings TIA to estimate the volumes on these movements. The volumes highlighted in green on Figure 2-2 were combined to form the westbound right turn volumes. The volumes highlighted in yellow on Figure 2-2 were combined to form the southbound left turn volumes. The volumes shown on **Figures 3.1 and 3.2** illustrate the adjusted “Full Build Out Horizon Traffic Volumes” from the Crossings TIA.

   Both Figure 2-2 and Figure 4-4 from the Crossings TIA are included in **Appendix C**.

2. The traffic associated with Copperwood was removed from Figures 3.1 and 3.2 by subtracting all inbound and outbound traffic accessing the area. The resulting volumes are illustrated on **Figures 3.3 and 3.4**.

3. The full-build volumes illustrated on Figures 3.3 and 3.4 were divided in half, since it was assumed that the traffic at the ten-year horizon would be approximately half that anticipated at the full-build horizon for the Crossings (this is similar to the assumptions made for other TIAs in West Lethbridge). The resulting ten-year background volumes are illustrated on **Figures 3.5 and 3.6**.

4. The volumes associated with Stage 1 of Copperwood were isolated from Figures 4.1 and 4.2 of the Copperwood TIA (Included in **Appendix D**). A review of these volumes revealed that a substantial portion of traffic was entering Copperwood via the Coalbanks Gate W access, but then dissipating prior to reaching the Coalbanks Gate / Coalbanks Boulevard intersection. Therefore, the inbound volumes were adjusted to account for this apparent anomaly in the background volumes. One quarter of the traffic shown making the westbound left turn into Copperwood at Coalbanks Gate W (Intersection 40) was transferred to Coalbanks Link W (Intersection 71). To be conservative in the analysis of the internal intersections, volumes at the Coalbanks Gate W / Coalbanks Boulevard intersection (Intersection 42) were not reduced, and one half of the traffic transferred to Coalbanks Link W (intersection 71) was carried through to make the southbound left onto Coalbanks Boulevard W at Intersection 52. The resulting Copperwood Stage 1 volumes are illustrated on **Figures 3.7 and 3.8**.

5. The volumes associated with Varsity Village were isolated from Figures 4.3 and 4.4 of the Copperwood TIA (included in **Appendix D**). Because these figures illustrate a full-build horizon, the volumes were divided by two to represent the ten-year horizon volumes associated with Varsity Village. These volumes are illustrated on **Figures 3.9 and 3.10**.

6. The volumes in Figure 3.5 were combined with the volumes in Figures 3.7 and 3.9 to form the full-build horizon morning peak hour background volumes for Stage 2 of Copperwood. Likewise the volumes in Figure 3.6 were combined with the volumes in Figures 3.8 and 3.10 to form the full-build horizon afternoon peak hour background volumes for Stage 2 of Copperwood.

   Lastly, the volumes at the intersection of Whoop Up Drive / Metis Trail were developed by taking the approach volumes along Metis Trail and Whoop Up Drive, and applying the trip distribution assumptions agreed to as part of the scoping for the Copperwood Stage 2 TIA (See Table 3.5). The resulting background volumes for Copperwood Stage 2 are illustrated in **Figures 3.11 and 3.12**.

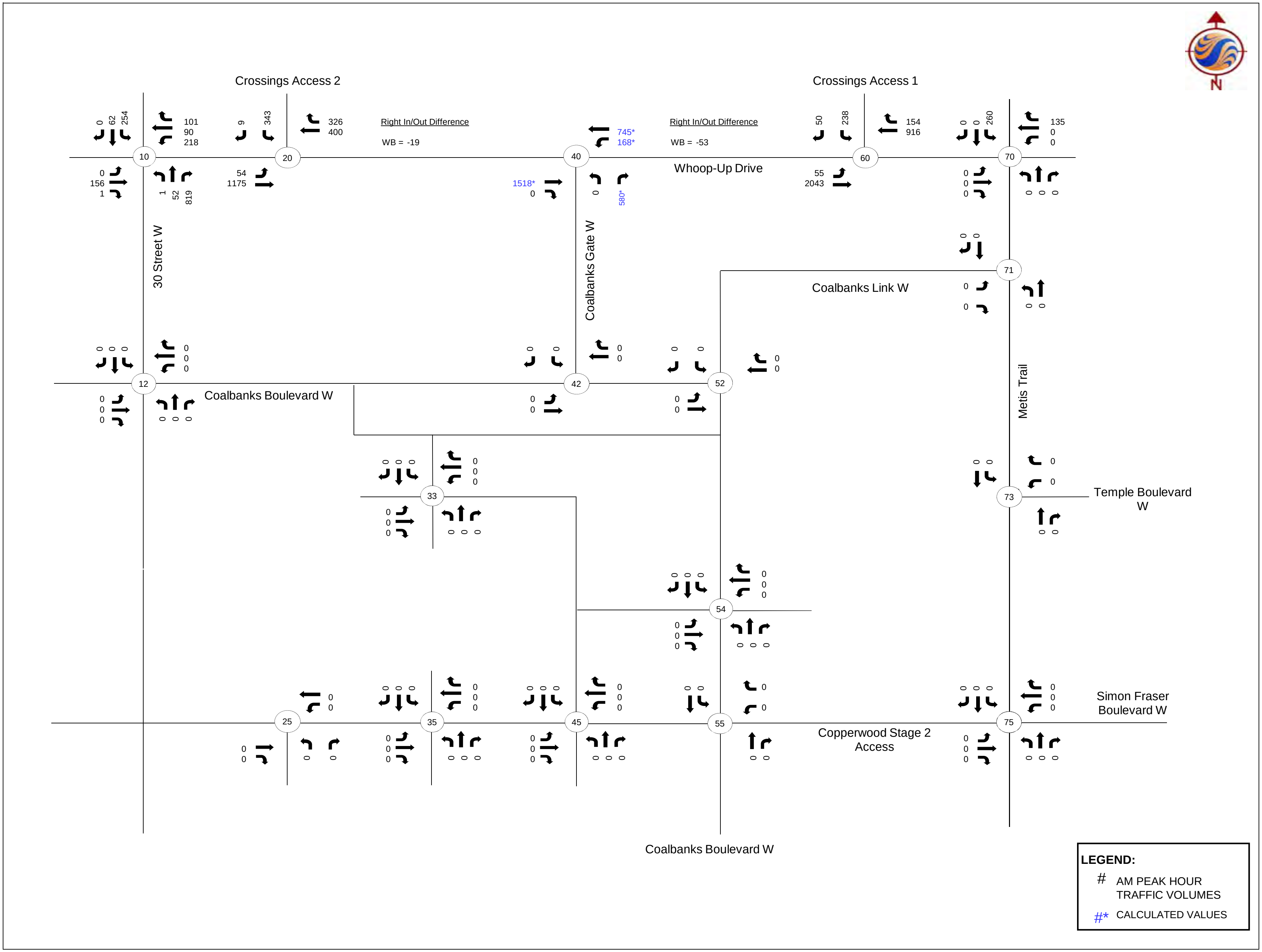


Figure 3.1
Crossings TIA Full-Build Volumes
AM Peak Hour
(From Crossings TIA Figure 4-4)

COPPERWOOD STAGE 2 OUTLINE PLAN

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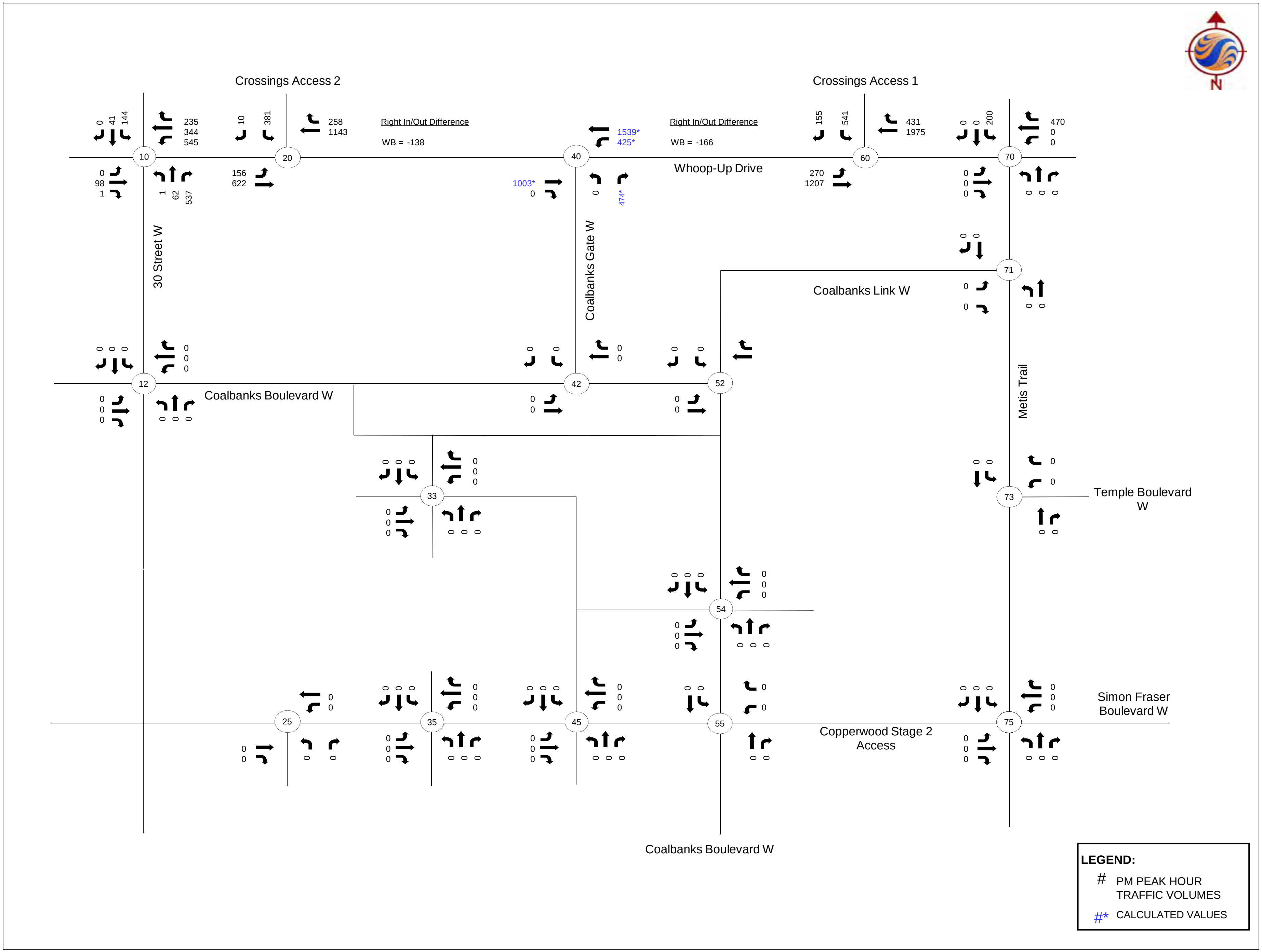

Figure 3.2
Crossings TIA Full-Build Volumes
PM Peak Hour
(From Crossings TIA Figure 4-4)

COPPERWOOD STAGE 2 OUTLINE PLAN

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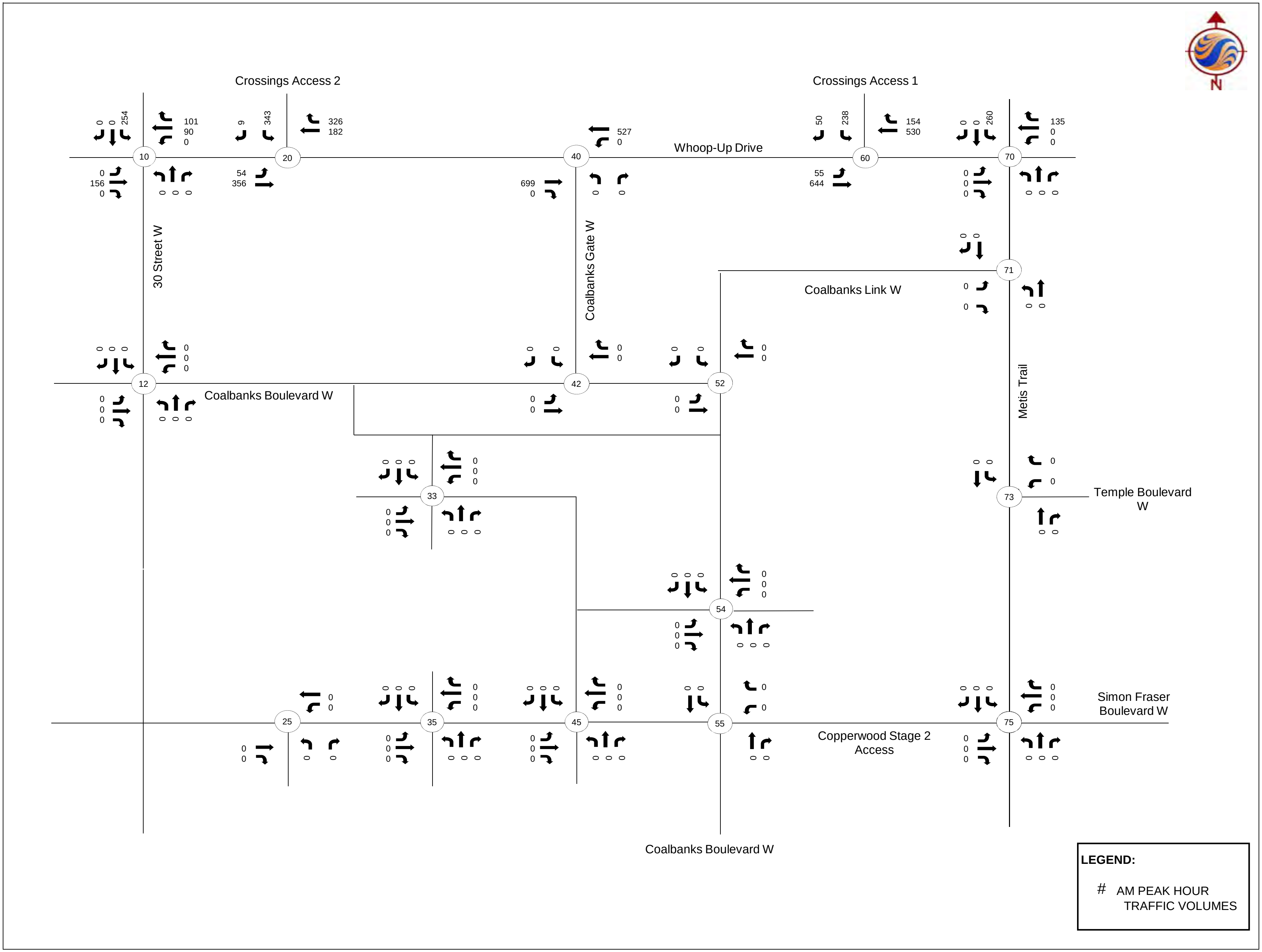

Figure 3.3
Crossings TIA Full-Build Volumes
Copperwood Removed
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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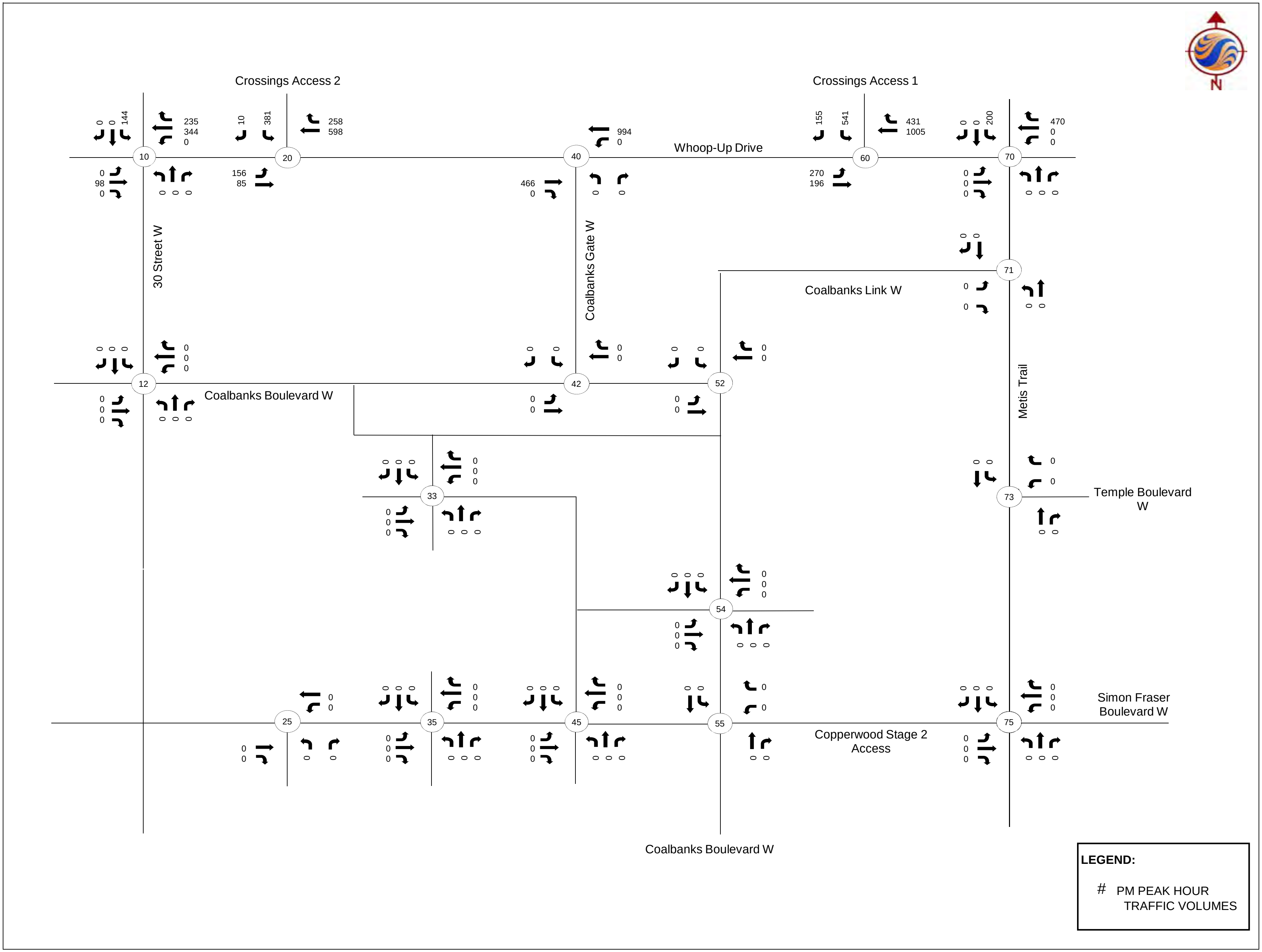

Figure 3.4
Crossings TIA Full-Build Volumes
Copperwood Removed
PM Peak Hour

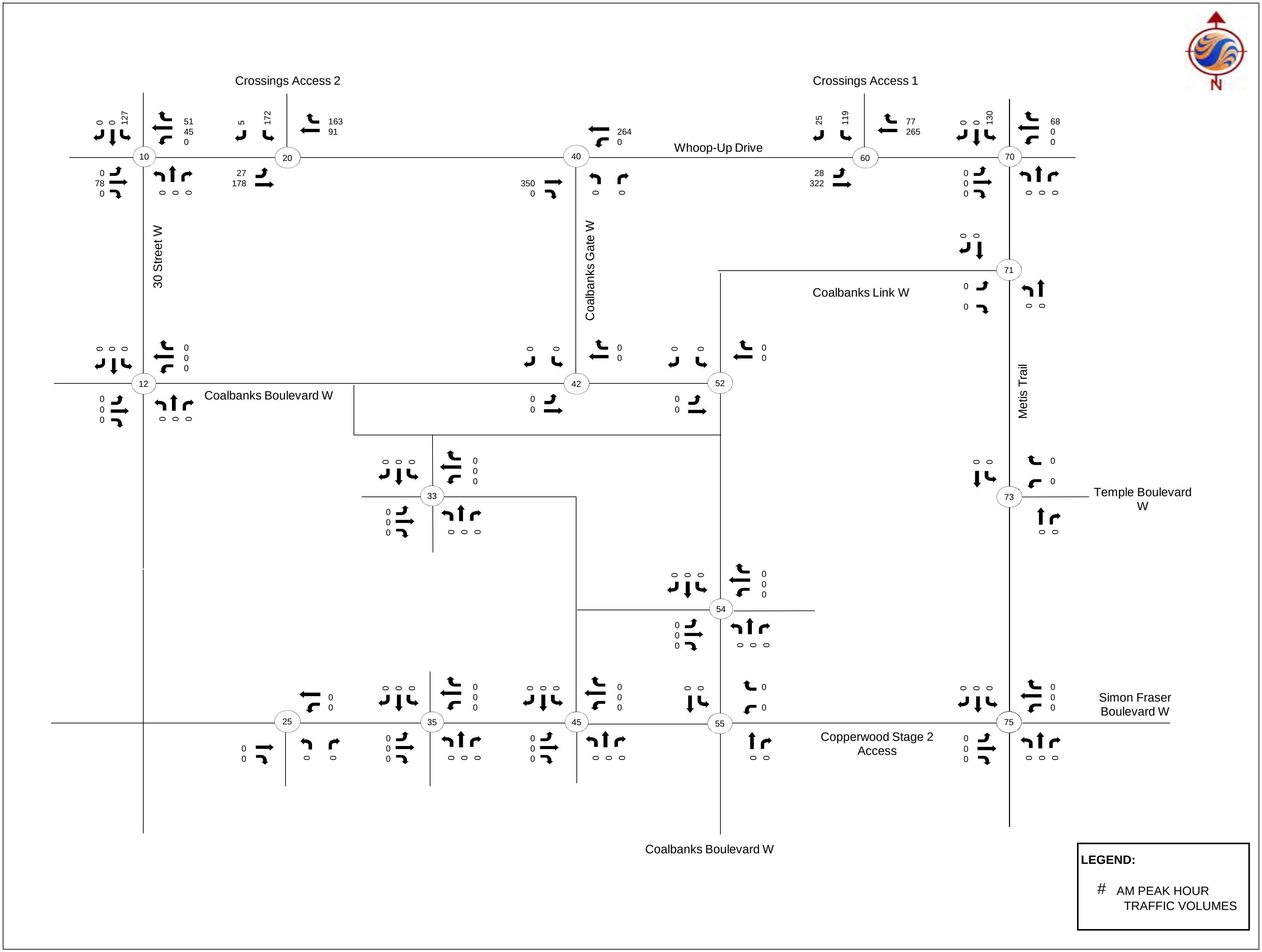

Figure 3.5
Background Traffic
Adjusted to Ten Year Horizon
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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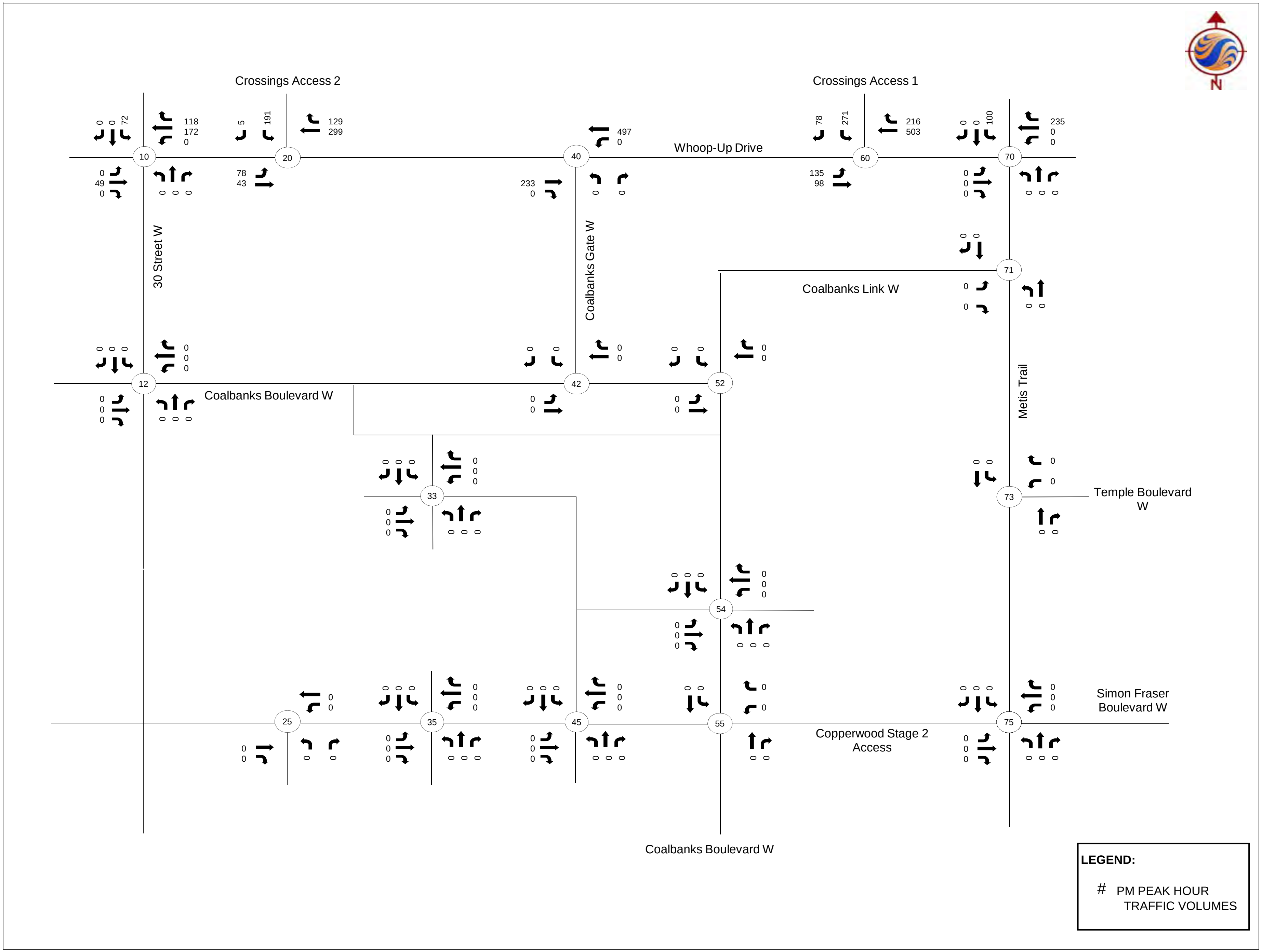

Figure 3.6
Background Traffic
Adjusted to Ten Year Horizon
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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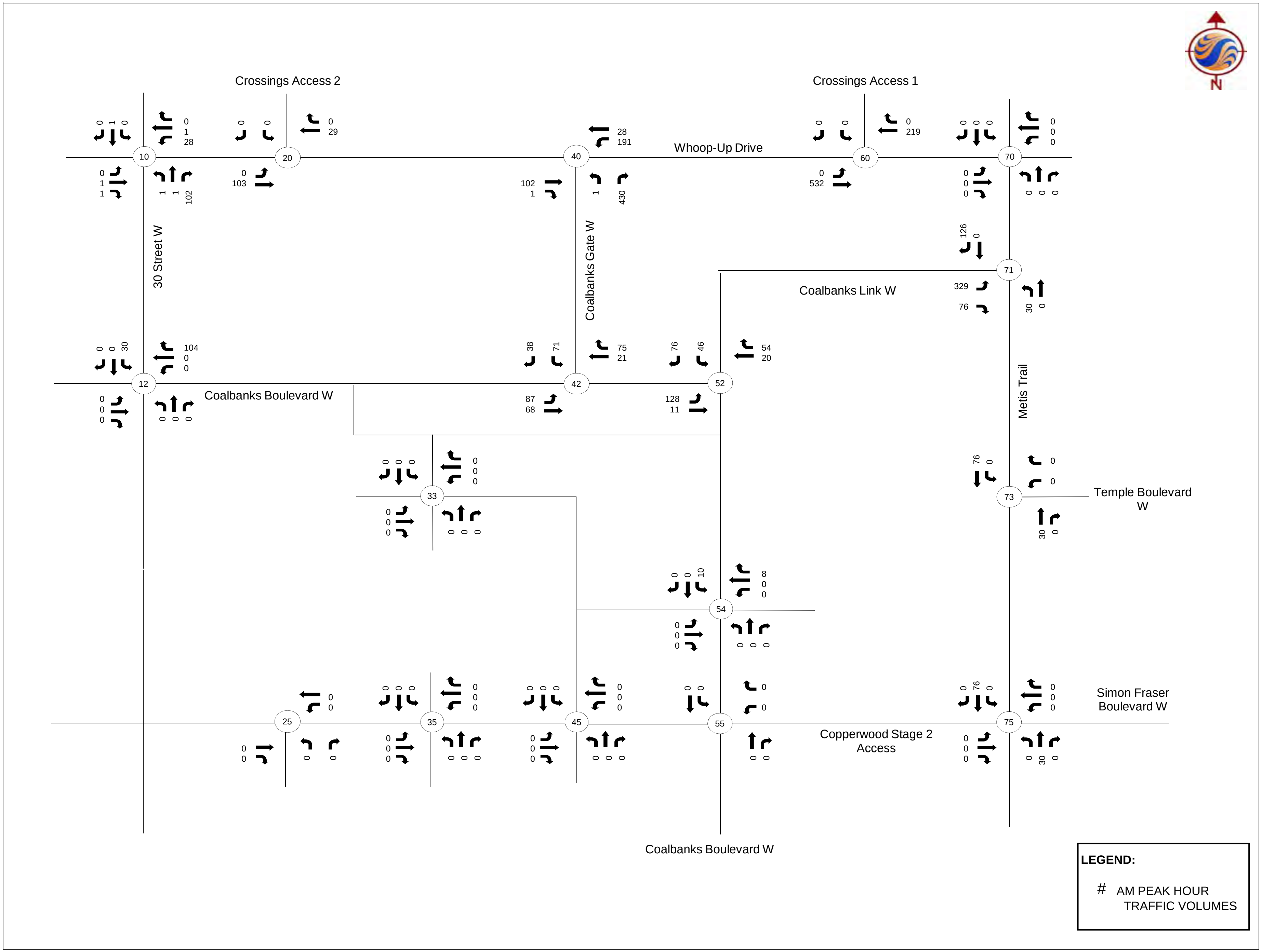

Figure 3.7
Copperwood Stage 1 Volumes
AM Peak Hour
(From Copperwood TIA Figure 4.1)

COPPERWOOD STAGE 2 OUTLINE PLAN

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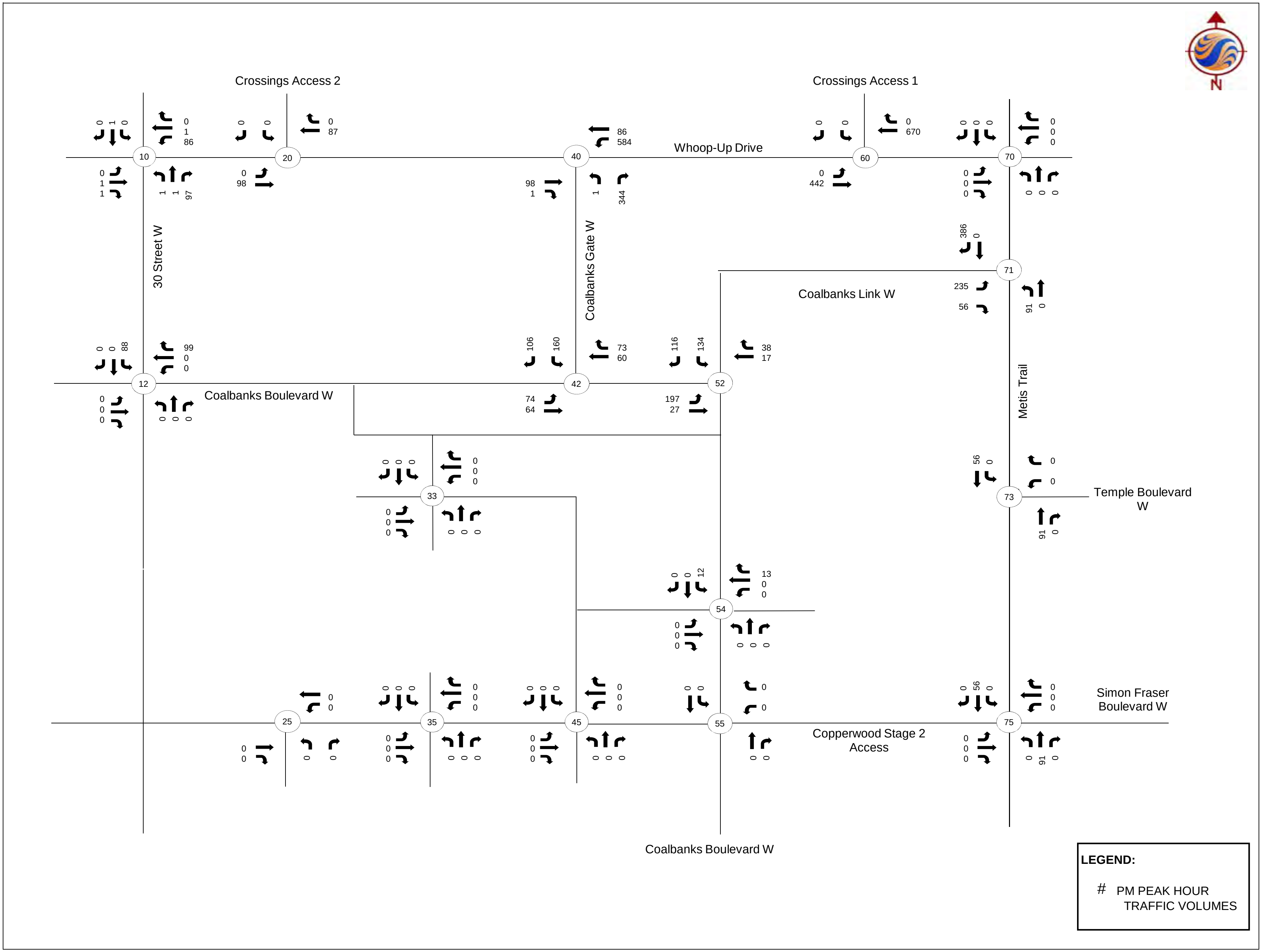

Figure 3.8
Copperwood Stage 1 Volumes
PM Peak Hour
(From Copperwood TIA Figure 4.2)

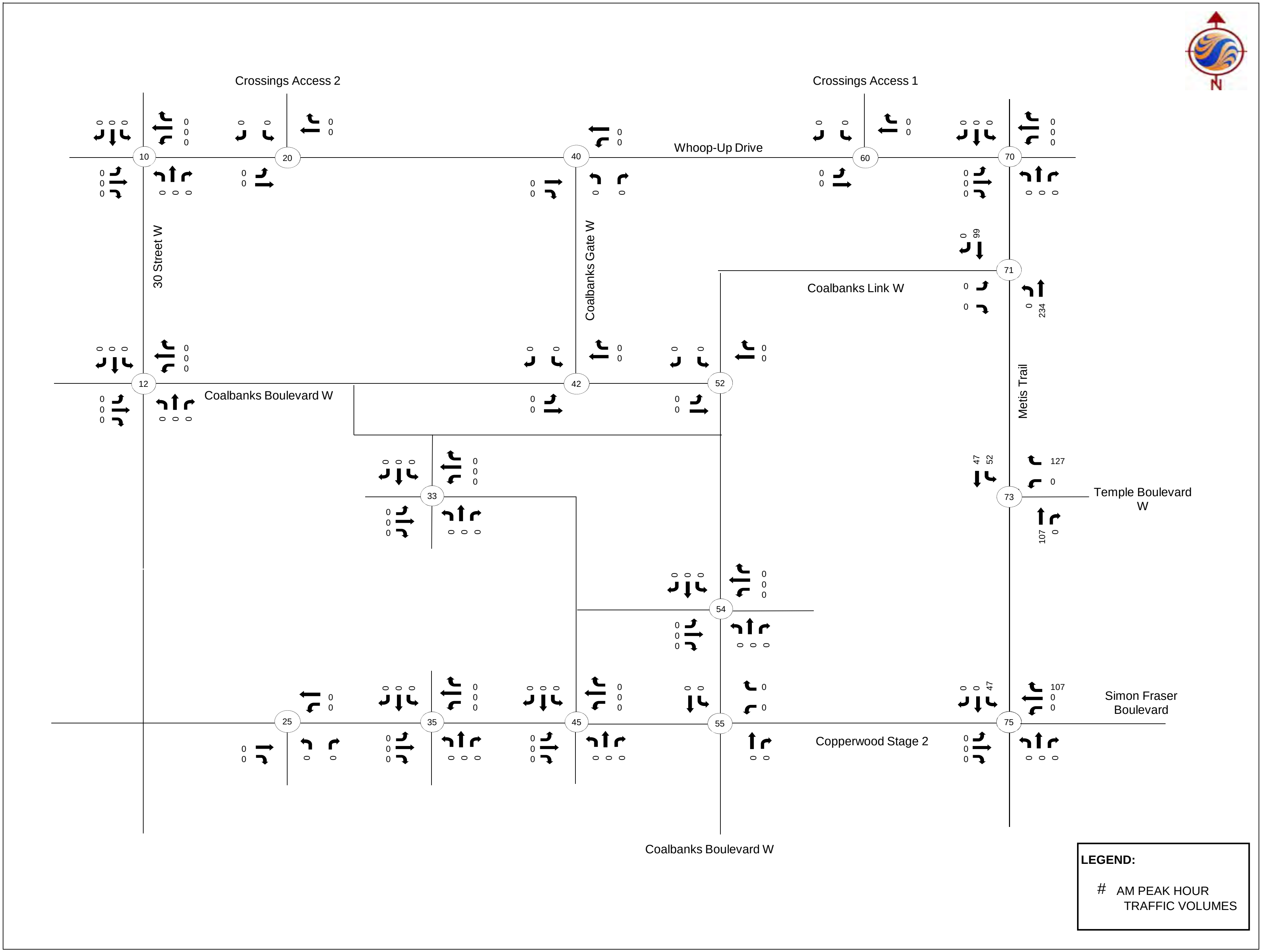

Figure 3.9
Varsity Village 10 Year Volumes
AM Peak Hour
(From Copperwood TIA Figure 4.3)

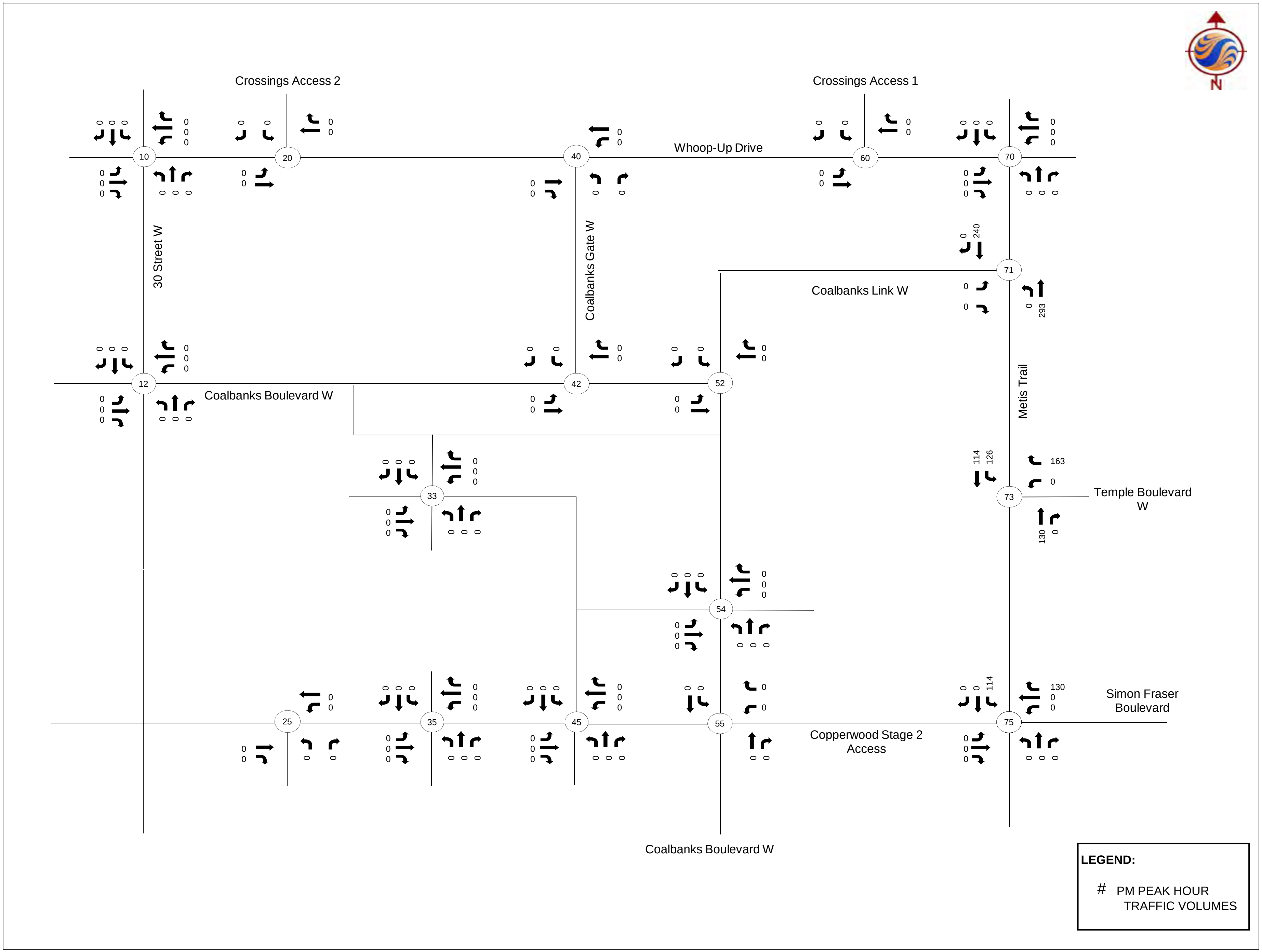

Figure 3.10
Varsity Village 10 Year Volumes
PM Peak Hour
(From Copperwood TIA Figure 4.4)

COPPERWOOD STAGE 2 OUTLINE PLAN

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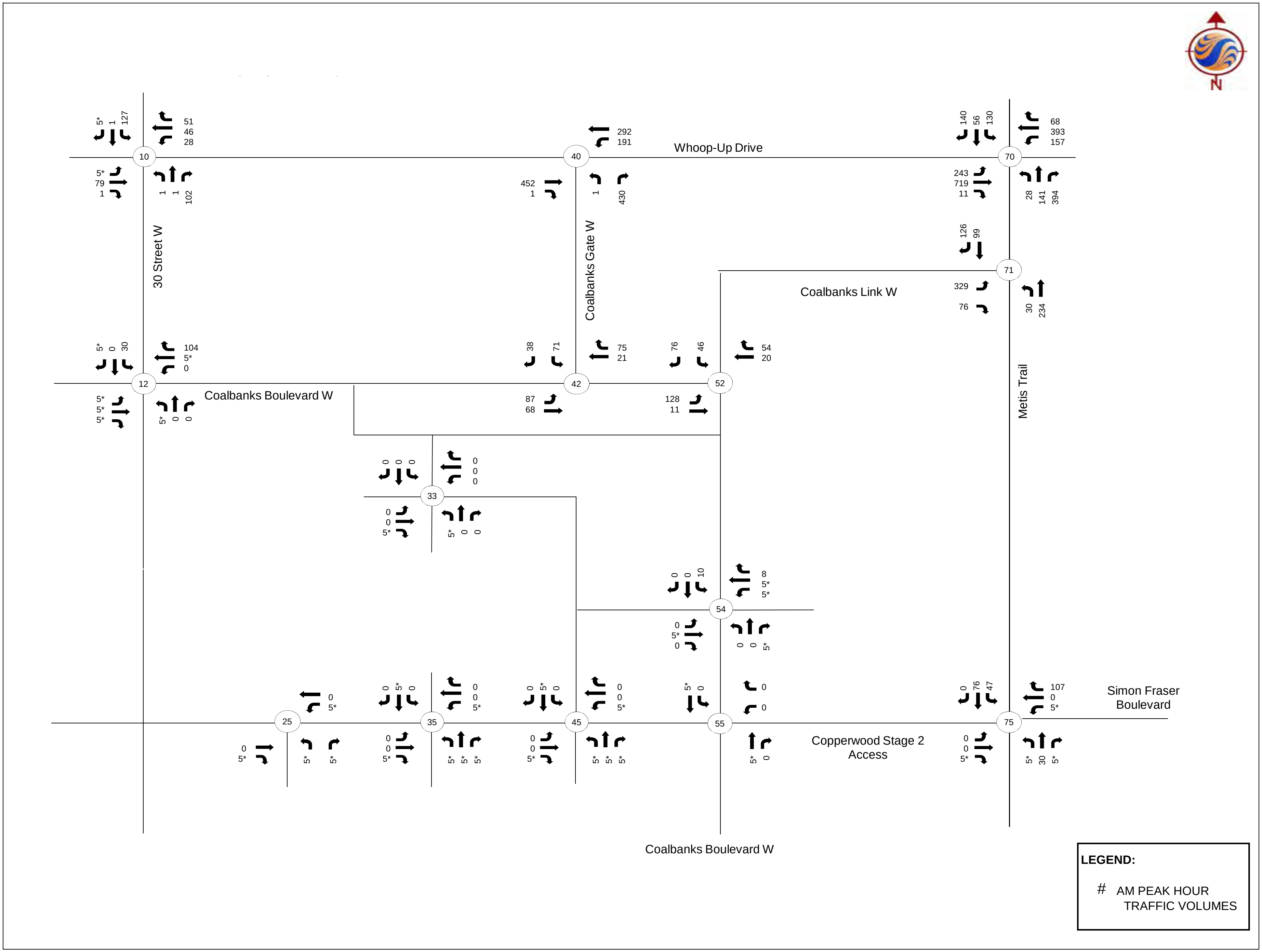

Figure 3.11
Copperwood Stage 2
Background Volumes
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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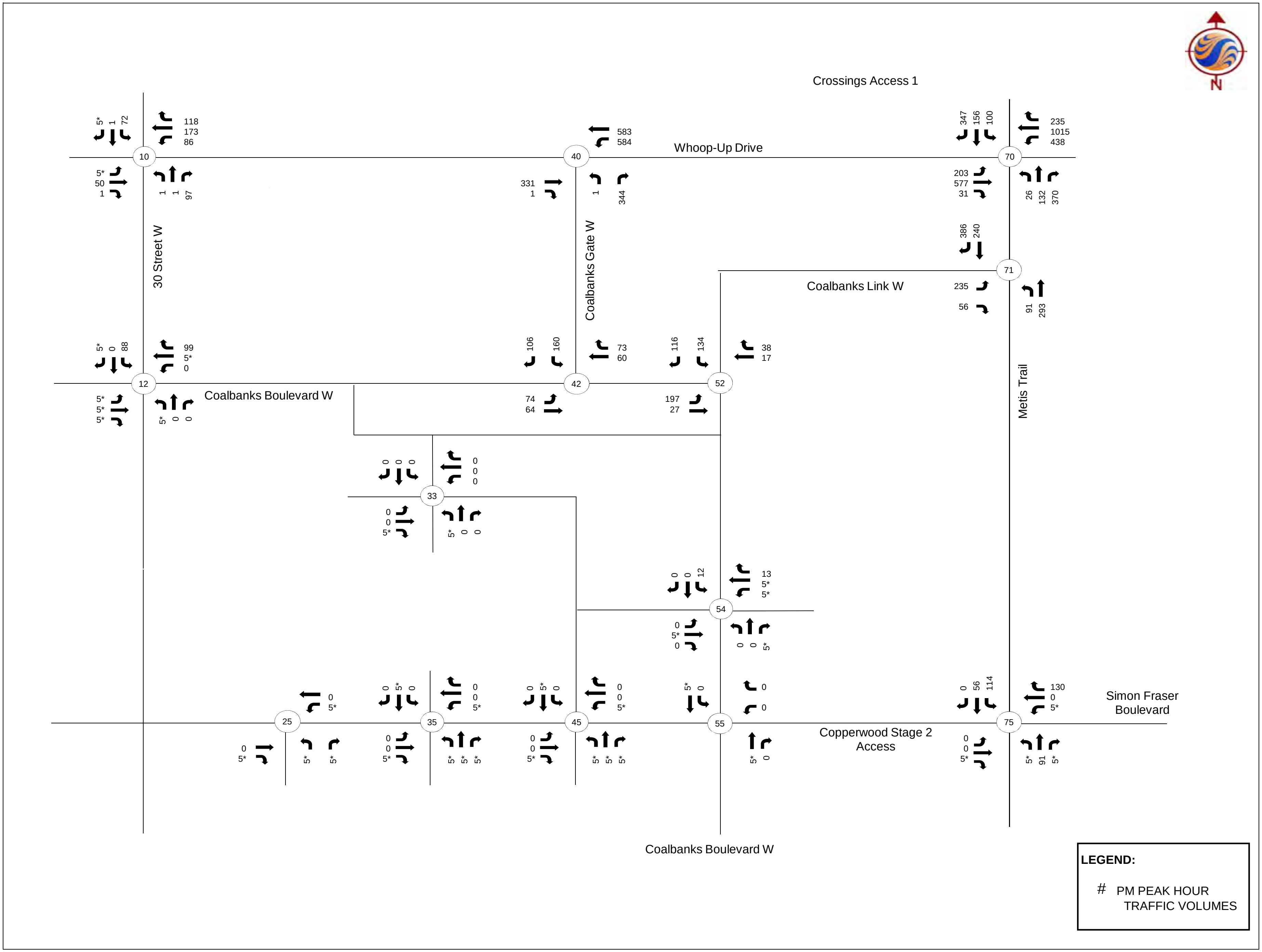

Figure 3.12
Copperwood Stage 2
Background Volumes
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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3.2 TRIP GENERATION

In assessing the trip-generating potential of the proposed development, we have applied the City of Lethbridge trip generation rates for the low and medium density residential units. The trip generation rates are summarized in **Table 3.1**.

Table 3.1 – Trip Generation Rates

Use	AM Peak Hour			PM Peak Hour		
		In	Out		In	Out
Low Density Residential	0.77 vph/unit	26%	74%	1.02 vph/unit	64%	36%
Medium Density Residential	0.75 vph/unit	29%	71%	0.92 vph/unit	61%	39%

The resulting site traffic generated by the proposed development for the ten-year full-build horizon is summarized in **Table 3.2**.

Table 3.2 – Trip Generation

Use	Number Of Units	Trip Generation					
		AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Low Density Residential	588	453	118	335	600	384	216
Medium Density Residential	302	227	66	161	278	170	108
Total Trip Generation	**890**	**680**	**184**	**496**	**878**	**554**	**324**

3.3 TRIP DISTRIBTUTION AND ASSIGNMENT

The directional distribution patterns for trips generated by the development were established during the initial TIA sign-off period. **Table 3.3** summarizes the distribution patterns for the residential components of the development:

Table 3.3 – Trip Distribution

Métis Trail (North)	Whoop Up Drive (East)	Simon Fraser Boulevard (East)
25%	70%	5%

The morning and afternoon peak hour traffic generated by the residential components of Country Meadows was assigned to the area road network based on the distribution patterns shown in **Table 3.5**. **Figures 3.13 and 3.14** illustrate the site-generated traffic volumes for the full-build horizon.

The site-generated traffic volumes were added to the background traffic volumes. The resulting full-build post-development traffic volumes are illustrated in **Figures 3.15 and 3.16**.

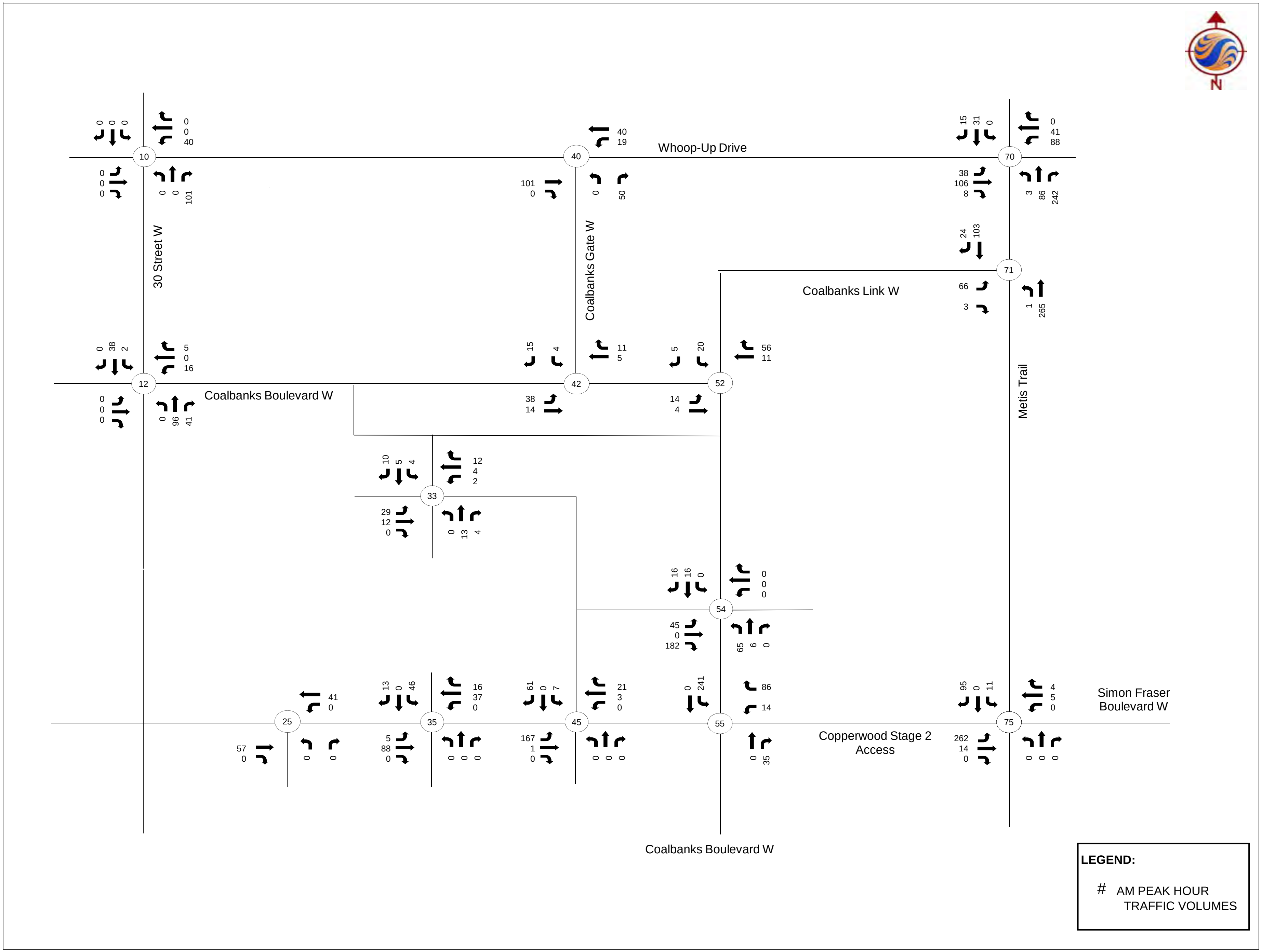

Figure 3.13
Site-Generated Traffic Volumes
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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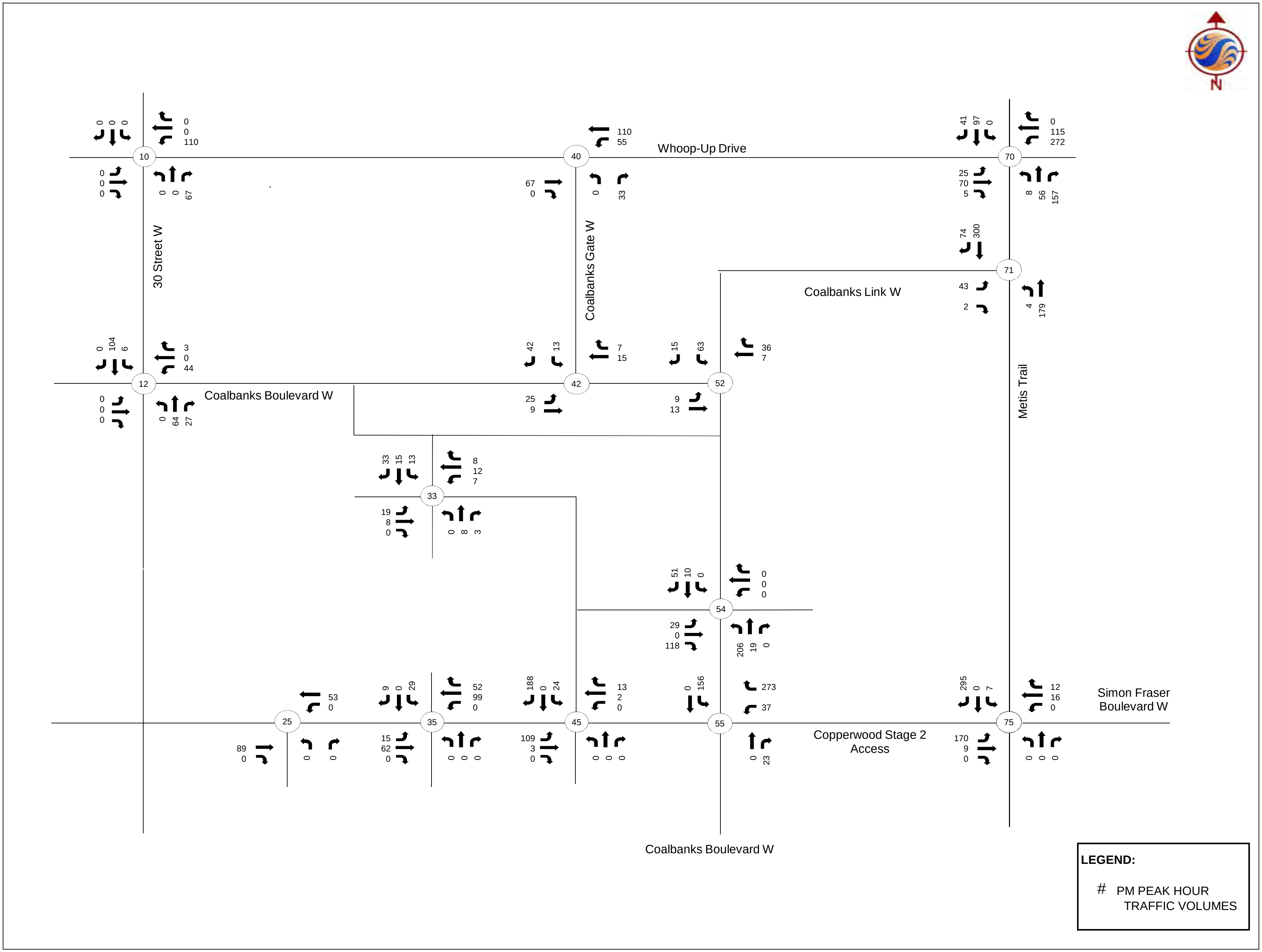

Figure 3.14
Site-Generated Traffic Volumes
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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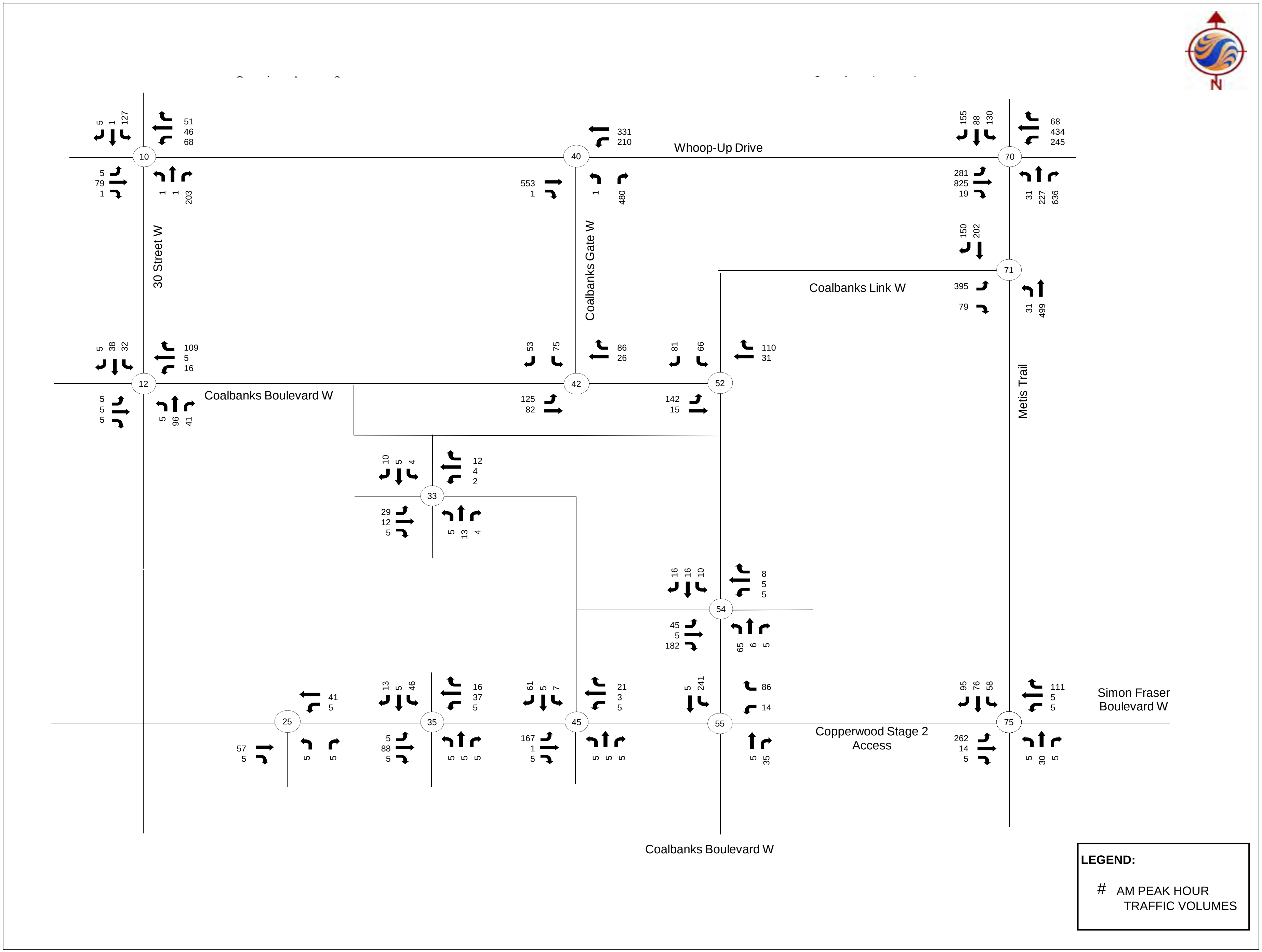

Figure 3.15
Post-Development Traffic Volumes
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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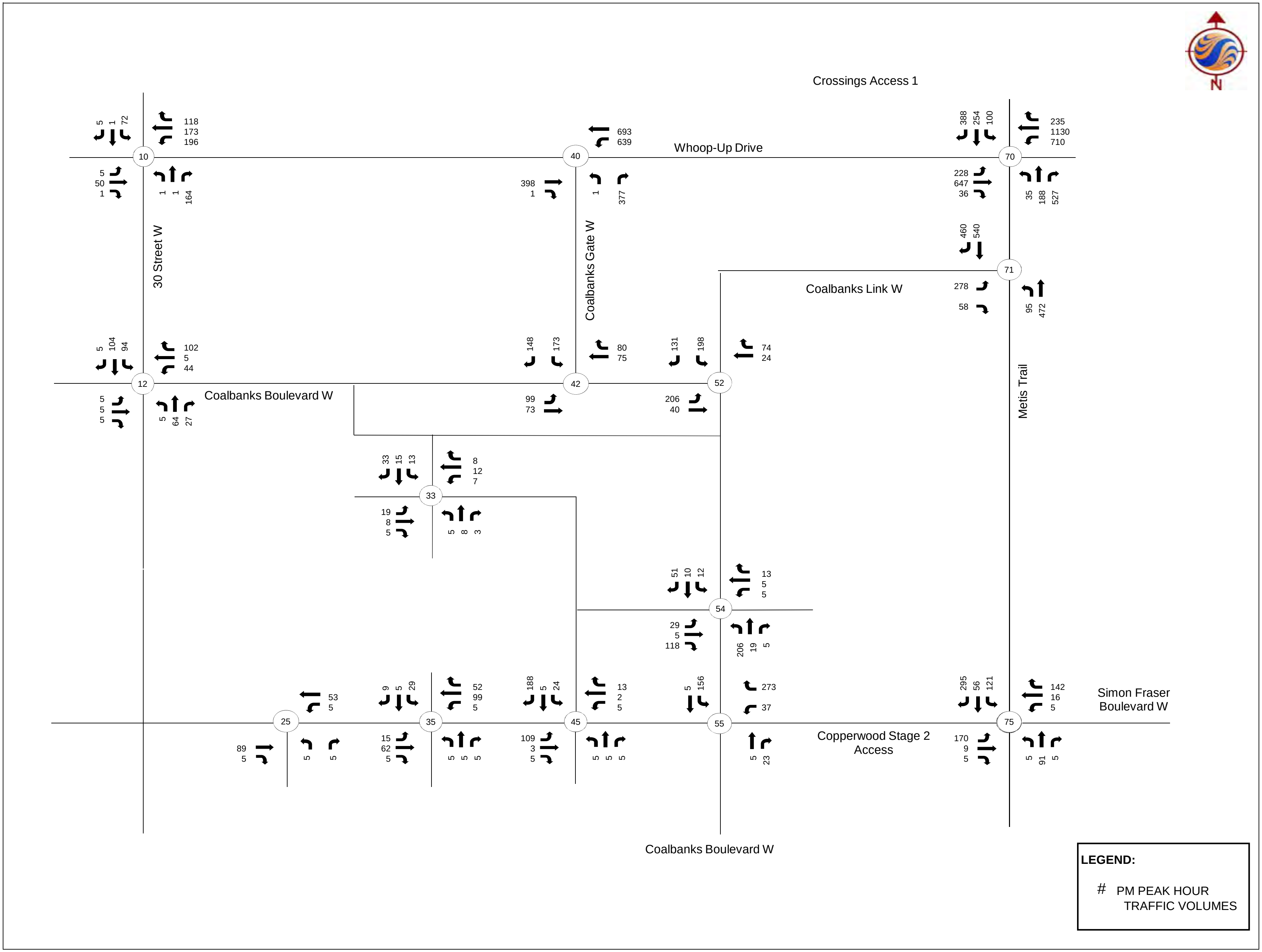

Figure 3.16
Post-Development Traffic Volumes
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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4.0 Intersection Analysis

4.1 ANALYSIS CRITERIA

Analysis for roundabout intersections was undertaken using the SIDRA Intersection 5.1 software package, which is based on the updated Highway Capacity Manual (HCM 2010). For roundabouts, the methodology considers the intersection geometry, the traffic volumes, the posted speed limit, the gap-acceptance behavior of drivers and pedestrian effects. The average delay for each lane group and the overall intersection are calculated. An operation level of service is then assigned based on the calculated average delay.

Analysis for conventional signalized/unsignalized intersections was undertaken using the Synchro 7 software package, which is based on the Highway Capacity Manual (HCM 2000). For unsignalized intersections, the methodology considers the intersection geometry, the traffic volumes, the posted speed limit and the type of intersection control. The average delay for each individual movement from the minor street, the major street left-turn movements and the overall intersection are calculated. An operation level of service (LOS) is then assigned based on the calculated average delay.

For signalized intersections, the methodology considers the intersection geometry, the traffic volumes, the posted speed limit, the traffic signal phasing / timing plan as well as pedestrian volumes. The average delay for each lane group and the overall intersection are calculated. An operation LOS is then assigned based on the calculated average delay.

The level of service criteria for both signalized and unsignalized intersections is described in **Table 4.1**.

Table 4.1 – Level of Service Criteria

Level of Service	Average Control Delay (seconds per vehicle)		Comment
	Signalized Intersection	Unsignalized Intersection	
A	10.0 or less	10.0 or less	Very good operation
B	10.1 to 20.0	10.1 to 15.0	Good operation
C	20.1 to 35.0	15.1 to 25.0	Acceptable operation
D	35.1 to 55.0	25.1 to 35.0	Congestion
E	55.1 to 80.0	35.1 to 50.0	Significant congestion
F	More than 80.0	More than 50.0	Unacceptable operation
Breakdown	Very high	Very high	Calculations are meaningless

The volume-to-capacity (v / c) ratio was also considered. If the v / c ratio for a movement is greater than 1.00, then that movement has technically exceeded capacity. The City's threshold for the v / c ratio is 0.80 for through movements and 0.90 for critical movements.

4.2 FULL-BUILD HORIZON BACKGROUND OPERATING CONDITIONS

Based on the initial scoping discussion with the City of Lethbridge Infrastructure Services group, it was agreed that Metis Trail and Whoop Up Drive would be initially considered as two-lane roadways with center median designated left turn lanes. Upon review of the background volumes established, it was determined that these roads would require four-lane cross-sections at a minimum to the first intersections to the south and west respectively (the access to Copperwood Stage 1, in the case of Metis Trail, and the first access to the Crossings, in the case of Whoop-Up Drive).

This is consistent with the ten-year horizons presented in both the Crossings TIA and the Copperwood Stage 1 TIA, referenced in Section 3.1 of this report. Further, the intersections of Coalbanks Gate W / Whoop-Up Drive (Intersection 40) and Coalbanks Link W (Intersection 71) were assumed to be signalized, consistent with the ten year analysis presented in the Copperwood Stage 1 TIA.

The full-build horizon background operating conditions during the AM and PM peak hours were reviewed using the volumes shown in **Figures 3.13 and 3.14**. Analysis of the intersections within the Stage 2 outline plan area was not conducted as it was not warranted based on the background volumes. This includes intersections 12, 25, 33, 35, 45, 54, 55, and 75. **Table 4.2** summarizes the results of our analysis for the full-build horizon background morning and afternoon peak hour volumes. The outputs for the full-build horizon background analysis are included in **Appendix E**. The recommended lane configurations for the full-build horizon background scenario are illustrated in **Figure 4.1**. Unless otherwise noted all dedicated right turn lanes are assumed to have 50 meter storage.

The results of the full-build horizon background analysis summarized in **Table 4.2** indicate the following:

- Whoop Up Drive / Metis Trail W (Intersection 70): the intersection was analyzed assuming a four-lane cross-section with designated left turn lanes on all approaches. Based on this configuration, the west leg of the intersection is expected to experience some operational deficiencies. The intersection was therefore analyzed with an added designated westbound right turn lane. Based on this improved configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Northbound left turn lane – 60 meters
    - Southbound left turn lane – 60 meters
    - Westbound left turn lane – 120 meters
    - Eastbound left turn lane – 60 meters

- Whoop Up Drive / Coalbanks Gate W (Intersection 40): the intersection was analyzed assuming a two-lane cross section along Whoop Up Drive with a designated westbound left turn lane in the median. Coalbanks Gate consists of an (already constructed) four-lane approach. As indicated above, the intersection was assumed to be signalized (as shown in the ten year horizon for the Copperwood Stage 1 TIA). Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Westbound left turn lane – 120 meters
- Metis Trail / Coalbanks Link W (Intersection 71): the intersection was analyzed assuming a four-lane cross-section on the north leg (requirement based on the Whoop Up Drive / Metis Trail intersection), and two-lane cross-sections on both the south and west approaches. With this configuration, the outside lane of southbound Metis Trail will drop as a designated right turn lane at the intersection. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Northbound left turn lane – 60 meters

  The intersection was also analyzed as a single-lane roundabout with two-lane (one in each direction) approaches on all legs. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Whoop Up Drive / 30 Street W (Intersection 10): the intersection was analyzed assuming a two-lane cross-section with stop-control placed on the 30 Street W approaches. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Westbound left turn lane – 60 meters
    - Eastbound left turn lane – 60 meters
- Coalbanks Gate W / Coalbanks Boulevard W (Intersection 42): the intersection was analyzed as constructed, with two-lane cross-sections on all roads and yield control placed on Coalbanks Gate W. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Coalbanks Link W / Coalbanks Boulevard W (Intersection 52): the intersection was analyzed as constructed, with two-lane cross-sections on all roads and yield control placed on Coalbanks Link W. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.

Table 4.2 - Background Operating Conditions

Intersection	Intersection ID#	Intersection Control	Interval	Measure	Eastbound Left	Eastbound Through	Eastbound Right	Westbound Left	Westbound Through	Westbound Right	Northbound Left	Northbound Through	Northbound Right	Southbound Left	Southbound Through	Southbound Right	Level of Service
Whoop Up Drive Metis Trail W	70	Signalized	AM Peak Hour	Volumes (vph)	243	719	11	157	393	68	28	141	394	130	56	140	C
				Level of Service	B	C		B	C	A	B	B		C	A		
				V/C Ratio by Movement	0.55	0.76		0.55	0.46	0.14	0.09	0.72		0.52	0.25		
				95th Percentile Queue (m)	41	90		26	43	9	7	31		24	11		
			PM Peak Hour	Volumes (vph)	203	577	31	438	1015	235	26	132	370	100	156	347	C
				Level of Service	D	D		C	C	A	C	B		D	B		
				V/C Ratio by Movement	0.75	0.80		0.85	0.80	0.32	0.16	0.74		0.54	0.66		
				95th Percentile Queue (m)	62	111		114	136	24	12	33		35	45		
Whoop Up Drive Coalbanks Gate W	40	Signalized	AM Peak Hour	Volumes (vph)		452	1	191	292		1		430				B
				Level of Service		C		A	A		C		B				
				V/C Ratio by Movement		0.77		0.51	0.28		0.00		0.71				
				95th Percentile Queue (m)		94		22	32		1		31				
			PM Peak Hour	Volumes (vph)		331	1	584	583		1		344				C
				Level of Service		D		C	A		C		B				
				V/C Ratio by Movement		0.82		0.90	0.49		0.00		0.68				
				95th Percentile Queue (m)		127		121	60		2		22				
Coalbanks Link W Metis Trail W	71	Signalized	AM Peak Hour	Volumes (vph)	329		76				30	234			99	126	B
				Level of Service		C					A	B			A	A	
				V/C Ratio by Movement		0.72					0.07	0.33			0.14	0.18	
				95th Percentile Queue (m)		53					6	29			13	7	
			PM Peak Hour	Volumes (vph)	235		56				91	293			240	386	A
				Level of Service		B					A	B			A	A	
				V/C Ratio by Movement		0.60					0.23	0.38			0.31	0.45	
				95th Percentile Queue (m)		36					13	34			28	12	
Coalbanks Link W Metis Trail W	71	Roundabout	AM Peak Hour	Volumes (vph)	329		76				30	234			99	126	A
				Level of Service		A					B	B			A	A	
				V/C Ratio by Movement		0.48					0.41	0.41			0.25	0.25	
				95th Percentile Queue (m)		21					14	14			8	8	
			PM Peak Hour	Volumes (vph)	235		56				91	293			240	386	B
				Level of Service		A					B	B			C	C	
				V/C Ratio by Movement		0.41					0.54	0.54			0.74	0.74	
				95th Percentile Queue (m)		14					24	24			50	50	
Whoop Up Drive 30 Street W	10	Stop-Controlled on Entrance Road	AM Peak Hour	Volumes (vph)	5	79	1	28	46	51	1	1	102	127	1	5	A*
				Level of Service	A	A		A	A			A			B		
				V/C Ratio by Movement	0.00	0.05		0.02	0.06			0.12			0.29		
				95th Percentile Queue (m)	0	0		1	0			3			9		
			PM Peak Hour	Volumes (vph)	5	50	1	86	173	118	1	1	97	72	1	5	A*
				Level of Service	A	A		A	A			A			C		
				V/C Ratio by Movement	0.00	0.03		0.06	0.19			0.11			0.26		
				95th Percentile Queue (m)	0	0		2	0			3			8		
Coalbanks Boulevard W Coalbanks Gate W	42	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	87	68			21	75				71		38	A*
				Level of Service	A				A						B		
				V/C Ratio by Movement	0.07				0.06						0.18		
				95th Percentile Queue (m)	2				0						5		
			PM Peak Hour	Volumes (vph)	74	64			60	73				160		106	A*
				Level of Service	A				A						B		
				V/C Ratio by Movement	0.06				0.09						0.43		
				95th Percentile Queue (m)	1				0						16		
Intersection 52	52	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	128	11			20	54				46		76	A*
				Level of Service	A				A						B		
				V/C Ratio by Movement	0.10				0.05						0.18		
				95th Percentile Queue (m)	2				0						5		
			PM Peak Hour	Volumes (vph)	197	27			17	38				134		116	A*
				Level of Service	A				A						C		
				V/C Ratio by Movement	0.15				0.04						0.47		
				95th Percentile Queue (m)	4				0						19		

*ICU LOS Reported (HCM LOS not calculated for unsignalized intersections with control on the side street only)

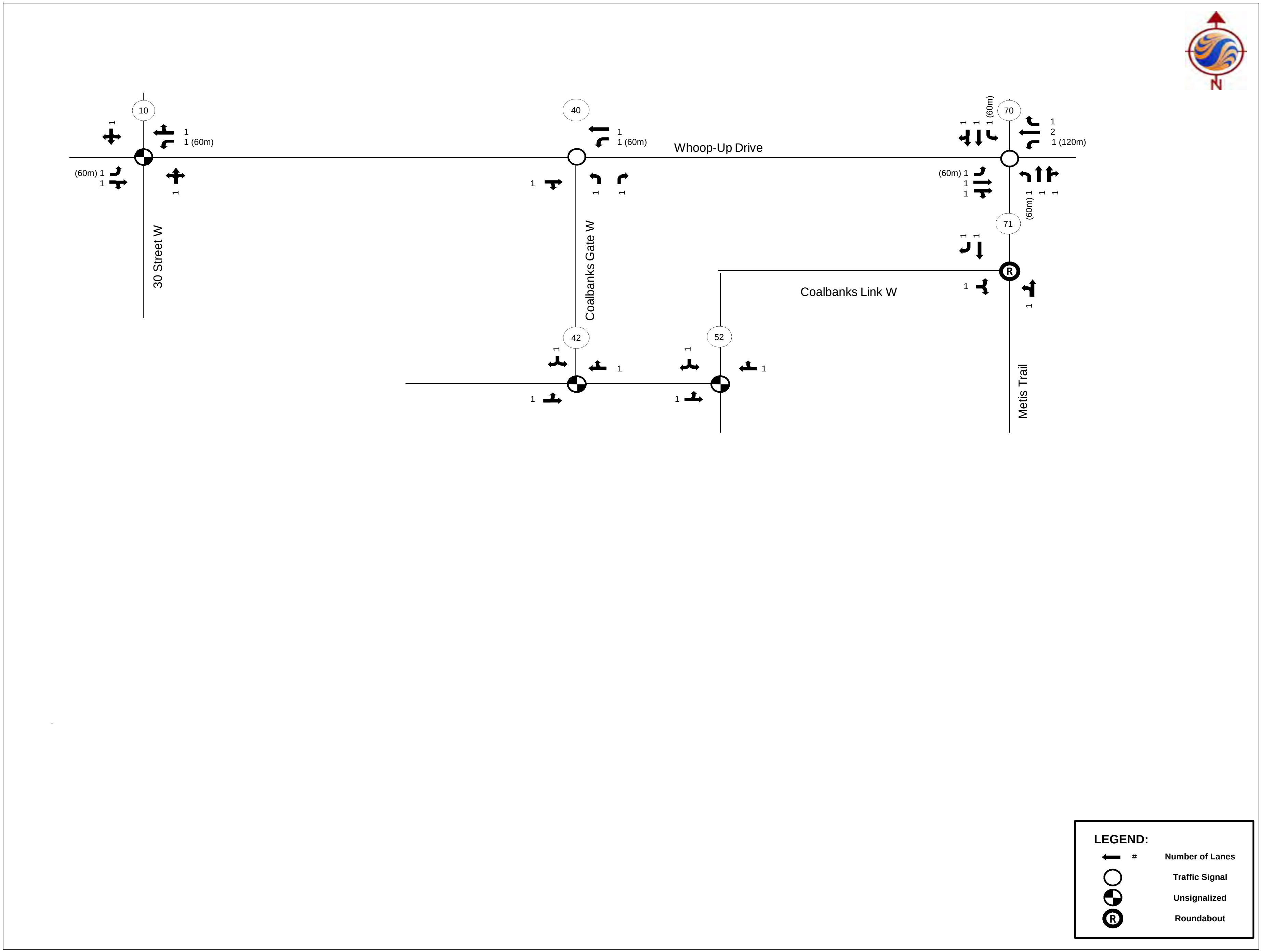

Figure 4.1
Copperwood Stage 2
Background
Recommended Lane Configurations

COPPERWOOD STAGE 2 OUTLINE PLAN

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4.3 FULL-BUILD HORIZON POST-DEVELOPMENT OPERATING CONDITIONS

The full-build horizon post-development operating conditions during the AM and PM peak hours were reviewed using the volumes shown in **Figures 3.15 and 3.16**. **Table 4.3** summarizes the results of our analysis for the full-build horizon post-development morning and afternoon peak hour volumes. The outputs for the full-build horizon post-development analysis are included in **Appendix F**.

The recommended lane configurations for the full-build horizon post-development scenario are illustrated in **Figure 4.2**. Intersections 12, 25, 45, and 54 were analyzed as roundabouts, as two collector standard roads intersect at each of these locations. This is consistent with Figure 9.1 from the outline plan and provides for flexibility for future development of West Lethbridge Phase 2 ASP lands to the south. Intersection 35 was analyzed as a traditional unsignalized intersection as a local road is intersecting with the collector at this location. Unless otherwise noted all dedicated right turn lanes are assumed to have 50 meter storage.

The results of the full-build horizon post-development analysis summarized in **Table 4.3** indicate the following:

- <u>Whoop Up Drive / Metis Trail W (Intersection 70):</u> the intersection is expected to experience some operational deficiencies based on the configuration described in the background analysis. The intersection was therefore analyzed with the addition of dual eastbound and westbound left turn lanes as well as a northbound free right turn lane. Based on this improved configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Northbound left turn lane – 60 meters
    - Southbound left turn lane – 60 meters
    - Westbound dual left turn lanes – 120 meters per lane
    - Eastbound dual left turn lanes – 60 meters per lane
- <u>Whoop Up Drive / Coalbanks Gate W (Intersection 40):</u> Based on the configuration described in the background analysis, the intersection is expected to continue operate sufficiently. The westbound left turn lane is slightly above the City's threshold in terms of the volume to capacity ratio (0.92), and is experiencing some moderately-heavy queuing. The intersection should be reviewed as build out of the West Lethbridge Phase 2 ASP area proceeds, and consideration for improvements such as a dual westbound left turn lane or addition of eastbound through lanes may be warranted. All other movements are expected to operate at acceptable levels of service with v/c ratios below the City's thresholds. Some Based on the queuing analysis the following minimum storage lengths are recommended:
    - Westbound left turn lane – 170 meters

- Metis Trail / Coalbanks Link W (Intersection 71): Based on the configuration described in the background analysis, the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Northbound left turn lane – 60 meters

  The intersection was also analyzed as a single-lane roundabout as described in the analysis of background conditions above (Section 4.2). Based on this configuration, the intersection is expected to be over-capacity due to the high overall volume of vehicles approaching from the north. This can be mitigated with the addition of a southbound right turn by-pass lane, similar to the configuration recommended for the conventional intersection. With the addition of the designated southbound right turn lane, the intersection will operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Whoop Up Drive / 30 Street W (Intersection 10): Based on the configuration described in the background analysis, the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds. Based on the queuing analysis the following minimum storage lengths are recommended:
    - Westbound left turn lane – 60 meters
    - Eastbound left turn lane – 60 meters
- Coalbanks Gate W / Coalbanks Boulevard W (Intersection 42): Based on the configuration described in the background analysis, the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Coalbanks Link W / Coalbanks Boulevard W (Intersection 52): Based on the configuration described in the background analysis, the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Simon Fraser Boulevard / Copperwood Stage 2 Access / Metis Trail W (Intersection 75): the intersection was analyzed assuming two-lane cross-sections on all approaches, with center median designated left turn lanes along Metis Trail. Based on this configuration with a four-way stop control in place, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. The intersection should be reviewed as build out of the West Lethbridge Phase 2 ASP area proceeds, with consideration for a signal or other improvements being discussed.

  The intersection was also analyzed as a single-lane roundabout with two-lane (one in each direction) approaches on all legs. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the volumes presented for the post-development horizon.
- Copperwood Stage 2 Access / Coalbanks Boulevard W (Intersection 55): the intersection was analyzed assuming two-lane cross-sections on all roads and yield control placed on the Copperwood Stage 2 Access road. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.

The intersection was also analyzed as a single-lane roundabout with two-lane (one in each direction) approaches on all legs. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds. The updated outline plan indicates a roundabout will be constructed at this location.

- Coalbanks Boulevard / Intersection 54 (Intersection 54): the intersection was analyzed as a two-lane roundabout. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Intersection 45: the intersection was analyzed as a two-lane roundabout. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Intersection 25: the intersection was analyzed as a two-lane roundabout. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Intersection 12: the intersection was analyzed as a two-lane roundabout. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Intersection 33: the intersection was analyzed assuming two-lane cross-sections on all roads and yield control placed on the minor approaches. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.
- Intersection 35: the intersection was analyzed assuming two-lane cross-sections on all roads and yield control placed on the (local road) minor approaches. Based on this configuration, the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds.

The internal collector running between intersections 25 and 45 is a straight section of notable length. Traffic calming measures along this segment will be considered at detail design and implemented where appropriate.

Table 4.3 - Post-Development Operating Conditions

Intersection	Intersection ID#	Intersection Control	Interval	Measure	Eastbound			Westbound			Northbound			Southbound			Level of Service
					Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Whoop Up Drive Metis Trail W	70	Signalized	AM Peak Hour	Volumes (vph)	281	825	19	245	434	68	31	227	636	130	88	155	C
				Level of Service	D	C		D	C	A	B	C	A	C	B		
				V/C Ratio by Movement	0.64	0.85		0.71	0.48	0.14	0.11	0.48	0.45	0.43	0.33		
				95th Percentile Queue (m)	39	101		43	50	9	9	30	0	30	16		
			PM Peak Hour	Volumes (vph)	228	647	36	710	1130	235	35	188	527	100	254	388	D
				Level of Service	D	D		D	D	A	C	D	A	C	D		
				V/C Ratio by Movement	0.66	0.86		0.88	0.88	0.33	0.23	0.42	0.37	0.38	0.86		
				95th Percentile Queue (m)	43	111		121	167	30	15	34	0	34	90		
Whoop Up Drive Coalbanks Gate W	40	Signalized	AM Peak Hour	Volumes (vph)		553	1	210	331		1		480				C
				Level of Service		C		C	A		C		B				
				V/C Ratio by Movement		0.86		0.68	0.32		0.00		0.82				
				95th Percentile Queue (m)		135		49	39		1		55				
			PM Peak Hour	Volumes (vph)		398	1	639	693		1		377				C
				Level of Service		D		D	A		D		B				
				V/C Ratio by Movement		0.84		0.92	0.53		0.00		0.76				
				95th Percentile Queue (m)		182		170	75		2		28				
Coalbanks Link W Metis Trail W	71	Signalized	AM Peak Hour	Volumes (vph)	395		79				31	499			202	150	B
				Level of Service	C						B	B			B	A	
				V/C Ratio by Movement	0.80						0.08	0.69			0.28	0.21	
				95th Percentile Queue (m)	79						6	76			27	8	
			PM Peak Hour	Volumes (vph)	278		58				95	472			540	460	B
				Level of Service	C						B	B			B	A	
				V/C Ratio by Movement	0.69						0.47	0.59			0.67	0.50	
				95th Percentile Queue (m)	56						19	60			73	11	
Coalbanks Link W Metis Trail W	71	Roundabout	AM Peak Hour	Volumes (vph)	395		79				31	499			202	150	C
				Level of Service	B						E				A	A	
				V/C Ratio by Movement	0.64						0.90				0.22	0.17	
				95th Percentile Queue (m)	36						90				7	5	
			PM Peak Hour	Volumes (vph)	278		58				95	472			540	460	C
				Level of Service	C						D				B	B	
				V/C Ratio by Movement	0.68						0.84				0.64	0.55	
				95th Percentile Queue (m)	33						76				35	26	
Whoop Up Drive 30 Street W	10	Stop-Controlled on Entrance Road	AM Peak Hour	Volumes (vph)	5	79	1	68	46	51	1	1	203	127	1	5	A*
				Level of Service	A	A		A	A		A			D			
				V/C Ratio by Movement	0.00	0.05		0.05	0.06		0.24			0.47			
				95th Percentile Queue (m)	0	0		1	0		7			18			
			PM Peak Hour	Volumes (vph)	5	50	1	196	173	118	1	1	164	72	1	5	A*
				Level of Service	A	A		A	A		A			E			
				V/C Ratio by Movement	0.00	0.03		0.15	0.19		0.19			0.50			
				95th Percentile Queue (m)	0	0		4	0		5			19			
Coalbanks Boulevard W Coalbanks Gate W	42	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	125	82			26	86				75		53	A*
				Level of Service	A				A					B			
				V/C Ratio by Movement	0.10				0.07					0.23			
				95th Percentile Queue (m)	3				0					7			
			PM Peak Hour	Volumes (vph)	99	73			75	80				173		148	A*
				Level of Service	A				A					C			
				V/C Ratio by Movement	0.08				0.10					0.55			
				95th Percentile Queue (m)	2				0					26			
Intersection 52	52	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	142	15			31	110				66		81	A*
				Level of Service	A				A					B			
				V/C Ratio by Movement	0.11				0.09					0.24			
				95th Percentile Queue (m)	3				0					7			
			PM Peak Hour	Volumes (vph)	206	40			24	74				198		131	A*
				Level of Service	A				A					D			
				V/C Ratio by Movement	0.16				0.07					0.71			
				95th Percentile Queue (m)	4				0					43			
Metis Trail W Fraser Boulevard W	75	Four-Way Stop Control on Entrance Road	AM Peak Hour	Volumes (vph)	262	14	5	5	5	111	5	30	5	58	76	95	B
				Level of Service	B			A			A	A		A	A		
				V/C Ratio by Movement	0.45			0.18			0.01	0.07		0.12	0.29		
				95th Percentile Queue (m)	-			-			-	-		-	-		
			PM Peak Hour	Volumes (vph)	170	9	5	5	16	142	5	91	5	121	56	295	B
				Level of Service	B			B			A	A		B	B		
				V/C Ratio by Movement	0.35			0.28			0.01	0.2		0.25	0.59		
				95th Percentile Queue (m)	-			-			-	-		-	-		
Metis Trail W Fraser Boulevard W	75	Roundabout	AM Peak Hour	Volumes (vph)	262	14	5	5	5	111	5	30	5	58	76	95	A
				Level of Service	A			B			B			A			
				V/C Ratio by Movement	0.35			0.18			0.06			0.25			
				95th Percentile Queue (m)	12			5			2			8			
			PM Peak Hour	Volumes (vph)	170	9	5	5	16	142	5	91	5	121	56	295	A
				Level of Service	B			B			B			A			
				V/C Ratio by Movement	0.24			0.24			0.15			0.52			
				95th Percentile Queue (m)	7			7			4			25			
Intersection 55	55	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)				14		86		5	35	241	5		A*
				Level of Service				A				A		A			
				V/C Ratio by Movement				0.13				0.03		0.18			
				95th Percentile Queue (m)				4				0		5			
			PM Peak Hour	Volumes (vph)				37		273		5	23	156	5		A*
				Level of Service				B				A		A			
				V/C Ratio by Movement				0.37				0.02		0.11			
				95th Percentile Queue (m)				13				0		3			
Intersection 55	55	Roundabout	AM Peak Hour	Volumes (vph)				14		86		5	35	241	5		A
				Level of Service				A				A		A			
				V/C Ratio by Movement				0.10				0.05		0.26			
				95th Percentile Queue (m)				3				1		9			
			PM Peak Hour	Volumes (vph)				37		273		5	23	156	5		A
				Level of Service				A				A		A			
				V/C Ratio by Movement				0.32				0.03		0.17			
				95th Percentile Queue (m)				12				1		5			
Intersection 33	33	Two-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	29	12	5	2	4	12	5	13	4	4	5	10	A*
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.06			0.02			0.00			0.00			
				95th Percentile Queue (m)	1			1			0			0			
			PM Peak Hour	Volumes (vph)	19	8	5	7	12	8	5	8	3	13	15	33	A*
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.04			0.04			0.00			0.01			
				95th Percentile Queue (m)	1			1			0			0			

Table 4.3 - Post-Development Operating Conditions

Intersection	Intersection ID#	Intersection Control	Interval	Measure	Eastbound			Westbound			Northbound			Southbound			Level of Service
					Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
Intersection 35	35	Two-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	5	88	5	5	37	16	5	5	5	46	5	13	A*
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.00			0.00			0.02			0.09			
				95th Percentile Queue (m)	0			0			1			2			
			PM Peak Hour	Volumes (vph)	15	62	5	5	99	52	5	5	5	29	5	9	A*
				Level of Service	A			A			B			B			
				V/C Ratio by Movement	0.01			0.00			0.02			0.07			
				95th Percentile Queue (m)	0			0			1			2			
Intersection 54	54	Two-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	5	2	12	1	6	16	3	8	18	7	4	14	A
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.25			0.02			0.08			0.05			
				95th Percentile Queue (m)	8			1			2			1			
			PM Peak Hour	Volumes (vph)	33	6	134	6	6	15	234	22	6	14	11	58	A
				Level of Service	A			B			A			A			
				V/C Ratio by Movement	0.16			0.03			0.25			0.10			
				95th Percentile Queue (m)	5			1			8			3			
Intersection 45	45	Four-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	190	1	6	6	3	24	6	6	6	8	6	69	A
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.18			0.04			0.02			0.08			
				95th Percentile Queue (m)	6			1			1			2			
			PM Peak Hour	Volumes (vph)	124	3	6	6	2	15	6	6	6	27	6	214	A
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.13			0.02			0.02			0.13			
				95th Percentile Queue (m)	4			1			1			4			
Intersection 25	25	One-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)		65	6	6	47		6		6				A
				Level of Service		A		A			A						
				V/C Ratio by Movement		0.06		0.05			0.01						
				95th Percentile Queue (m)		2		1			0						
			PM Peak Hour	Volumes (vph)		101	6	6	60		6		6				A
				Level of Service		A		A			A						
				V/C Ratio by Movement		0.10		0.06			0.01						
				95th Percentile Queue (m)		3		2			0						
Coalbanks Boulevard W 30 Street W	12	Two-Way Yield Control on Side Street	AM Peak Hour	Volumes (vph)	6	6	6	18	6	124	6	109	47	36	43	6	A
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.02			0.15			0.15			0.08			
				95th Percentile Queue (m)	0			4			5			2			
			PM Peak Hour	Volumes (vph)	6	6	6	50	6	116	6	73	31	107	118	6	A
				Level of Service	A			A			A			A			
				V/C Ratio by Movement	0.02			0.17			0.11			0.22			
				95th Percentile Queue (m)	1			5			3			7			

*ICU LOS Reported (HCM LOS not calculated for unsignalized intersections with control on the side street only)

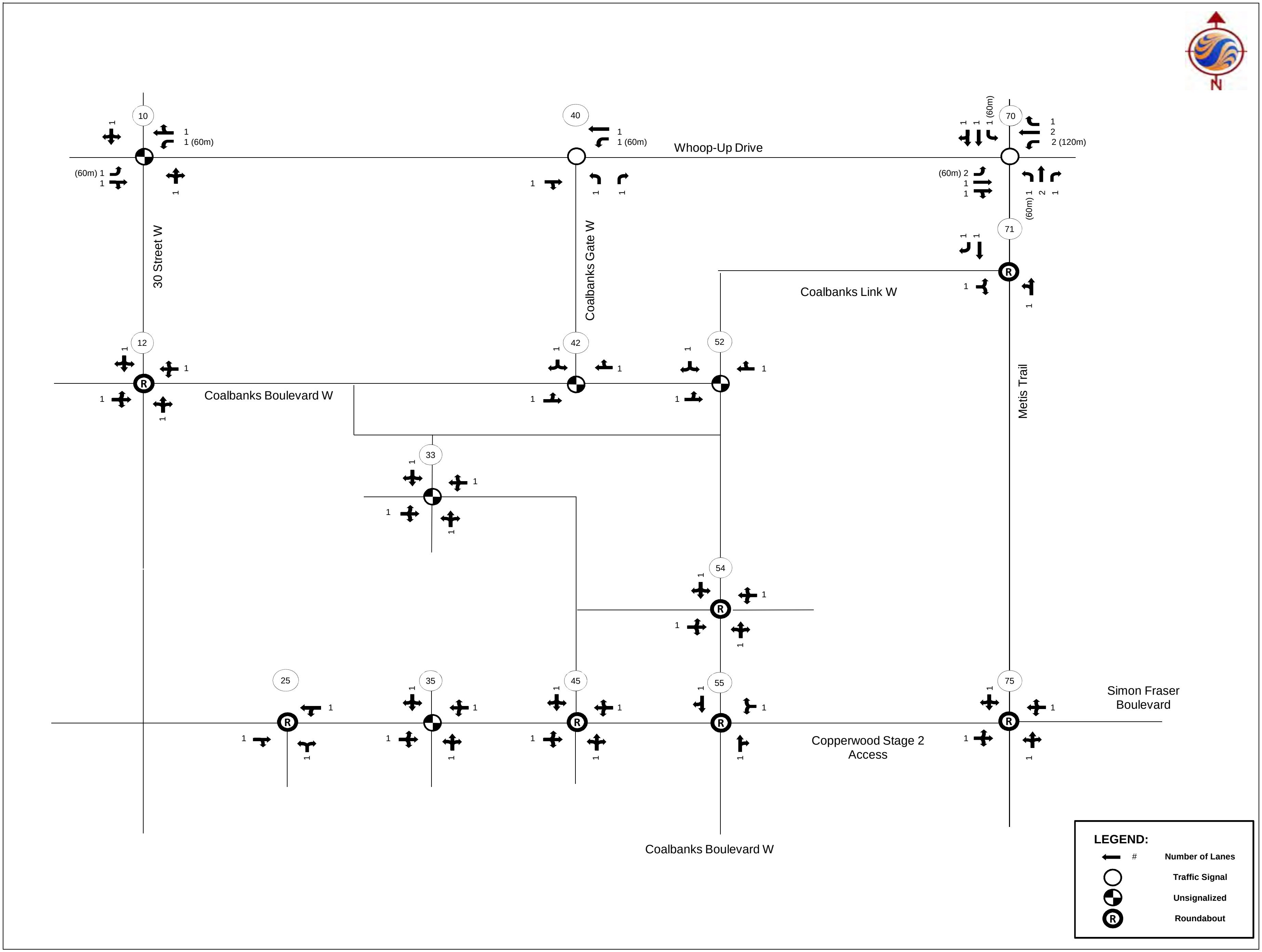


Figure 4.2
Copperwood Stage 2
Post-Development
Recommended Lane Configurations

COPPERWOOD STAGE 2 OUTLINE PLAN

V:\Active\112944453\planning\analysis\120313_report_final_traffic.xlsx

4.4 INTERNAL ROAD NETWORK CLASSIFICATION

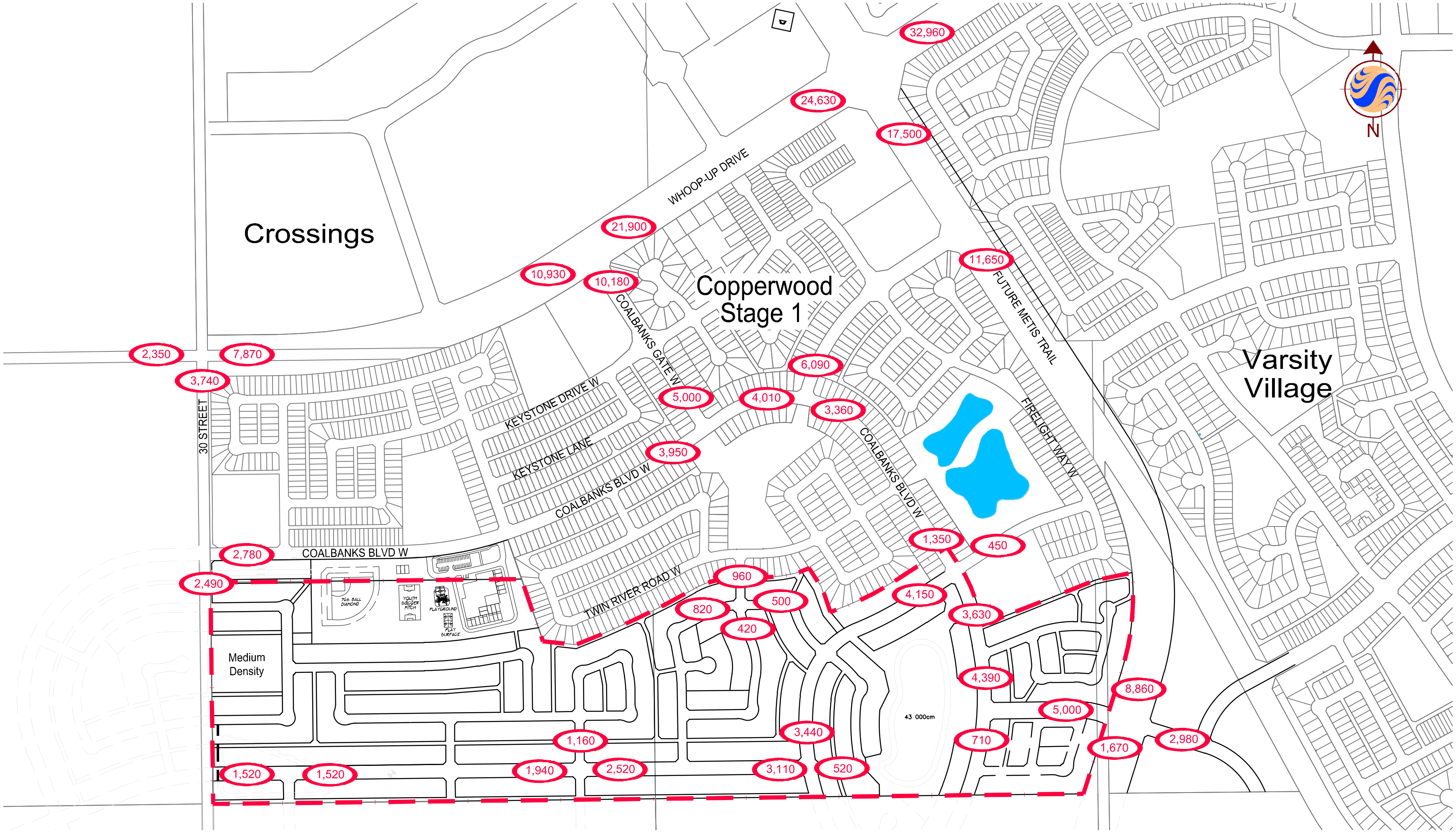
In order to determine the daily volumes on the proposed road network within Copperwood Stage 2 outline plan area, we first determined the PM peak hour link volumes and then factored the PM link volumes up by 10 to obtain the daily traffic volumes.

Figure 4.3 illustrates the projected daily volumes on the road network reviewed as part of the Copperwood Stage 2 TIA.

The City of Lethbridge Design Guidelines classifies roadways into designations with the following daily vehicular traffic volumes:

- Arterial: > 15,000 vehicles per day (vpd)
- Super Collector: 2,000 – 15,000 vpd
- Community Entrance Road: 2,000 – 8,000 vpd
- Major Collector: 2,000 – 8,000 vpd
- Minor Collector Road: < 4,000 vpd
- Local Road: < 2,000 vpd

The projected daily volumes shown on **Figure 4.3** are within the design guidelines for all the roadways in the plan area. Based on the Outline Plan and the projected daily traffic volumes, the recommended roadway classifications are shown in **Figure 4.4**.



NTS

April 2012
112944453

ORIGINAL SHEET – ANSI B

Stantec

Legend

Copperwood Stage 2 Boundary

Estimated Daily Two-Way Traffic Volumes (Vehicles Per Day)

Client/Project

DAYTONA URBAN DEVELOPMENT CORP.

City of Lethbridge RELD

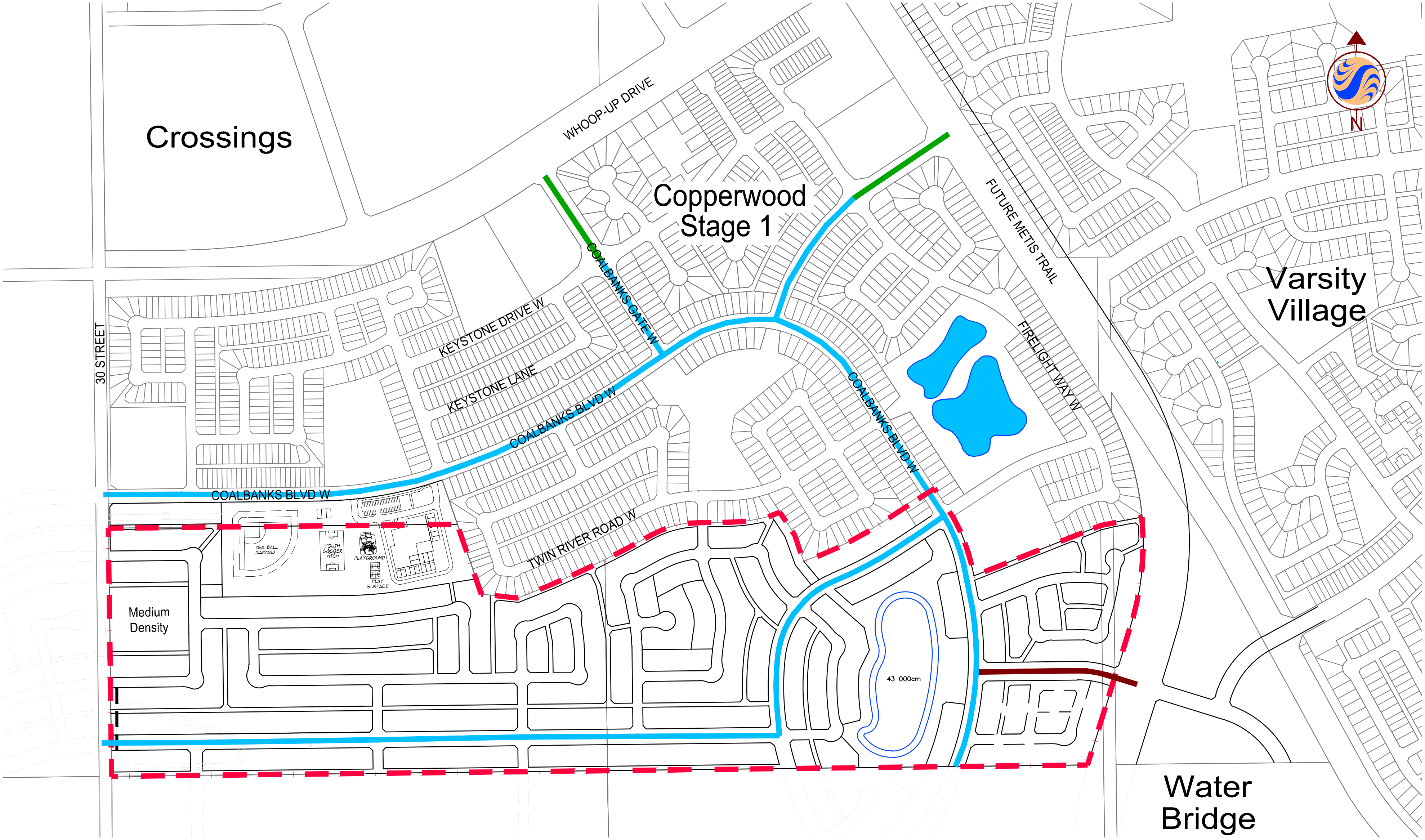
COPPERWOOD STAGE II OUTLINE PLAN

Figure No.

4.3

Title

Internal Daily Traffic Volumes



NTS

April 2012
112944453

ORIGINAL SHEET – ANSI B

Stantec

Legend

- Copperwood Stage II Boundary
- Community Entrance/Super Collector
- Super Collector
- Major Collector

Client/Project
DAYTONA URBAN DEVELOPMENT CORP.
City of Lethbridge RELD
COPPERWOOD STAGE II OUTLINE PLAN

Figure No.
4.4

Title
Internal Road Network Classification

5.0 Conclusions

The internal collector roadway and the four entrance roads (including those providing access to Copperwood Stage 1) have been classified according to the requirements established in the City of Lethbridge Design Guidelines.

Nine intersections internal to Copperwood (including some in Stage 1 of the development) were analyzed at the full build horizon. Intersections 12, 25, 45, and 54 were analyzed as roundabouts since two collector standard roads intersect at each of these locations. This is consistent with Figure 9.1 from the outline plan and should provide for flexibility for future development of West Lethbridge Phase 2 ASP lands to the south. Intersection 35 was analyzed as a traditional unsignalized intersection (not consistent with Figure 9.1 from the outline plan) because a local road is intersecting with the collector at this location.

Intersections 33, and 55 were analyzed as unsignalized intersections as per the hierarchy described in the City of Lethbridge TIA Guidelines. Intersections 42 and 52 were analyzed based on their as-constructed configurations.

For the full-build horizon, Metis Trail and Whoop Up Drive were assumed to be constructed as four-lane cross-sections until the first intersections south and west respectively (the access to Copperwood Stage 1, in the case of Metis Trail, and the first access to the Crossings, in the case of Whoop Up Drive).

Based on the analysis of the full-build background traffic volumes, the following infrastructure requirements were identified:

- Whoop Up Drive / Metis Trail W (Intersection 70): the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the recommended four-lane cross-section with the addition of a designated westbound right turn lane
- Whoop Up Drive / Coalbanks Gate W (Intersection 40): the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds assuming a designated westbound left turn lane and signalization are in place
- Whoop Up Drive / 30 Street W (Intersection 10): the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the recommended two-lane cross-section with stop-control placed on the 30 Street approaches
- Metis Trail / Coalbanks Link W (Intersection 71): the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the recommended four-lane north approach with signalization in place

For the full-build post-development traffic volumes, the following improvements to the infrastructure requirements for the background volumes were recommended:

- Whoop Up Drive / Metis Trail W (Intersection 70): the addition of dual eastbound and westbound left turn lanes; the addition of a northbound free right turn lane
- Whoop Up Drive / Coalbanks Gate W (Intersection 40): the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the configuration described in the background analysis. This intersection location should be monitored as development of the West Lethbridge Phase 2 ASP area proceeds, as improvements such as a dual westbound left turn lane or additional eastbound through lanes may be warranted.
- Whoop Up Drive / 30 Street W (Intersection 10): the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the configuration described in the background analysis
- Metis Trail / Coalbanks Link W (Intersection 71): the intersection is expected to continue to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the configuration described in the background analysis
- Simon Fraser Boulevard / Copperwood Stage 2 Access / Metis Trail W (Intersection 75): the intersection is expected to operate at an acceptable level of service with v/c ratios below the City's thresholds based on the recommended configuration which consists of a two-lane cross-section on all approaches and four-way stop-control

All internal intersections and approaches are expected to operate sufficiently based on the assumptions stated in the report.

The internal collector running between intersections 25 and 45 is a straight section of notable length. Traffic calming measures along this segment will be considered at detail design and implemented where appropriate.

Appendix A – Correspondence with City of Lethbridge

April 16, 2012

Copperwood Stage-2 TIA Comments

- Section 3.2: This refers to Coalbanks Gate being the only access currently, in practice the Coalbanks Links W connection to Metis Trail Gravel road does also exist as a second access point from Copperwood Stage-1.
- In the absence of counts on Coalbanks Link W/Metis Trail W access, Table 1 and Table 2 do not represent the reality, suggest removing these Tables and revising text.
- Figure 3.1 to figure 3.8 – Traffic volumes do not add up at Whoop-up Dr/Metis trail (Intersection 70), please check.
- Label Copperwood Stage 1 Access to Metis Trail as "Coalbanks Link W".
- Section 4.2 –page 4.3: Please analyze Metis Trail/Coalanks Link W as a 2 lane roundabout intersection (please see the attached drawing showing the Plan of the subject section of Metis Trail – this is draft info, please delete it after you have completed the analysis).
- Section 4.3: I consider the analysis on Copperwood Stage 2 Access/Coalbanks Blvd W (Intersection 55) and Metis Trail/Simon Fraser Blvd (Copperwood stage 2 Access) as interim, since both these intersections will be impacted from lands south of this OP area (not considered in your analysis). We would like roundabouts at these intersections. Please revise this section for Intersection 71 as a roundabout as well.
- Figure 4.3: Make the daily volumes legible (make the dots smaller and may be text smaller or use schematic rather than the drawing as background).
- Figure 4.4: No need to show local roads, the color confuses with Super collector. The 30th St W cannot be a minor collector (again your analysis is interim; there are lands to be developed west of this road). Do not show any classification for this road.
- I would accept intersection 35 to be yield-control, but I have concerns that the section of the road between intersections 25-45 may lead to speeding complaints. I would like to include a recommendation to consider traffic calming measures on this road. Please include this in the recommendations and revise the OP Figure 9.1.

Ahmed Ali, P.Eng., PTOE
Transportation Engineering Manager

Piechotta, Cole

From: Ahmed.Ali@lethbridge.ca
Sent: Friday, February 24, 2012 2:50 PM
To: Piechotta, Cole
Cc: Schmidtke, Brad; Thatcher, David; Huber, Devin
Subject: RE: Copperwood Stage 2 - Initial TIA Sign-Off / 13 Street N Access Management Study
Attachments: Copperwood 2 OP - TIA study intersections .pdf

Cole,
Please see my comments on Copperwood TIA marked beside your scope text. I remember having answered all your queries on 13 St/Hardiville study in our conversation earlier this week.
Please call me if you have any further questions.

Ahmed

Ahmed Ali, P.Eng., PTOE
Transportation Engineering Manager
Infrastructure Services
City of *Lethbridge*

304 Stafford Dr N, Lethbridge, Alberta, Canada T1H 2A6
Phone:403-320-4038, Cell: 403-393-4685, Fax: 403-329-4657
ahmed.ali@lethbridge.ca, www.lethbridge.ca

From: Piechotta, Cole [mailto:Cole.Piechotta@stantec.com]
Sent: Friday, January 20, 2012 6:35 PM
To: Ahmed Ali
Cc: Schmidtke, Brad; Thatcher, David
Subject: Copperwood Stage 2 - Initial TIA Sign-Off

Ahmed,

The following summarizes the scope we're proposing for the TIA in support of the Copperwood Stage 2 Outline Plan. One notable omission from this proposed scope is the assumptions we plan to use for background traffic. We want to give this a little more thought and I'm planning to submit our assumed background volumes towards the end of next week.

My hope for this correspondence is that we can finalize our assumptions for trip generation and distribution specific to Copperwood Stage 2. As always any comments, questions, and suggestions are welcome.

One key assumption for Copperwood is that all units will be built by the ten-year horizon. Brad has indicated that in the discussions he and the planners have had with the developer, it was suggested that the intent is to complete Stage 2 within ten years. This seems consistent with Stage 1, which as I understand began building around 2005 and is now nearing completion. Therefore we are proposing to analyze one horizon only. I want to be quite certain we are using the best assumptions for the distribution and the background road network (points 6 and 8 below). If you wanted to discuss further these assumptions, please don't hesitate to give me a call.

Review Subject

1. Site plan, development statistics: - OK

   Characteristics of the development are as follows:

   - 588 low density units (R-CL land use)
   - 101 medium density units (R-75 land use)
   - 201 mixed density units (R-M land use)
   - **588 low density units**
   - **302 medium density units**

   Attached for reference is **Figure 7.1 – Proposed Land Use Designations** (from our gate 3 submission).

2. Traffic impact study area:

   The proposed site is bound by Metis Trail to the east, Copperwood Stage 1 to the north, and future residential land uses to the south and west. There are two connections to Stage 1 of Copperwood.

   I've included a scan with the intersections we are proposing to analyze circled. All arterial intersections have been included as well as the connections to Stage 1 of Copperwood. We've also included key internal intersections. – I have included a few additional intersection, please see the attached

3. Traffic analysis period(s):

   The weekday AM and PM peak hour periods will be analyzed. Daily Traffic Volumes will also be considered in order to confirm roadway classifications. - OK

4. Planning horizons:

   It is anticipated that all 588 low density units and all 302 medium density units will be built by the ten-year horizon. - OK

5. Trip generation factors: (review also pass-by, diverted and synergy trip rates): - OK

   The following trip generation rates will be used:

Use	AM Peak Hour			PM Peak Hour		
		In	Out		In	Out
Low Density Residential	0.77 vph/unit	26%	74%	1.02 vph/unit	64%	36%
Medium Density Residential	0.75 vph/unit	29%	71%	0.92 vph/unit	61%	39%

   Daily traffic volumes will be estimated by applying a factor of 10 to the PM peak hour volumes.

6. Basis for Trip Distribution:

   We are proposing to use the following distribution

   - 10% - Whoop-Up Drive West – 0%
   - 50% - Whoop-Up Drive East – 70%
   - 30% Metis Trail North – 25%
   - 10% Metis Trail South – 0%
   - Simon Fraser East – 5%

7. Source for Future Background Traffic:

    As indicated above, we are proposing to submit our assumed background traffic in approximately one week. – the background volume figures and methodology are OK

8. Assumed Road Improvements:

    Assumed the following road network:

    - Metis Trail constructed with a four-lane cross-section north of Macleod Trail – Please assume 2 lanes for Metis Trail between Whoopup Dr and Simon Fraser Blvd W, we do not expect the section between Simon Fraser and Macleod to be built at 10 year horizon
    - Whoop-Up Drive constructed with a four lane cross-section to Chinook Trail – Whoopup would remain as existing (2 lanes with a CLTL lane) will be extended up to 30 St W.
    - Chinook Trail constructed – two-lane cross-section – Chinook trail is not expected to be constructed in the 10 year horizon.

9. Traffic Analysis Software:

    Synchro 7 will be used to analyze signalized and unsignalized intersections; SIDRA Intersection 5.0 will be used to analyze roundabouts. - OK

<u>Data Collection</u>

1. Existing Traffic Counts:

    The subdivision is located on an undeveloped parcel of land in west Lethbridge, and therefore it is not anticipated that counts of existing intersections will be required for analysis purposes. – Whoopup Dr/Coalbanks Gate W is an existing intersection and will require counts

2. Signal Timings:

    It is not anticipated that existing signal timings will be required for the study - OK.

3. Bicycle Route Map:

    See attached "**Figure 6.1 – Open Space Network**" from our gate 3 submission, which illustrates the local pathway system with connections to the regional system. - OK

4. Bus Routes and Signs:

    See attached "**Figure 10.1 – Preliminary Transit & Bus Stops**" from our gate 3 submission, which illustrates the proposed transit routing and bus stop locations within the development. - OK

5. Local Parking Issues:

    Some residential properties are proposed to have frontage along roundabouts in the area. The potential for queuing at the roundabout intersections will be reviewed and "no parking" zones will be recommended where necessary to ensure roundabouts are accessible. - OK

6. Local Traffic Issues:

    No Local Traffic issues anticipated.- OK

Please review the above sumbission at your earliest convenience. If you have any questions or comments, please do not hesitate to get in touch with me,

Cole Piechotta, P.Eng.
Transportation Engineer
Stantec
200 - 325 25th Street South East
Calgary AB T2A 7H8
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Fx: (403) 716-8129
cole.piechotta@stantec.com
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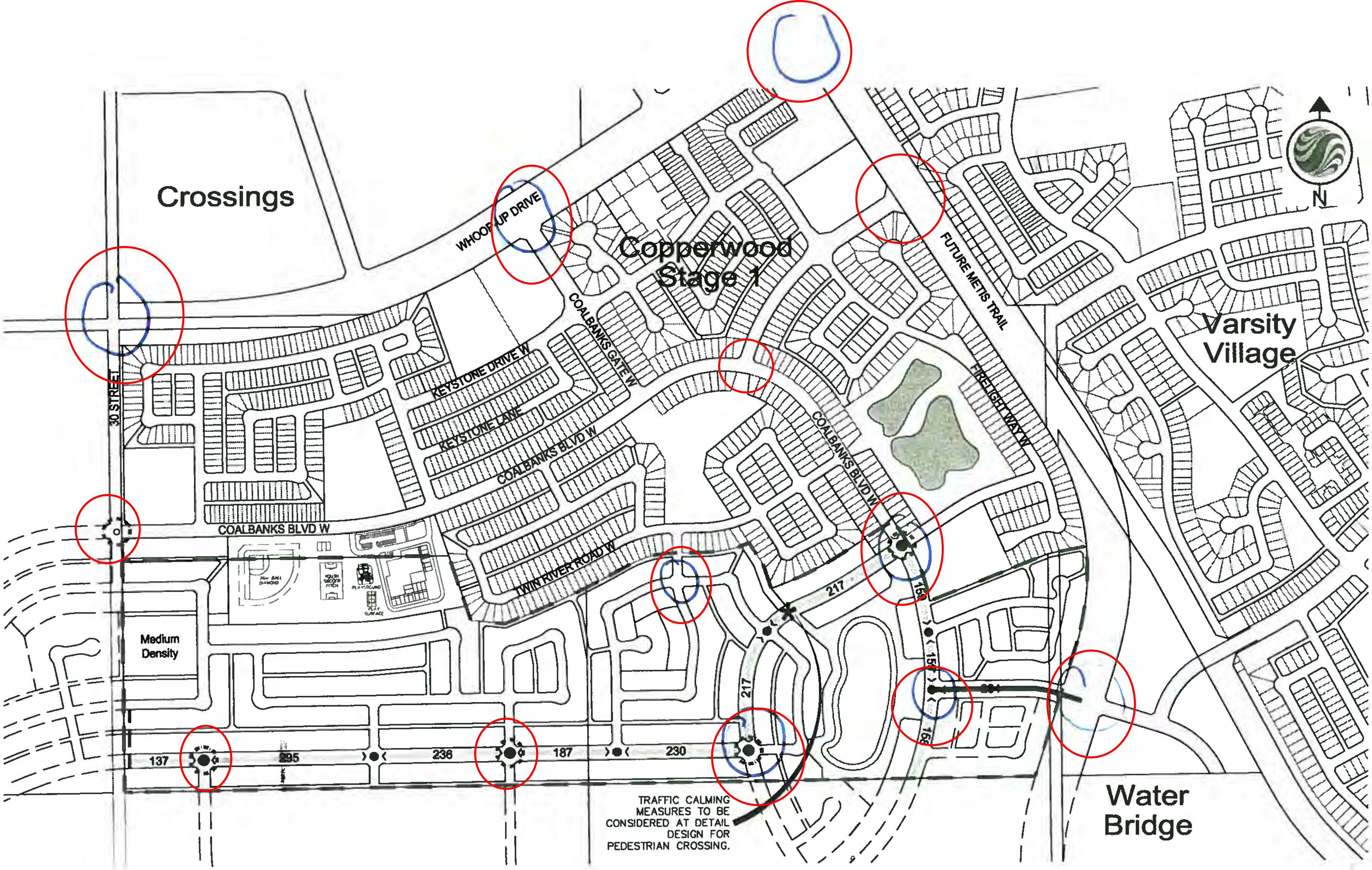

NTS

December 2011
112944453

ORIGINAL SHEET - ANSI B

Stantec

Legend

- Copperwood Stage 2 Boundary
- Community Entrance/Super Collector
- Major Collector
- Minor Collector
- ● ‹100m› ● Intersection Spacing
- Potential Roundabout

Client/Project
DAYTONA URBAN DEVELOPMENT CORP.
COPPERWOOD STAGE 2
OUTLINE PLAN

Figure No.
9.1

Title
Preliminary Transporation Network

V:\1129\active\112944452_53\drawings\OP drawings\Gate 3\cx gt3-fig 9.1-Prelim Trans Network.dwg
2011 12 07 02:57PM By: abraun

Piechotta, Cole

From: Piechotta, Cole
Sent: Friday, February 17, 2012 6:13 PM
To: Ahmed Ali (Ahmed.Ali@lethbridge.ca)
Subject: RE: Copperwood Stage 2 - Initial TIA Sign-Off
Attachments: background_traffic.pdf

Ahmed,

As indicated in my message earlier this week (regarding Copperwood and the Access Management Study for north Lethbridge), I am sending this message describing the methodology I am proposing to use for the background traffic for Copperwood Stage 2.

Similar to the Garry Station and Country Meadows TIAs, the Crossings TIA (iTrans, July 2007) was used as the basis for the background traffic along Whoop-Up Drive and Metis Trail. The volumes associated with Copperwood were then removed and added back using the information from the Copperwood TIA (UMA, December 2005). Background volumes on Metis Trail related to the west access of Varsity Village were also added using the information from the Copperwood TIA.

The specific breakdown used is as follows:

1. Figure 4-4 from the Crossings TIA, which displays "full-build" volumes along Whoop-Up Drive was used as the basis for the background traffic. The volumes shown in blue colour were calculated based on the adjacent intersections (the east access to Copperwood off Whoop-Up Drive was not shown on Figure 4-4).

   See Figures 1A and 1B from the file "background_trafifc.pdf"

2. The traffic associated with Copperwood was removed from Figures 1A and 1B by subtracting all inbound and outbound traffic accessing the area.

   See Figures 2A and 2B from the file "background_traffic.pdf"

3. The full-build volumes in Figures 2A and 2B were divided by two; it was assumed that the traffic at the ten-year horizon would be approximately half that anticipated at the full-build horizon for the Crossings (similar to our assumption for the Garry Station TIA).

   See Figures 3A and 3B from the file "background_traffic.pdf"

4. The volumes associated with Stage 1 of Copperwood, as well as the ten year-horizon volumes for Varsity Village which take access/egress from Metis Trail, were isolated from Figures 4.1 and 4.2 of the Copperwood TIA.

   See Figures 4A, 4B, 5A, and 5B from the file "background_traffic.pdf"

5. The volumes in Figure 3A were combined with the volumes in Figures 4A and 5A to produce the ten-year horizon morning peak hour background volumes for Copperwood Stage 2. Similarly the 'B' series of figures were combined to produce the afternoon peak hour background volumes.

   See Figures 6A and 6B from the file "background_traffic.pdf"

I believe some further adjustments may be necessary, specifically the following:

i. Assignment of background volumes to the intersection of Whoop-Up Drive / Metis Trail (this intersection was not included in the previous reports)

ii. Adjustment to Copperwood Stage 1 volume to account for some traffic using the south access to Metis Trail.

One final comment related to the land-use designations for Copperwood Stage 2: in the previous Initial TIA Sign-Off email (see below) I had indicated that generation for the units designated 'R-M' ("mixed desnsity") would be undertaken using the rate for “medium density”. Upon review of the land-use I think these units are more likely to generate volumes in line with “low density” and to reflect this I am considering using the low density rate. I am just curious as to your thoughts regarding the generating potential of this land use.

Please review the background volumes as well as the remainder of the information regarding the proposed scope. I will be contacting you to discuss in the early part of next week.

Regards,

Cole Piechotta, P.Eng.
Transportation Engineer
Stantec
200 - 325 25th Street South East
Calgary AB T2A 7H8
Ph: (403) 716-1462
Fx: (403) 716-8129
cole.piechotta@stantec.com
stantec.com

From: Piechotta, Cole
Sent: Friday, January 20, 2012 6:35 PM
To: Ahmed Ali (Ahmed.Ali@lethbridge.ca)
Cc: Schmidtke, Brad; Thatcher, David
Subject: Copperwood Stage 2 - Initial TIA Sign-Off

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I've included a scan with the intersections we are proposing to analyze circled. All arterial intersections have been included as well as the connections to Stage 1 of Copperwood. We've also included key internal intersections.

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The weekday AM and PM peak hour periods will be analyzed. Daily Traffic Volumes will also be considered in order to confirm roadway classifications.

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Please review the above sumbission at your earliest convenience. If you have any questions or comments, please do not hesitate to get in touch with me,

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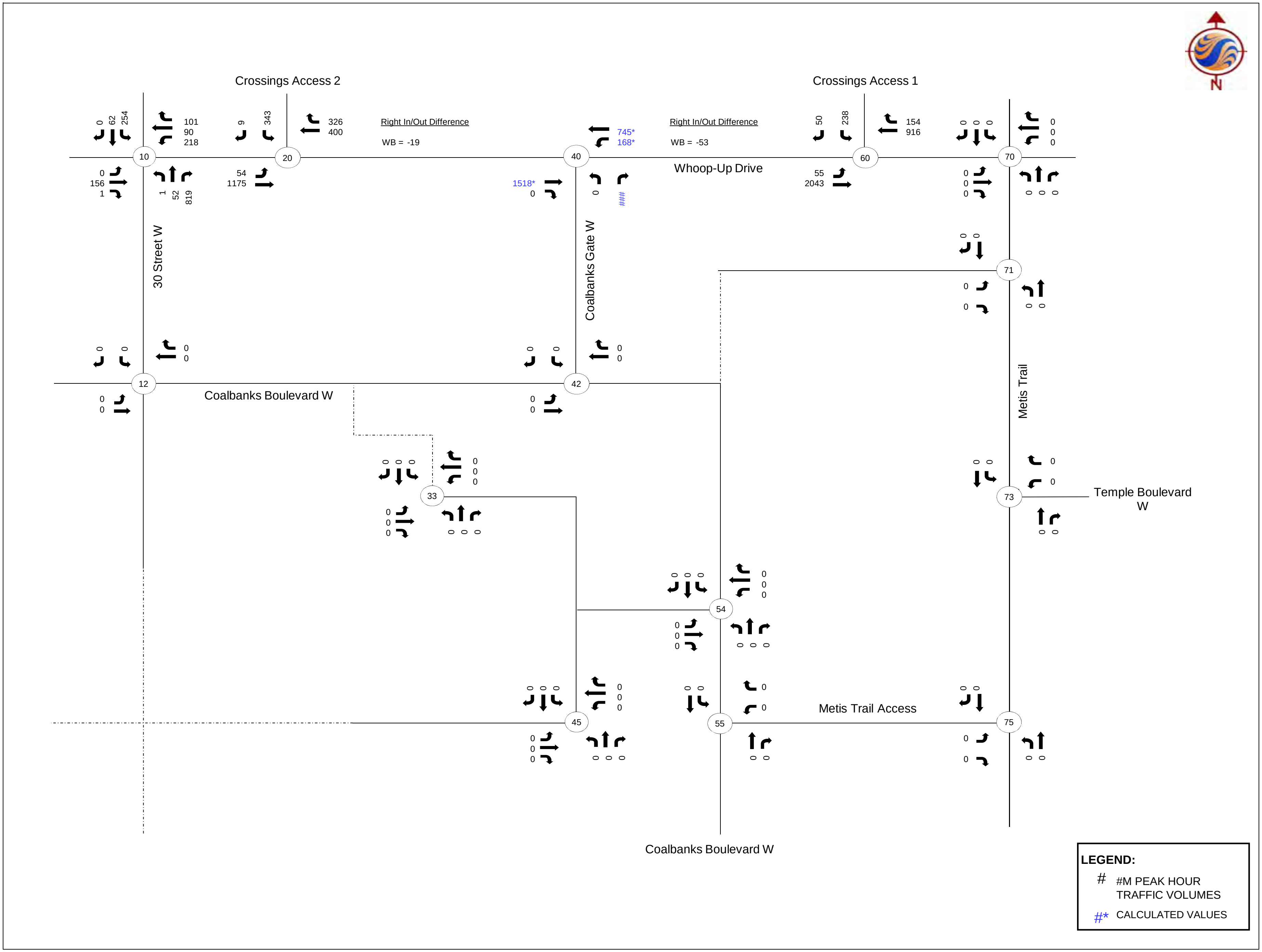

COPPERWOOD STAGE 2 OUTLINE PLAN

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Figure 1A
Background Traffic
AM Peak Hour
(From Crossings TIA Figure 4-4)

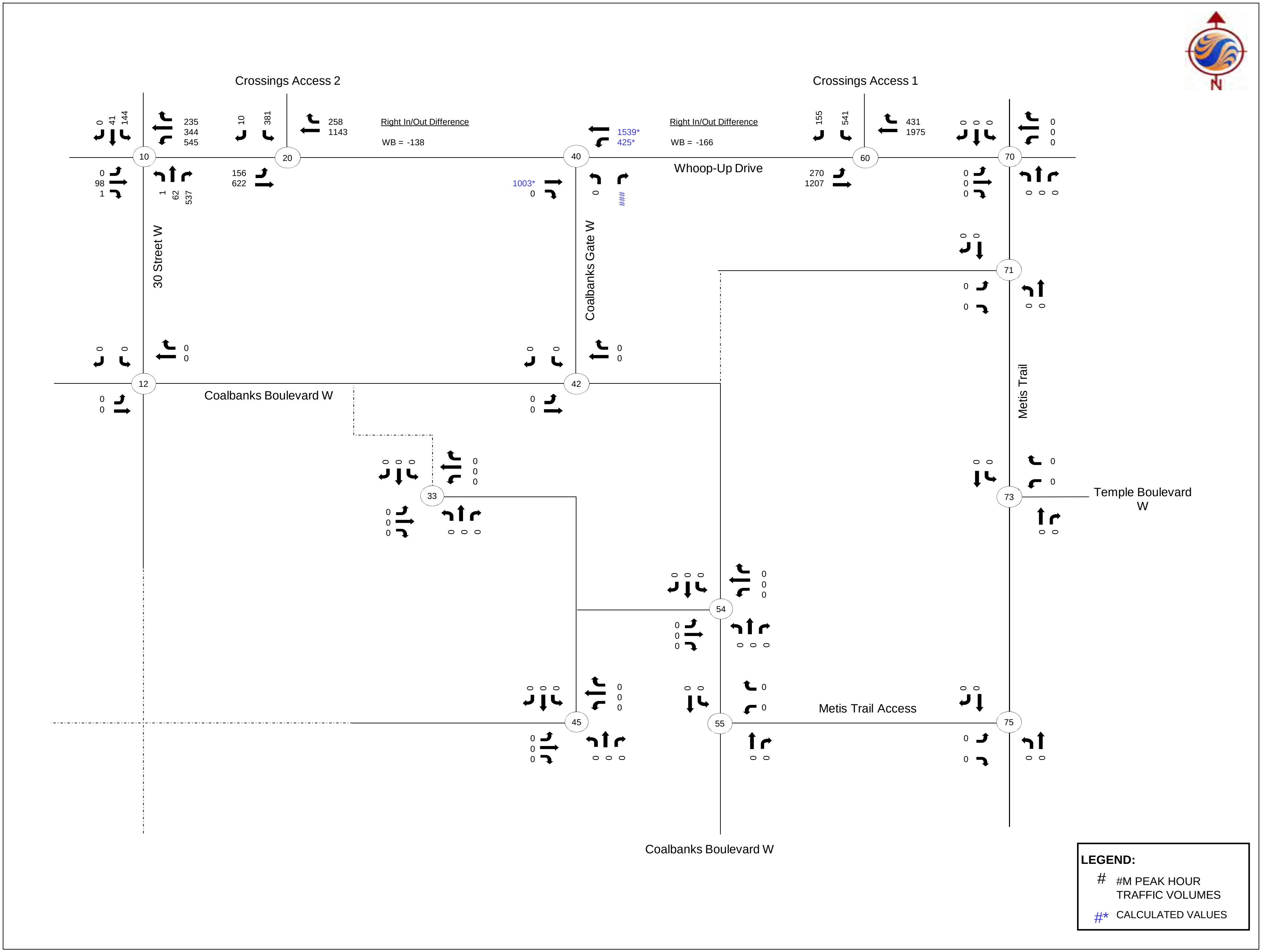

Figure 1B
Background Traffic
PM Peak Hour
(From Crossings TIA Figure 4-4)

COPPERWOOD STAGE 2 OUTLINE PLAN

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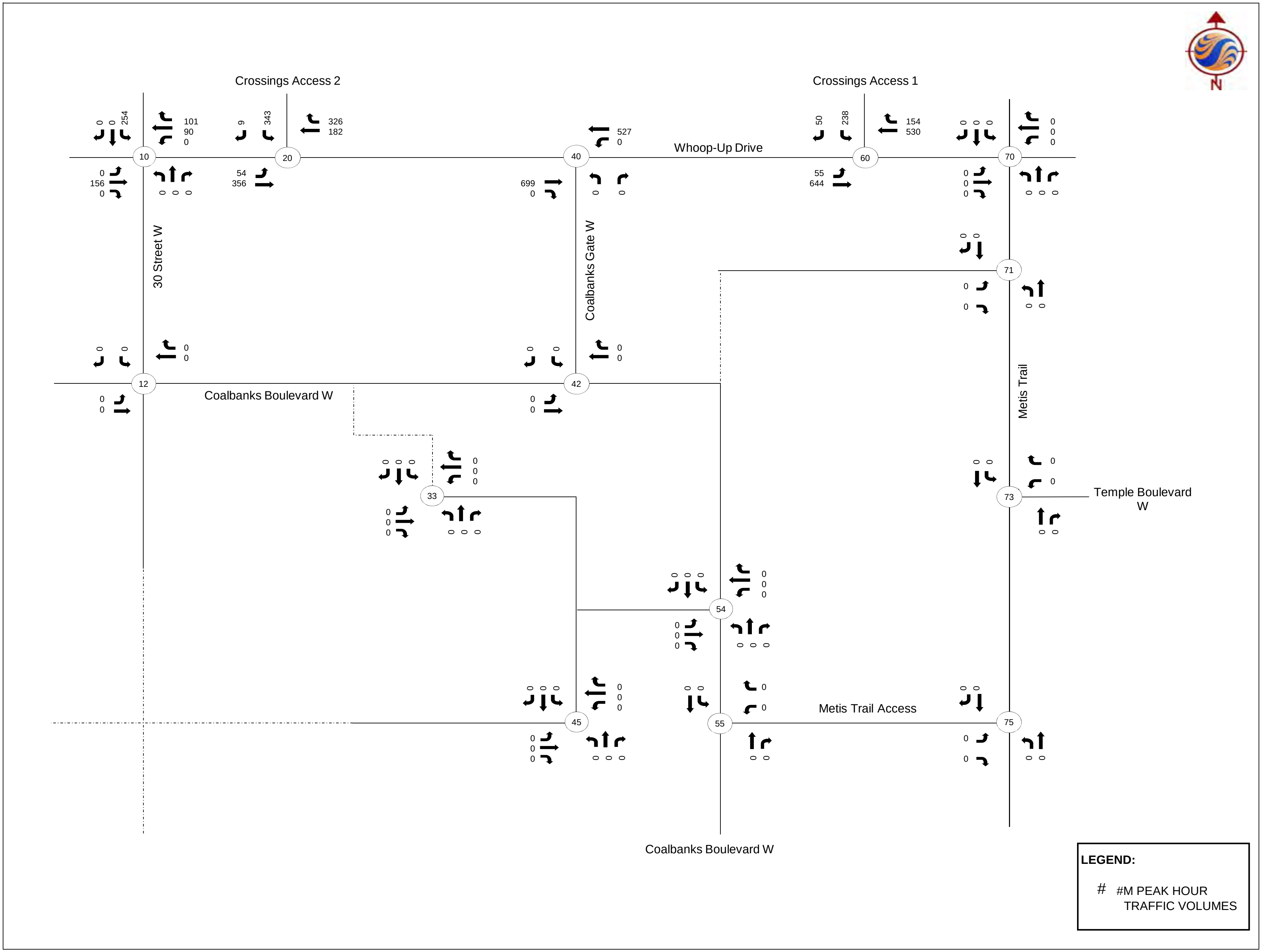

Figure 2A
Background Traffic
Copperwood Removed
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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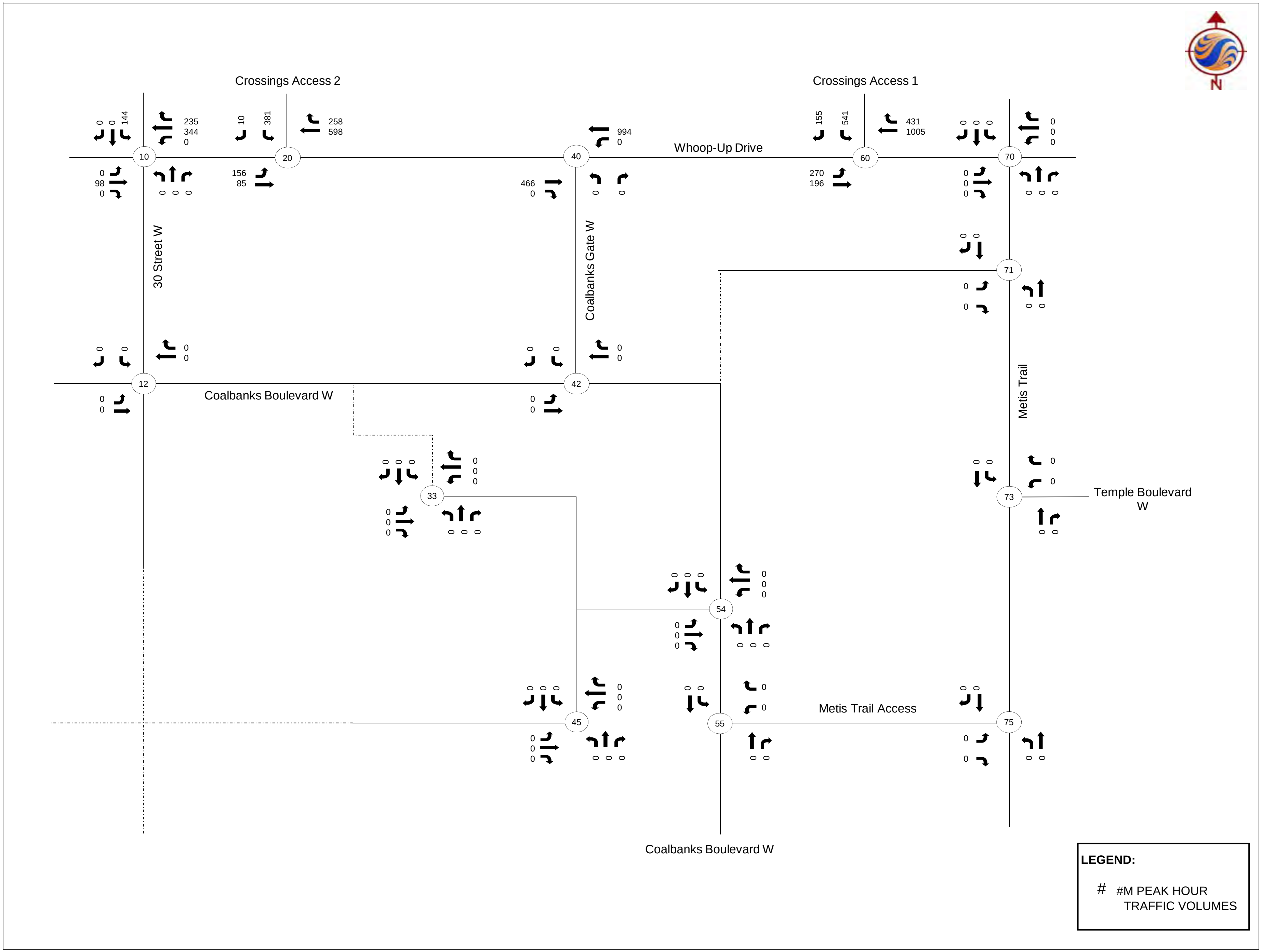

Figure 2B
Background Traffic
Copperwood Removed
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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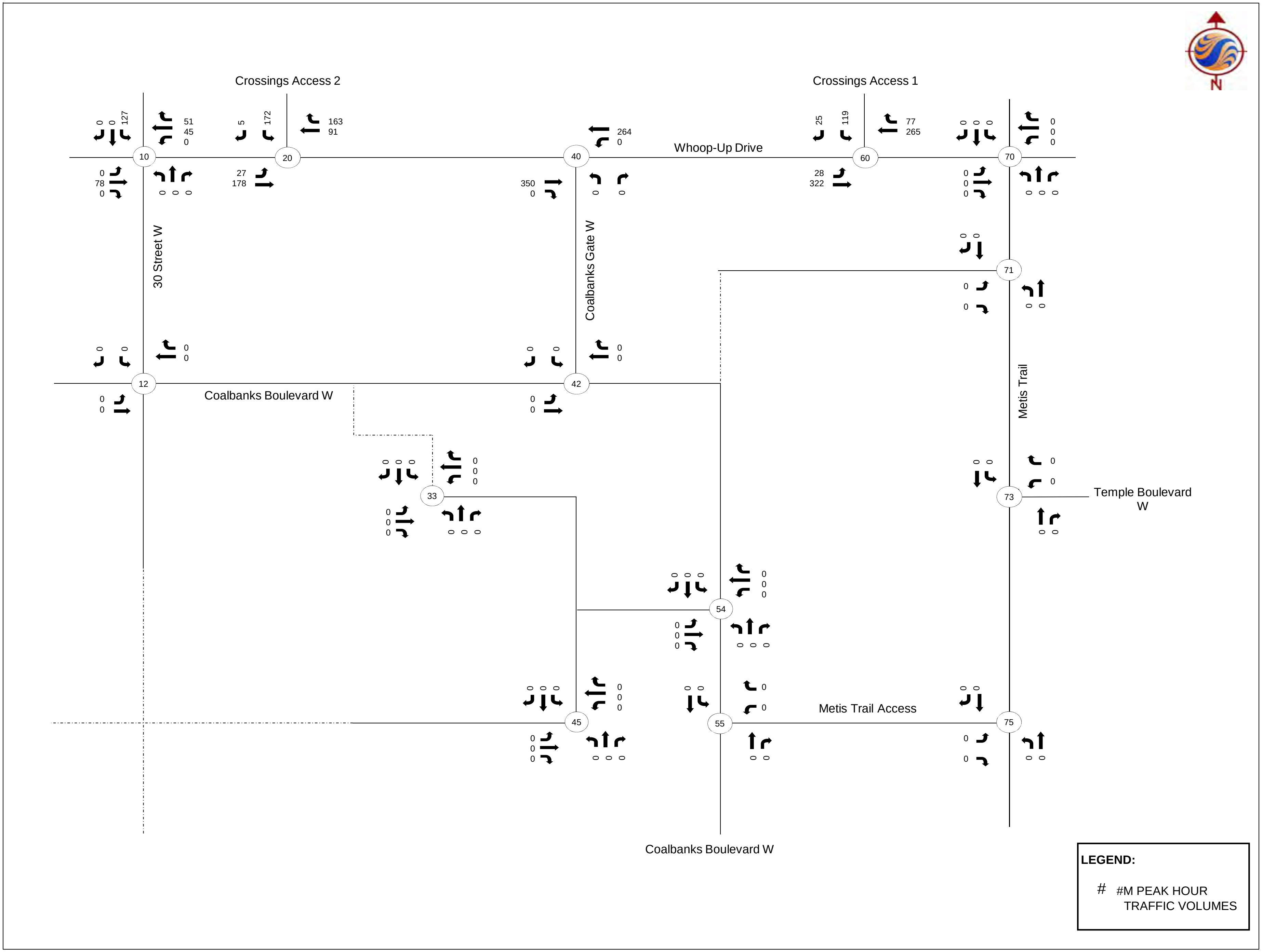

Figure 3A
Background Traffic
Adjusted to Ten Year Horizon
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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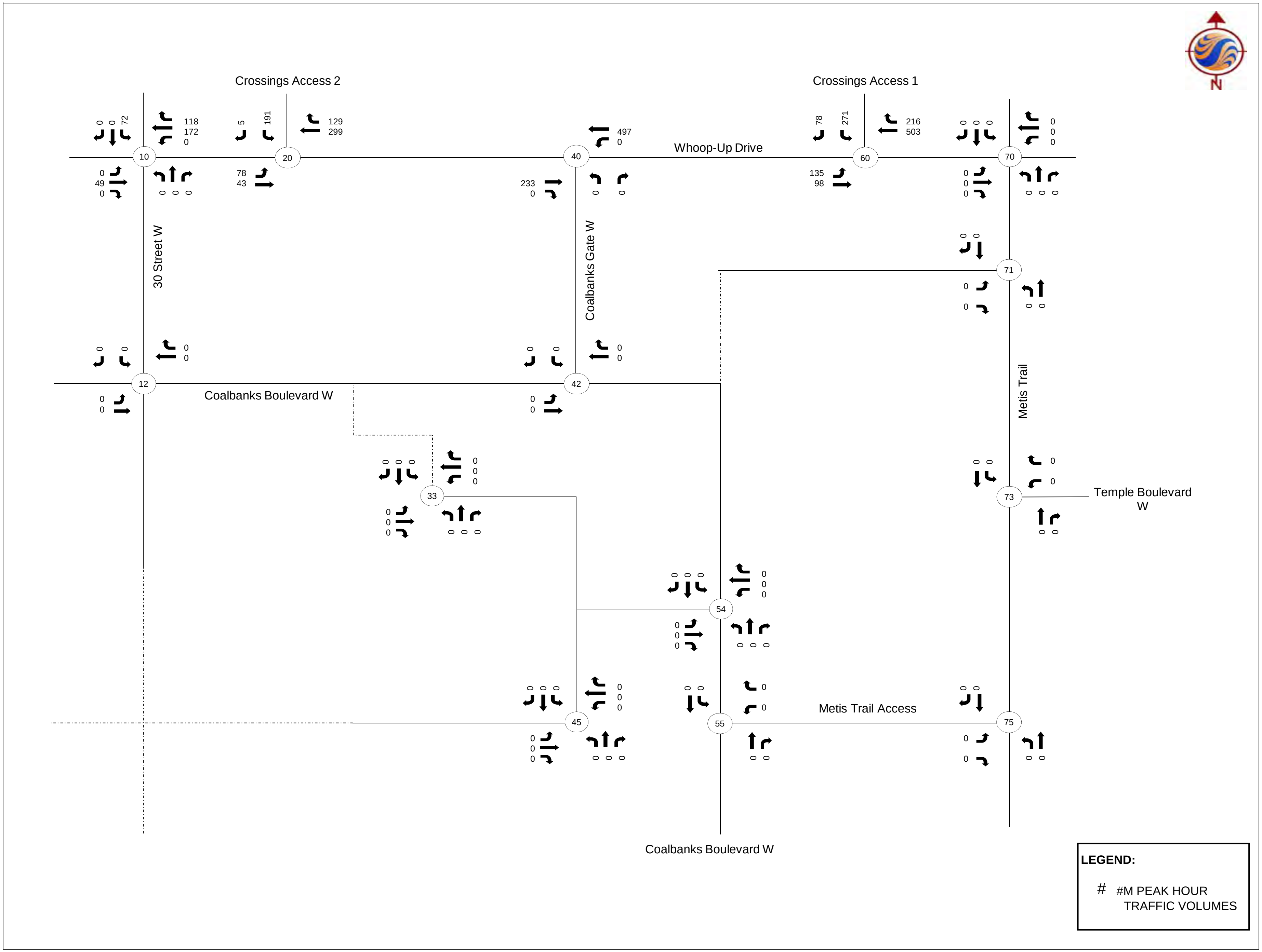

Figure 3B
Background Traffic
Adjusted to Ten Year Horizon
PM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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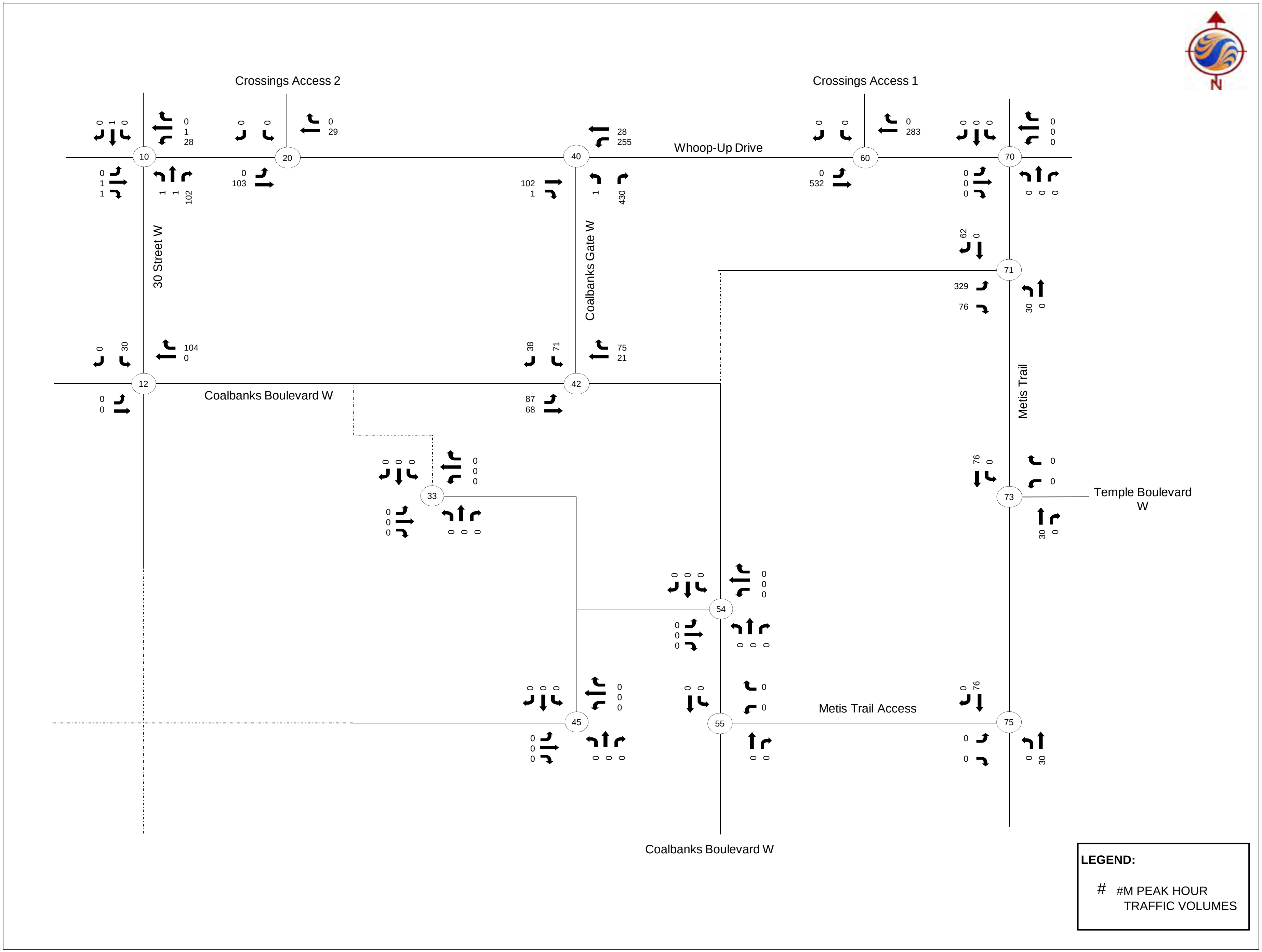

Figure 4A
Copperwood Stage 1 Volumes
AM Peak Hour
(From Copperwood TIA Figure 4.1)

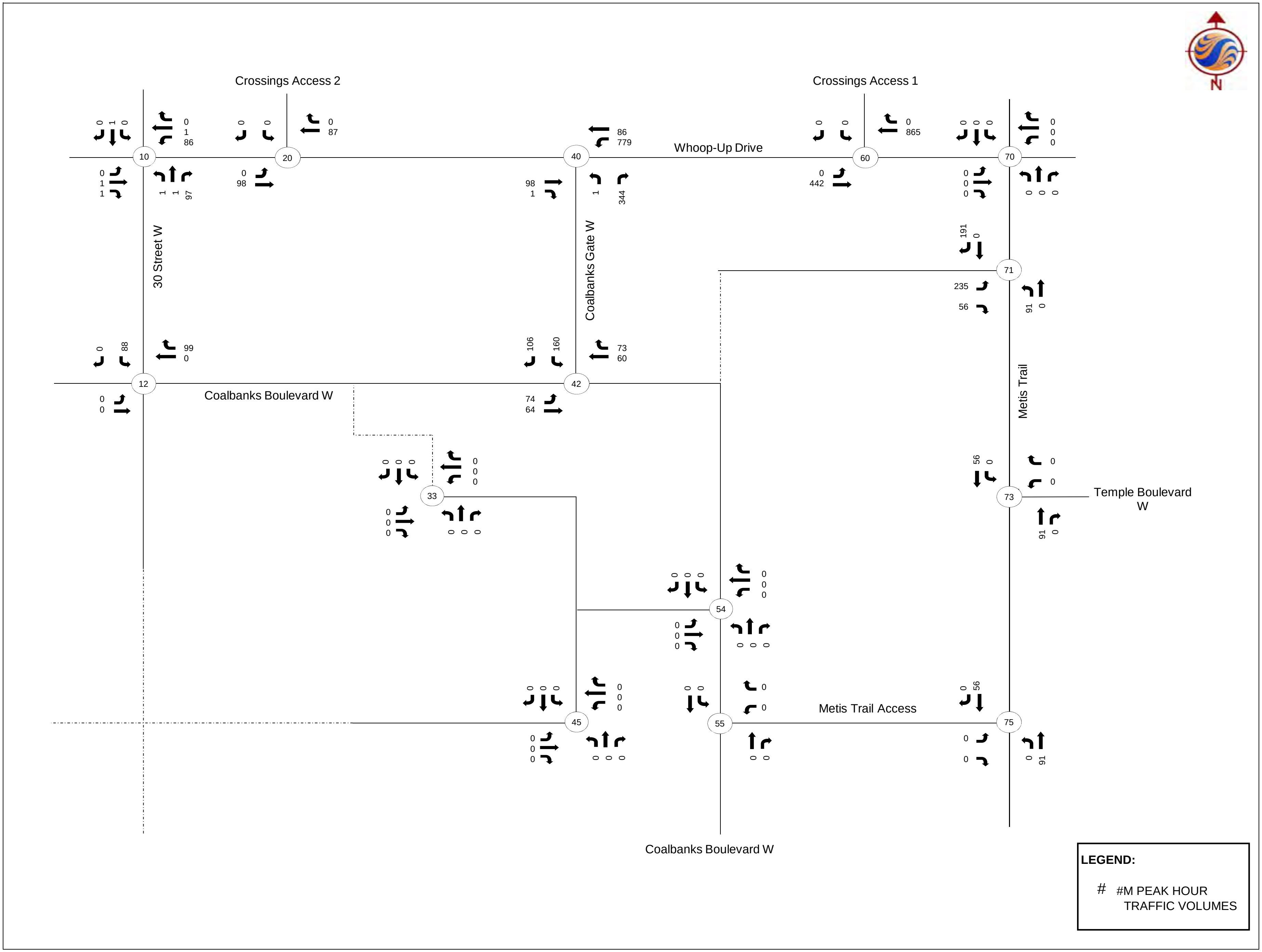

Figure 4B
Copperwood Stage 1 Volumes
PM Peak Hour
(From Copperwood TIA Figure 4.2)

COPPERWOOD STAGE 2 OUTLINE PLAN

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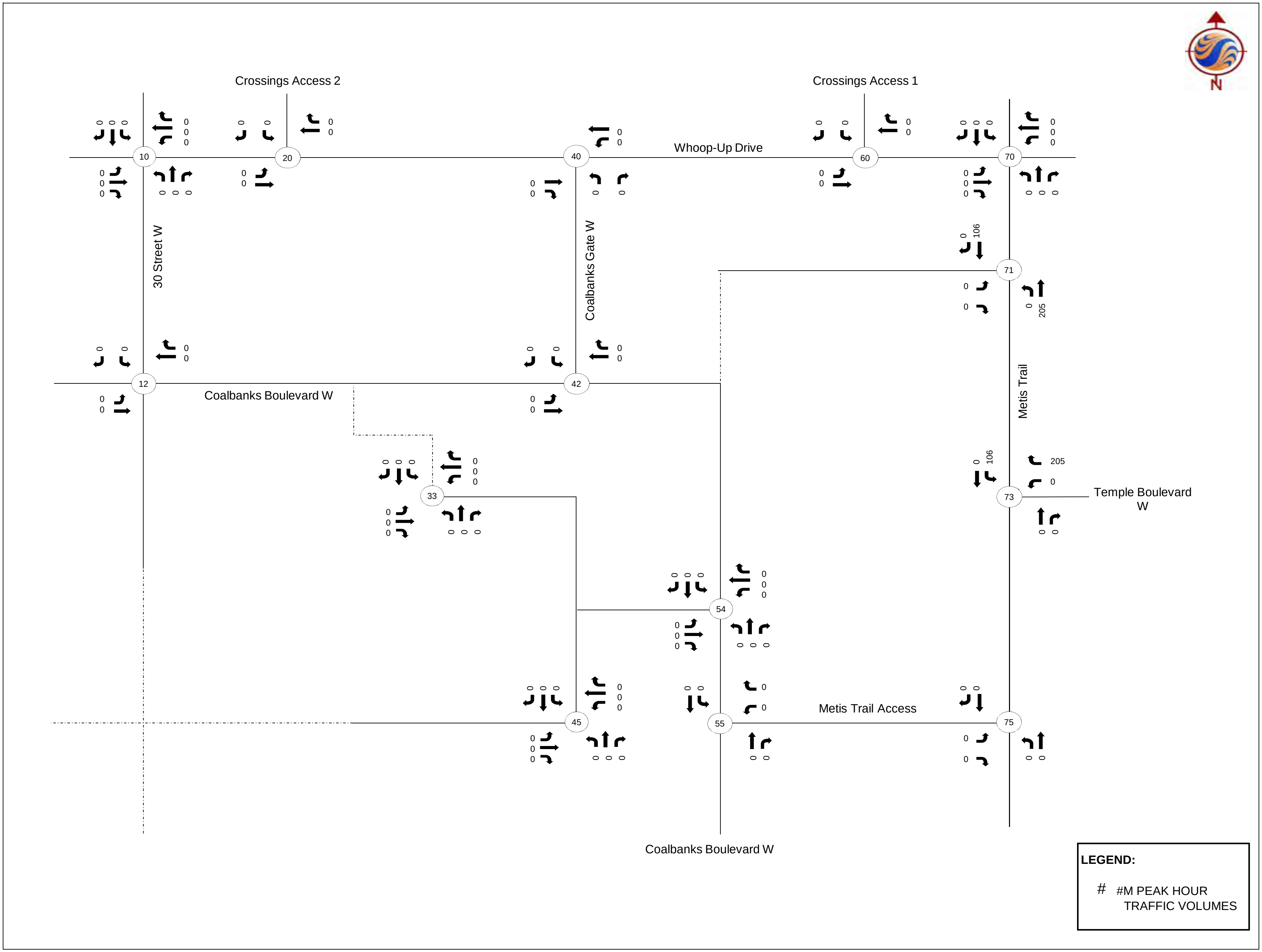

Figure 5A
Varsity Village 10 Year Volumes
AM Peak Hour
(From Copperwood TIA Figure 4.1)

COPPERWOOD STAGE 2 OUTLINE PLAN

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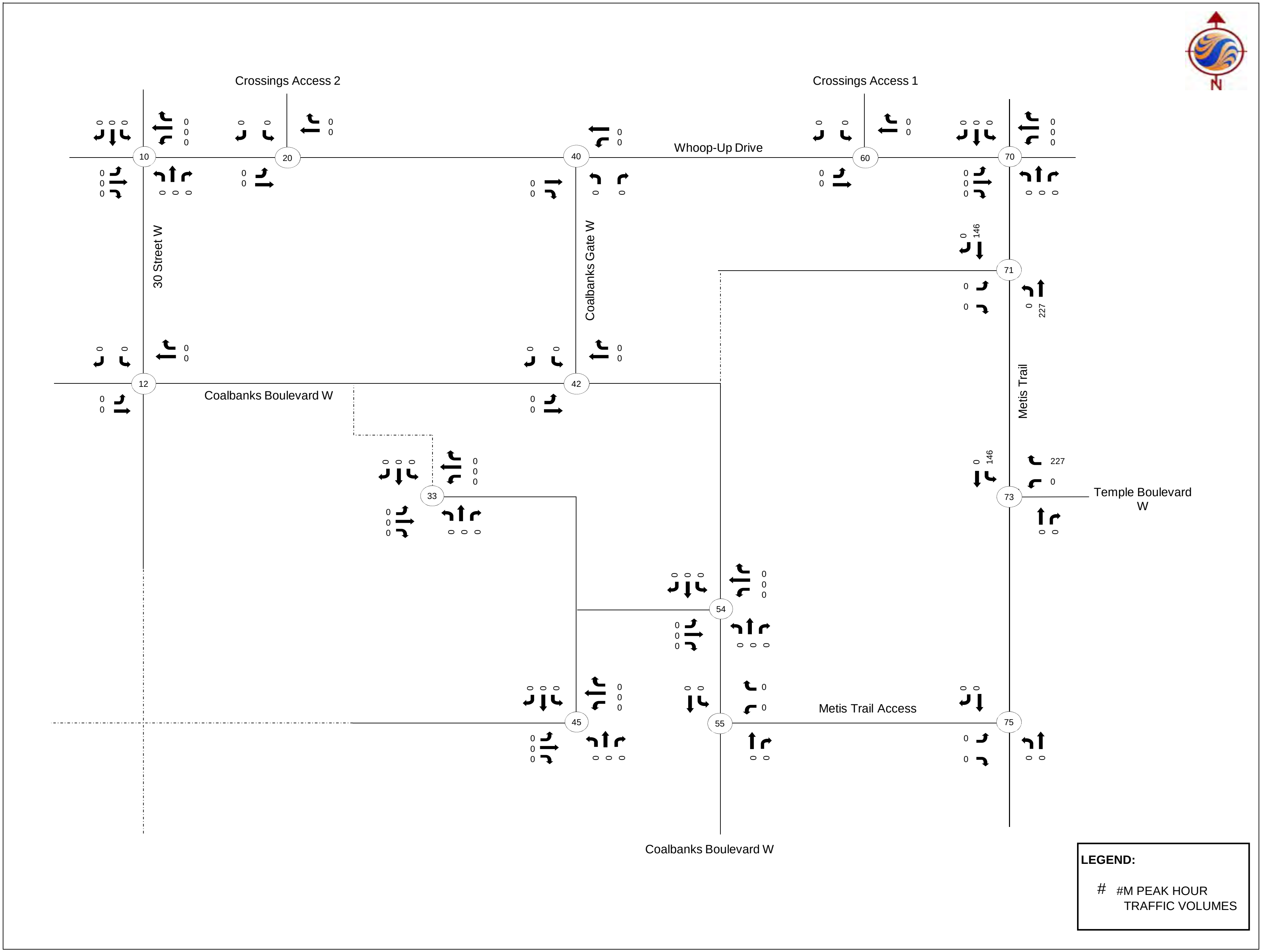

Figure 5B
Varsity Village 10 Year Volumes
PM Peak Hour
(From Copperwood TIA Figure 4.2)

COPPERWOOD STAGE 2 OUTLINE PLAN

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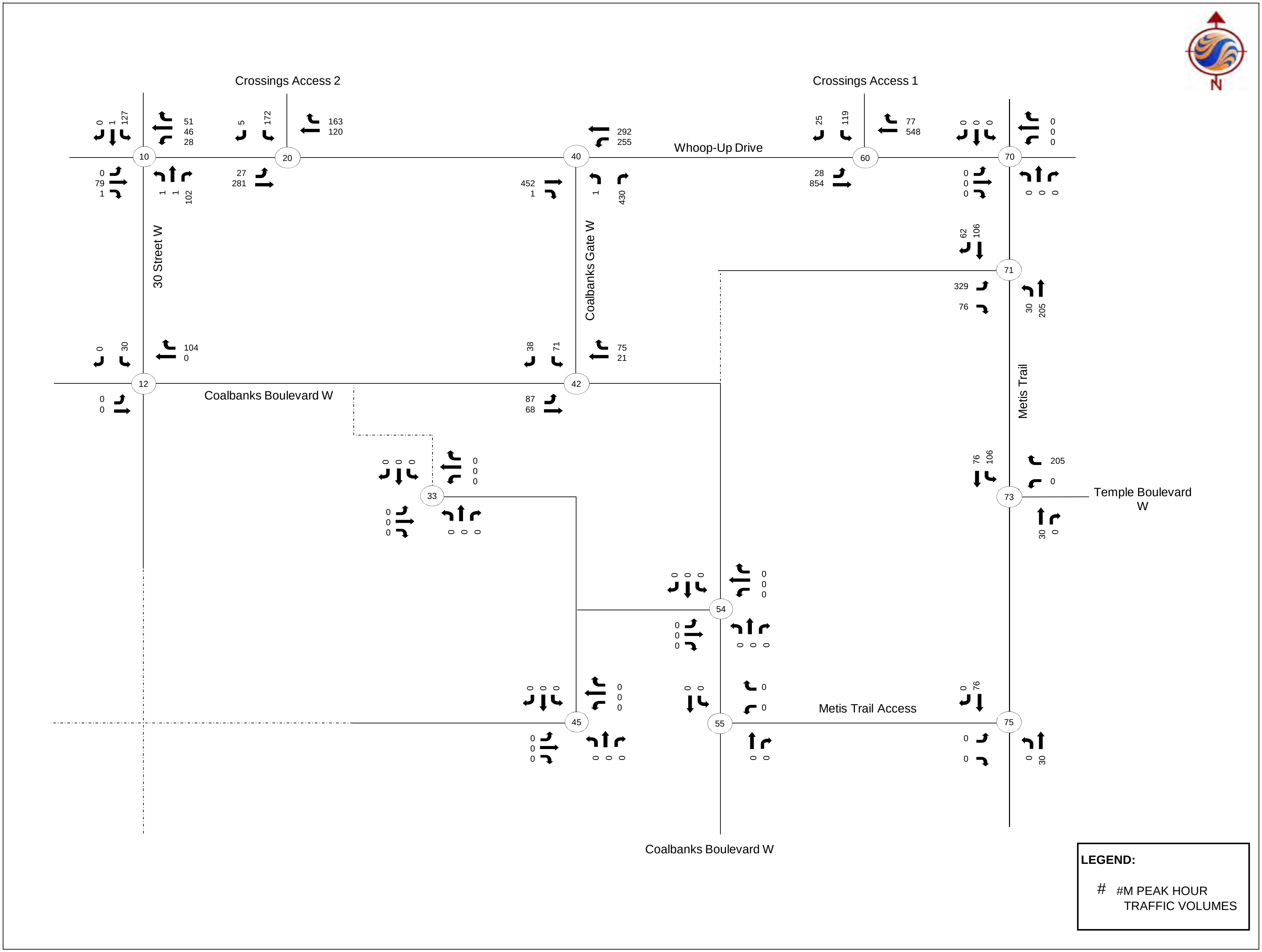

COPPERWOOD STAGE 2 OUTLINE PLAN

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Figure 6A
10 Year Horizon
Background Volumes
AM Peak Hour

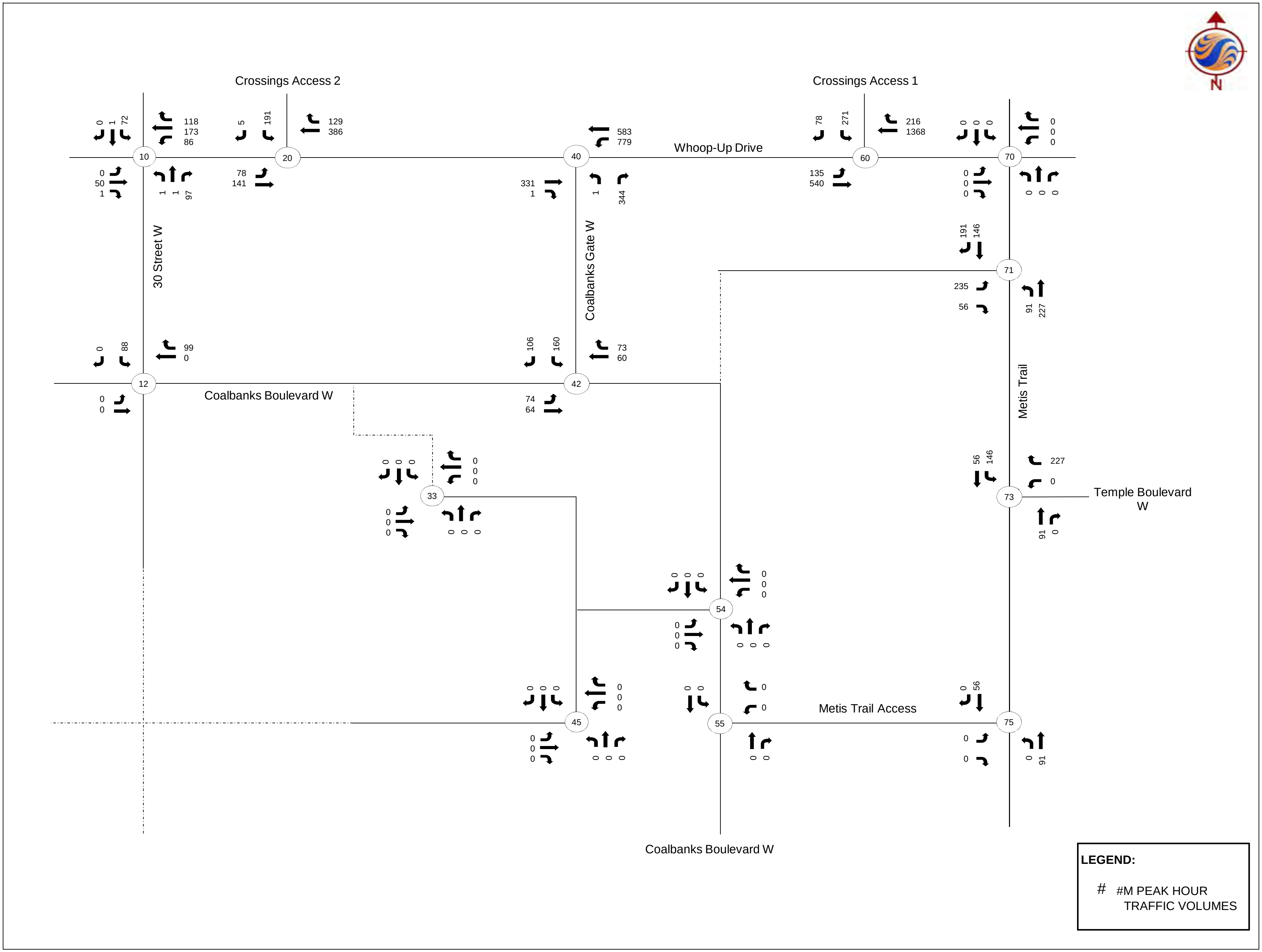

Figure 6B
10 Year Horizon
Background Volumes
AM Peak Hour

COPPERWOOD STAGE 2 OUTLINE PLAN

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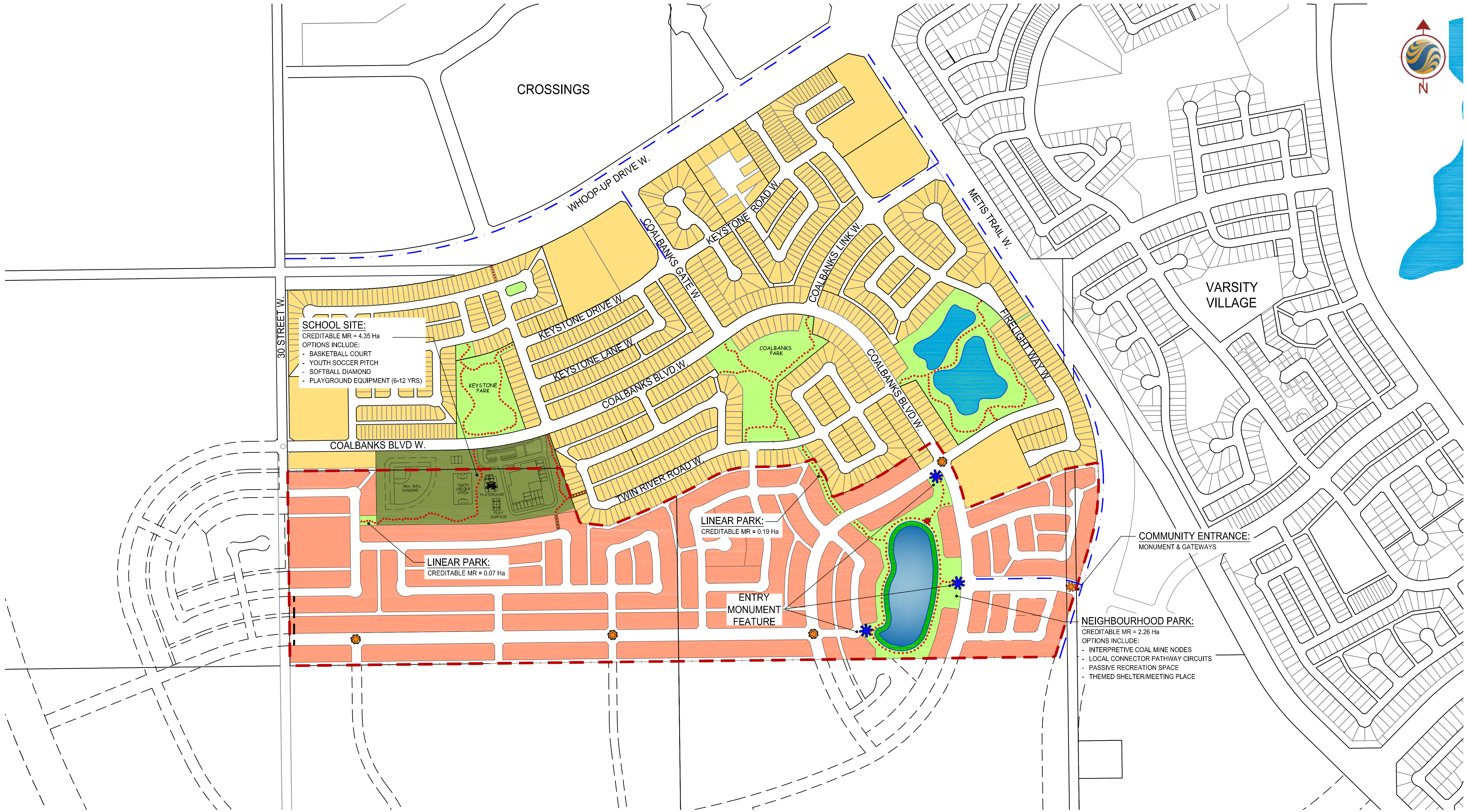
Appendix B – Outline Plan Figures



NTS

December 2011
112944453

Legend

- Copperwood Stage 2 Boundary
- Public Building, Parks & Recreation (P-B)
- Parks and Recreation (P-R)
- Open Space (OS n/c)
- Stormwater Management Facility (Wet Pond)
- Local Connector Pathways
- Regional Multi-Use Pathway
- Themed Gateway Entrance to Park
- Special Park Amenity Features
- Community Entry and Theme Elements
- Stage 1
- Stage 2

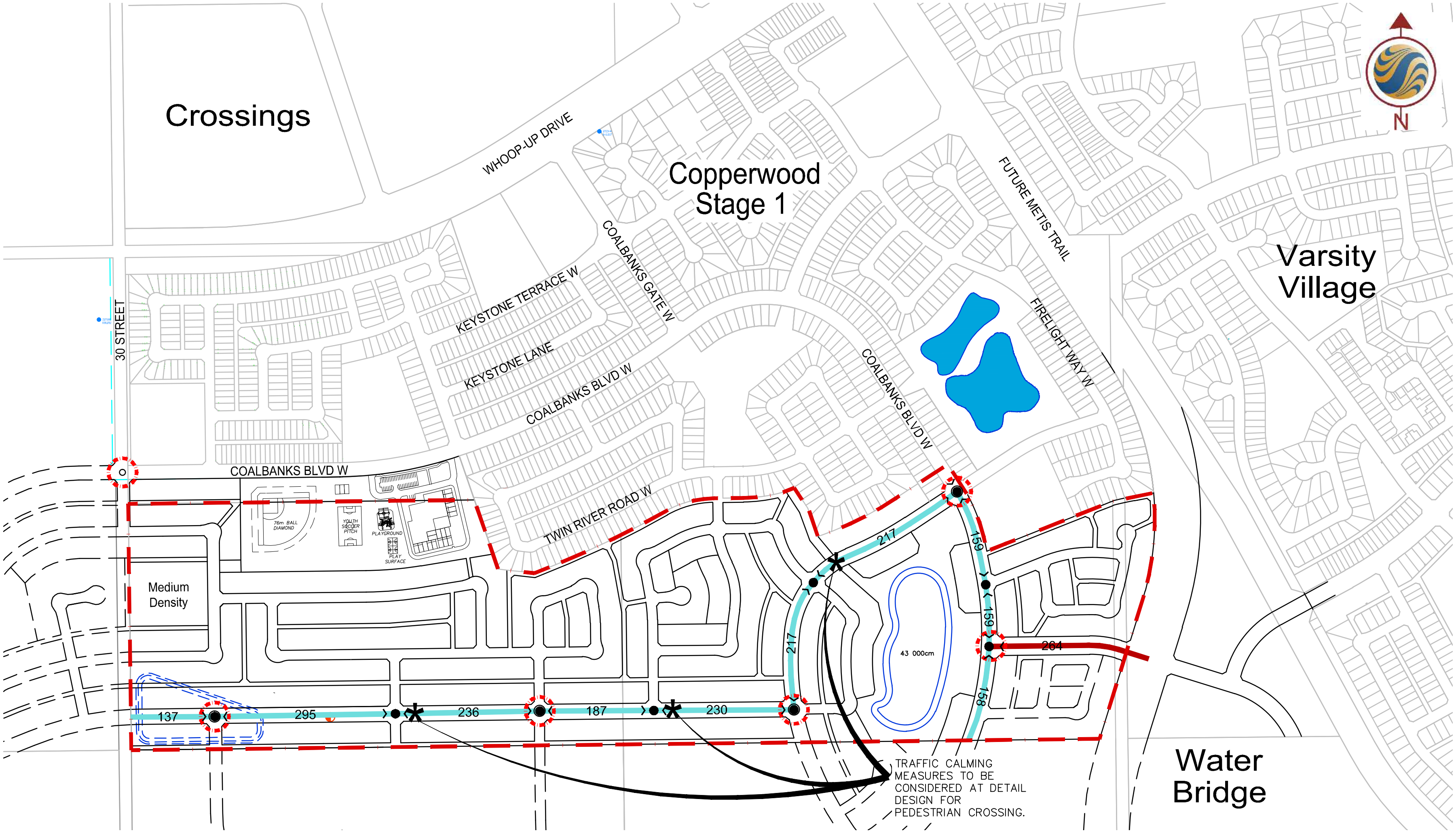
ORIGINAL SHEET - ANSI B

Stantec

Client/Project
DAYTONA URBAN DEVELOPMENT CORP.
COPPERWOOD STAGE 2
OUTLINE PLAN

Figure No.
6.4

Title
Open Space
Area Context Plan



NTS

May 2012
112944453

Legend
- Copperwood Stage 2 Boundary
- Community Entrance/Super Collector
- Major Collector
- Minor Collector
- ● ‹100m› ● Intersection Spacing
- Roundabout

Stantec

Client/Project
DAYTONA URBAN DEVELOPMENT CORP.
COPPERWOOD STAGE 2
OUTLINE PLAN

Figure No.
9.1

Title
Preliminary Transporation Network

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Appendix C – Crossings TIA Volumes

Figure 4-4: Full Build Out Horizon Traffic Volumes

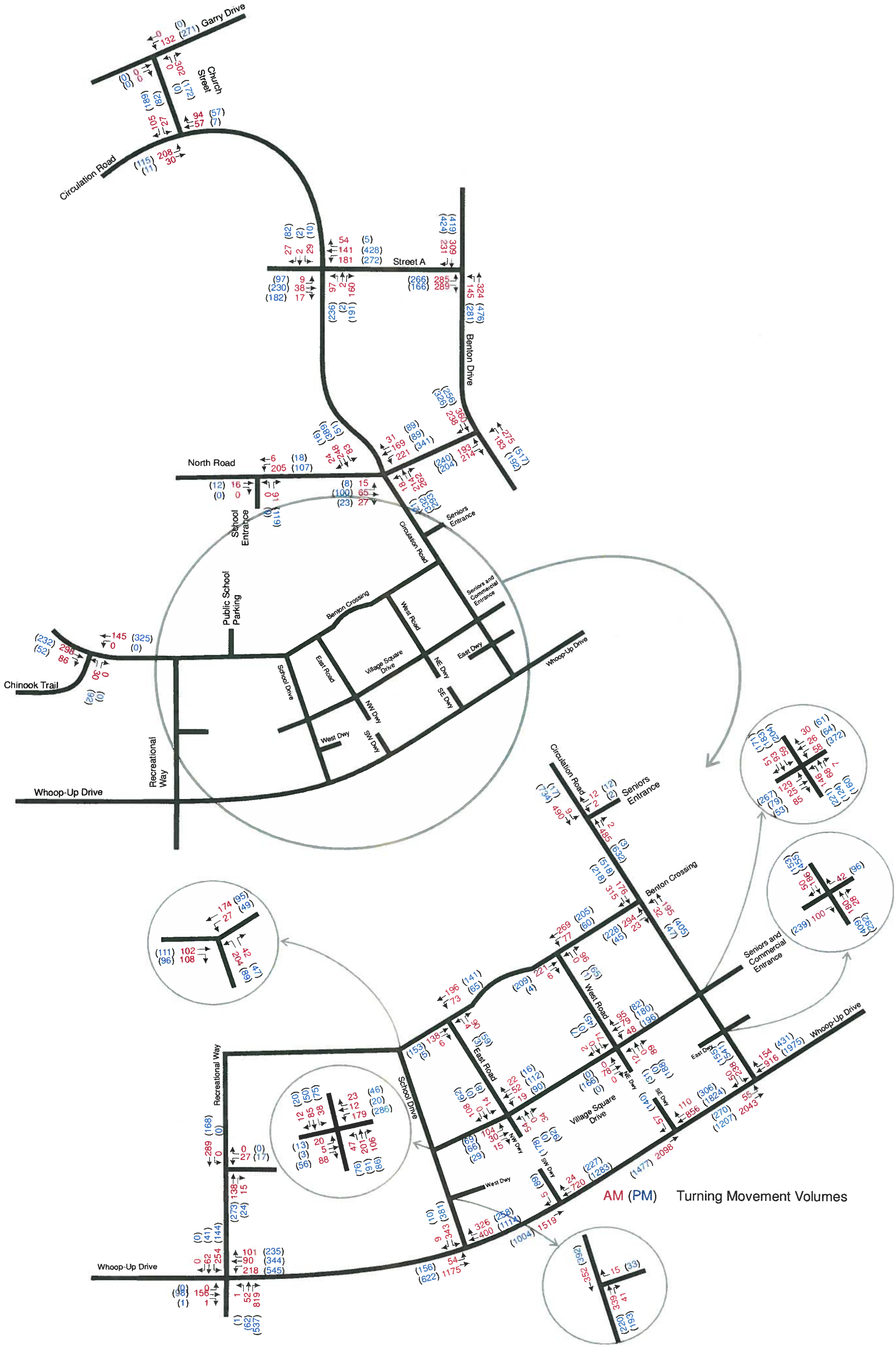
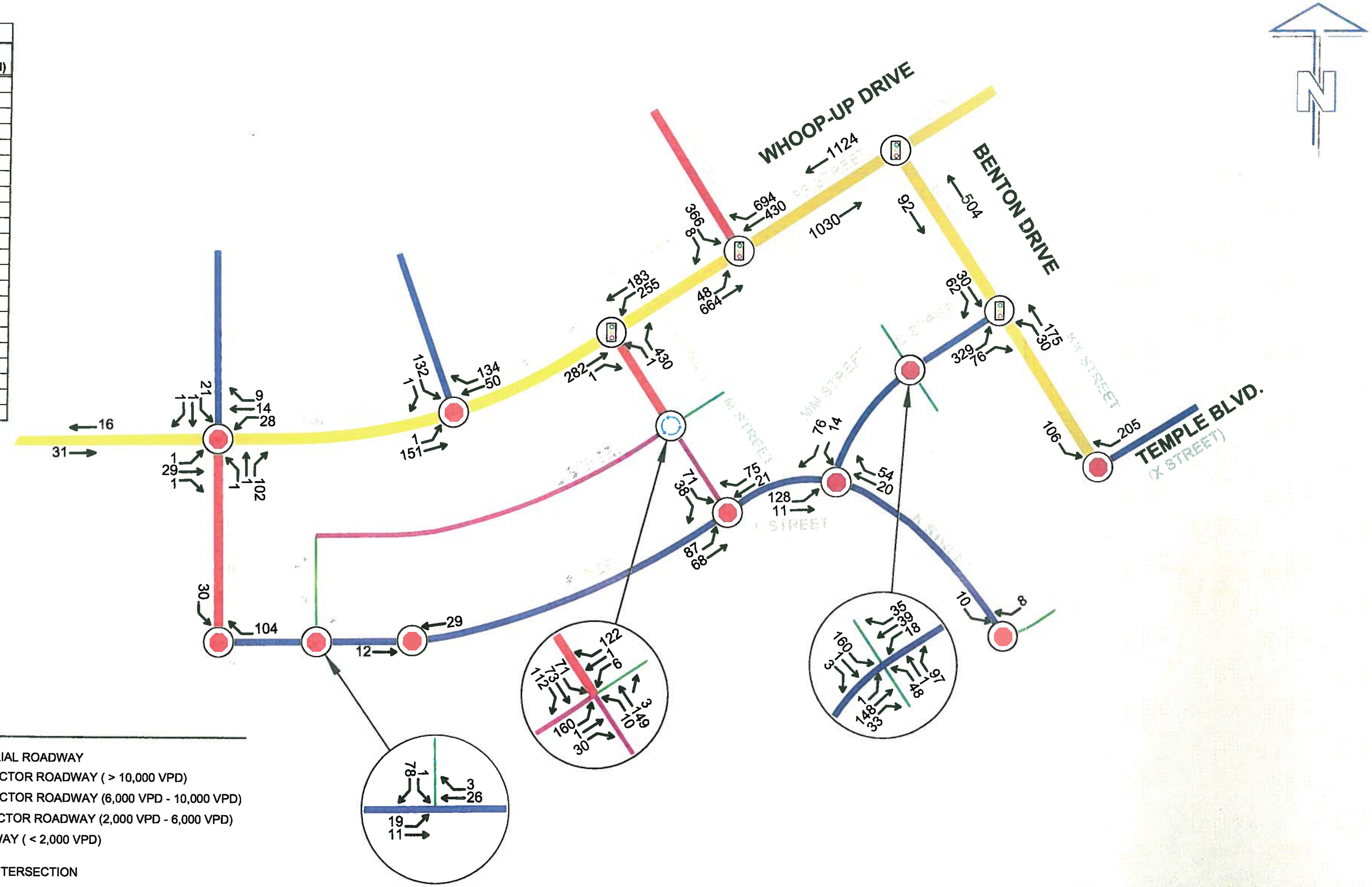


Figure 2-2: Full Build Out Background Traffic Volumes

Appendix D – Copperwood Stage 1 TIA Volumes

AADT AM VOLUME SUMMARY		
ROADWAY LINK	TOTAL AM	AADT VOLUME (AM)
C	479	4790
D	687	6870
E	134	1340
K	100	1000
I	235	2350
M	271	2710
N	252	2520
O	41	410
P	134	1340
T	101	1010
U	314	3140
X	311	3110
Y	2730	27300
Z	1116	11160
AA	268	2680
BB	34	340
DD	203	2030
EE	1150	11500
FF	2154	21540
KK	311	3110
LL	596	5960
MM	272	2720



LEGEND:

- MAJOR ARTERIAL ROADWAY
- SUPER COLLECTOR ROADWAY (> 10,000 VPD)
- MAJOR COLLECTOR ROADWAY (6,000 VPD - 10,000 VPD)
- MINOR COLLECTOR ROADWAY (2,000 VPD - 6,000 VPD)
- LOCAL ROADWAY (< 2,000 VPD)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- ROUNDABOUT

NOTE:

ROADWAY CLASSIFICATIONS NOTED ON THIS DRAWING REPRESENT SOUTH VILLAGE FULL BUILDOUT CLASSIFICATIONS

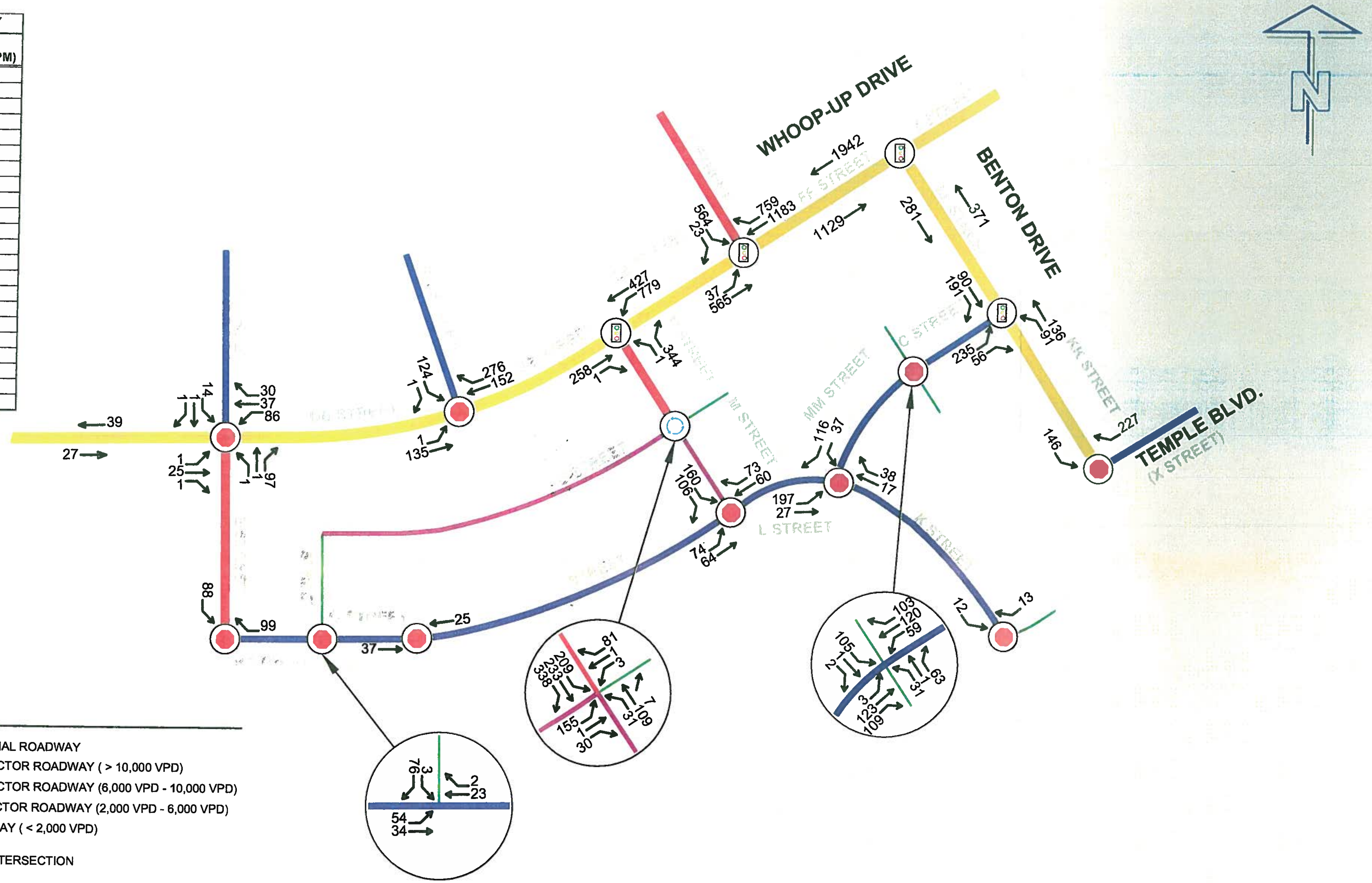
Daytona Urban Development Corp.
Copperwood
Outline Plan

10 Year Projected Traffic Volumes and Movements AM Peak Hour

Figure 4.1

UMA | AECOM

AADT PM VOLUME SUMMARY		
ROADWAY LINK	TOTAL PM	AADT VOLUME (PM)
C	573	5730
D	1125	11250
E	187	1870
K	121	1210
L	357	3570
M	413	4130
N	362	3620
O	62	620
P	187	1870
T	135	1350
U	556	5560
X	373	3730
Y	3703	37030
Z	1383	13830
AA	402	4020
BB	48	480
DD	289	2890
EE	1808	18080
FF	3071	30710
KK	373	3730
LL	652	6520
MM	388	3880



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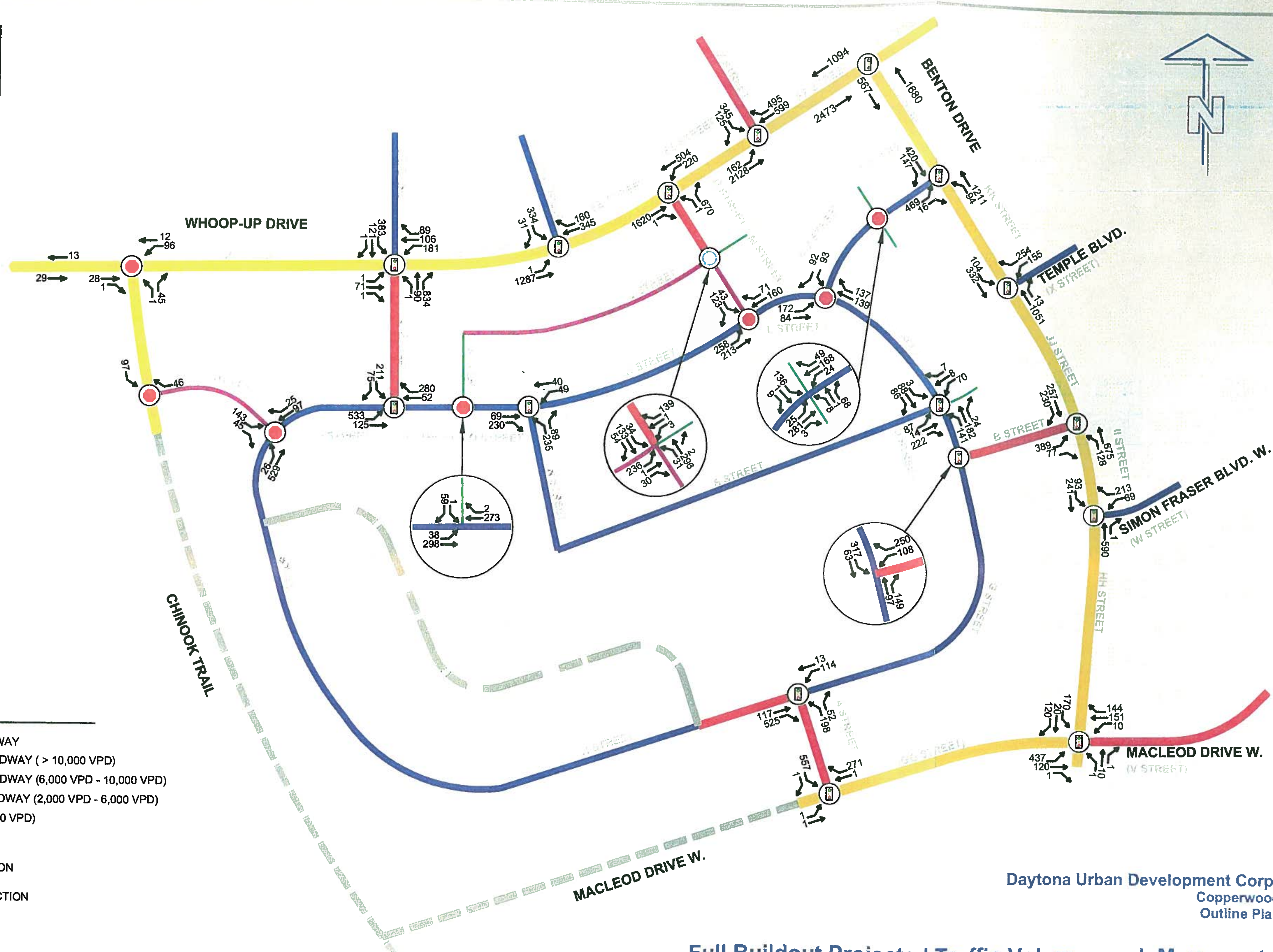
Daytona Urban Development Corp.
Copperwood
Outline Plan

10 Year Projected Traffic Volumes and Movements PM Peak Hour

Figure 4.2

AADT AM VOLUME SUMMARY		
ROADWAY LINK	TOTAL AM	AADT VOLUME (AM)
A	884	8840
B	824	8240
C	726	7260
D	892	8920
E	1234	12340
F	280	2800
G	519	5190
H	861	8610
I	693	6930
J	727	7270
K	453	4530
L	487	4870
M	495	4950
N	777	7770
O	574	5740
P	668	6680
Q	807	8070
R	602	6020
S	602	6020
T	98	980
U	360	3600
V	824	8240
W	376	3760
X	526	5260
Y	5440	54400
Z	1127	11270
AA	526	5260
BB	685	6850
CC	181	1810
DD	1664	16640
EE	3014	30140
FF	3567	35670
GG	830	8300
HH	901	9010
II	1137	11370
JJ	1551	15510
KK	1741	17410
LL	2247	22470
MM	494	4940



LEGEND:

- MAJOR ARTERIAL ROADWAY
- SUPER COLLECTOR ROADWAY (> 10,000 VPD)
- MAJOR COLLECTOR ROADWAY (6,000 VPD - 10,000 VPD)
- MINOR COLLECTOR ROADWAY (2,000 VPD - 6,000 VPD)
- LOCAL ROADWAY (< 2,000 VPD)
- FUTURE ROADWAY
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- ROUNDABOUT

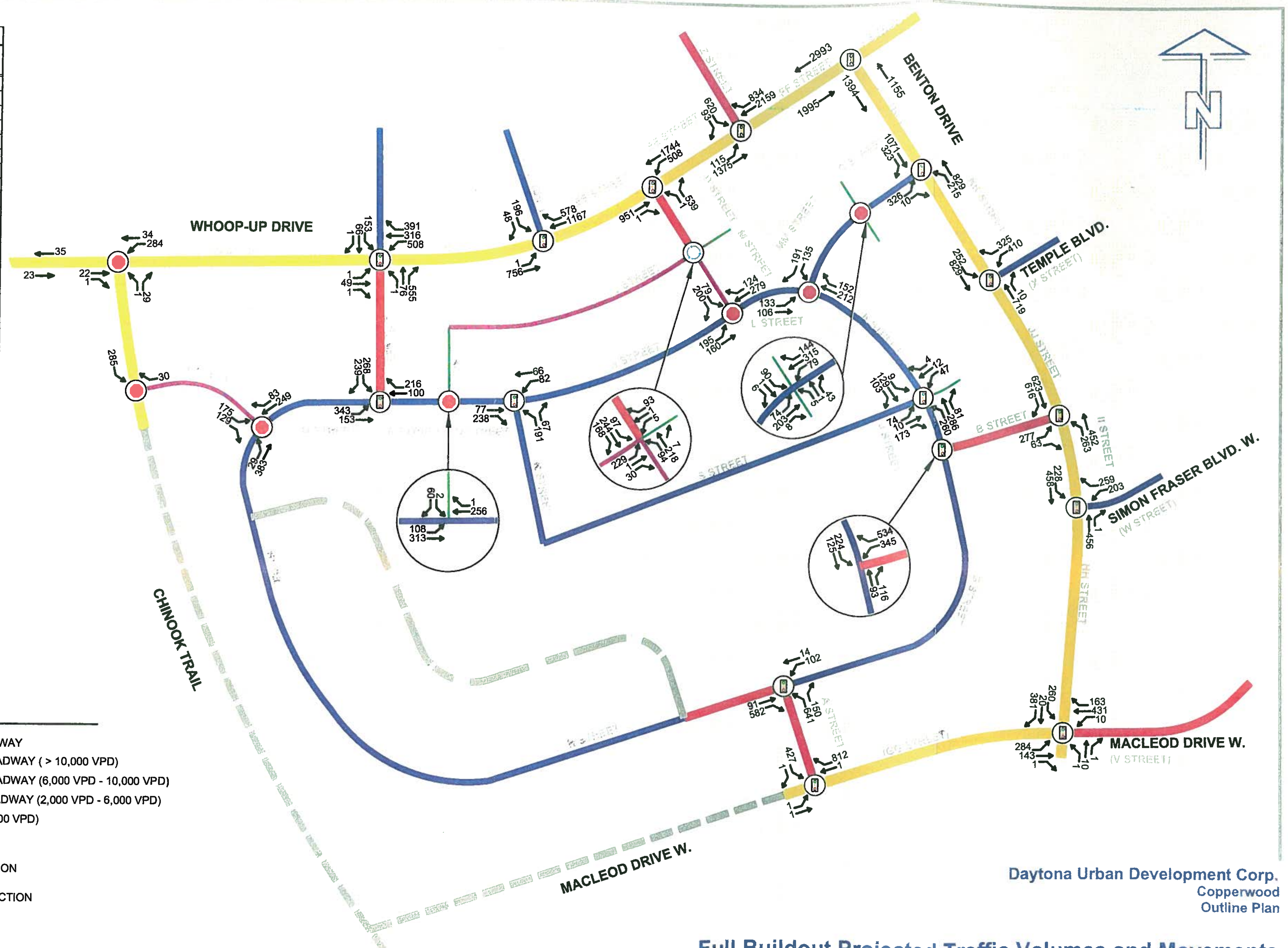
Daytona Urban Development Corp.
Copperwood
Outline Plan

Full Buildout Projected Traffic Volumes and Movements AM Peak Hour

Figure 4.3

UMA | AECOM

AADT PM VOLUME SUMMARY		
ROADWAY LINK	TOTAL PM	AADT VOLUME (PM)
A	1378	13780
B	1219	12190
C	874	8740
D	1049	10490
E	1211	12110
F	483	4830
G	816	8160
H	1344	13440
I	784	7840
J	976	9760
K	605	6050
L	642	6420
M	598	5980
N	878	8780
O	572	5720
P	737	7370
Q	902	9020
R	579	5790
S	694	6940
T	170	1700
U	530	5300
V	1008	10080
W	691	6910
X	997	9970
Y	6848	68480
Z	1662	16620
AA	823	8230
BB	688	6880
CC	369	3690
DD	1972	19720
EE	3472	34720
FF	4988	49880
GG	1241	12410
HH	1118	11180
II	1401	14010
JJ	1968	19680
KK	2125	21250
LL	2549	25490
MM	611	6110



LEGEND:

- MAJOR ARTERIAL ROADWAY
- SUPER COLLECTOR ROADWAY (> 10,000 VPD)
- MAJOR COLLECTOR ROADWAY (6,000 VPD - 10,000 VPD)
- MINOR COLLECTOR ROADWAY (2,000 VPD - 6,000 VPD)
- LOCAL ROADWAY (< 2,000 VPD)
- FUTURE ROADWAY
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- ROUNDABOUT

Daytona Urban Development Corp.
Copperwood
Outline Plan

Full Buildout Projected Traffic Volumes and Movements
PM Peak Hour

Figure 4.4

UMA | AECOM

Appendix E – Existing Count Information

INTERSECTION TRAFFIC FLOW ANALYSIS REPORT

ME2 TRANSPORTATION DATA CORP.

Location WHOOP UP DRIVE & COALBANK GATE - LETH Date THURSDAY 8 MARCH 2012 Observers MS

time	FROM THE NORTH on						FROM THE SOUTH on Coalbank Gate						FROM THE EAST on Whoopup Drive						FROM THE WEST on Whoopup Drive					
ending	LT	ST	RT	CV	PED	BIKE	LT	ST	RT	CV	PED	BIKE	LT	ST	RT	CV	PED	BIKE	LT	ST	RT	CV	PED	BIKE
7:15	0	0	0	0	0	0	1	0	31	1	0	0	20	2	0	0	0	0	0	5	2	0	1	0
7:30	0	0	0	0	0	0	0	0	61	2	1	0	16	0	0	4	0	0	0	4	0	0	2	0
7:45	0	0	0	0	0	0	2	0	149	4	0	0	21	3	0	4	0	0	0	6	2	0	17	0
8:00	0	0	0	0	0	0	1	0	98	2	0	0	39	4	0	6	2	0	0	6	6	0	9	0
8:15	0	0	0	0	0	0	4	0	109	2	0	0	55	3	0	5	1	0	0	5	1	0	2	0
8:30	0	0	0	0	0	0	1	0	81	2	0	0	30	2	0	2	0	0	0	4	0	0	1	0
8:45	0	0	0	0	0	0	1	0	61	3	0	0	23	3	0	0	0	0	0	3	0	0	2	0
9:00	0	0	0	0	0	0	0	0	51	2	0	0	39	2	0	4	0	0	0	1	2	0	0	0
2 hr total	0	0	0	0	0	0	10	0	641	18	1	0	243	19	0	25	3	0	0	34	13	0	34	0
		0		#DIV/0!				651		3%				262		10%				47		0%		
peak hour	0	0	0				8	0	437				145	12	0				0	21	9			
		0						445						157						30				
4:15	0	0	0	0	0	0	2	0	30	2	0	0	52	2	0	2	0	0	0	2	2	1	7	0
4:30	0	0	0	0	0	0	2	0	31	1	0	0	69	7	0	2	0	0	0	3	1	0	0	0
4:45	0	0	0	0	0	0	1	0	40	0	0	0	76	1	0	1	0	0	0	4	2	1	1	0
5:00	0	0	0	0	0	0	0	0	32	4	0	0	91	3	0	1	0	0	0	8	5	2	1	0
5:15	0	0	0	0	0	0	1	0	54	1	0	0	86	3	0	0	0	0	0	3	1	0	0	0
5:30	0	0	0	0	0	0	0	0	40	1	0	0	82	3	0	1	0	0	0	3	0	0	0	0
5:45	0	0	0	0	0	0	0	0	35	0	0	0	68	3	0	0	0	0	0	2	0	0	1	0
6:00	0	0	0	0	0	0	1	0	51	2	0	0	53	4	0	1	0	0	0	3	0	0	2	0
2 hr total	0	0	0	0	0	0	7	0	313	11	0	0	577	26	0	8	0	0	0	28	11	4	12	0
		0		#DIV/0!				320		3%				603		1%				39		10%		
peak hour	0	0	0				2	0	166				335	10	0				0	18	8			
		0						168						345						26				
4 hour	0	0	0				17	0	954				820	45	0				0	62	24			
total		0						971						865						86				

Appendix F – Background Analysis Summaries

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	452	1	191	292	1	430
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)		0.0	120.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)		20.0	20.0		20.0	20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1889	0	1566	1889	1847	1653
Flt Permitted			0.200		0.950	
Satd. Flow (perm)	1889	0	330	1889	1847	1653
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						439
Link Speed (k/h)	60			60	50	
Link Distance (m)	301.2			299.7	207.3	
Travel Time (s)	18.1			18.0	14.9	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	2%	2%
Adj. Flow (vph)	514	1	217	332	1	489
Shared Lane Traffic (%)						
Lane Group Flow (vph)	515	0	217	332	1	489
Turn Type			pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	10.0
Minimum Split (s)	21.0		15.0	21.0	15.0	15.0
Total Split (s)	41.0	0.0	18.0	59.0	31.0	31.0
Total Split (%)	45.6%	0.0%	20.0%	65.6%	34.4%	34.4%
Maximum Green (s)	36.0		13.0	54.0	26.0	26.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.5		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Walk Time (s)	6.0			6.0	6.0	6.0
Flash Dont Walk (s)	10.0			10.0	10.0	10.0
Pedestrian Calls (#/hr)	5			5	5	5
Act Effct Green (s)	21.2		37.2	37.2	12.3	12.3
Actuated g/C Ratio	0.35		0.62	0.62	0.21	0.21
v/c Ratio	0.77		0.51	0.28	0.00	0.71
Control Delay	26.0		9.9	6.2	22.0	10.7
Queue Delay	0.0		0.0	0.0	0.0	0.0

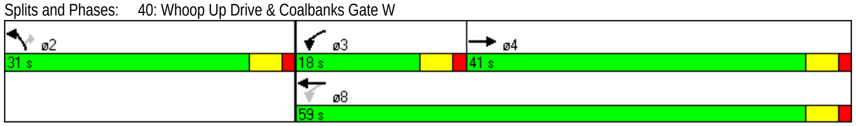
Copperwood Stage 2 Outline Plan - Ten Year Background Volumes AM Peak Hour
40: Whoop Up Drive & Coalbanks Gate W 3/13/2012

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Total Delay	26.0		9.9	6.2	22.0	10.7
LOS	C		A	A	C	B
Approach Delay	26.0			7.6	10.7	
Approach LOS	C			A	B	
Queue Length 50th (m)	43.4		7.5	11.9	0.1	4.2
Queue Length 95th (m)	93.6		22.0	32.4	1.4	30.8
Internal Link Dist (m)	277.2			275.7	183.3	
Turn Bay Length (m)			120.0			
Base Capacity (vph)	1180		484	1708	833	987
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.44		0.45	0.19	0.00	0.50

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 59.9
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 14.7 Intersection LOS: B
Intersection Capacity Utilization 63.1% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 40: Whoop Up Drive & Coalbanks Gate W



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↑	↱	↰	↑↱		↰	↑↱	
Volume (vph)	243	719	11	157	393	68	28	141	394	130	56	140
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Width (m)	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8
Storage Length (m)	60.0		0.0	120.0		50.0	60.0		0.0	60.0		0.0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (m)	20.0		20.0	20.0		20.0	20.0		20.0	20.0		20.0
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.998				0.850		0.889			0.893	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1566	3195	0	1566	3202	1606	1566	2846	0	1566	2859	0
Flt Permitted	0.400			0.226			0.612			0.226		
Satd. Flow (perm)	659	3195	0	372	3202	1606	1009	2846	0	372	2859	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				77		354			159	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		290.9			537.6			346.6			268.8	
Travel Time (s)		17.5			32.3			20.8			16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	276	817	12	178	447	77	32	160	448	148	64	159
Shared Lane Traffic (%)												
Lane Group Flow (vph)	276	829	0	178	447	77	32	608	0	148	223	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		
Detector Phase	5	2		1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	20.0		5.0	20.0	20.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	26.5		12.0	26.5	26.5	12.0	26.5		12.0	26.5	
Total Split (s)	15.0	29.5	0.0	12.0	26.5	26.5	12.0	26.5	0.0	12.0	26.5	0.0
Total Split (%)	18.8%	36.9%	0.0%	15.0%	33.1%	33.1%	15.0%	33.1%	0.0%	15.0%	33.1%	0.0%
Maximum Green (s)	12.0	24.0		9.0	21.0	21.0	9.0	21.0		9.0	21.0	
Yellow Time (s)	3.0	3.5		3.0	3.5	3.5	3.0	3.5		3.0	3.5	
All-Red Time (s)	0.0	2.0		0.0	2.0	2.0	0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	5.5	4.0	3.0	5.5	5.5	3.0	5.5	4.0	3.0	5.5	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min	Min	None	None		None	None	
Walk Time (s)		6.0			6.0	6.0		6.0			6.0	
Flash Dont Walk (s)		15.0			15.0	15.0		15.0			15.0	
Pedestrian Calls (#/hr)		5			5	5		5			5	
Act Effct Green (s)	37.0	23.5		32.0	21.0	21.0	21.0	13.5		24.6	18.8	
Actuated g/C Ratio	0.54	0.34		0.47	0.31	0.31	0.31	0.20		0.36	0.27	
v/c Ratio	0.55	0.76		0.55	0.46	0.14	0.09	0.72		0.52	0.25	
Control Delay	15.3	27.7		18.1	23.1	6.7	14.2	16.4		21.8	8.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

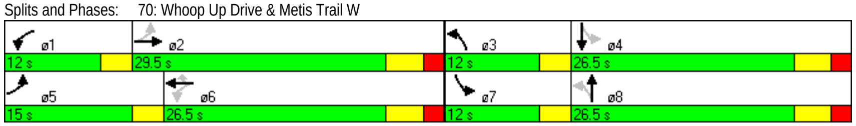
Copperwood Stage 2 Outline Plan - Ten Year Background Volumes AM Peak Hour
70: Whoop Up Drive & Metis Trail W 4/24/2012

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	15.3	27.7		18.1	23.1	6.7	14.2	16.4		21.8	8.2	
LOS	B	C		B	C	A	B	B		C	A	
Approach Delay		24.6			20.0			16.2			13.6	
Approach LOS		C			C			B			B	
Queue Length 50th (m)	18.9	51.0		11.3	25.5	0.0	2.7	16.4		13.3	3.0	
Queue Length 95th (m)	40.8	#89.5		#26.4	43.3	8.9	7.1	30.7		24.0	11.2	
Internal Link Dist (m)		266.9			513.6			322.6			244.8	
Turn Bay Length (m)	60.0			120.0		50.0	60.0			60.0		
Base Capacity (vph)	521	1139		336	998	553	409	1130		292	1041	
Starvation Cap Reductn	0	0		0	0	0	0	0		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	0.53	0.73		0.53	0.45	0.14	0.08	0.54		0.51	0.21	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 68.8
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 20.1 Intersection LOS: C
Intersection Capacity Utilization 73.1% 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.

Splits and Phases: 70: Whoop Up Drive & Metis Trail W

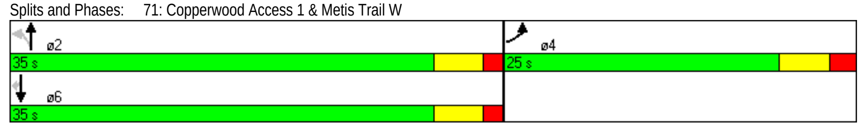


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	329	76	30	234	99	126
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)	0.0	0.0	60.0			0.0
Storage Lanes	1	0	1			1
Taper Length (m)	20.0	20.0	20.0			20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.975					0.850
Flt Protected	0.961		0.950			
Satd. Flow (prot)	1822	0	1566	1889	1889	1606
Flt Permitted	0.961		0.685			
Satd. Flow (perm)	1822	0	1129	1889	1889	1606
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	20					143
Link Speed (k/h)	50			60	60	
Link Distance (m)	184.3			322.5	346.6	
Travel Time (s)	13.3			19.4	20.8	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	2%	2%	5%	5%	5%	5%
Adj. Flow (vph)	374	86	34	266	112	143
Shared Lane Traffic (%)						
Lane Group Flow (vph)	460	0	34	266	112	143
Turn Type			Perm			Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Detector Phase	4		2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0		20.0	20.0	10.0	10.0
Minimum Split (s)	23.5		25.0	25.0	21.0	21.0
Total Split (s)	25.0	0.0	35.0	35.0	35.0	35.0
Total Split (%)	41.7%	0.0%	58.3%	58.3%	58.3%	58.3%
Maximum Green (s)	19.5		30.0	30.0	30.0	30.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	2.0		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	4.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		Min	Min	Min	Min
Walk Time (s)	6.0		6.0	6.0	6.0	6.0
Flash Dont Walk (s)	12.0		10.0	10.0	10.0	10.0
Pedestrian Calls (#/hr)	5		5	5	5	5
Act Effct Green (s)	15.9		20.1	20.1	20.1	20.1
Actuated g/C Ratio	0.34		0.43	0.43	0.43	0.43
v/c Ratio	0.72		0.07	0.33	0.14	0.18
Control Delay	20.0		9.6	11.1	9.7	3.1
Queue Delay	0.0		0.0	0.0	0.0	0.0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Total Delay	20.0		9.6	11.1	9.7	3.1
LOS	C		A	B	A	A
Approach Delay	20.0			10.9	6.0	
Approach LOS	C			B	A	
Queue Length 50th (m)	30.1		1.6	13.8	5.3	0.0
Queue Length 95th (m)	52.7		5.6	28.6	13.2	7.2
Internal Link Dist (m)	160.3			298.5	322.6	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	779		732	1224	1224	1091
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.59		0.05	0.22	0.09	0.13

Intersection Summary	
Area Type: Other	
Cycle Length: 60	
Actuated Cycle Length: 46.5	
Natural Cycle: 50	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.72	
Intersection Signal Delay: 13.8	Intersection LOS: B
Intersection Capacity Utilization 50.2%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 71: Copperwood Access 1 & Metis Trail W



MOVEMENT SUMMARY

Site: Intersection 71 AM - Background

Intersection 71 AM - Background Volumes
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	34	5.0	0.413	10.5	LOS B	1.8	14.4	0.56	0.98	35.0
8	T	266	5.0	0.413	10.5	LOS B	1.8	14.4	0.56	0.72	38.0
Approach		300	5.0	0.413	10.5	LOS B	1.8	14.4	0.56	0.75	37.6
North: Metis Trail W											
4	T	113	5.0	0.246	5.8	LOS A	1.0	8.1	0.14	0.38	43.5
14	R	143	5.0	0.246	5.8	LOS A	1.0	8.1	0.14	0.47	42.5
Approach		256	5.0	0.246	5.8	LOS A	1.0	8.1	0.14	0.43	42.9
West: Copperwood Access 1 (Intersection 71)											
5	L	374	5.0	0.482	9.6	LOS A	2.6	20.5	0.37	0.66	27.5
12	R	86	5.0	0.482	9.6	LOS A	2.6	20.5	0.37	0.43	29.0
Approach		460	5.0	0.482	9.6	LOS A	2.6	20.5	0.37	0.62	27.7
All Vehicles		1016	5.0	0.482	8.9	LOS A	2.6	20.5	0.37	0.61	34.5

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	79	1	28	46	51	1	1	102	127	1	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	90	1	32	52	58	1	1	116	144	1	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	110			91			224	276	90	362	247	81
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	110			91			224	276	90	362	247	81
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			100	100	88	72	100	99
cM capacity (veh/h)	1461			1485			713	616	967	511	639	979

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	6	91	32	110	118	151
Volume Left	6	0	32	0	1	144
Volume Right	0	1	0	58	116	6
cSH	1461	1700	1485	1700	959	522
Volume to Capacity	0.00	0.05	0.02	0.06	0.12	0.29
Queue Length 95th (m)	0.1	0.0	0.5	0.0	3.2	9.1
Control Delay (s)	7.5	0.0	7.5	0.0	9.3	14.7
Lane LOS	A		A		A	B
Approach Delay (s)	0.4		1.7		9.3	14.7
Approach LOS					A	B

Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	87	68	21	75	71	38
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	99	77	24	85	81	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	109				341	66
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	109				341	66
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				87	96
cM capacity (veh/h)	1481				611	997

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	176	109	124
Volume Left	99	0	81
Volume Right	0	85	43
cSH	1481	1700	706
Volume to Capacity	0.07	0.06	0.18
Queue Length 95th (m)	1.6	0.0	4.8
Control Delay (s)	4.5	0.0	11.2
Lane LOS	A		B
Approach Delay (s)	4.5	0.0	11.2
Approach LOS			B

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	29.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	128	11	20	54	46	76
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	145	12	23	61	52	86
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	84				357	53
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	84				357	53
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				91	91
cM capacity (veh/h)	1513				580	1014

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	158	84	139
Volume Left	145	0	52
Volume Right	0	61	86
cSH	1513	1700	791
Volume to Capacity	0.10	0.05	0.18
Queue Length 95th (m)	2.4	0.0	4.8
Control Delay (s)	7.1	0.0	10.5
Lane LOS	A		B
Approach Delay (s)	7.1	0.0	10.5
Approach LOS			B

Intersection Summary			
Average Delay	6.8		
Intersection Capacity Utilization	29.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	331	1	584	583	1	344
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)		0.0	120.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)		20.0	20.0		20.0	20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1889	0	1566	1889	1847	1653
Flt Permitted			0.193		0.950	
Satd. Flow (perm)	1889	0	318	1889	1847	1653
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						391
Link Speed (k/h)	60			60	50	
Link Distance (m)	301.2			299.7	206.5	
Travel Time (s)	18.1			18.0	14.9	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	2%	2%
Adj. Flow (vph)	376	1	664	662	1	391
Shared Lane Traffic (%)						
Lane Group Flow (vph)	377	0	664	662	1	391
Turn Type			pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	10.0
Minimum Split (s)	21.0		15.0	21.0	15.0	15.0
Total Split (s)	23.0	0.0	52.0	75.0	15.0	15.0
Total Split (%)	25.6%	0.0%	57.8%	83.3%	16.7%	16.7%
Maximum Green (s)	18.0		47.0	70.0	10.0	10.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.5		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Walk Time (s)	6.0			6.0	6.0	6.0
Flash Dont Walk (s)	10.0			10.0	10.0	10.0
Pedestrian Calls (#/hr)	5			5	5	5
Act Effct Green (s)	18.5		54.5	54.5	11.2	11.2
Actuated g/C Ratio	0.24		0.72	0.72	0.15	0.15
v/c Ratio	0.82		0.90	0.49	0.00	0.68
Control Delay	47.2		30.5	6.0	33.0	10.6
Queue Delay	0.0		0.0	0.0	0.0	0.0

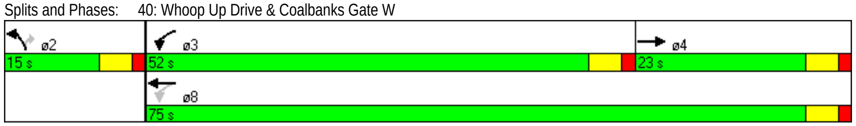
Copperwood Stage 2 Outline Plan - Ten Year Background Volumes PM Peak Hour
40: Whoop Up Drive & Coalbanks Gate W 3/13/2012

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Total Delay	47.2		30.5	6.0	33.0	10.6
LOS	D		C	A	C	B
Approach Delay	47.2			18.3	10.6	
Approach LOS	D			B	B	
Queue Length 50th (m)	49.4		63.3	30.1	0.1	0.0
Queue Length 95th (m)	#127.1		121.4	60.1	1.6	22.0
Internal Link Dist (m)	277.2			275.7	182.5	
Turn Bay Length (m)			120.0			
Base Capacity (vph)	459		1027	1712	273	577
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.82		0.65	0.39	0.00	0.68

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 76
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 22.1 Intersection LOS: C
Intersection Capacity Utilization 74.9% 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.

Splits and Phases: 40: Whoop Up Drive & Coalbanks Gate W



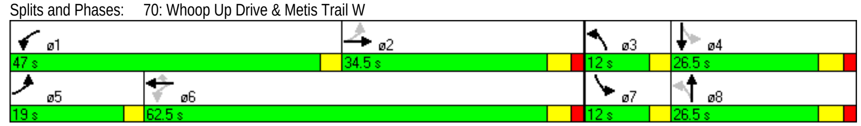
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↑	↱	↰	↑↱		↰	↑↱	
Volume (vph)	203	577	31	438	1015	235	26	132	370	100	156	347
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Width (m)	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8
Storage Length (m)	60.0		0.0	120.0		50.0	60.0		0.0	60.0		0.0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (m)	20.0		20.0	20.0		20.0	20.0		20.0	20.0		20.0
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.992				0.850		0.889			0.896	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1566	3176	0	1566	3202	1606	1566	2846	0	1566	2869	0
Flt Permitted	0.202			0.180			0.286			0.219		
Satd. Flow (perm)	333	3176	0	297	3202	1606	471	2846	0	361	2869	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				190		420			343	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		290.9			537.6			346.6			268.8	
Travel Time (s)		17.5			32.3			20.8			16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	231	656	35	498	1153	267	30	150	420	114	177	394
Shared Lane Traffic (%)												
Lane Group Flow (vph)	231	691	0	498	1153	267	30	570	0	114	571	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		
Detector Phase	5	2		1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	20.0		5.0	20.0	20.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	26.5		12.0	26.5	26.5	12.0	26.5		12.0	26.5	
Total Split (s)	19.0	34.5	0.0	47.0	62.5	62.5	12.0	26.5	0.0	12.0	26.5	0.0
Total Split (%)	15.8%	28.8%	0.0%	39.2%	52.1%	52.1%	10.0%	22.1%	0.0%	10.0%	22.1%	0.0%
Maximum Green (s)	16.0	29.0		44.0	57.0	57.0	9.0	21.0		9.0	21.0	
Yellow Time (s)	3.0	3.5		3.0	3.5	3.5	3.0	3.5		3.0	3.5	
All-Red Time (s)	0.0	2.0		0.0	2.0	2.0	0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	5.5	4.0	3.0	5.5	5.5	3.0	5.5	4.0	3.0	5.5	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min	Min	None	None		None	None	
Walk Time (s)		6.0			6.0	6.0		6.0			6.0	
Flash Dont Walk (s)		15.0			15.0	15.0		15.0			15.0	
Pedestrian Calls (#/hr)		5			5	5		5			5	
Act Effct Green (s)	41.5	26.0		61.9	43.2	43.2	23.3	13.8		27.4	20.0	
Actuated g/C Ratio	0.43	0.27		0.64	0.45	0.45	0.24	0.14		0.28	0.21	
v/c Ratio	0.75	0.80		0.85	0.80	0.32	0.16	0.74		0.54	0.66	
Control Delay	38.2	43.0		33.3	28.2	6.6	30.7	18.2		39.9	20.0	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	38.2	43.0		33.3	28.2	6.6	30.7	18.2		39.9	20.0	
LOS	D	D		C	C	A	C	B		D	B	
Approach Delay		41.8			26.5			18.8			23.3	
Approach LOS		D			C			B			C	
Queue Length 50th (m)	18.8	61.1		61.6	89.0	7.6	4.2	13.8		16.7	21.3	
Queue Length 95th (m)	#62.4	#111.1		114.1	135.8	24.0	12.2	33.3		34.8	44.5	
Internal Link Dist (m)		266.9			513.6			322.6			244.8	
Turn Bay Length (m)	60.0			120.0		50.0	60.0			60.0		
Base Capacity (vph)	368	994		793	1964	1059	232	968		219	920	
Starvation Cap Reductn	0	0		0	0	0	0	0		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	0.63	0.70		0.63	0.59	0.25	0.13	0.59		0.52	0.62	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 96.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 28.3 Intersection LOS: C
Intersection Capacity Utilization 83.5% 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: 70: Whoop Up Drive & Metis Trail W



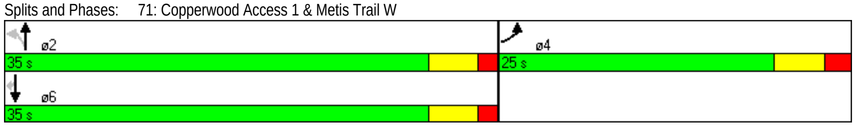
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	235	56	91	293	240	386
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)	0.0	0.0	60.0			0.0
Storage Lanes	1	0	1			1
Taper Length (m)	20.0	20.0	20.0			20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.974					0.850
Flt Protected	0.961		0.950			
Satd. Flow (prot)	1820	0	1566	1889	1889	1606
Flt Permitted	0.961		0.591			
Satd. Flow (perm)	1820	0	974	1889	1889	1606
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	21					439
Link Speed (k/h)	50			60	60	
Link Distance (m)	184.3			322.5	346.6	
Travel Time (s)	13.3			19.4	20.8	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	2%	2%	5%	5%	5%	5%
Adj. Flow (vph)	267	64	103	333	273	439
Shared Lane Traffic (%)						
Lane Group Flow (vph)	331	0	103	333	273	439
Turn Type			Perm			Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Detector Phase	4		2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0		20.0	20.0	10.0	10.0
Minimum Split (s)	23.5		25.0	25.0	21.0	21.0
Total Split (s)	25.0	0.0	35.0	35.0	35.0	35.0
Total Split (%)	41.7%	0.0%	58.3%	58.3%	58.3%	58.3%
Maximum Green (s)	19.5		30.0	30.0	30.0	30.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	2.0		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	4.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		Min	Min	Min	Min
Walk Time (s)	6.0		6.0	6.0	6.0	6.0
Flash Dont Walk (s)	12.0		10.0	10.0	10.0	10.0
Pedestrian Calls (#/hr)	5		5	5	5	5
Act Effct Green (s)	12.8		20.1	20.1	20.1	20.1
Actuated g/C Ratio	0.29		0.46	0.46	0.46	0.46
v/c Ratio	0.60		0.23	0.38	0.31	0.45
Control Delay	17.2		9.8	10.0	9.4	2.9
Queue Delay	0.0		0.0	0.0	0.0	0.0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Total Delay	17.2		9.8	10.0	9.4	2.9
LOS	B		A	B	A	A
Approach Delay	17.2			10.0	5.4	
Approach LOS	B			A	A	
Queue Length 50th (m)	19.4		4.0	14.2	11.2	0.0
Queue Length 95th (m)	35.6		13.3	34.3	27.7	11.5
Internal Link Dist (m)	160.3			298.5	322.6	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	833		676	1311	1311	1249
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.40		0.15	0.25	0.21	0.35

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 43.4
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.60
Intersection Signal Delay: 9.4 Intersection LOS: A
Intersection Capacity Utilization 61.1% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 71: Copperwood Access 1 & Metis Trail W



MOVEMENT SUMMARY

Site: Intersection 71 PM - Background

Intersection 71 AM - Background Volumes
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	103	5.0	0.537	12.1	LOS B	3.0	23.9	0.57	0.92	33.7
8	T	333	5.0	0.537	12.1	LOS B	3.0	23.9	0.57	0.69	36.4
Approach		436	5.0	0.537	12.1	LOS B	3.0	23.9	0.57	0.74	35.7
North: Metis Trail W											
4	T	273	5.0	0.737	17.1	LOS C	6.3	50.2	0.56	0.52	33.3
14	R	439	5.0	0.737	17.1	LOS C	6.3	50.2	0.56	0.57	32.8
Approach		711	5.0	0.737	17.1	LOS C	6.3	50.2	0.56	0.55	33.0
West: Copperwood Access 1 (Intersection 71)											
5	L	267	5.0	0.409	9.6	LOS A	1.8	14.4	0.50	0.77	27.6
12	R	64	5.0	0.409	9.6	LOS A	1.8	14.4	0.50	0.59	28.9
Approach		331	5.0	0.409	9.6	LOS A	1.8	14.4	0.50	0.73	27.8
All Vehicles		1478	5.0	0.737	14.0	LOS B	6.3	50.2	0.55	0.65	32.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

SIDRA INTERSECTION

10: Whoop Up Drive & 30 Street W

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	50	1	86	173	118	1	1	97	72	1	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	57	1	98	197	134	1	1	110	82	1	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	331			58			467	595	57	638	528	264
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	331			58			467	595	57	638	528	264
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			94			100	100	89	75	100	99
cM capacity (veh/h)	1212			1527			475	389	1009	328	424	775

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	6	58	98	331	112	89
Volume Left	6	0	98	0	1	82
Volume Right	0	1	0	134	110	6
cSH	1212	1700	1527	1700	982	342
Volume to Capacity	0.00	0.03	0.06	0.19	0.11	0.26
Queue Length 95th (m)	0.1	0.0	1.6	0.0	2.9	7.7
Control Delay (s)	8.0	0.0	7.5	0.0	9.1	19.2
Lane LOS	A		A		A	C
Approach Delay (s)	0.7		1.7		9.1	19.2
Approach LOS					A	C

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	35.8%	ICU Level of Service	A
Analysis Period (min)	15		

42: Coalbanks Boulevard W & Coalbanks Gate W

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	74	64	60	73	160	106
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	84	73	68	83	182	120
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	151				351	110
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	151				351	110
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				70	87
cM capacity (veh/h)	1430				609	944

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	157	151	302
Volume Left	84	0	182
Volume Right	0	83	120
cSH	1430	1700	709
Volume to Capacity	0.06	0.09	0.43
Queue Length 95th (m)	1.4	0.0	16.3
Control Delay (s)	4.3	0.0	13.8
Lane LOS	A		B
Approach Delay (s)	4.3	0.0	13.8
Approach LOS			B

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	43.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	197	27	17	38	134	116
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	224	31	19	43	152	132
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	62				519	41
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	62				519	41
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	85				66	87
cM capacity (veh/h)	1540				442	1030

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	255	62	284
Volume Left	224	0	152
Volume Right	0	43	132
cSH	1540	1700	601
Volume to Capacity	0.15	0.04	0.47
Queue Length 95th (m)	3.9	0.0	19.2
Control Delay (s)	6.9	0.0	16.2
Lane LOS	A		C
Approach Delay (s)	6.9	0.0	16.2
Approach LOS			C

Intersection Summary			
Average Delay	10.6		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix G – Post-Development Analysis Summaries

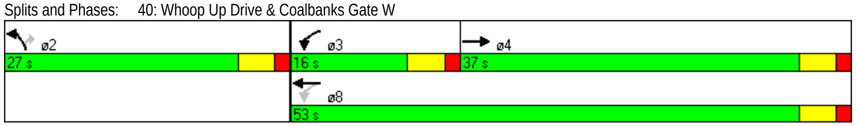
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	553	1	210	331	1	480
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)		0.0	60.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)		20.0	20.0		20.0	20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1889	0	1566	1889	1847	1653
Flt Permitted			0.129		0.950	
Satd. Flow (perm)	1889	0	213	1889	1847	1653
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						382
Link Speed (k/h)	60			60	50	
Link Distance (m)	301.2			299.7	214.8	
Travel Time (s)	18.1			18.0	15.5	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	2%	2%
Adj. Flow (vph)	628	1	239	376	1	545
Shared Lane Traffic (%)						
Lane Group Flow (vph)	629	0	239	376	1	545
Turn Type			pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	10.0
Minimum Split (s)	21.0		15.0	21.0	15.0	15.0
Total Split (s)	37.0	0.0	16.0	53.0	27.0	27.0
Total Split (%)	46.3%	0.0%	20.0%	66.3%	33.8%	33.8%
Maximum Green (s)	32.0		11.0	48.0	22.0	22.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.5		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Walk Time (s)	6.0			6.0	6.0	6.0
Flash Dont Walk (s)	10.0			10.0	10.0	10.0
Pedestrian Calls (#/hr)	5			5	5	5
Act Effct Green (s)	25.9		41.9	41.9	15.0	15.0
Actuated g/C Ratio	0.39		0.62	0.62	0.22	0.22
v/c Ratio	0.86		0.68	0.32	0.00	0.82
Control Delay	33.5		24.0	7.4	22.0	19.6
Queue Delay	0.0		0.0	0.0	0.0	0.0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Total Delay	33.5		24.0	7.4	22.0	19.6
LOS	C		C	A	C	B
Approach Delay	33.5			13.9	19.6	
Approach LOS	C			B	B	
Queue Length 50th (m)	68.9		13.2	18.5	0.1	18.4
Queue Length 95th (m)	#134.6		#49.3	39.4	m1.2	55.0
Internal Link Dist (m)	277.2			275.7	190.8	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	927		361	1390	623	811
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.68		0.66	0.27	0.00	0.67

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 67.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 22.5 Intersection LOS: C
Intersection Capacity Utilization 72.3% ICU Level of Service C
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: 40: Whoop Up Drive & Coalbanks Gate W



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	281	825	19	245	434	68	31	227	636	130	88	155
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Width (m)	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8
Storage Length (m)	60.0		0.0	120.0		50.0	60.0		50.0	60.0		0.0
Storage Lanes	2		0	2		1	1		1	1		0
Taper Length (m)	20.0		20.0	20.0		20.0	20.0		20.0	20.0		20.0
Lane Util. Factor	0.97	0.95	0.95	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95
Frt		0.997				0.850			0.850		0.904	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3038	3192	0	3038	3202	1606	1566	3202	1606	1566	2894	0
Flt Permitted	0.950			0.950			0.582			0.476		
Satd. Flow (perm)	3038	3192	0	3038	3202	1606	959	3202	1606	785	2894	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3				77			456		176	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		290.9			209.7			346.6			268.8	
Travel Time (s)		17.5			12.6			20.8			16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	319	938	22	278	493	77	35	258	723	148	100	176
Shared Lane Traffic (%)												
Lane Group Flow (vph)	319	960	0	278	493	77	35	258	723	148	276	0
Turn Type	Prot			Prot		Perm	pm+pt		Free	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6	8		Free	4		
Detector Phase	5	2		1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	20.0		5.0	20.0	20.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	26.5		12.0	26.5	26.5	12.0	26.5		12.0	26.5	
Total Split (s)	19.0	37.4	0.0	14.0	32.4	32.4	12.0	26.6	0.0	12.0	26.6	0.0
Total Split (%)	21.1%	41.6%	0.0%	15.6%	36.0%	36.0%	13.3%	29.6%	0.0%	13.3%	29.6%	0.0%
Maximum Green (s)	15.0	31.9		10.0	26.9	26.9	9.0	21.1		8.5	21.1	
Yellow Time (s)	3.0	3.5		3.0	3.5	3.5	3.0	3.5		3.5	3.5	
All-Red Time (s)	1.0	2.0		1.0	2.0	2.0	0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.5	4.0	4.0	5.5	5.5	3.0	5.5	4.0	3.5	5.5	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min	Min	None	None		None	None	
Walk Time (s)		6.0			6.0	6.0		6.0			6.0	
Flash Dont Walk (s)		15.0			15.0	15.0		15.0			15.0	
Pedestrian Calls (#/hr)		5			5	5		5			5	
Act Effct Green (s)	12.7	27.5		9.9	24.6	24.6	22.1	12.9	77.3	25.7	19.0	
Actuated g/C Ratio	0.16	0.36		0.13	0.32	0.32	0.29	0.17	1.00	0.33	0.25	
v/c Ratio	0.64	0.85		0.71	0.48	0.14	0.11	0.48	0.45	0.43	0.33	
Control Delay	37.5	31.6		46.0	24.0	6.4	18.5	33.0	0.9	23.5	11.9	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

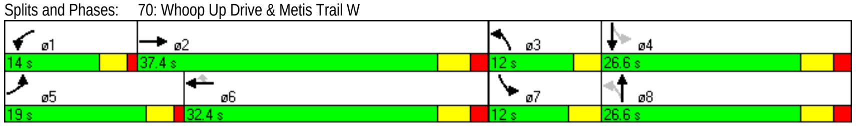
Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes AM Peak Hour
70: Whoop Up Drive & Metis Trail W 4/24/2012

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	37.5	31.6		46.0	24.0	6.4	18.5	33.0	0.9	23.5	11.9	
LOS	D	C		D	C	A	B	C	A	C	B	
Approach Delay		33.1			29.6			9.7			15.9	
Approach LOS		C			C			A			B	
Queue Length 50th (m)	22.5	64.7		20.5	29.7	0.0	3.4	18.6	0.0	15.9	6.6	
Queue Length 95th (m)	39.0	100.5		#42.8	50.3	8.9	9.2	29.6	0.0	29.6	16.4	
Internal Link Dist (m)		266.9			185.7			322.6			244.8	
Turn Bay Length (m)	60.0			120.0		50.0	60.0		50.0	60.0		
Base Capacity (vph)	596	1335		398	1128	616	376	885	1606	348	937	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.54	0.72		0.70	0.44	0.13	0.09	0.29	0.45	0.43	0.29	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 77.3
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 23.5 Intersection LOS: C
Intersection Capacity Utilization 65.0% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 70: Whoop Up Drive & Metis Trail W



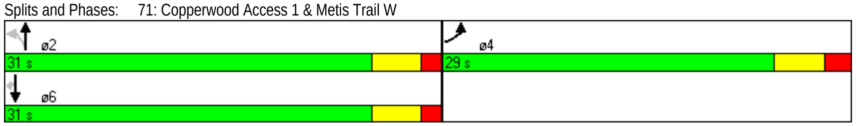
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	395	79	31	499	202	150
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)	0.0	0.0	60.0			0.0
Storage Lanes	1	0	1			1
Taper Length (m)	20.0	20.0	20.0			20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.977					0.850
Flt Protected	0.960		0.950			
Satd. Flow (prot)	1824	0	1566	1889	1889	1606
Flt Permitted	0.960		0.615			
Satd. Flow (perm)	1824	0	1014	1889	1889	1606
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	20					170
Link Speed (k/h)	50			60	60	
Link Distance (m)	184.3			322.5	346.6	
Travel Time (s)	13.3			19.4	20.8	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	2%	2%	5%	5%	5%	5%
Adj. Flow (vph)	449	90	35	567	230	170
Shared Lane Traffic (%)						
Lane Group Flow (vph)	539	0	35	567	230	170
Turn Type			Perm			Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Detector Phase	4		2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0		20.0	20.0	20.0	20.0
Minimum Split (s)	23.5		25.0	25.0	25.0	25.0
Total Split (s)	29.0	0.0	31.0	31.0	31.0	31.0
Total Split (%)	48.3%	0.0%	51.7%	51.7%	51.7%	51.7%
Maximum Green (s)	23.5		26.0	26.0	26.0	26.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	2.0		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	4.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		Min	Min	Min	Min
Walk Time (s)	6.0		6.0	6.0	6.0	6.0
Flash Dont Walk (s)	12.0		10.0	10.0	10.0	10.0
Pedestrian Calls (#/hr)	5		5	5	5	5
Act Effct Green (s)	18.6		22.3	22.3	22.3	22.3
Actuated g/C Ratio	0.36		0.43	0.43	0.43	0.43
v/c Ratio	0.80		0.08	0.69	0.28	0.21
Control Delay	25.4		10.5	18.2	11.6	2.9
Queue Delay	0.0		0.0	0.0	0.0	0.0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Total Delay	25.4		10.5	18.2	11.6	2.9
LOS	C		B	B	B	A
Approach Delay	25.4			17.8	7.9	
Approach LOS	C			B	A	
Queue Length 50th (m)	37.9		1.8	41.1	13.3	0.0
Queue Length 95th (m)	#78.6		6.3	76.2	27.4	8.1
Internal Link Dist (m)	160.3			298.5	322.6	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	857		520	969	969	907
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.63		0.07	0.59	0.24	0.19

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 51.6
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 17.9 Intersection LOS: B
Intersection Capacity Utilization 66.3% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 71: Copperwood Access 1 & Metis Trail W



MOVEMENT SUMMARY

Site: Intersection 71 AM - Upgraded

Intersection 71 AM - Upgraded
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	35	5.0	0.897	38.7	LOS E	11.4	89.9	0.96	1.33	22.5
8	T	567	5.0	0.897	38.7	LOS E	11.4	89.9	0.96	1.31	22.5
Approach		602	5.0	0.897	38.7	LOS E	11.4	89.9	0.96	1.31	22.5
North: Metis Trail W											
4	T	230	5.0	0.223	5.6	LOS A	0.9	7.0	0.14	0.39	43.9
14	R	170	5.0	0.165	5.0	LOS A	0.6	4.9	0.13	0.47	43.0
Approach		400	5.0	0.223	5.4	LOS A	0.9	7.0	0.14	0.43	43.5
West: Copperwood Access 1 (Intersection 71)											
5	L	449	5.0	0.637	14.6	LOS B	4.5	35.7	0.62	0.82	24.5
12	R	90	5.0	0.637	14.6	LOS B	4.5	35.7	0.62	0.69	24.8
Approach		539	5.0	0.637	14.6	LOS B	4.5	35.7	0.62	0.80	24.6
All Vehicles		1541	5.0	0.897	21.6	LOS C	11.4	89.9	0.63	0.90	27.0

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	79	1	68	46	51	1	1	203	127	1	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	90	1	77	52	58	1	1	231	144	1	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	110			91			315	366	90	568	338	81
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	110			91			315	366	90	568	338	81
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			100	100	76	54	100	99
cM capacity (veh/h)	1461			1485			606	531	967	316	551	979

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	6	91	77	110	233	151
Volume Left	6	0	77	0	1	144
Volume Right	0	1	0	58	231	6
cSH	1461	1700	1485	1700	961	325
Volume to Capacity	0.00	0.05	0.05	0.06	0.24	0.47
Queue Length 95th (m)	0.1	0.0	1.3	0.0	7.2	17.9
Control Delay (s)	7.5	0.0	7.6	0.0	9.9	25.4
Lane LOS	A		A		A	D
Approach Delay (s)	0.4		3.1		9.9	25.4
Approach LOS					A	D

Intersection Summary			
Average Delay	10.1		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	29	12	5	2	4	12	5	13	4	4	5	10
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	33	14	6	2	5	14	6	15	5	5	6	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	65	51	11	61	55	17	17			19		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	65	51	11	61	55	17	17			19		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	98	99	100	99	99	100			100		
cM capacity (veh/h)	909	835	1069	913	831	1062	1600			1597		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	52	20	25	22
Volume Left	33	2	6	5
Volume Right	6	14	5	11
cSH	903	983	1600	1597
Volume to Capacity	0.06	0.02	0.00	0.00
Queue Length 95th (m)	1.4	0.5	0.1	0.1
Control Delay (s)	9.2	8.7	1.7	1.5
Lane LOS	A	A	A	A
Approach Delay (s)	9.2	8.7	1.7	1.5
Approach LOS	A	A		

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	19.4%	ICU Level of Service	A
Analysis Period (min)	15		

35: Internal Collector Road & Intersection 35

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	88	5	5	37	16	5	5	5	46	5	13
Sign Control		Free			Free			Yield			Yield	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	100	6	6	42	18	6	6	6	52	6	15
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	60			106			194	186	103	185	180	51
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	60			106			194	186	103	185	180	51
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	99	99	93	99	99
cM capacity (veh/h)	1543			1486			745	703	952	762	709	1017

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	111	66	17	73
Volume Left	6	6	6	52
Volume Right	6	18	6	15
cSH	1543	1486	786	798
Volume to Capacity	0.00	0.00	0.02	0.09
Queue Length 95th (m)	0.1	0.1	0.5	2.3
Control Delay (s)	0.4	0.7	9.7	10.0
Lane LOS	A	A	A	A
Approach Delay (s)	0.4	0.7	9.7	10.0
Approach LOS			A	A

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		

42: Coalbanks Boulevard W & Coalbanks Gate W

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	125	82	26	86	75	53
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	142	93	30	98	85	60
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	127				456	78
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	127				456	78
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	90				83	94
cM capacity (veh/h)	1459				508	982

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	235	127	145
Volume Left	142	0	85
Volume Right	0	98	60
cSH	1459	1700	635
Volume to Capacity	0.10	0.07	0.23
Queue Length 95th (m)	2.5	0.0	6.7
Control Delay (s)	5.0	0.0	12.3
Lane LOS	A		B
Approach Delay (s)	5.0	0.0	12.3
Approach LOS			B

Intersection Summary			
Average Delay	5.8		
Intersection Capacity Utilization	33.6%	ICU Level of Service	A
Analysis Period (min)	15		

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes
52: Coalbanks Boulevard W & Intersection 52

AM Peak Hour
3/13/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	142	15	31	110	66	81
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	161	17	35	125	75	92
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	160				438	98
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	160				438	98
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				85	90
cM capacity (veh/h)	1419				511	958

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	178	160	167
Volume Left	161	0	75
Volume Right	0	125	92
cSH	1419	1700	688
Volume to Capacity	0.11	0.09	0.24
Queue Length 95th (m)	2.9	0.0	7.2
Control Delay (s)	7.2	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	7.2	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	37.9%	ICU Level of Service	A
Analysis Period (min)	15		

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes
55: Copperwood Access 2 & Coalbanks Boulevard W

AM Peak Hour
3/13/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	14	86	5	35	241	5
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	16	98	6	40	274	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	579	26			45	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	579	26			45	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	91			82	
cM capacity (veh/h)	394	1050			1562	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	114	45	280
Volume Left	16	0	274
Volume Right	98	40	0
cSH	851	1700	1562
Volume to Capacity	0.13	0.03	0.18
Queue Length 95th (m)	3.5	0.0	4.8
Control Delay (s)	9.9	0.0	7.7
Lane LOS	A		A
Approach Delay (s)	9.9	0.0	7.7
Approach LOS	A		

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	34.7%	ICU Level of Service	A
Analysis Period (min)	15		

MOVEMENT SUMMARY

Site: Intersection 55 AM

Intersection 55 AM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coalbanks Boulevard W											
8	T	6	2.0	0.054	3.6	LOS A	0.2	1.4	0.36	0.40	38.6
18	R	40	2.0	0.054	4.7	LOS A	0.2	1.4	0.36	0.49	37.8
Approach		45	2.0	0.054	4.5	LOS A	0.2	1.4	0.36	0.48	37.9
East: Copperwood Stage 2 Access											
1	L	16	2.0	0.103	8.8	LOS A	0.4	2.9	0.04	0.79	38.2
16	R	98	2.0	0.103	3.4	LOS A	0.4	2.9	0.04	0.34	43.6
Approach		114	2.0	0.103	4.2	LOS A	0.4	2.9	0.04	0.40	42.6
North: Coalbanks Boulevard W											
7	L	274	2.0	0.257	8.8	LOS A	1.1	8.7	0.09	0.61	34.7
4	T	6	2.0	0.257	2.4	LOS A	1.1	8.7	0.09	0.21	42.3
Approach		280	2.0	0.257	8.7	LOS A	1.1	8.7	0.09	0.60	34.8
All Vehicles		439	2.0	0.257	7.1	LOS A	1.1	8.7	0.11	0.54	37.1

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	262	14	5	5	5	111	5	30	5	58	76	95
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	298	16	6	6	6	126	6	34	6	66	86	108

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	319	138	6	40	66	194
Volume Left (vph)	298	6	6	0	66	0
Volume Right (vph)	6	126	0	6	0	108
Hadj (s)	0.21	-0.51	0.58	-0.01	0.58	-0.30
Departure Headway (s)	5.1	4.7	6.7	6.1	6.4	5.5
Degree Utilization, x	0.45	0.18	0.01	0.07	0.12	0.29
Capacity (veh/h)	675	713	490	535	532	620
Control Delay (s)	12.2	8.7	8.5	8.3	9.0	9.5
Approach Delay (s)	12.2	8.7	8.3		9.4	
Approach LOS	B	A	A		A	

Intersection Summary			
Delay	10.4		
HCM Level of Service	B		
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

MOVEMENT SUMMARY

Intersection 75 AM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	6	5.0	0.063	10.7	LOS B	0.2	1.6	0.43	0.88	38.0
8	T	34	5.0	0.063	4.3	LOS A	0.2	1.6	0.43	0.47	41.8
18	R	6	5.0	0.063	5.4	LOS A	0.2	1.6	0.43	0.57	41.3
Approach		45	5.0	0.063	5.2	LOS A	0.2	1.6	0.43	0.53	41.2
East: Simon Fraser Boulevard W											
1	L	6	5.0	0.182	10.7	LOS B	0.6	5.1	0.45	0.85	32.2
6	T	6	5.0	0.182	4.3	LOS A	0.6	5.1	0.45	0.47	35.7
16	R	126	5.0	0.182	5.3	LOS A	0.6	5.1	0.45	0.56	35.1
Approach		138	5.0	0.182	5.5	LOS A	0.6	5.1	0.45	0.57	34.9
North: Metis Trail W											
7	L	66	5.0	0.246	8.9	LOS A	1.0	8.1	0.09	0.78	38.9
4	T	86	5.0	0.246	2.5	LOS A	1.0	8.1	0.09	0.23	45.0
14	R	108	5.0	0.246	3.5	LOS A	1.0	8.1	0.09	0.35	43.7
Approach		260	5.0	0.246	4.5	LOS A	1.0	8.1	0.09	0.42	42.6
West: Copperwood Stage 2 Access											
5	L	298	5.0	0.351	9.8	LOS A	1.5	12.3	0.37	0.67	36.6
2	T	16	5.0	0.351	3.4	LOS A	1.5	12.3	0.37	0.37	40.7
12	R	6	5.0	0.351	4.5	LOS A	1.5	12.3	0.37	0.45	40.1
Approach		319	5.0	0.351	9.4	LOS A	1.5	12.3	0.37	0.65	36.8
All Vehicles		763	5.0	0.351	6.8	LOS A	1.5	12.3	0.29	0.55	38.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Intersection 12 AM

Intersection 12 AM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: 30 Street W											
3	L	6	2.0	0.153	9.0	LOS A	0.6	4.5	0.15	0.87	32.7
8	T	109	2.0	0.153	2.6	LOS A	0.6	4.5	0.15	0.27	39.6
18	R	47	2.0	0.153	3.6	LOS A	0.6	4.5	0.15	0.39	37.7
Approach		161	2.0	0.153	3.1	LOS A	0.6	4.5	0.15	0.33	38.7
East: Intersection 12											
1	L	18	2.0	0.151	9.4	LOS A	0.6	4.4	0.26	0.76	33.9
6	T	6	2.0	0.151	2.9	LOS A	0.6	4.4	0.26	0.31	39.3
16	R	124	2.0	0.151	4.0	LOS A	0.6	4.4	0.26	0.41	38.0
Approach		148	2.0	0.151	4.6	LOS A	0.6	4.4	0.26	0.45	37.4
North: 30 Street W											
7	L	36	2.0	0.079	8.9	LOS A	0.3	2.2	0.11	0.77	30.8
4	T	43	2.0	0.079	2.5	LOS A	0.3	2.2	0.11	0.23	38.8
14	R	6	2.0	0.079	3.5	LOS A	0.3	2.2	0.11	0.35	36.3
Approach		85	2.0	0.079	5.3	LOS A	0.3	2.2	0.11	0.47	34.2
West: Intersection 12											
5	L	6	2.0	0.017	9.2	LOS A	0.1	0.4	0.20	0.74	30.5
2	T	6	2.0	0.017	2.7	LOS A	0.1	0.4	0.20	0.27	36.8
12	R	6	2.0	0.017	3.8	LOS A	0.1	0.4	0.20	0.37	34.9
Approach		17	2.0	0.017	5.2	LOS A	0.1	0.4	0.20	0.46	33.5
All Vehicles		411	2.0	0.153	4.2	LOS A	0.6	4.5	0.18	0.41	37.1

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Intersection 25 AM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Intersection 25											
3	L	6	2.0	0.011	3.6	LOS A	0.0	0.3	0.16	0.67	29.8
18	R	6	2.0	0.011	3.6	LOS A	0.0	0.3	0.16	0.33	33.4
Approach		11	2.0	0.011	3.6	LOS A	0.0	0.3	0.16	0.50	31.3
East: Major Collector											
1	L	6	2.0	0.047	3.7	LOS A	0.2	1.3	0.04	0.95	35.7
6	T	47	2.0	0.047	3.7	LOS A	0.2	1.3	0.04	0.25	40.9
Approach		52	2.0	0.047	3.7	LOS A	0.2	1.3	0.04	0.32	40.2
West: Major Collector											
2	T	65	2.0	0.064	3.8	LOS A	0.2	1.7	0.04	0.25	35.9
12	R	6	2.0	0.064	3.8	LOS A	0.2	1.7	0.04	0.39	34.2
Approach		70	2.0	0.064	3.8	LOS A	0.2	1.7	0.04	0.26	35.8
All Vehicles		134	2.0	0.064	3.7	LOS A	0.2	1.7	0.05	0.31	37.6

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Intersection 45 AM

Intersection 45 AM
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Intersection 45											
3	L	6	2.0	0.019	9.6	LOS A	0.1	0.5	0.30	0.74	33.0
8	T	6	2.0	0.019	3.2	LOS A	0.1	0.5	0.30	0.33	37.7
18	R	6	2.0	0.019	4.2	LOS A	0.1	0.5	0.30	0.41	36.6
Approach		17	2.0	0.019	5.7	LOS A	0.1	0.5	0.30	0.49	35.4
East: Intersection 45											
1	L	6	2.0	0.036	9.6	LOS A	0.1	0.9	0.31	0.75	30.3
6	T	3	2.0	0.036	3.2	LOS A	0.1	0.9	0.31	0.34	34.9
16	R	24	2.0	0.036	4.3	LOS A	0.1	0.9	0.31	0.43	33.5
Approach		33	2.0	0.036	5.1	LOS A	0.1	0.9	0.31	0.48	32.9
North: Major Collector											
7	L	8	2.0	0.076	8.8	LOS A	0.3	2.1	0.07	0.79	36.9
4	T	6	2.0	0.076	2.4	LOS A	0.3	2.1	0.07	0.23	44.1
14	R	69	2.0	0.076	3.5	LOS A	0.3	2.1	0.07	0.35	42.4
Approach		83	2.0	0.076	3.9	LOS A	0.3	2.1	0.07	0.38	41.8
West: Major Collector											
5	L	190	2.0	0.181	8.8	LOS A	0.7	5.6	0.09	0.61	37.2
2	T	1	2.0	0.181	2.4	LOS A	0.7	5.6	0.09	0.21	43.9
12	R	6	2.0	0.181	3.5	LOS A	0.7	5.6	0.09	0.31	42.4
Approach		197	2.0	0.181	8.7	LOS A	0.7	5.6	0.09	0.60	37.3
All Vehicles		330	2.0	0.181	6.9	LOS A	0.7	5.6	0.12	0.53	38.0

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Intersection 54 AM

Intersection 54 AM
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coalbanks Boulevard W											
3	L	74	2.0	0.084	9.1	LOS A	0.3	2.3	0.18	0.63	34.4
8	T	7	2.0	0.084	2.6	LOS A	0.3	2.3	0.18	0.24	40.8
18	R	6	2.0	0.084	3.7	LOS A	0.3	2.3	0.18	0.34	39.3
Approach		86	2.0	0.084	8.2	LOS A	0.3	2.3	0.18	0.58	35.0
East: Intersection 54											
1	L	6	2.0	0.021	9.3	LOS A	0.1	0.5	0.24	0.74	30.5
6	T	6	2.0	0.021	2.9	LOS A	0.1	0.5	0.24	0.29	36.1
16	R	9	2.0	0.021	3.9	LOS A	0.1	0.5	0.24	0.39	34.4
Approach		20	2.0	0.021	5.1	LOS A	0.1	0.5	0.24	0.46	33.3
North: Coalbanks Boulevard W											
7	L	11	2.0	0.047	9.1	LOS A	0.2	1.2	0.19	0.77	34.6
4	T	18	2.0	0.047	2.7	LOS A	0.2	1.2	0.19	0.27	40.8
14	R	18	2.0	0.047	3.8	LOS A	0.2	1.2	0.19	0.38	39.3
Approach		48	2.0	0.047	4.6	LOS A	0.2	1.2	0.19	0.43	38.4
West: Intersection 54											
5	L	51	2.0	0.247	8.9	LOS A	1.1	8.2	0.14	0.74	36.7
2	T	6	2.0	0.247	2.5	LOS A	1.1	8.2	0.14	0.24	43.0
12	R	207	2.0	0.247	3.6	LOS A	1.1	8.2	0.14	0.35	41.6
Approach		264	2.0	0.247	4.6	LOS A	1.1	8.2	0.14	0.43	40.5
All Vehicles		418	2.0	0.247	5.4	LOS A	1.1	8.2	0.16	0.46	38.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

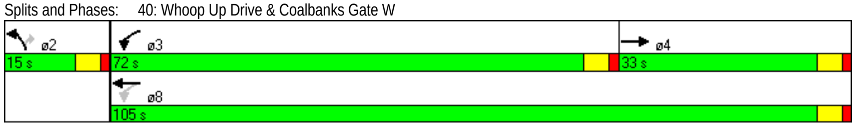
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	398	1	639	693	1	377
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)		0.0	60.0		0.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)		20.0	20.0		20.0	20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1889	0	1566	1889	1847	1653
Flt Permitted			0.145		0.950	
Satd. Flow (perm)	1889	0	239	1889	1847	1653
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						428
Link Speed (k/h)	60			60	50	
Link Distance (m)	301.2			299.7	210.6	
Travel Time (s)	18.1			18.0	15.2	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	2%	2%
Adj. Flow (vph)	452	1	726	788	1	428
Shared Lane Traffic (%)						
Lane Group Flow (vph)	453	0	726	788	1	428
Turn Type			pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	10.0
Minimum Split (s)	21.0		15.0	21.0	15.0	15.0
Total Split (s)	33.0	0.0	72.0	105.0	15.0	15.0
Total Split (%)	27.5%	0.0%	60.0%	87.5%	12.5%	12.5%
Maximum Green (s)	28.0		67.0	100.0	10.0	10.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.5		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	4.0	5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Walk Time (s)	6.0			6.0	6.0	6.0
Flash Dont Walk (s)	10.0			10.0	10.0	10.0
Pedestrian Calls (#/hr)	5			5	5	5
Act Effct Green (s)	28.7		79.1	79.1	11.2	11.2
Actuated g/C Ratio	0.29		0.79	0.79	0.11	0.11
v/c Ratio	0.84		0.92	0.53	0.00	0.76
Control Delay	52.1		37.3	5.4	46.0	14.0
Queue Delay	0.0		0.0	0.0	0.0	0.0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Total Delay	52.1		37.3	5.4	46.0	14.0
LOS	D		D	A	D	B
Approach Delay	52.1			20.7	14.1	
Approach LOS	D			C	B	
Queue Length 50th (m)	80.4		103.4	40.2	0.2	1.0
Queue Length 95th (m)	#182.0		170.3	74.5	m1.8	27.5
Internal Link Dist (m)	277.2			275.7	186.6	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	539		1097	1781	206	564
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.84		0.66	0.44	0.00	0.76

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 100.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 25.4 Intersection LOS: C
Intersection Capacity Utilization 82.1% 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: 40: Whoop Up Drive & Coalbanks Gate W



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	228	647	36	710	1130	235	35	188	527	100	254	388
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Width (m)	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8	3.5	3.7	4.8
Storage Length (m)	60.0		0.0	120.0		50.0	60.0		50.0	60.0		0.0
Storage Lanes	2		0	2		1	1		1	1		0
Taper Length (m)	20.0		20.0	20.0		20.0	20.0		20.0	20.0		20.0
Lane Util. Factor	0.97	0.95	0.95	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95
Frt		0.992				0.850			0.850		0.909	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3038	3176	0	3038	3202	1606	1566	3202	1606	1566	2910	0
Flt Permitted	0.950			0.950			0.220			0.519		
Satd. Flow (perm)	3038	3176	0	3038	3202	1606	363	3202	1606	855	2910	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				165			579		286	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		290.9			206.2			346.6			268.8	
Travel Time (s)		17.5			12.4			20.8			16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Adj. Flow (vph)	259	735	41	807	1284	267	40	214	599	114	289	441
Shared Lane Traffic (%)												
Lane Group Flow (vph)	259	776	0	807	1284	267	40	214	599	114	730	0
Turn Type	Prot			Prot		Perm	pm+pt		Free	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6	8		Free	4		
Detector Phase	5	2		1	6	6	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	20.0		5.0	20.0	20.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	26.5		12.0	26.5	26.5	12.0	26.5		12.0	26.5	
Total Split (s)	20.0	40.0	0.0	40.0	60.0	60.0	12.0	28.0	0.0	12.0	28.0	0.0
Total Split (%)	16.7%	33.3%	0.0%	33.3%	50.0%	50.0%	10.0%	23.3%	0.0%	10.0%	23.3%	0.0%
Maximum Green (s)	16.0	34.5		36.0	54.5	54.5	9.0	22.5		9.0	22.5	
Yellow Time (s)	3.0	3.5		3.0	3.5	3.5	3.0	3.5		3.0	3.5	
All-Red Time (s)	1.0	2.0		1.0	2.0	2.0	0.0	2.0		0.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.5	4.0	4.0	5.5	5.5	3.0	5.5	4.0	3.0	5.5	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min	Min	None	None		None	None	
Walk Time (s)		6.0			6.0	6.0		6.0			6.0	
Flash Dont Walk (s)		15.0			15.0	15.0		15.0			15.0	
Pedestrian Calls (#/hr)		5			5	5		5			5	
Act Effct Green (s)	13.7	29.9		31.8	47.9	47.9	26.7	16.8	105.7	29.9	22.6	
Actuated g/C Ratio	0.13	0.28		0.30	0.45	0.45	0.25	0.16	1.00	0.28	0.21	
v/c Ratio	0.66	0.86		0.88	0.88	0.33	0.23	0.42	0.37	0.38	0.86	
Control Delay	54.7	47.7		48.9	35.6	8.8	32.7	44.1	0.7	34.5	37.6	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	54.7	47.7		48.9	35.6	8.8	32.7	44.1	0.7	34.5	37.6	
LOS	D	D		D	D	A	C	D	A	C	D	
Approach Delay		49.5			37.1			13.1			37.2	
Approach LOS		D			D			B			D	
Queue Length 50th (m)	29.7	88.3		90.6	136.3	13.2	6.6	23.1	0.0	19.8	56.3	
Queue Length 95th (m)	43.0	111.0		#121.0	167.4	29.6	14.6	34.1	0.0	34.1	#89.7	
Internal Link Dist (m)		266.9			182.2			322.6			244.8	
Turn Bay Length (m)	60.0			120.0		50.0	60.0		50.0	60.0		
Base Capacity (vph)	474	1072		1066	1702	931	204	702	1606	305	863	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.55	0.72		0.76	0.75	0.29	0.20	0.30	0.37	0.37	0.85	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 105.7
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 35.6 Intersection LOS: D
Intersection Capacity Utilization 83.8% 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: 70: Whoop Up Drive & Metis Trail W

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	278	58	95	472	540	460
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Width (m)	4.8	4.8	3.5	4.8	4.8	4.8
Storage Length (m)	0.0	0.0	60.0			0.0
Storage Lanes	1	0	1			1
Taper Length (m)	20.0	20.0	20.0			20.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.977					0.850
Flt Protected	0.960		0.950			
Satd. Flow (prot)	1824	0	1566	1889	1889	1606
Flt Permitted	0.960		0.287			
Satd. Flow (perm)	1824	0	473	1889	1889	1606
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	19					523
Link Speed (k/h)	50			60	60	
Link Distance (m)	184.3			322.5	346.6	
Travel Time (s)	13.3			19.4	20.8	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	2%	2%	5%	5%	5%	5%
Adj. Flow (vph)	316	66	108	536	614	523
Shared Lane Traffic (%)						
Lane Group Flow (vph)	382	0	108	536	614	523
Turn Type			Perm			Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Detector Phase	4		2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0		20.0	20.0	10.0	10.0
Minimum Split (s)	23.5		25.0	25.0	21.0	21.0
Total Split (s)	25.0	0.0	35.0	35.0	35.0	35.0
Total Split (%)	41.7%	0.0%	58.3%	58.3%	58.3%	58.3%
Maximum Green (s)	19.5		30.0	30.0	30.0	30.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	2.0		1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	4.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		Min	Min	Min	Min
Walk Time (s)	6.0		6.0	6.0	6.0	6.0
Flash Dont Walk (s)	12.0		10.0	10.0	10.0	10.0
Pedestrian Calls (#/hr)	5		5	5	5	5
Act Effct Green (s)	14.5		23.7	23.7	23.7	23.7
Actuated g/C Ratio	0.30		0.48	0.48	0.48	0.48
v/c Ratio	0.69		0.47	0.59	0.67	0.50
Control Delay	22.2		17.8	12.8	14.7	2.9
Queue Delay	0.0		0.0	0.0	0.0	0.0

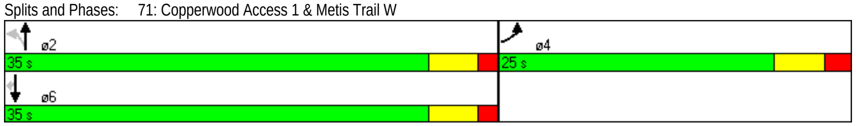
Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes PM Peak Hour
71: Copperwood Access 1 & Metis Trail W 3/13/2012

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Total Delay	22.2		17.8	12.8	14.7	2.9
LOS	C		B	B	B	A
Approach Delay	22.2			13.7	9.2	
Approach LOS	C			B	A	
Queue Length 50th (m)	24.8		5.6	29.7	36.1	0.0
Queue Length 95th (m)	55.9		19.3	60.4	73.2	11.2
Internal Link Dist (m)	160.3			298.5	322.6	
Turn Bay Length (m)			60.0			
Base Capacity (vph)	757		297	1188	1188	1204
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.50		0.36	0.45	0.52	0.43

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 48.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 12.9 Intersection LOS: B
Intersection Capacity Utilization 81.0% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 71: Copperwood Access 1 & Metis Trail W



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MOVEMENT SUMMARY

Site: Intersection 71 PM - Upgraded

Intersection 71 AM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	108	5.0	0.835	27.7	LOS D	9.6	76.1	0.88	1.15	26.2
8	T	536	5.0	0.835	27.7	LOS D	9.6	76.1	0.88	1.09	26.7
Approach		644	5.0	0.835	27.7	LOS D	9.6	76.1	0.88	1.10	26.6
North: Metis Trail W											
4	T	614	5.0	0.643	13.5	LOS B	4.5	35.3	0.47	0.51	36.2
14	R	523	5.0	0.547	11.0	LOS B	3.2	25.5	0.40	0.55	37.1
Approach		1136	5.0	0.643	12.3	LOS B	4.5	35.3	0.44	0.53	36.6
West: Copperwood Access 1 (Intersection 71)											
5	L	316	5.0	0.676	22.0	LOS C	4.2	33.0	0.77	1.07	21.1
12	R	66	5.0	0.676	22.0	LOS C	4.2	33.0	0.77	0.99	20.6
Approach		382	5.0	0.676	22.0	LOS C	4.2	33.0	0.77	1.06	21.0
All Vehicles		2163	5.0	0.835	18.6	LOS C	9.6	76.1	0.63	0.79	30.2

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

SIDRA INTERSECTION

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes — PM Peak Hour
10: Whoop Up Drive & 30 Street W

3/13/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	50	1	196	173	118	1	1	164	72	1	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	6	57	1	223	197	134	1	1	186	82	1	6
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	331			58			717	845	57	964	778	264
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	331			58			717	845	57	964	778	264
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			85			100	100	82	52	100	99
cM capacity (veh/h)	1212			1527			302	255	1009	169	278	775

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	6	58	223	331	189	89
Volume Left	6	0	223	0	1	82
Volume Right	0	1	0	134	186	6
cSH	1212	1700	1527	1700	978	179
Volume to Capacity	0.00	0.03	0.15	0.19	0.19	0.50
Queue Length 95th (m)	0.1	0.0	3.9	0.0	5.4	18.5
Control Delay (s)	8.0	0.0	7.8	0.0	9.6	43.5
Lane LOS	A		A		A	E
Approach Delay (s)	0.7		3.1		9.6	43.5
Approach LOS					A	E

Intersection Summary			
Average Delay	8.3		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes — PM Peak Hour
33: Intersection 33 &

3/13/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	19	8	5	7	12	8	5	8	3	13	15	33
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	22	9	6	8	14	9	6	9	3	15	17	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	103	89	36	98	106	11	55			12		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	103	89	36	98	106	11	55			12		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	99	99	99	98	99	100			99		
cM capacity (veh/h)	849	791	1037	863	774	1070	1551			1606		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	36	31	18	69
Volume Left	22	8	6	15
Volume Right	6	9	3	38
cSH	858	868	1551	1606
Volume to Capacity	0.04	0.04	0.00	0.01
Queue Length 95th (m)	1.0	0.8	0.1	0.2
Control Delay (s)	9.4	9.3	2.3	1.6
Lane LOS	A	A	A	A
Approach Delay (s)	9.4	9.3	2.3	1.6
Approach LOS	A	A		

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	15.2%	ICU Level of Service	A
Analysis Period (min)	15		

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes — PM Peak Hour
35: Internal Collector Road & Intersection 35
3/13/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	15	62	5	5	99	52	5	5	5	29	5	9
Sign Control		Free			Free			Yield			Yield	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	17	70	6	6	112	59	6	6	6	33	6	10
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	172			76			274	290	73	269	264	142
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	172			76			274	290	73	269	264	142
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	95	99	99
cM capacity (veh/h)	1405			1523			658	610	989	666	631	906

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	93	177	17	49
Volume Left	17	6	6	33
Volume Right	6	59	6	10
cSH	1405	1523	720	701
Volume to Capacity	0.01	0.00	0.02	0.07
Queue Length 95th (m)	0.3	0.1	0.6	1.7
Control Delay (s)	1.5	0.3	10.1	10.5
Lane LOS	A	A	B	B
Approach Delay (s)	1.5	0.3	10.1	10.5
Approach LOS			B	B

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	23.3%	ICU Level of Service	A
Analysis Period (min)	15		

Copperwood Stage 2 Outline Plan - Ten Year Post-Development Volumes — PM Peak Hour
42: Coalbanks Boulevard W & Coalbanks Gate W
3/13/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	99	73	75	80	173	148
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	112	83	85	91	197	168
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	176				439	131
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	176				439	131
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				63	82
cM capacity (veh/h)	1400				529	919

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	195	176	365
Volume Left	112	0	197
Volume Right	0	91	168
cSH	1400	1700	658
Volume to Capacity	0.08	0.10	0.55
Queue Length 95th (m)	2.0	0.0	26.0
Control Delay (s)	4.8	0.0	17.1
Lane LOS	A		C
Approach Delay (s)	4.8	0.0	17.1
Approach LOS			C

Intersection Summary			
Average Delay	9.7		
Intersection Capacity Utilization	50.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	206	40	24	74	198	131
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	234	45	27	84	225	149
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	111				583	69
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	111				583	69
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	84				44	85
cM capacity (veh/h)	1478				399	994

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	280	111	374
Volume Left	234	0	225
Volume Right	0	84	149
cSH	1478	1700	524
Volume to Capacity	0.16	0.07	0.71
Queue Length 95th (m)	4.3	0.0	43.4
Control Delay (s)	6.8	0.0	27.1
Lane LOS	A		D
Approach Delay (s)	6.8	0.0	27.1
Approach LOS			D

Intersection Summary			
Average Delay	15.8		
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	37	273	5	23	156	5
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	42	310	6	26	177	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	379	19			32	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	379	19			32	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	71			89	
cM capacity (veh/h)	553	1060			1580	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	352	32	183
Volume Left	42	0	177
Volume Right	310	26	0
cSH	955	1700	1580
Volume to Capacity	0.37	0.02	0.11
Queue Length 95th (m)	13.0	0.0	2.9
Control Delay (s)	11.0	0.0	7.4
Lane LOS	B		A
Approach Delay (s)	11.0	0.0	7.4
Approach LOS	B		

Intersection Summary			
Average Delay	9.2		
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		

MOVEMENT SUMMARY

Intersection 55 PM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coalbanks Boulevard W											
8	T	6	2.0	0.034	3.1	LOS A	0.1	0.9	0.28	0.33	39.7
18	R	26	2.0	0.034	4.2	LOS A	0.1	0.9	0.28	0.42	38.6
Approach		32	2.0	0.034	4.0	LOS A	0.1	0.9	0.28	0.41	38.8
East: Copperwood Stage 2 Access											
1	L	42	2.0	0.320	8.8	LOS A	1.5	11.9	0.05	0.78	38.1
16	R	310	2.0	0.320	3.4	LOS A	1.5	11.9	0.05	0.34	43.5
Approach		352	2.0	0.320	4.1	LOS A	1.5	11.9	0.05	0.40	42.7
North: Coalbanks Boulevard W											
7	L	177	2.0	0.173	9.0	LOS A	0.7	5.2	0.15	0.61	34.4
4	T	6	2.0	0.173	2.5	LOS A	0.7	5.2	0.15	0.23	41.2
Approach		183	2.0	0.173	8.8	LOS A	0.7	5.2	0.15	0.60	34.6
All Vehicles		567	2.0	0.320	5.6	LOS A	1.5	11.9	0.10	0.46	39.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	170	9	5	5	16	142	5	91	5	121	56	295
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	193	10	6	6	18	161	6	103	6	138	64	335

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	209	185	6	109	138	399
Volume Left (vph)	193	6	6	0	138	0
Volume Right (vph)	6	161	0	6	0	335
Hadj (s)	0.20	-0.48	0.58	0.05	0.58	-0.50
Departure Headway (s)	6.0	5.4	7.0	6.5	6.5	5.4
Degree Utilization, x	0.35	0.28	0.01	0.20	0.25	0.59
Capacity (veh/h)	554	603	467	503	535	651
Control Delay (s)	12.2	10.5	8.9	9.9	10.4	14.7
Approach Delay (s)	12.2	10.5	9.8		13.6	
Approach LOS	B	B	A		B	

Intersection Summary			
Delay	12.4		
HCM Level of Service	B		
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		

MOVEMENT SUMMARY

Site: Intersection 75 PM

Intersection 75 PM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Metis Trail W											
3	L	6	5.0	0.153	10.7	LOS B	0.5	4.2	0.44	0.93	38.2
8	T	103	5.0	0.153	4.2	LOS A	0.5	4.2	0.44	0.47	41.9
18	R	6	5.0	0.153	5.3	LOS A	0.5	4.2	0.44	0.57	41.5
Approach		115	5.0	0.153	4.6	LOS A	0.5	4.2	0.44	0.50	41.7
East: Simon Fraser Boulevard W											
1	L	6	5.0	0.237	10.6	LOS B	0.9	7.0	0.44	0.85	32.4
6	T	18	5.0	0.237	4.1	LOS A	0.9	7.0	0.44	0.45	35.8
16	R	161	5.0	0.237	5.2	LOS A	0.9	7.0	0.44	0.55	35.1
Approach		185	5.0	0.237	5.3	LOS A	0.9	7.0	0.44	0.55	35.1
North: Metis Trail W											
7	L	138	5.0	0.515	9.1	LOS A	3.1	24.8	0.19	0.72	38.6
4	T	64	5.0	0.515	2.6	LOS A	3.1	24.8	0.19	0.25	43.8
14	R	335	5.0	0.515	3.7	LOS A	3.1	24.8	0.19	0.35	42.8
Approach		536	5.0	0.515	4.9	LOS A	3.1	24.8	0.19	0.44	41.6
West: Copperwood Stage 2 Access											
5	L	193	5.0	0.242	10.0	LOS B	0.9	7.4	0.37	0.69	36.6
2	T	10	5.0	0.242	3.6	LOS A	0.9	7.4	0.37	0.38	40.6
12	R	6	5.0	0.242	4.6	LOS A	0.9	7.4	0.37	0.47	40.0
Approach		209	5.0	0.242	9.5	LOS A	0.9	7.4	0.37	0.67	36.8
All Vehicles		1045	5.0	0.515	5.9	LOS A	3.1	24.8	0.30	0.51	39.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Intersection 12 PM

Intersection 12 PM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: 30 Street W											
3	L	6	2.0	0.111	9.3	LOS A	0.4	3.1	0.25	0.85	32.6
8	T	73	2.0	0.111	2.9	LOS A	0.4	3.1	0.25	0.32	38.1
18	R	31	2.0	0.111	4.0	LOS A	0.4	3.1	0.25	0.43	36.6
Approach		109	2.0	0.111	3.5	LOS A	0.4	3.1	0.25	0.38	37.3
East: Intersection 12											
1	L	50	2.0	0.169	9.2	LOS A	0.7	5.1	0.22	0.72	33.9
6	T	6	2.0	0.169	2.8	LOS A	0.7	5.1	0.22	0.28	39.8
16	R	116	2.0	0.169	3.8	LOS A	0.7	5.1	0.22	0.38	38.4
Approach		172	2.0	0.169	5.3	LOS A	0.7	5.1	0.22	0.48	36.8
North: 30 Street W											
7	L	107	2.0	0.222	9.1	LOS A	0.9	7.1	0.19	0.75	30.5
4	T	118	2.0	0.222	2.7	LOS A	0.9	7.1	0.19	0.27	37.0
14	R	6	2.0	0.222	3.7	LOS A	0.9	7.1	0.19	0.37	35.0
Approach		231	2.0	0.222	5.7	LOS A	0.9	7.1	0.19	0.49	33.2
West: Intersection 12											
5	L	6	2.0	0.020	10.0	LOS A	0.1	0.5	0.35	0.75	30.0
2	T	6	2.0	0.020	3.6	LOS A	0.1	0.5	0.35	0.37	34.0
12	R	6	2.0	0.020	4.6	LOS A	0.1	0.5	0.35	0.45	32.9
Approach		17	2.0	0.020	6.0	LOS A	0.1	0.5	0.35	0.53	32.0
All Vehicles		528	2.0	0.222	5.1	LOS A	0.9	7.1	0.22	0.46	35.2

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Intersection 25 PM
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Intersection 25											
3	L	6	2.0	0.011	3.7	LOS A	0.0	0.3	0.20	0.67	29.7
18	R	6	2.0	0.011	3.7	LOS A	0.0	0.3	0.20	0.35	33.1
Approach		11	2.0	0.011	3.7	LOS A	0.0	0.3	0.20	0.51	31.1
East: Major Collector											
1	L	6	2.0	0.060	3.8	LOS A	0.2	1.6	0.04	0.96	35.6
6	T	60	2.0	0.060	3.8	LOS A	0.2	1.6	0.04	0.25	40.8
Approach		66	2.0	0.060	3.8	LOS A	0.2	1.6	0.04	0.31	40.2
West: Major Collector											
2	T	101	2.0	0.097	4.1	LOS A	0.4	2.7	0.04	0.25	35.4
12	R	6	2.0	0.097	4.1	LOS A	0.4	2.7	0.04	0.39	33.7
Approach		107	2.0	0.097	4.1	LOS A	0.4	2.7	0.04	0.26	35.3
All Vehicles		184	2.0	0.097	4.0	LOS A	0.4	2.7	0.05	0.29	37.3

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
HCM Delay Model used.

MOVEMENT SUMMARY

Site: Intersection 45 PM

Intersection 45 PM
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Intersection 45											
3	L	6	2.0	0.018	9.4	LOS A	0.1	0.5	0.26	0.74	33.1
8	T	6	2.0	0.018	3.0	LOS A	0.1	0.5	0.26	0.30	38.4
18	R	6	2.0	0.018	4.0	LOS A	0.1	0.5	0.26	0.39	37.0
Approach		17	2.0	0.018	5.5	LOS A	0.1	0.5	0.26	0.48	35.8
East: Intersection 45											
1	L	6	2.0	0.024	9.3	LOS A	0.1	0.6	0.24	0.73	30.4
6	T	2	2.0	0.024	2.9	LOS A	0.1	0.6	0.24	0.29	35.9
16	R	15	2.0	0.024	4.0	LOS A	0.1	0.6	0.24	0.38	34.3
Approach		23	2.0	0.024	5.2	LOS A	0.1	0.6	0.24	0.46	33.1
North: Major Collector											
7	L	27	2.0	0.226	8.8	LOS A	1.0	7.4	0.08	0.78	36.9
4	T	6	2.0	0.226	2.4	LOS A	1.0	7.4	0.08	0.23	44.0
14	R	214	2.0	0.226	3.5	LOS A	1.0	7.4	0.08	0.35	42.3
Approach		247	2.0	0.226	4.0	LOS A	1.0	7.4	0.08	0.39	41.6
West: Major Collector											
5	L	124	2.0	0.125	8.9	LOS A	0.5	3.6	0.13	0.62	37.0
2	T	3	2.0	0.125	2.5	LOS A	0.5	3.6	0.13	0.22	43.4
12	R	6	2.0	0.125	3.6	LOS A	0.5	3.6	0.13	0.32	42.0
Approach		133	2.0	0.125	8.5	LOS A	0.5	3.6	0.13	0.59	37.3
All Vehicles		419	2.0	0.226	5.6	LOS A	1.0	7.4	0.11	0.46	39.4

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Intersection 54 PM
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coalbanks Boulevard W											
3	L	234	2.0	0.249	9.0	LOS A	1.1	8.2	0.18	0.63	34.3
8	T	22	2.0	0.249	2.6	LOS A	1.1	8.2	0.18	0.24	40.7
18	R	6	2.0	0.249	3.7	LOS A	1.1	8.2	0.18	0.34	39.2
Approach		261	2.0	0.249	8.4	LOS A	1.1	8.2	0.18	0.59	34.8
East: Intersection 54											
1	L	6	2.0	0.032	10.1	LOS B	0.1	0.8	0.37	0.77	30.0
6	T	6	2.0	0.032	3.6	LOS A	0.1	0.8	0.37	0.39	33.8
16	R	15	2.0	0.032	4.7	LOS A	0.1	0.8	0.37	0.47	32.8
Approach		26	2.0	0.032	5.6	LOS A	0.1	0.8	0.37	0.52	32.2
North: Coalbanks Boulevard W											
7	L	14	2.0	0.096	10.0	LOS A	0.3	2.6	0.36	0.79	34.1
4	T	11	2.0	0.096	3.5	LOS A	0.3	2.6	0.36	0.39	38.3
14	R	58	2.0	0.096	4.6	LOS A	0.3	2.6	0.36	0.48	37.4
Approach		83	2.0	0.096	5.3	LOS A	0.3	2.6	0.36	0.52	36.9
West: Intersection 54											
5	L	33	2.0	0.161	8.9	LOS A	0.6	4.8	0.12	0.75	36.8
2	T	6	2.0	0.161	2.5	LOS A	0.6	4.8	0.12	0.24	43.4
12	R	134	2.0	0.161	3.5	LOS A	0.6	4.8	0.12	0.35	41.9
Approach		173	2.0	0.161	4.5	LOS A	0.6	4.8	0.12	0.42	40.7
All Vehicles		543	2.0	0.249	6.6	LOS A	1.1	8.2	0.20	0.52	36.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Sign Control.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: US HCM 2010.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

Copperwood
Daytona Urban Development Corp.

APPENDIX C

Geotechnical Evaluation

Stantec Consulting Ltd.

ISSUED FOR USE

GEOTECHNICAL EVALUATION – DESKTOP STUDY
COPPERWOOD COMMUNITY
LETHBRIDGE, ALBERTA

L12101425

February 2009

EBA Engineering Consultants Ltd.
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1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation, comprising a desktop study, conducted by EBA Engineering Consultants Ltd. (EBA) for the Copperwood Community development, to be located in West Lethbridge, Alberta.

The scope of work for the geotechnical evaluation was described in a proposal issued to Mr. Trent Purvis, P.Eng, of Stantec Consulting Ltd. (Stantec) on July 25, 2008. The objective of this evaluation was to determine the general subsurface conditions in the area of the proposed development (from a desktop study of existing data) and to provide general recommendations for the geotechnical aspects of design and construction for the residential subdivision development.

This document is intended to be suitable for review at the Outline Plan/Master Plan stage of planning. Authorization to proceed with the evaluation was provided by Mr. Purvis on behalf of Daytona Land Corporation (Daytona).

EBA has also completed an environmental site assessment for this development which will be reported under separate cover. Environmental issues are not discussed in this geotechnical report.

2.0 PROJECT DETAILS AND SCOPE OF WORK

Based on information provided by Stantec, it is understood that an outline plan is required for two, 80 acre parcels of land located south of the existing Copperwood community. The major components of this development will include single family and multifamily residential housing and park areas across most of the property limits, including a stormwater management facility. The foundation system for the housing will likely be shallow spread footings and a grade supported lower level floor slab, typical of other residential developments in the area.

The proposed street developments will be designed and constructed to City of Lethbridge Infrastructure Services Engineering Standards. The majority of the roadways may consist of designated 'local' pavement structures, with some arterial or collector pavement structures, as required. A detailed pavement design for the respective street sections has not been requested as part of this evaluation, but may be completed at a later date.

Previous geotechnical evaluations completed by EBA in the vicinity of the project site include the "Sunridge Subdivision Project, Phases 1-3)" (EBA File 0404-4400681) completed in 2004, the "Sunridge Phase B Development" (EBA File L12101358) completed in 2008 (to the south of these lands) as well as the Benton Drive Preliminary Roadway Design in 2008 (EBA File L12101004) (to the east and northeast).

The agreed work scope for this evaluation consisted of a desktop study of the existing geotechnical information and provision of general geotechnical recommendations for development consideration, suitable for the Outline Plan/Master Plan Stage.

3.0 SUBSURFACE CONDITIONS

3.1 SURFACE FEATURES

Figure 1 presents the plan area of the proposed Copperwood community and location within West Lethbridge. The land to be developed is bounded on the south by undeveloped lands, on the west by 30 Street West, on the north by the existing Copperwood Subdivision and by Whoop Up Drive West. To the east is the Benton Drive right-of-way as well as Phase "B" of the Sunridge Subdivision. The legal land descriptions include NW ¼, Section 22-8-22-W4M and NE ¼ Section 22-8-22-W4M.

The property was noted to be undeveloped at the time of fieldwork. The ground surface was noted to be undulating, with site drainage generally towards low-lying areas.

3.2 HISTORICAL AERIAL PHOTOGRAPHIC REVIEW

Based on EBA's knowledge of this property's history, including an air photo review from the 1950s to the present day, it has been utilized solely for agricultural purposes and has generally not been developed. The exception includes a number of natural gas pipelines which abut the property. Additional commentary on these pipelines is provided in EBA's ESA report. It is understood that setback distances from pipelines will be included in the subdivision planning. However, these are not discussed further in this geotechnical report.

Within some areas of the property, historical air photos indicate a number of low lying areas, in some cases, evident as seasonal sloughs. These areas were evident as sloughs/depressions in older air photos. In some air photos taken in wet seasons, the low lying areas contain ponded surface water.

3.3 GENERAL SOIL CONDITIONS

The subsurface stratigraphy for the proposed development site is expected to be somewhat variable for the surficial soils, however, relatively consistent at lower depths (below 2 m). The site in general should consist of layers of topsoil, underlain by native lacustrine clay and silt, with predominantly glacial clay till at underlying depths below ground surface elevation.

The topsoil thickness should be expected to be variable, between 100 mm to 300 mm in thickness. It is important to note that based on the proposed stripping methodology (i.e. equipment usage) the thickness of stripping may vary. Isolated areas of increased organic thickness and wetter surface conditions should be expected in low lying areas of the site noted above.

Based on borehole information in this area (from previous evaluations), layers of native lacustrine clay are expected underlying the topsoil, with typical layer thicknesses varying between 1 m and 3 m.

The native lacustrine clay is typically silty, with some sand to sandy, varying between damp to very moist, low to medium plastic, with some high plastic inclusions, varying between firm to very stiff in consistency and light brown coloured. The clay soil typically varies between somewhat dry to wet of its optimum moisture content (OMC). The lacustrine layer often grades into native lacustrine silt, which is typically sandy with a trace of clay, damp to moist, low plastic, stiff to very stiff in consistency, and light brown coloured, with occasional thin sand lenses. Moisture contents within the near surface lacustrine soils typically vary between approximately 10 and 22%, with isolated wetter or drier areas. The above noted low lying areas are expected to have wetter surficial soil conditions.

Underlying the near surface soil layers, glacial clay till is generally expected, extending to depths exceeding 9 m. The clay till is typically silty, with some sand to sandy, a trace of gravel, moist, medium plastic and varying between stiff to hard in consistency. The clay till also typically contains traces of fine coal fragments, zones of higher plastic inclusions, as well as occasional thin sand and silt lenses. Moisture contents within the clay till typically vary between 15 and 20%, with isolated wetter or drier zones. The clay till soil in this area is typically close to or several percent wet of its optimum moisture content.

Based on previous experience in this area, Standard Proctor maximum dry density values within the clay till typically range between approximately 1750 to 1850 kg/m^3, at optimum moisture contents of 15 to 18%. In addition, the results of laboratory hydraulic conductivity testing in this area of Lethbridge have resulted in measured state permeability (K) values in the order of approximately 1.0E-08 cm/sec.

The groundwater levels in this area typically vary between approximately 2 m to 7 m below ground surface. For geotechnical reporting purposes, based on the groundwater data obtained from previous evaluations, significant groundwater problems are not expected for the majority of excavations expected for this development and relatively minimal dewatering should generally be necessary in isolated areas. The above noted groundwater levels are considered to be localized water, which is perched or trapped within zones of sandy material within the clay till soil.

3.4 MINING ACTIVITY

Research was conducted to review the possible existence of mine workings within the boundary of the proposed development area, using a publication by ERCB (Coal Mine Atlas, 1988) and other literature in EBA's library. The review indicated that no mine workings exist within the development limits.

4.0 GENERAL CONSIDERATIONS

4.1 GENERAL SUBDIVISION DEVELOPMENT

Pending completion of a detailed geotechnical evaluation for this development, all construction recommendations presented in this summary report for consideration are based on the assumption that an adequate level of monitoring will be provided during construction and that all construction will be carried out by a suitably qualified Contractor, experienced in earthworks construction. An adequate level of monitoring for earthworks construction is considered to be full-time monitoring, compaction testing and complimentary laboratory materials analyses.

The initial topsoil stripping depth should be considered as being of particular importance. In this area, the surficial topsoil (A Horizon) layer is somewhat variable in thickness and can be attributed to cultivation of the land surface. However, for such a development, the majority of any underlying B Horizon layer (organic stained, but inorganic) can likely remain in place during site stripping and incorporated into the fill mass during general site grading. Full-time monitoring by experienced personnel is recommended in order to avoid over-stripping and to ensure appropriate material mixing and placement.

Subgrade preparation is required in all subdivision development areas, including lot grading as well as all paved areas to City of Lethbridge Standards. This includes stripping of topsoil and deleterious soil, debris, or fill materials, scarification and moisture conditioning and compaction. The native medium plastic clay and clay till soils should be acceptable for site grading purposes in all areas. The near surface clay soil appears to be variable across the site and moisture conditioning will be required to reduce the swelling potential of this soil and to achieve the compaction standards recommended. Proof-rolling within roadways to detect soft areas is also recommended.

Isolated wet areas should be expected, as discussed. These areas commonly have increased organic thickness as well as soft subgrade conditions. Special review of wet organic areas will be required and all organic topsoil must be removed from these areas. These areas should be identified during a more detailed geotechnical evaluation. All organics, wet and soft soils and debris must be removed from these areas during site grading. These areas should then be infilled with general engineered fill.

The clay till soil should be suitable for compacted clay liner materials, as discussed in subsequent sections of this report. The clay soils may also be suitable, pending laboratory analysis of this soil type, however, lacustrine soils, particularly very silty clay or silt, in local experience should best be used in areas outside the containment area.

The construction methodology for installation of the utility services is anticipated to be open trench excavation. It is considered possible that trenchless technology may be given consideration for crossings at critical locations. As excavation proceeds, following stripping, the excavated soil will generally be comprised of a mixture of clay, silt, and clay till soils. Generally, variable soil moisture conditions should be expected in all areas, varying between dry of optimum and wet of optimum (sometimes significantly so).

Materials separation and treatment for approved backfill soils are discussed in the subsequent sections of this report. Moisture conditioning of all soil materials to closer to optimum moisture content should be expected by the contractor. Waste or unusable materials should be wasted off site, dried to more suitable moisture, or replaced with better quality trench backfill materials.

4.2 LOT GRADING

In general terms, the lot grading should be designed and carried out to the current City of Lethbridge Infrastructure Services Engineering Standards. All lots should be initially graded for drainage at a minimum gradient of 2%. The existing surficial site soils comprising medium plastic clay and clay till are suitable for use as 'landscape fill' materials or for use as 'general engineered fill' materials for lot grading.

Deleterious materials encountered should be removed from the site. These materials are not suitable for use as general engineered fill for this development. As noted, any organics, soft and wet soils or deleterious materials must be removed, where encountered, to expose the underlying native clay soil. The excavated areas must be backfilled with general engineered fill.

The moisture content of the site soil materials at surface is expected to be above or below the anticipated optimum moisture content for these soils in most areas. It is anticipated therefore, that moisture conditioning will be required at the site for proper compaction. The earthwork contractor should, however, make his own estimate of the requirements and should consider such factors as weather and construction procedures.

General engineered fill materials for lot grading should be moisture conditioned to within a range of –1% of optimum to +2% of the optimum moisture content prior to compaction and compacted to a minimum of 98% of SPD.

4.3 STREET SUBGRADE PREPARATION

Subgrade preparation should be undertaken prior to pavement construction. The recommended standard for subgrade preparation is a minimum of 98% of Standard Proctor Density (SPD). Clay soils should be compacted with moisture content –1% to +2% of the Optimum Moisture Content (OMC). For cohesionless soil types, the moisture content should be ±2% of the OMC. A minimum depth of subgrade preparation of 300 mm is recommended for previously constructed embankments and areas within the utility trench backfill footprint. A 600 mm subgrade preparation depth is recommended for undisturbed areas.

In isolated areas where clay fill soils are encountered, these should be removed, moisture conditioned, and replaced to design subgrade elevation as general engineered fill materials to the recommended compaction standards set out in this report.

Although the conditions expected from experience in this area, specifically in terms of groundwater levels, are generally not expected to be significantly adverse, it would be prudent to include a contingency for geotextile, should localized areas of subgrade instability be encountered. Use of geotextile should not be considered as an alternate for subgrade preparation as recommended, but an alternative should subgrade instability exist after subgrade preparation.

Based on EBA's local experience, the contractor should be made aware that subgrade difficulties often arise at moisture contents of 3% over optimum, as noted in the current

City of Lethbridge Standards, where siltier soils are encountered. Therefore, in practice, the moisture content within proposed paved areas should be limited to no more than 2% over optimum for acceptable subgrade support conditions.

Backfill to raise these areas to subgrade level should be general engineered cohesive fill materials, as defined in this report, moisture conditioned and compacted as noted previously. The subgrade should be prepared and graded to allow drainage into catchbasins. Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics.

It is imperative that positive surface drainage be provided to prevent ponding of water within the roadway structure and subsequent softening and loss of strength of the subgrade materials. Surrounding landscaping should be such that runoff water is prevented from ponding beside paved areas in order to avoid softening and premature failure of the pavement surface.

The pavement design should include provisions for subsurface drainage of the pavement granular layers. For urban sections it is considered appropriate to provide subsurface drainage in the form of longitudinal subdrains along the edge of the pavement structure. Subdrains will provide a means of evacuating water that infiltrates the pavement structure, either through cracks and vertical details (e.g. face of gutter), or from peripheral surface runoff. The subdrain should consist of a perforated flexible plastic drainpipe (100 mm diameter), complete with filter sock. The drain should be placed along the edge of the pavement section in a recessed area of the prepared subgrade. Positive outfall of the drains should be provided at catchbasin locations or other stormwater outfalls.

4.4 CONSTRUCTION EXCAVATIONS

Excavations should be carried out in accordance with the Alberta Occupational Health and Safety Regulations. For this project, the depth for the trench excavations could possibly vary between 2 m and 9 m below existing ground surface. The following recommendations notwithstanding, the responsibility of trench and all excavation cut slopes resides with the Contractor and should take into consideration site specific conditions concerning soil stratigraphy and groundwater. All excavations should be reviewed by a geotechnical engineer prior to personnel working within the base of the excavation.

As excavation proceeds, consideration should be given to separation of the varying soil materials encountered as far as practical and where economically viable. For example, clay soils with moisture contents of close to the optimum moisture content for the materials should be stockpiled separately from wetter clay soils, which will require mixing or drying.

Excavations within stiff clay soils which are to be deeper than 1.5 m should have the sides shored and braced or the slopes should be cut back no steeper than 1.0 horizontal to 1.7 vertical. Flatter side slopes may be required in areas where groundwater is encountered within sand/silt seams, which may cause local sloughing and instability of the excavation sidewalls. In these instances, the excavation configuration design should be reviewed by a geotechnical engineer as required, prior to allowing personnel to enter the base of the excavation. Some widening of the trench slope (1.0H:1.0V) should be expected near the existing ground surface if wetter surficial soils will be encountered. Thin wedges of soil should not be left in place between separate trenches (i.e. between alignments of water lines versus sanitary lines) unless approved by qualified personnel (professional engineer).

Vertical trench cuts utilizing trench box wall support is not recommended for this project due to the inherent difficulty in compacting the backfill materials to an engineered standard, as well as the potential of cave-ins of the excavation sidewalls against the utility box.

Any encountered groundwater seepage should be directed towards sumps for removal from the excavation. Conventional construction sump pumps should be capable of accommodating groundwater control.

The maximum allowable sideslopes for utility trenches may not be governed by OH&S regulations, but by construction methodology for ensuring appropriate transition lengths from backfill soils to native soils. As an example, an appropriate transition of 1H:1V is normally recommended to avoid abrupt changes in subgrade stiffness and subsequent consolidation/cracking of the pavement structure. However, areas of multiple trenches, varying trench depth, and position of trenches (parallel or perpendicular to roadway alignments) need to be considered. EBA would be pleased to provide further specific recommendations, once final roadway/utility configurations are known.

The composition and consistencies of the soils encountered along the utility alignment are such that conventional hydraulic excavators should be able to remove these materials. It should be noted that the risk of encountering boulders is considered to be low.

Temporary surcharge loads, such as spill piles, should not be allowed within a distance equal to the depth of the excavation from an unsupported excavation face while mobile equipment should be kept back at least 3.0 m. All excavation should be checked regularly for signs of sloughing, especially after rainfall periods. Small earth falls from the sideslopes are a potential source of danger to workmen and must be guarded against.

4.5 TRENCH BACKFILL AND COMPACTION

All utility pipes should be properly embedded within manufacturer approved granular bedding materials (pipe zone). The granular bedding should extend to a minimum of 100 mm and 300 mm below and above the utility pipe respectively, or to greater thicknesses if recommended by the utility pipe manufacturer. The granular bedding material should conform to the requirements and gradation presented in Appendix B of this report or to the standards set by City of Lethbridge.

The existing site soils comprising clay, silt, or clay till, are considered adequate for use as 'general engineered fill' within the trenches above the bedding zone. Requirements for 'general engineered fill' are defined in Appendix B.

The moisture content of the clay, silt, and clay till soils are estimated to be variable with respect to their Standard Proctor optimum moisture content (OMC). As such, moisture conditioning should be anticipated for this project. The earthwork contractor should, however, make his own estimate of the requirements and should consider such factors as weather and construction procedures.

The level of compaction of the backfill must be suitable to limit post construction trench settlement both for the road embankment as well as to maintain the design surface drainage (stormwater control) profile of the right-of-ways. Therefore, a minimum compaction level of 95% of Standard Proctor maximum dry density (SPD) is recommended for backfill within the pipe zone of the trench (to 300 mm above the top of pipe). For the remainder of the trench backfill, a minimum compaction standard of 98 percent of SPD should be utilized in all areas. The compacted thickness of each lift of backfill shall not exceed 250 mm. Moisture conditioning to minus 1% of optimum and 2% over optimum moisture content of the soils should be specified for general trench backfill. During placement of the backfill materials it is recommended that 'notching' of the excavation sidewalls (1H:1V) every 1 m height occur to develop a bond between the native soils and backfill materials, resulting in less potential for long-term settlement or consolidation.

Localized sand and/or silt pockets which may be encountered within the clay till should be 'wasted' or incorporated into the approved backfill materials, as specified by qualified personnel, ensuring the design intent of the backfill work is maintained.

It should be noted that the ultimate performance of the trench backfill is directly related to the uniformity of the backfill compaction. In order to achieve the uniformity, the lift thickness and compaction criteria should be strictly enforced. General recommendations regarding backfill materials and compaction are contained in Appendix B.

4.6 CONCRETE ISSUES

4.6.1 Concrete Type

For this development, based on EBA's experience and CSA A23.1-04, the recommended concrete exposure classification for general usage should be Class S-2 (CSA A23.1-04, Table 3). For this exposure classification, alternatives include the usage of Type HS (Sulphate Resistant) Portland cement, or blends of cement and supplementary cementing materials, conforming to Type MSb and/or Type HSb cements (CSA A3001-03).

For all concrete exposed to soil and/or groundwater (i.e., including all building foundation concrete, all below grade concrete, and surface works concrete), a maximum water/cementing materials (W/CM) ratio of 0.45 is recommended. Based on EBA's experience with Alberta aggregates, a W/CM ratio of 0.45 normally corresponds to a 28-day compressive strength of 28 MPa or greater (32 MPa at 56-days).

Air entrainment of 4 to 6% by volume is recommended for all concrete exposed to freezing temperatures, native soils and/or groundwater. This should be increased to 5 to 7% for exterior flatwork.

4.6.2 Concrete Surface Works

With respect to surface works concrete (i.e., specifically concrete curbs and sidewalks), the recommendations provided in this report for subgrade preparation, including moisture conditioning and compaction, are intended to provide relative uniformity in the subgrade. The intention of uniformity, with respect to material type and moisture content, is to reduce the risk of differential concrete movements due to soil volume changes as a result of fluctuating moisture content. For these types of developments, a gradual increase in moisture content is common, resulting from precipitation, reduced evaporation, and irrigation. However, some differential movement and subsequent cracking of concrete surface works should be anticipated, typical for the Lethbridge area.

With respect to providing a layer of granular material beneath surface works concrete, there are both positive and negative consequences. In the positive sense, it must be assumed that the subgrade will be uniformly graded properly such that any moisture gaining access beneath the concrete within the granular layer would be drained away quickly to an area designed to accommodate excess moisture (i.e., roadway weeping tile tied into the storm system). If well drained, the provision of granular material also serves to reduce some differential distortions, when washed materials are used, and has been documented as helping to reduce longitudinal cracking.

On the negative side, if free drainage of the granular layer is not designed, constructed, and maintained, granular materials provide easy access for excess moisture to pond below the concrete, causing swelling of the medium plastic subgrade soils and/or consolidation of fill soils. There is also a risk of softening of the adjacent roadway pavement edges.

The risk of differential movement of the subgrade soils and the economic consequence for either option should be given due consideration by the municipal engineer.

4.7 STORMWATER POND DEVELOPMENT

4.7.1 General

A stormwater containment pond is understood for this development. Specific design details of the pond have not yet been finalized, however, it is assumed that the deepest invert of pond will be approximately 4 m to 5 m below final design grades.

It is assumed that most portions of the stormwater pond(s) will retain water throughout the year (wet pond). Other areas will be considered as dry ponds. The retention ponds will provide overland stormwater drainage for this area in accordance with municipal regulations.

Based on similar developments in the City, it is recommended that the proposed sideslopes for the pond below normal operating level should be no steeper than 3 horizontal to 1 vertical. Above normal water level, the sideslopes are recommended to be no steeper than approximately 5 horizontal to 1 vertical.

In the preparation of the recommendations provided in this report for the geotechnical aspects of design and construction of the containment pond, EBA reviewed pertinent sections of the "Stormwater Management Guidelines for the Province of Alberta", dated January 2006 as prepared by the Municipal Program Development Branch of Alberta Environmental Protection (known now as Alberta Environment (AENV)).

4.7.2 General Pond Base Preparation

Following stripping of any organic material from the pond, the containment basin areas should be over-excavated beneath the proposed invert elevation in order to allow sufficient thickness of compacted clay base liner. The clay till soil within the base of the excavation should then be scarified to a minimum depth of 300 mm, moisture conditioned to between –1% and +2% of optimum moisture content, and recompacted to a minimum of 98% of SPD. The intent is to improve the base conditions and to provide a low permeable pond base, effectively increasing the clay liner thickness by 300 mm.

The basin sidewalls in the cut areas (up to high water level) should also be over-excavated a sufficient amount to allow the construction of a compacted clay liner with the exposed subgrade scarified, moisture conditioned, and compacted as noted above.

Monitoring of excavated soils within the pond footprint is recommended so that unsuitable materials, such as low plastic silts or cohesionless sands are wasted or incorporated only in general landscape areas (above high water level), where low permeability is not a requirement.

The composition and consistencies of the soils encountered on the property are such that conventional hydraulic excavators should be able to remove these materials. Cobbles and boulders may be present within the clay till matrix, albeit infrequently. General recommendations regarding backfill materials and compaction as well as construction excavations are given in Appendix B.

4.7.3 Remoulded Clay Liner

The following recommendations for the design and construction of remoulded clay liners are based on compliance with Alberta Environment's publication, "Stormwater Management Guidelines for the Province of Alberta", dated January 2006. This publication does not specifically provide permeability recommendations for wet ponds, however, it does provide a guideline in Figure 6.10, Wet Detention Pond Plan Sections, for "suitable subgrade to prevent infiltration below permanent depth (Max = 1.2 m/Min = 0.6 m).

Pending laboratory analysis of the site soils in the pond area, based on previous experience, the clay till soils are most likely suitable for use as a compacted clay liner, in conformance with the guidelines. Based on previous experience, for preliminary consideration, it is recommended that the thickness of remoulded clay liner be 0.6 m along the base of the wet pond and 1.0 m along the sidewalls up to normal water elevation. The sidewall liner thickness may be reduced to 0.6 m from normal water level to high water level and in other areas which will normally not be below the water level. These thicknesses account of the potential of desiccation of the upper 0.2 m during the initial periods when the wet pond is empty. They also account for potential disturbance (primarily of the sidewalls) during storm events or during periods of shore maintenance. To clarify further, the 0.3 m initial subgrade preparation depth may be included as part of the total liner thickness, provided base preparation is completed in accordance with the recommendations of this report.

Dry pond areas do not have a specific liner requirement. However, subgrade preparation to a depth of 300 mm, and compaction is recommended for dry pond areas.

The plan dimensions of the excavation should exceed the final "toe to toe" interior basin dimensions to provide an overlap between the pond floor liner and berm or sideslope liner. The subgrade should be relatively level and proof-rolled to provide a good base for compacting the first liner lift to the specified density. Soft pockets that would prevent sufficient compaction of the liner must be overexcavated and replaced with compacted cohesive clay fill materials. In lieu of satisfying the compaction requirements, a geotextile fabric may be required on or about the elevation of any encountered soft subgrade, although this is not anticipated for the current site conditions.

Careful site observation and testing will be required to avoid incorporating low or non-plastic materials into the liner. It is recommended that materials with a liquid limit of less than 30% not be incorporated into the liner. However, low plastic clays, silt or sands not meeting liner requirements, may be used in the top area of the embankment above HWL or outside the liner zone for berms.

Soil moisture contents for the clay till are generally variable with respect to the optimum moisture content. Moisture conditioning will be required during liner construction for the pond. Appropriate methods of moisture conditioning should be reviewed with qualified construction personnel prior to final design of the liner system.

Subsequent to the preparation of the pond floor (to 0.3 m depth), the excavated clay soils (liner borrow material) should be moisture conditioned to between –1% of the optimum and +3% over the optimum moisture content as determined by the Standard Proctor Test. Each lift should then be compacted to a minimum of 98% of SPD in lifts of maximum 150 mm compacted thickness to a total placed liner thickness of 0.6 m for the base, as recommended above.

A maximum "clod" size of 100 mm during moisture conditioning (prior to compaction) will produce relatively uniform moisture content throughout the soil matrix and a relatively homogenous compacted soil structure. The size of the "clods" can be controlled with agricultural equipment such as a disk. As far as practical, the liner should be built up in a uniform fashion over the containment basin area, in order to avoid sections of "butted fill" where seepage paths may develop. Compaction should be carried out utilizing "kneading" type compaction equipment such as vibratory padfoot or sheepsfoot type compactors. Completed liner areas should have the surface smoothed by a vibratory smooth drum roller. Sideslope liners in "cut" areas should have a minimum thickness (perpendicular to the slope face) of 1.0 m, as noted. The cohesive materials for the sideslope liners should be moisture conditioned and compacted as indicated above for the pond bottom.

If a lift of liner soil is allowed to become dry and desiccated prior to the placement of the next lift, the exposed surface should be scarified, re-moisture conditioned, and recompacted. Prior to lake filling and during maintenance periods when the pond is empty, the pond bottom should be prevented from drying out beyond 0.2 m as accounted for in the design liner thickness.

5.0 FOUNDATIONS

5.1 SHALLOW FOUNDATIONS

Shallow foundations, if considered, should be constructed approximately 1.4 m below the final design exterior ground surface (frost protection requirement). At this depth the foundation subgrade soil generally consists of firm to very stiff, damp to very moist, medium plastic, silty clay or clay till.

The net allowable static bearing pressure for the design of strip and spread footings for residential construction at this depth may be taken as 150 kPa, on native, undisturbed clay soils, subject to other recommendations in this report. The allowable static bearing pressure is based on correlation between Standard Penetration Test 'N' values. The factor of safety used from ultimate bearing capacity was 3.0. Footing dimensions should be in accordance with the minimum requirements of the Alberta Building Code 1997 (Section 9.15.3 Footings). Bearing certification is recommended to ensure that the footings are placed on competent native clay soils.

It is recommended to use a smooth edge-trimming bucket or Grade-All for final excavation to the foundation subgrade elevation to minimize disturbance of the founding soils. The foundation concrete should be placed immediately following excavation to ensure the bearing clay soil does not dry out to below the plastic limit.

The anticipated foundation clay soils are expected to be prone to volume changes (both heave and consolidation) with varying moisture content. Therefore, a permanent weeping tile system is also recommended around the outside perimeter of the structure at the foundation elevation to maintain a consistent moisture profile of the founding soils. This will reduce the potential of differential movement (heave or consolidation) of the foundations.

Settlement of footings designed and constructed in accordance with the above recommendations should be well within the normally tolerated values of 25 mm total and 20 mm differential.

Recommendations for depth of cover for footings are presented under 'Frost Protection'. Further recommendations regarding shallow foundations are given in Appendix B.

5.2 BASEMENT CONSTRUCTION

5.2.1 Basement Floor Slabs

Slab-on-grade construction for basements is considered feasible providing certain precautions are undertaken. All excavation should be carried out remotely using a smooth-mouth bucket or Grade-All at final grade in order to minimize disturbance of the base. Basement floor slabs should be supported by a minimum of 150 mm compacted, clean, free-draining granular material.

In areas where floor slabs bear on a clay subgrade, the clay at this site may swell following completion of the floor slabs. Therefore, some movement should be anticipated. Any light columns in the basement designed to support the main floor should be of the adjustable "telepost" type. If partitions are constructed in the basement, provision must be made so that, if the basement floor slab heaves, the partitions do not raise the main floor. A minimum allowance of 25 mm should be left between the top plates of basement partitions and the floor above them to accommodate heaving of the floor slab. This heaving allowance is less applicable for interior columns founded on spread footings.

The slab subgrade should be sloped to provide positive drainage to the edge of the slab. A minimum drainage gradient of 0.5 percent is recommended.

Slabs-on-grade should be separated from bearing members to allow some differential movement. If differential movement is unacceptable, a structurally supported floor system or crawlspace may be considered.

General recommendations for floor slab construction are also presented in Appendix B.

5.2.2 Basement Walls

All basement walls should be designed to resist lateral earth pressures in an "at-rest" condition. This condition assumes a triangular pressure distribution and may be calculated using the following:

$$P_o = K_o\ (\gamma H + q)$$

where:

P_o	=	lateral earth pressure "at-rest" condition (no wall movement occurs at a given depth)
K_o	=	co-efficient of earth pressure "at-rest" condition (use 0.5 for silt or clay backfill and 0.45 for sand and gravel backfill)
γ	=	bulk unit weight of backfill soil (use 19 or 21 kN/m^3 for clay or granular backfill, respectively)
H	=	depth below final grade (m)
q	=	surcharge pressure at ground level (kPa)

It is assumed that drainage is provided for all basement walls through the installation of weeping tile and hydrostatic pressures will not be a factor in design.

Backfill around concrete basement walls should not commence before the concrete has reached a minimum two-thirds of its 28-day strength and first floor framing are in place or the walls are laterally braced. Only hand operated compaction equipment should be employed within 600 mm of the concrete walls. Caution should be used when compacting backfill to avoid high lateral loads caused by excessive compactive effort. A compaction standard of 95% of Standard Proctor maximum dry density (SPD) is recommended. To avoid differential wall pressures, the backfill should be brought up evenly around the walls. A minimum 600 mm thick engineered clay cap should be placed at the ground surface to minimize the infiltration of surface water.

5.3 FOUNDATION PERIMETER DRAINAGE REQUIREMENTS

As part of this evaluation, a review included a document entitled, "A Consolidation of a By-Law of the City of Lethbridge Respecting a Sewerage Service Charge and Regulating the Disposal of Sewage and the Discharge of Liquids and Waste into the Lethbridge Sewerage System".

It is understood that all residential weeping tiles will be tied from residential sumps into the City storm sewer system. An acceptable weeping tile system should consist of a perforated weeping tile wrapped in a geosock or geotextile fabric, in turn surrounded with a minimum of 150 mm thick blanket of washed rock (maximum size 20 mm). The weeping tile should have a minimum 0.5% slope leading to a sump to then discharge as noted above.

5.4 FROST PROTECTION

For protection against frost action, perimeter footings in heated structures should be extended to such depths as to provide a minimum soil cover of 1.4 m. Isolated or exterior footings in unheated structures should have a minimum soil cover of 2.1 m unless provided with equivalent insulation.

5.5 SEISMIC DESIGN

The Site Classification recommended for Seismic Site Response is Classification D, as noted in Table 4.1.8.4.a of the National Building Code of Canada (NBCC) 2005.

6.0 DESIGN AND CONSTRUCTION GUIDELINES

Recommended general design and construction guidelines are provided in Appendix B, under the following headings.

- Shallow Foundations
- Construction Excavations
- Floor Slabs-on-Grade
- Backfill Materials and Compaction
- Proof-Rolling

These guidelines are intended to present standards of good practice. Although supplemental to the main text of this report, they should be interpreted as part of the report. Design recommendations presented herein are based on the premise that these guidelines will be followed. The design and construction guidelines are not intended to represent detailed specifications for the works although they may prove useful in the preparation of such specifications. In the event of any discrepancy between the main text of this report and Appendix B, the main text should govern.

7.0 REVIEW OF DESIGN AND CONSTRUCTION

EBA should be given the opportunity to review details of the design and specifications, related to geotechnical aspects of this project, prior to construction.

Bearing surfaces and foundation installation should be monitored by qualified geotechnical personnel during construction. EBA will provide these services, if requested.

8.0 LIMITATIONS

Recommendations presented herein are based on a review of available geotechnical information in the vicinity of the subject property. The conditions described are considered to be reasonably representative of the site. If, however, conditions other than those reported are noted during subsequent phases of the project, EBA should be notified and given the opportunity to review our current recommendations in light of new findings.

This report and its contents are intended for the sole use of Daytona Land Corporation, Stantec Consulting Ltd., and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than those noted, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions of EBA's Services Agreement and the General Conditions provided in Appendix A of this report.

9.0 CLOSURE

We trust this report satisfies your present requirements. We would be pleased to provide further information that may be needed during design and to advise on the geotechnical aspects of specifications for inclusion in contract documents. Should you require additional information or monitoring services, please do not hesitate to contact our office.

Respectfully submitted,
EBA Engineering Consultants Ltd.

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/sdt

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.

Signature ____________

Date February 4, 2009

PERMIT NUMBER: P245

The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIGURES

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NOTE
NOT TO SCALE

CLIENT

Stantec Consulting Ltd.

EBA Engineering Consultants Ltd.

COPPERWOOD OUTLINE STRUCTURE PLAN

SITE PLAN

PROJECT NO.	DWN	CKD	REV
L12101425	LCH	GR	0

OFFICE	DATE
LETH	January 29, 2009

Figure 1

APPENDIX

APPENDIX A GEOTECHNICAL REPORT – GENERAL CONDITIONS

GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgemental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

8.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

9.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

10.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

11.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

12.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

13.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

14.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX

APPENDIX B RECOMMENDED GENERAL DESIGN AND CONSTRUCTION GUIDELINES

SHALLOW FOUNDATIONS

Design and construction of shallow foundations should comply with relevant Building Code requirements.

The term 'shallow foundations' includes strip and spread footings, mat slab and raft foundations.

Minimum footing dimensions in plan should be 0.45 m and 0.9 m for strip and square footings respectively.

No loose, disturbed or sloughed material should be allowed to remain in open foundation excavations. Hand cleaning should be undertaken to prepare an acceptable bearing surface. Recompaction of disturbed or loosened bearing surface may be required.

Foundation excavations and bearing surfaces should be protected from rain, snow, freezing temperatures, excessive drying and the ingress of free water before, during and after footing construction.

Footing excavations should be carried down into the designated bearing stratum.

After the bearing surface is approved, a mud slab should be poured to protect the soil and provide a working surface for construction, should immediate foundation construction not be intended.

All constructed foundations should be placed on unfrozen soils, which should be at all times protected from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to check that the recommendations contained in this report have been followed.

Where over-excavation has been carried out through a weak or unsuitable stratum to reach into a suitable bearing stratum or where a foundation pad is to be placed above stripped natural ground surface such over-excavation may be backfilled to subgrade elevation utilizing either structural fill or lean-mix concrete. These materials are defined under the separate heading 'Backfill Materials and Compaction'.

CONSTRUCTION EXCAVATIONS

Construction should be in accordance with good practice and comply with the requirements of the responsible regulatory agencies.

All excavations greater than 1.5 m deep should be sloped or shored for worker protection.

Shallow excavations up to about 3 m depth may use temporary sideslopes of 1H:1V. A flatter slope of 2H:1V should be used if groundwater is encountered. Localized sloughing can be expected from these slopes.

Deep excavations or trenches may require temporary support if space limitations or economic considerations preclude the use of sloped excavations.

For excavations greater than 3 m depth, temporary support should be designed by a qualified geotechnical engineer. The design and proposed installation and construction procedures should be submitted to EBA for review.

The construction of a temporary support system should be monitored. Detailed records should be taken of installation methods, materials, in situ conditions and the movement of the system. If anchors are used, they should be load tested. EBA can provide further information on monitoring and testing procedures if required.

Attention should be paid to structures or buried service lines close to the excavation. For structures, a general guideline is that if a line projected down, at 45 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, these structures may require underpinning or special shoring techniques to avoid damaging earth movements. The need for any underpinning or special shoring techniques and the scope of monitoring required can be determined when details of the service ducts and vaults, foundation configuration of existing buildings and final design excavation levels are known.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

FLOOR SLABS-ON-GRADE

All soft, loose or organic material should be removed from beneath slab areas. If any local 'hard spots' such as old basement walls are revealed beneath the slab area, these should be overexcavated and removed to not less than 0.9 m below underside of slab level. The exposed soil should be proof-rolled and the final grade restored by general engineered fill placement. If proof-rolling reveals any soft or loose spots, these should be excavated and the desired grade restored by general engineered fill placement. Proof-rolling should be carried out in accordance with the recommendations given elsewhere in this Appendix. The subgrade should be compacted to a depth of not less than 0.3 m to a density of not less than 98 percent Standard Proctor Maximum Dry Density (ASTM Test Method D698).

If, for economic reasons, it is considered desirable to leave low quality material in-place beneath a slab-on-grade, special ground treatment procedures may be considered, EBA could provide additional advice on this aspect if required.

A levelling course of 20 mm crushed gravel at least 150 mm in compacted thickness, is recommended directly beneath all slabs-on-grade. Alternatively a minimum thickness of 150 mm of pit-run gravel overlain by a minimum thickness of 50 mm of 20 mm crushed gravel may be used. Very coarse material (larger than 25 mm diameter) should be avoided directly beneath the slab-on-grade to limit potential stress concentrations within the slab. All levelling courses directly under floor slabs should be compacted to 100 percent of Standard Proctor maximum dry density.

General engineered fill, pit-run gravel and crushed gravel are defined under the heading 'Backfill Materials and Compaction' elsewhere in this Appendix.

The slab should be structurally independent from walls and columns supported on foundations. This is to reduce any structural distress that may occur as a result of differential soil movements. If it is intended to place any internal non-load bearing partition walls directly on a slab-on-grade, such walls should also be structurally independent from other elements of the building founded on a conventional foundation system so that some relative vertical movement of the walls can occur freely.

The excavated subgrade beneath slabs-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of free water. This applies during and after the construction period.

A minimum slab concrete thickness of 100 mm is recommended. Control joints should be provided in all slabs. Typically for a 125 mm slab thickness; control joints should be placed on a 3 m square grid, should be sawn to a depth of one-quarter the slab thickness and have a width of approximately 3 mm.

Wire mesh reinforcement, 150 mm square grid, should be provided to reduce the possibility of uncontrolled slab cracking. The mesh should be adequately supported and should be located at mid-height of the slab with adequate cover.

BACKFILL MATERIALS AND COMPACTION

Maximum density, as used in this section, means Standard Proctor Maximum Dry Density (ASTM Test D698) unless specifically noted otherwise. Optimum moisture content is as defined in this text.

"General engineered fill" materials should comprise clean, well-graded granular soils or inorganic, low-plastic cohesive soils. Such material should be placed in compacted lifts not exceeding 200 mm and compacted to not less than 98% of maximum density, at a moisture content at or slightly above optimum.

"Structural fill" materials should comprise clean, well-graded inorganic granular soils. Such fill should be placed in compacted lifts not exceeding 150 mm and compacted to not less than 98% of maximum density, at a moisture content near or slightly above optimum.

"Landscape fill" material may comprise soils without regard to engineering quality. Such soils should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90% of maximum density.

Backfill adjacent to and above footings, abutment walls, basement walls, grade beams and pile caps or below highway, street or parking lot pavement sections should comprise general engineered fill materials as defined above.

Backfill supporting structural loads should comprise structural fill materials as defined above.

Backfill adjacent to exterior footings, foundation walls, grade beams and pile caps and within 300 mm of final grade should comprise low-plastic cohesive general engineered fill as defined above. Such backfill should provide a relatively impervious surface layer to reduce seepage into the sub-soil.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction, careful observation of the foundation wall for deflection should be carried out continuously. Where deflection is apparent, the compactive effort should be reduced accordingly. In order to reduce potential compaction induced stresses, only hand held compaction equipment should be used in the compaction of fill within 500 mm of retaining walls or basement walls.

Backfill materials should not be placed in a frozen state or placed on a frozen subgrade. All lumps of materials should be broken down during placement.

Where the maximum-sized particles in any backfill material exceed 50% of the lift thickness or minimum dimension of the cross-section to be backfilled, such particles should be removed and placed at the other more suitable locations on site or screened-off prior to delivery to site.

Bonding should be provided between backfill lifts, if the previous lift has become desiccated. For the fine-grained materials, the previous lift should be scarified to 75 mm in depth followed by proper moisture conditioning and recompaction.

Recommendations for the specifications for various backfill types are presented below.

"Pit-run gravel" should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing By Weight
200 mm	100 of Total Sample
150 mm	96 - 100 of Total Sample
75 mm	60 - 80 of Total Sample
25 mm	70 - 100 of Material Passing 75 mm Sieve
4.75 mm	25 - 63 of Material Passing 75 mm Sieve
1.18 mm	14 - 41 of Material Passing 75 mm Sieve
0.60 mm	7 - 30 of Material Passing 75 mm Sieve
0.15 mm	3 - 18 of Material Passing 75 mm Sieve
0.075 mm	2 - 9 of Material Passing 75 mm Sieve

Any grading variation from the above should be at the discretion of the Engineer; however, the percent of material passing the 0.075 mm sieve should not exceed 2/3 of the material passing the 0.6 mm sieve. The pit-run gravel should be free of any form of coating and any gravel containing clay, loam or other deleterious materials should be rejected. No oversized material should be tolerated.

"Crushed gravel" should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing by Weight (Nominal Gravel Size)		
	100 mm	50 mm	25 mm
100 mm	100	—	—
75 mm	90 - 100	—	—
50 mm	—	100	—
40 mm	60 - 80	90 - 100	—
25 mm	—	—	100
20 mm	40 - 66	50 - 75	95 - 100
10 mm	25 - 54	25 - 52	60 - 80
4.75 mm	15 - 43	15 - 40	40 - 60
2.36 mm	10 - 35	10 - 33	28 - 48
0.60 mm	5 - 23	5 - 23	13 - 29
0.30 mm	—	—	9 - 21
0.15 mm	3 - 12	2 - 14	6 - 15
0.075 mm	2 - 10	1 - 10	4 - 10

Gravel:

100 mm Crushed Gravel: At least 13% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

50 mm Crushed Gravel: At least 13% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

25 mm Crushed Gravel: At least 50% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

Any gravel containing deleterious material should be rejected.

"Coarse gravel" for bedding and drainage should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing By Weight (Nominal Gravel Size)	
	50 mm	40 mm
50 mm	100	—
40 mm	90 - 100	100
25 mm	—	95 - 100
20 mm	35 - 70	—
15 mm	—	25 - 60
10 mm	10 - 30	—
4.75 mm	0 - 5	0 - 10
2.36 mm	—	0 - 5

"Coarse sand" for bedding and drainage should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing By Weight
10 mm	100
4.75 mm	95 – 100
2.36 mm	80 – 100
1.18 mm	50 - 85
0.60 mm	25 - 60
0.30 mm	10 - 30
0.15 mm	2 - 10

"Lean-mix concrete" should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

PROOF-ROLLING

Proof-rolling is a method of detecting soft areas in an 'as-excavated' subgrade for fill, pavement, floor or foundations or detecting non-uniformity of compacted embankment. The intent is to detect soft areas or areas of low shear strength not otherwise revealed by means of testholes, density testing, or visual examination of the site surface and to check that any fill placed or subgrade meets the necessary design strength requirements.

Proof-rolling should be observed by qualified geotechnical personnel.

Proof-rolling is generally accomplished by the use of a heavy (15 to 60 tonne) rubber-tired roller having 4 wheels abreast on independent axles with high contact wheel pressures (inflation pressures ranging from 550 kPa (80 psi) up to 1030 kPa (150 psi).

A heavily loaded tandem axle gravel truck may be used in lieu of the equipment described in the paragraph above. The truck should be loaded to approximately 10 tonnes per axle and a minimum tire pressure of 550 kPa (80 psi).

Ground speed - maximum 8 km/hr recommended 4 km/hr.

The recommended procedure is two complete coverages with the proof-rolling equipment in one direction and a second series of two coverages made at right angles to the first series; one 'coverage' means that every point of the proof-rolled surface has been subjected to the tire pressure of a loaded wheel. Less rigorous procedures may be acceptable under certain conditions subject to the approval of an engineer.

Any areas of soft, rutted, or displaced materials detected should be either recompacted with additional fill or the existing material removed and replaced with general engineered fill, or properly moisture conditioned as necessary.

The surface of the grade under the action of the proof-roller should be observed, noting; visible deflection and rebound of the surface, formation of a crack pattern in the compacted surface or shear failure in the surface of granular soils as ridging between wheel tracks.

If any part of an area indicates significantly more distress than other parts, the cause should be investigated, by, for example, shallow auger holes.

In the case of granular subgrades, distress will generally consist of either compression due to insufficient compaction or shearing under the tires. In the first case, rolling should be continued until no further compression occurs. In the second case, the tire pressure should be reduced to a point where the subgrade can carry the load without significant deflection and subsequently gradually increased to its specified pressure as the subgrade increases in shear strength under this compaction.

Copperwood
Daytona Urban Development Corp.

APPENDIX D

Phase 1 Environmental Site Assessment

Phase 1 ESA – Supplementary Information

Stantec Consulting Ltd.

ISSUED FOR USE

PHASE I ENVIRONMENTAL SITE ASSESSMENT
PORTIONS OF N-22-008-22 W4M AND A PORTION OF NW-23-008-22 W4M
LETHBRIDGE, ALBERTA

L22101248

March 2009

EBA Engineering Consultants Ltd.
p. 403.329.9009 • f. 403.328.8817
442 – 10 Street North • Lethbridge, Alberta T1H 2C7 • CANADA

EXECUTIVE SUMMARY

FOREWORD

Stantec Consulting Ltd. (Stantec) retained EBA Engineering Consultants Ltd. (EBA) to conduct a Phase I Environmental Site Assessment (ESA) of agricultural land located to the south of the Copperwood Residential Subdivision in Lethbridge, Alberta. The land is located in portions of N-22-008-22 W4M and a portion of NW-23-008-22 W4M. Collectively, these properties will hereinafter be referred to as the site.

The objective of the Phase I ESA was to comment on whether past or present land use, either off site or on site, may have a potential to cause environmental impairment to the site. EBA understands that Stantec requires this environmental investigation as part of the subdivision application process.

The Phase I ESA was conducted in general accordance with the Canadian Standards Association (CSA) Phase I ESA Standard Z768-01 (April 2003 revision).

FINDINGS AND CONCLUSIONS

An oil/gas lease site and associated pipelines (belonging to Bonavista Petroleum Ltd. and Bonavista Oil & Gas Ltd., respectively) are present on the southwest side of the site at 12-22-008-22 W4M. The well site and pipelines are considered to pose potential for environmental impairment to the site from drilling and construction activities, however; gathering of additional information pertaining to these activities was not within the scope of this Phase I ESA.

Several ephemeral wetlands that would potentially collect water in wet years were observed at the site during the site reconnaissance and noted in the aerial photograph review. Future development in these areas would require an approval under the Alberta *Water Act*. According to the aerial photograph review, several of these ephemeral wetlands have been cultivated since the 1950's. There is potential for methane generation from the buried organic material which is commonly found in wetland areas. Buried organic soils should be removed in the areas of future building development.

There are no additional potential on-site sources of environmental impairment relating to the site from historical or current on-site land uses.

There are no apparent potential off-site sources of environmental impairment relating to the site from historical or current off-site land uses.

Based on the present study, EBA recommends that additional work be conducted and information gathered to determine if a Phase II ESA is required. This would include additional upstream oilfield background searches including a core library search and Alberta Environment's drilling mud calculations. In addition, it should be determined if a Phase II ESA has previously been conducted on the site by the well site operator. Soil and groundwater quality may need to be assessed in the area within the well site boundary. The well and pipelines should also be considered during development planning and construction activities as there will be setback requirements.

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1.0 INTRODUCTION

1.1 GENERAL

Stantec Consulting Ltd. (Stantec) retained EBA Engineering Consultants Ltd. (EBA) to conduct a Phase I Environmental Site Assessment (ESA) of agricultural land located to the south of the Copperwood Residential Subdivision in Lethbridge, Alberta. The land is located in portions of N-22-008-22 W4M and a portion of NW-23-008-22 W4M. Collectively, these properties will hereinafter be referred to as the site.

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1.2 AUTHORIZATION

Mr. Trent Purvis of Stantec provided authorization to proceed with the present study via a signed Services Agreement to Ms. Mireille Rigaux of EBA on February 11, 2009.

1.3 SCOPE OF WORK

EBA conducted the following scope of work for the Phase I ESA:

- Conducted a records review for the site and surrounding properties. The records review included the following current and historic information searches:
  - Provincial regulatory information, including: the Petroleum Tank Management Association of Alberta (PTMAA); Abacus Datagraphics (AbaData) database; Alberta Environment's (AENV) database; Energy Resources Conservation Board (ERCB) Coal Mine Atlas; and the Online Water Well Database and Approval Viewer.
- Reviewed available regional and municipal regulatory information, including:
  - The City of Lethbridge.
  - The County of Lethbridge.
  - Historic information sources, including: property listing directories [i.e., Henderson's Business Directories (HBDs)]; fire insurance plans (FIPs); land titles; and historic aerial photographs.
  - Geologic and hydrogeologic information, including: internal EBA and published topographic, geologic, soils, and groundwater maps and reports.

  - Existing reports for the site (environmental/geotechnical/building materials) provided to EBA.
- Conducted a site visit to evaluate the extent and manner that present and surrounding activities may impact upon the site and the environment. Sampling was not included in the Phase I ESA.
- Evaluated the results and prepared this report discussing the site history and identified the potential for environmental concerns resulting from past or present land use on site and in the surrounding area.

1.4 QUALIFICATIONS OF ASSESSORS

Ms. Mireille Rigaux, B.Sc., conducted the historical research, records review, site visit, and prepared this report. Ms. Rigaux is an Environmental Scientist for EBA's Lethbridge Environmental Practice and has two years of experience in the environmental industry.

Mr. Deryck Masterman, B.Sc., A.Ag., conducted the preliminary review of the report. Mr. Masterman is an Environmental Scientist for EBA's Lethbridge Environmental Practice and has five years of experience in the environmental industry.

Mr. Sean Buckles, P. Eng conducted the final review of the report. Mr. Buckles is a Project Engineer in EBA's environmental practice in Calgary and has over 13 years of experience in conducting ESAs.

1.5 GENERAL SITE DETAILS

The irregularly-shaped site is located in west Lethbridge, south of the Copperwood residential subdivision and west of the Mountain Heights residential subdivisions. The site is located within the north half of 22-008-22 W4M and the NW quarter of 23-008-22 W4M corresponding with three municipal addresses, detailed in Table 1. The site primarily consists of undulating, cultivated agricultural land containing several ephemeral wetlands as well as a well site and associated pipelines (Bonavista Petroleum Ltd. and Bonavista Oil & Gas Ltd.) in the southwest corner

The site is bounded by Copperwood residential subdivision to the north. A portion of this subdivision was under construction at the time of the site reconnaissance. 30 Street West bounds the site to the west followed by agricultural farmland. Agricultural land bounds the site to the south. 25 Street bounds the site to the east followed by a small portion of agricultural farmland which is then followed by Mountain Heights residential subdivision.

2.0 RECORDS REVIEW

Figure 1 shows the site location plan and Figure 2 shows the site plan and surrounding land use. Photographs of the site are provided in Appendix A and the results of regulatory searches are provided in Appendix B. Records were reviewed for the site and for adjacent properties.

2.1 LEGAL DESCRIPTION, MUNICIPAL ADDRESSES, SIZE, AND OWNERSHIP

The site is located in Lethbridge, Alberta. The legal description, municipal address, zoning and ownership are summarized in Table 1.

TABLE 1: SITE LOCATION, SIZE, AND OWNERSHIP

Legal Description	Municipal Addresses	Zoning	Owner(s)
NW-23-008-22 W4M	100 Métis Trail West	Comprehensively Planned Low Density Residential (R-CL) Direct Control (DC)	The City of Lethbridge
NE-22-008-22 W4M	2424 – 25 Street West	Urban Reserve (UR)	Serdna Farms Ltd.
NW-22 -008-22 W4M	2425 – 30 Street West	Direct Control (DC)	Daytona Urban Development Corporation

Copies of the current land titles are provided in Appendix B.

2.2 HISTORIC RECORDS REVIEW

A historic records review was undertaken for the site and surrounding properties.

2.2.1 Historic Land Title Records

The results of the land title search are summarized in the following tables (Tables 2 to 4).

TABLE 2: LAND TITLES SUMMARY NW-23-008-22 W4M

Year(s) of Ownership	Owner(s)	EBA Evaluation
1975 to Present	The City of Lethbridge	No obvious potential for environmental concerns.
1950 to 1975	Anteric Hubbard	
1926 to 1950	The Soldier Settlement Board of Canada	

TABLE 3: LAND TITLES SUMMARY NE-22-008-22 W4M		
Year(s) of Ownership	Owner(s)	EBA Evaluation
2001 to present	Serdna Farms Ltd.	No obvious potential for environmental concerns.
1986 to 2001	Andres Transport Ltd.	The aerial photograph review identified no obvious evidence of activities associated with a transport company on the site (i.e. the land was not disturbed nor was there equipment present), therefore; there is no obvious potential for environmental concern.
1982 to 1986	Engineered Homes Limited	No obvious potential for environmental concern.
1970 to 1982	College Farms Ltd.	
1909 to 1970	Private landowners	

TABLE 4: LAND TITLES SUMMARY NW-22-008-22 W4M		
Year(s) of Ownership	Owner(s)	EBA Evaluation
2008 to present	Daytona Urban Development Corp.	No obvious potential for environmental concerns.
1976 to 2008	Jenny Ann Skinner and Beverly Gay Skinner and Sharon Hubbard	
1909 to 1976	Private landowners	

Land titles were obtained from Alberta Registries in Calgary, Alberta.

2.2.2 Aerial Photographs

Aerial photographs provide visual evidence of site occupancy, operational activities, and general site details. Aerial photographs capture a view of the site and the surrounding areas at a given time. Table 5 provides a detailed historical review of the aerial photographs.

TABLE 5: HISTORIC AIR PHOTO SUMMARY		
Year	Scale	Observations
1950	1:40,000	On Site: Cultivated agricultural land containing several ephemeral wetlands which do not appear to have water in them.
		Off Site: Cultivated agricultural land with a few scattered acreages and several ephemeral wetlands which do not appear to have water in them. 25 Street West is present adjacent to the site to the east.
1961	1:31,680	On Site: Similar to the 1950 photograph.
		Off Site: Similar to the 1950 aerial photograph.
1971	1:12,000	On Site: Similar to the 1961 photograph.
		Off Site: Similar to the 1961 aerial photograph.
1979	1:25,000	On Site: Several ephemeral wetlands scattered across the site had water present.

TABLE 5: HISTORIC AIR PHOTO SUMMARY		
Year	Scale	Observations
		Off Site: A rectangular strip has been removed and a soil or gravel stockpile is present on the north side of the property adjacent to the site to the east. The Mountain Heights residential subdivision is under construction approximately 100 m to the east of the site. Wetlands in the surrounding area appear to be filled with water.
1984	1:25,000	On Site: Similar to the 1979 photograph.
		Off Site: Similar to the 1979 aerial photograph.
1991	1: 30,000	On Site: The ephemeral wetlands across the site appear to be dry or were cultivated.
		Off Site: The stockpile that was previously on the north side of the property to the east has been removed and the land is under cultivation. The City of Lethbridge Electrical Substation #674S was constructed approximately 150 m to the southeast of the site. Construction on the Mountain Heights subdivision is ongoing and ephemeral wetlands in the area appear to be dry.
2001	1: 20,000	On Site: A lease road extending east from 30 Street West along the southern boundary of the site to a well site containing a square building are present on the southwest side of the site (current location of Bonavista 12-22-008-22 W4M).
		Off Site: Similar to the 1991 aerial photograph.
2007	1: 10,000	On Site: Similar to the 2001 photograph.
		Off Site: Copperwood residential subdivision is being constructed to the north of the site.

Notes:
To be read in conjunction with the accompanying report.
The aerial photographs are enlarged (where possible) for the review.
Aerial photographs were obtained from Alberta Sustainable Resource Development (ASRD).

The site remained vacant, agricultural land for the duration of the aerial photograph review with the exception of the lease site that was built between 1991 and 2001.

The surrounding land to the west and south remained undeveloped agricultural land for the duration of the aerial photograph review, with the exception of a soil material stockpile which was stored on the adjacent property to the east between 1971 and 1979. The stockpile was removed by 1991. Significant development in the area includes the Mountain Heights residential subdivision to the east of the site which was developed between 1971 and 1991 and Copperwood residential subdivision constructed between 2001 and 2007. Construction on Copperwood is ongoing.

2.2.3 Museum Archives

EBA contacted the Galt Museum and Archives for indications of historical land use at the site and the surrounding area; however, no records were available.

2.2.4 Business Directories

EBA contacted the Galt Museum and Archives for Henderson Business Directories (HBDs), however; no HBDs were available for the site or surrounding area.

2.2.5 Fire Insurance Maps (FIP)

EBA reviewed the 1955 (Revised 1965) FIP coverage maps for the City of Lethbridge (Western Canada Insurance Underwriters Association, 1955). The FIP maps did not provide coverage for the site.

2.2.6 Other Archival Records

No additional archival records were reviewed for the site.

2.3 PROVINCIAL REGULATORY INFORMATION

This section describes the results of provincial regulatory searches. Copies of the search results and correspondence are provided in Appendix B.

2.3.1 Petroleum Tank Management Association of Alberta (PTMAA)

EBA contacted the PTMAA regarding the potential for registered petroleum storage tanks (PSTs) at the site. The PTMAA response indicated that no records are available for the site (N-22-008-22 W4M or NW-23-008-22 W4M Lethbridge, Alberta). Please note that municipal addresses have been assigned to the site for approximately 30 years but these were not searched as no development or subdivision has occurred on the site in that time.

The PTMAA requires that all underground storage tanks (USTs) be registered; however, only aboveground storage tanks (ASTs) with a capacity greater than 2,500 L are required to be registered. The database is based on a limited survey conducted in 1992 and voluntary information submitted thereafter; therefore it is not considered to be a comprehensive inventory of tanks in Alberta.

2.3.2 Abacus Datagraphics (AbaData)

The AbaData database was searched to determine if oil/gas wells and/or pipelines exist or have existed at the site. AbaData indicated there are no records for utility rights-of-way (ROWs) on the site or in the surrounding area. AbaData indicated that an active well site and its associated pipelines are present on the southwest side of the site. Tables 6 and 7 outline the details of the well and pipelines.

TABLE 6: WELL INFORMATION

Bonavista Penny 12-22-8-22	
ID	00/12-22-008-22 W4/2
Company	Bonavista Petroleum Ltd.
Licence Number	0201406
Licence Date	May 16, 1997
Spud Date	July 9, 1997
Final Drill Date	July 13, 1997

TABLE 6: WELL INFORMATION	
Status	Gas Flow
Total Depth	1160 metres (3300 feet)
Location	SW side of site

TABLE 7: PIPELINE INFORMATION		
	30255-3	30255-5
Location	Extending east from Bonavista 09-21-8-22 W4M (approximately 330 m to the west of the site) to Bonavista 12-22-8-22 W4M (southwest side of the site).	Extending south from Bonavista 12-22-8-22 W4 (on the southwest side of the site) to Bonavista 13-15-008-22 W4 (approximately 1.1 km to the south of the site).
Permit Date	September 4, 1997	November 13, 1998
Company	Bonavista Oil & Gas Ltd.	Bonavista Oil & Gas Ltd.
From	12-22-008-22 W4M (well)	13-15-008-22 W4M (well)
To	09-21-008-22 W4M (pipeline)	12-22-008-22 W4M (pipeline)
Length	0.7 km	1.2 km
Substance	Natural gas	Natural gas
H2S	0 ppm	0 ppm

AbaData had no records or spills or facilities located on the site or the immediate surrounding area.

High pressure pipeline and well information provided by AbaData is current to January 30, 2009 and information on low pressure pipelines is current to November 1, 2005.

2.3.3 Alberta Environment (AENV)

The AENV Online Approval Viewer allows the public to view approvals, licenses, registrations, and permits issued under the Water Act and Environmental Protection and Enhancement Act (EPEA). The site is located within NE and NW-22-008-22 W4M and NW-23-008-22 W4M.

No approvals, licences, registrations or permits are present for NE and NW-22-008-22 W4M and NW-23-008-22 W4M.

The AENV Water Well Database has one record of a water well located within the north half of 22-008-22 W4M, however; the exact location of the wells is unknown. The water well database has no details pertaining to the well. If this well is encountered during site development, it should be decommissioned in accordance with the *Water Act*.

One additional water well was present within 14-22-008-22 W4M, however; this well is located approximately 200 m to the north of the site and is therefore not considered to be of concern to the site.

The Alberta Government SPIN Website map for the site and surrounding area outlined the pipeline ROW that is located on the southwest side of the site, however; no further details were available. No records of additional utility ROWs are available on the SPIN website.

2.3.4 Energy Resource Conservation Board (ERCB)

The ERCB Coal Mine Atlas was reviewed and it was determined that no coal mines were present within one kilometre of the site.

2.4 REGIONAL AND MUNICIPAL REGULATORY INFORMATION

This section describes the results of regional and municipal regulatory searches. Copies of the search results and correspondence are provided in Appendix B.

2.4.1 The City of Lethbridge

EBA requested a site inquiry with the City of Lethbridge (the City) for available information regarding environmental information at or near the site. The site inquiry indicated that no environmental information exists for the site.

The City of Lethbridge Interactive WebMap was also searched to determine the land use and zoning for the site and surrounding area, detailed in Sections 2.1 and 3.4 respectively.

2.4.2 The County of Lethbridge

EBA requested a site inquiry with the County of Lethbridge for available information regarding environmental information at or near the site. The site inquiry indicated that the site was annexed by the City of Lethbridge in 1975. At that time, all records and files pertaining to the site were turned over to the City.

2.5 LAND FORMS AND GEOLOGY

2.6 TOPOGRAPHY

Surface topography can influence the direction of migration of contaminants at the soil surface. The local topography is the topography at the site whereas regional topography is the overall expression of the soil surface in a given region. The surface topography of the site and surrounding area is undulating.

2.7 GEOLOGY

The surficial geology in the area is characterized by moraine till deposits with sporadic lenses of gravel, sand and silt (Shetson, 1981).

The stratigraphy of the Lethbridge area is generally comprised of 65 m to 70 m of surficial deposits overlying bedrock. Bedrock in the Lethbridge area consists of strata from the upper Oldman Formation and the lower Bearspaw Formation, both of the late Cretaceous Age (Tokarsky, 1973). The bedrock has a relatively flat surface dipping slightly to the northwest and is locally encountered at about geodetic elevation 840 m. The bedrock strata consist of thin beds of predominantly weak mudstones, siltstones, and sandstones with occasional bentonite and coal seams.

2.8 HYDROLOGY AND HYDROGEOLOGY

Groundwater is of significance as a potential means of contaminant transport. Regional groundwater flow is the overall direction of groundwater flow in a given region. There may be local groundwater flow within a region that is in a different direction from the regional flow and that is controlled by topography and/or subsurface soil conditions.

There are several ephemeral wetlands scattered across the site. According to the aerial photograph review, some of these wetlands contain water in wet years. Additional surface water bodies in the area include Nicolas Sheran Lake located in the Mountain Heights residential subdivision approximately 620 m to the northeast and a stormwater management pond located approximately 1.2 kilometres to the southeast in the Sunridge residential subdivision.

The Oldman River loops around the surrounding area to the west, south and east approximately 2.5 km to 3.5 km from the site (Tokarsky, 1973). It is anticipated that shallow and regional groundwater flow would be southeast towards the Oldman River. Perched groundwater tables have also been encountered in many areas of Lethbridge. The depth to these perched tables can vary from approximately 2 m below ground level to considerable depths within gravel, sand and/or silt seams. The flow of these perched tables can also vary in any direction or be still, dependent on the horizontal and vertical dip and the extent of the sand and/or silt seams.

It should be noted that topography, geologic materials, land development, and soil disturbances influence localized variances in groundwater movement and pattern. In addition, groundwater levels will fluctuate seasonally and in response to climatic conditions.

2.9 PREVIOUS REPORTS

No known previous reports were available for the site.

2.10 OTHER INFORMATION SOURCES

There were no other information sources reviewed for the site.

3.0 SITE VISIT

Ms. Rigaux of EBA visited the site on March 1, 2009. Full access to the site was available at the time of the site reconnaissance.

The reconnaissance included a visual inspection of the site and observations of adjacent properties to identify evidence of impairment or potential sources of impairment, which may adversely affect the site.

3.1 BUILDING DETAILS

There were no buildings located on the site at the time of the site reconnaissance and the site was not serviced.

3.2 SPECIAL ATTENTION ITEMS

Some construction materials, which may be present in buildings, may be hazardous to building occupants or users of the site. There were no buildings located on the site at the time of the site reconnaissance; however; other special attention items may be present at the site. The following table (Table 8) summarizes these special attention items. Further background information on these materials is provided in Appendix C.

TABLE 8: SPECIAL ATTENTION ITEMS

Item	Presence/ Potential	Comments
Asbestos	Low	No buildings were present on the site at the time of the site reconnaissance.
Lead		
Mould		
Ozone-depleting Substances (ODS)		
Urea Formaldehyde Foam Insulation (UFFI)		
Polychlorinated Biphenyls (PCBs)	Low	The City of Lethbridge Electrical Substation #674S is located approximately 150 m to the southeast of the site which is a potential source of PCBs, however; based on the distance from the site, the substation is not considered to be of potential environmental concern to the site.
Radon	Low	There was no radon gas testing reported for the site; however, natural radon concentrations are low in Alberta and radon gas concentrations are usually well below target limits set for Canada. There were no anthropogenic sources of radon gas identified.
Methane	Low	There was no methane gas testing reported for the site. Based upon information collected during this investigation (i.e., aerial photograph review, site reconnaissance), there is evidence of possible buried organics at the site that could produce methane. Suspected areas of potential methane generation include the ephemeral wetlands that are scattered across the site, some of which have been cultivated over. Refer to Section 3.3.5 regarding potential fill areas.

TABLE 8: SPECIAL ATTENTION ITEMS		
Item	Presence/ Potential	Comments
Electromagnetic (EM)	Low	The City of Lethbridge Electrical Substation #674S is located to the southeast of the site which could generate an EM field. Overhead powerlines are present adjacent to the east and west as well as one extending east from the electrical substation which could also generate EM fields.
Noise and Vibration	Low	25 Street West is adjacent to the site to the west and construction was ongoing to the east of the site in the Copperwood residential subdivision (to the north) both of which are potential sources of noise and vibration.

3.3 SITE OBSERVATIONS

This section describes observations made of the site during the site reconnaissance.

3.3.1 Surficial Stains

There were no areas of surficial staining noted at the site during the site reconnaissance.

3.3.2 Vegetation

The site was largely vegetated with wheat stubble at the time of the site reconnaissance. There were no signs of distressed vegetation at the time of the site reconnaissance.

3.3.3 Ponding of Water

Ephemeral wetlands were scattered across the site that would potentially collect water during wet years, however; the wetlands did not contain water at the time of the site reconnaissance. Future development in these areas would require an approval under the Alberta *Water Act*.

Under the Alberta Water Act, a "water body" refers to "any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood, and includes but is not limited to wetlands…" (Water Act, revised Statutes of Alberta 2000, Chapter W-3, Section 1). A wetland identified on the property would be considered a "water body" under the Alberta Water Act and should therefore be included in the wetland compensation plan.

AENV's Provincial Restoration and Compensation Guide (February 2007) defines a wetland as "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment".

3.3.4 Washouts and Erosion

There were no washouts or indications of erosion observed at the site during the site reconnaissance.

3.3.5 Fill Areas and Soil Conditions

Soil piles were not observed during the site reconnaissance, however; soil piles were located to the north of the site in the Copperwood residential subdivision. EBA suspects that the piles were derived locally during construction of the Copperwood subdivision, however; this was not verified during the course of this Phase I ESA. These soil piles are not considered to be of potential environmental concern to the site.

It should be noted that volumes and exact locations of potential fill material have not been determined as this is not within the scope of this Phase I ESA. The potential for methane generation is described in Section 3.2.

3.3.6 Oil/Gas Wells and Pipelines

A Bonavista Petroleum well site with a riser and a well shack was observed on the southwest side of the site. The well site had an access road that extended east from 30 Street West to the east towards the well site. As well, a Bonavista Oil & Gas Ltd. pipeline extended across the southwest corner of the site to the well head and then continued to the south. See Section 2.3.2 (AbaData) for well and pipeline details.

An ATCO Gas pipeline was observed crossing the southwest side of the site during the site visit, however; neither AbaData or SPINII had information pertaining to this pipeline.

3.3.7 Chemical Storage

No chemical storage was observed at the site during the site reconnaissance. Refer to Section 3.3.10 and Section 3.3.11 for details regarding storage tanks.

3.3.8 Transformers

There were no transformers observed at the site during the site reconnaissance. The City of Lethbridge Electrical Substation #674S is located approximately 150 m to the southeast of the site. The City would be responsible for any leaking or staining from transformers located in the substation.

3.3.9 Hydraulic Elevators and Hoists

There were no hydraulic elevators or hoists observed on the site during the site reconnaissance.

3.3.10 Vent Pipes and Underground Storage Tanks (USTs)

No USTs were observed at the site during the site reconnaissance. Please see Section 2.3.1 (PTMAA) for information about USTs in the surrounding area.

3.3.11 Above-Ground Storage Tanks (ASTs) and Drum Storage

No ASTs were observed at the site during the site reconnaissance. Please see Section 2.3.1 (PTMAA) for information about ASTs in the surrounding area.

3.3.12 General Housekeeping

The general housekeeping of the site was good and no obvious evidence of negligent acts or illegal dumping was observed during the site reconnaissance.

3.4 OFF-SITE OBSERVATIONS

The following table (Table 9) summarizes the surrounding land use.

TABLE 9: SURROUNDING LAND USE

Direction	Land Use	Business Name	Zoning	Observations EBA Evaluation
West, south and east	Agricultural	n/a	Urban Reserve (U-R)	No obvious potential for environmental concern.
North	Residential	Copperwood residential subdivision	Low Density Residential (R-L)	

The surrounding land to the north and east is primarily zoned low density residential. The surrounding land to the west and south is zoned urban reserve. Key surrounding land use is indicated on Figure 2.

4.0 DISCUSSION AND CONCLUSIONS

4.1 GENERAL

In general terms, there are two distinct types of potential environmental risk to any property. The first type of risk is from potential impairment from on-site land use. This would include potential accidental spills or site practices that may impact the site directly. The second type of risk is from impairment caused by adjacent property owners, which might then be transported through the subsurface soils by groundwater, or in overland runoff onto the site.

4.2 POTENTIAL FOR IMPAIRMENT FROM ON-SITE SOURCE(S)

An oil/gas lease site and associated pipelines (belonging to Bonavista Petroleum Ltd. and Bonavista Oil & Gas Ltd., respectively) are present on the southwest side of the site at 12-22-008-22 W4M. The well site and pipelines are considered to pose potential for environmental impairment to the site from drilling and construction activities, however;

gathering of additional information pertaining to these activities was not within the scope of this Phase I ESA.

Several ephemeral wetlands that would potentially collect water in wet years were observed at the site during the site reconnaissance and noted in the aerial photograph review. Future development in these areas would require an approval under the Alberta *Water Act*. According to the aerial photograph review, several of these ephemeral wetlands have been cultivated since the 1950's. There is potential for methane generation from the buried organic material which is commonly found in wetland areas. Buried organic soils should be removed in the areas of future building development.

There are no additional potential on-site sources of environmental impairment relating to the site from historical or current on-site land uses.

4.3 POTENTIAL FOR IMPAIRMENT FROM OFF-SITE SOURCE(S)

There are no apparent potential off-site sources of environmental impairment relating to the site from historical or current off-site land uses.

5.0 FURTHER ACTION/RENDERING AN OPINION

Based on the present study, EBA recommends that additional work be conducted and information gathered to determine if a Phase II ESA is required. This would include additional upstream oilfield background searches including a core library search and Alberta Environment's drilling mud calculations. In addition, it should be determined if a Phase II ESA has previously been conducted on the site by the well site operator. Soil and groundwater quality may need to be assessed in the area within the well site boundary.

6.0 LIMITATIONS OF LIABILITY

This report and its contents are intended for the sole use of Stantec Consulting Ltd. and their agents. EBA Engineering Consultants Ltd. does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Stantec Consulting Ltd., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user.

Use of this report is subject to the terms and conditions stated in EBA's Services Agreement and in the GeoEnvironmental Report – General Conditions provided in Appendix D of this report.

7.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact Ms. Mireille Rigaux at our Lethbridge office.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Mireille Rigaux, B.Sc.
Environmental Scientist

Deryck Masterman, B.Sc., A. Ag.
Environmental Scientist

PROFESSIONAL ENGINEER ALBERTA
SEAN D. BUCKLES
March 9/09

Reviewed by:

Sean Buckles, P. Eng
Project Engineer

/sdt

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature ______
Date March 10, 09
PERMIT NUMBER: P245
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

REFERENCES

ABACUS Datagraphics Website. Updated April 17, 2007. Abadata database http://www.abacusdatagraphics.com/.

Alberta Energy and Utilities Board. 2009. Information Services. Response included in Appendix B.

Alberta Environment. (date of last update not available). Authorization/Approval Viewer. Information obtained included in Appendix B. http://www3.gov.ab.ca/env/water/approvalviewer.html.

Alberta Environment. (date of last update not available). Water Well Database. Information obtained included in Appendix B. http://www.telusgeomatics.com/tgpub/ag_water/.

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Alberta Resource and Conservation Board Coal Mine Atlas. March 1988. Edmonton, Alberta.

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Canadian Standards Association. 2003. Z768-01, Phase I Environmental Site Assessment.

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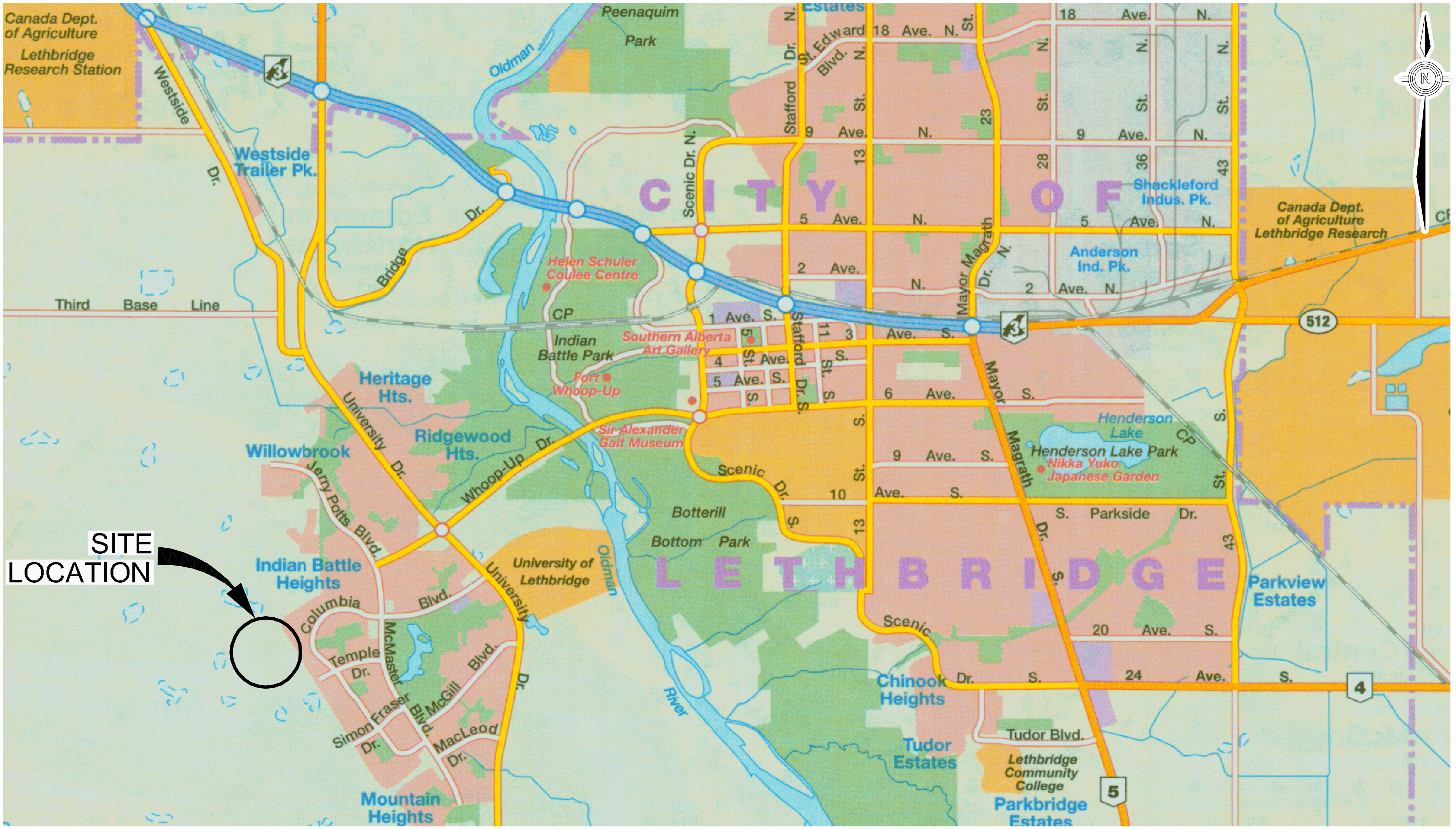
Western Canada Insurance Underwriters Association Fire Insurance Maps. Insurance Plan for the City of Lethbridge, Alberta. July, 1955. Winnipeg, Manitoba.

FIGURES

\\lethbridge\drafting\L221 Projects\L22101248\L22101248_FIG1.dwg



CLIENT	Stantec Consulting Ltd.

PORTIONS OF N 22-8-22 W4M AND PORTIONS OF NW 23-8-22 W4M

SITE LOCATION PLAN

EBA Engineering Consultants Ltd.

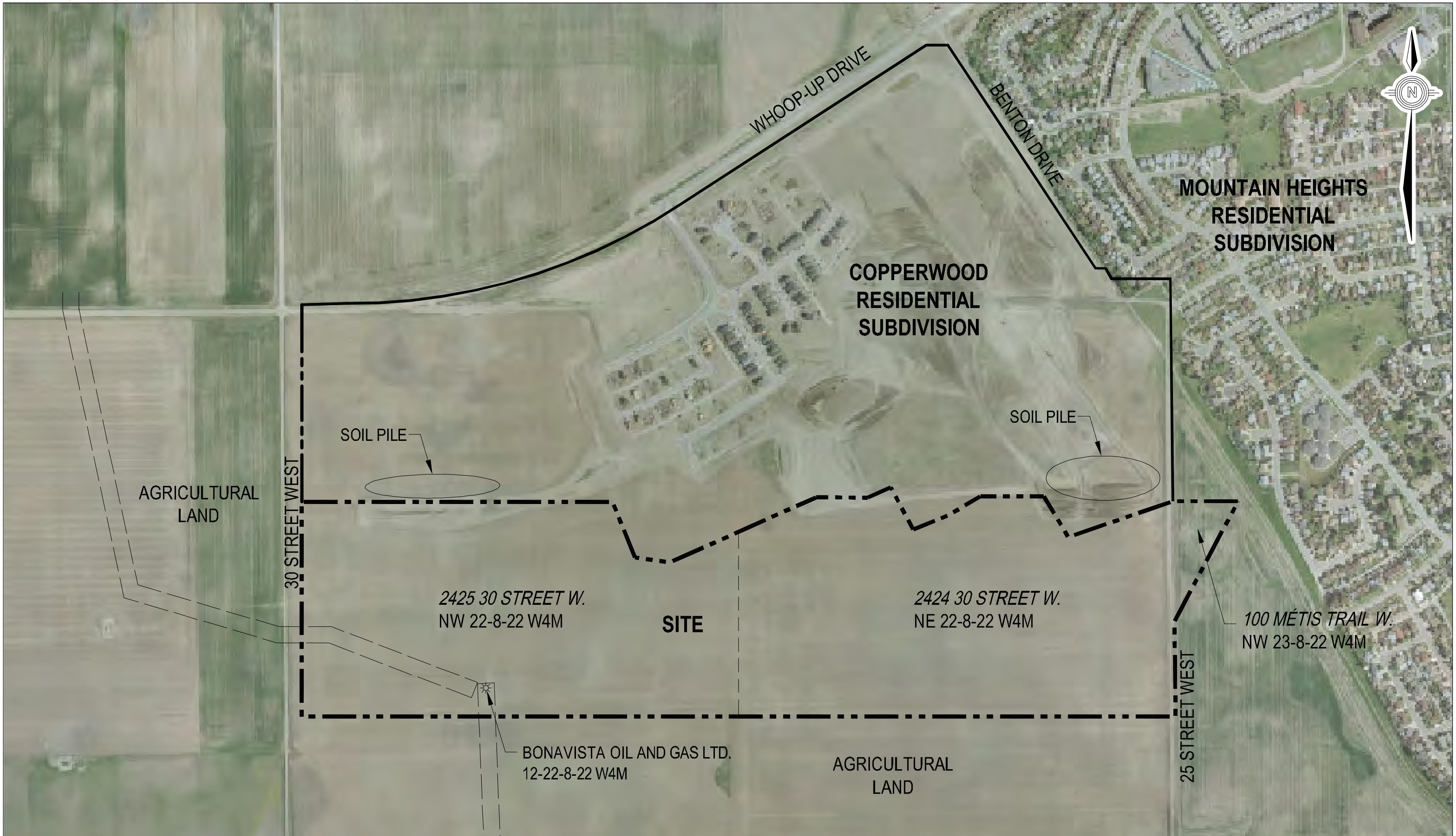
PROJECT NO.	DWN	CKD	REV
L22101248	LCH	MR	0

OFFICE	DATE
LETH	March 3, 2009

Figure 1

Scale 1:50000 — 0, 1, 1.5, 2.0, 2.5km

\\lethbridge\drafting\L221 Projects\L22101248\L22101248_FIG2.dwg



AIR PHOTO CIRCA 2007

LEGEND

SITE BOUNDARY

0 100 250 500m

SCALE 1:10000

CLIENT

Stantec Consulting Ltd.

EBA Engineering Consultants Ltd.

PORTIONS OF N 22-8-22 W4M AND PORTIONS OF NW 23-8-22 W4M

SITE PLAN

PROJECT NO.	DWN	CKD	REV
L22101248	LCH	MR	0
OFFICE	DATE		
LETH	March 6, 2009		

Figure 2

APPENDIX

APPENDIX A SITE PHOTOGRAPHS

Photo 1
Looking north at the eastern boundary NE-22-8-22 W4M from the southeast corner. Note 25 Street West on the right side.

Photo 2
Looking west at the northern boundary NE-22-8-22 W4M from the northeast corner.

Photo 3
Looking north at the portion of NW-23-8-22 W4M from the south side. Note 25 Street West on the left side.

Photo 4
Looking southwest across NE-22-8-22 W4M from the northwest corner.

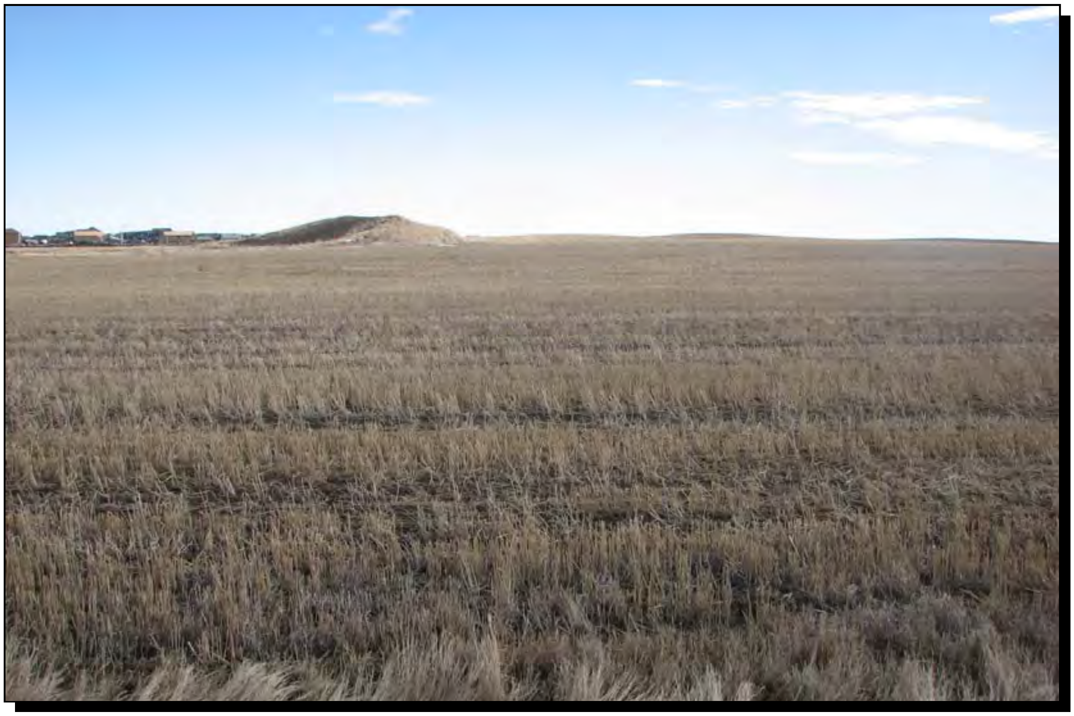


Photo 5
Looking east at the northern boundary of NW-22-8-22 W4M from the northwest corner.

Photo 6
Looking south at the western boundary of NW-22-8-22 W4M from the northwest corner. Note 30 Street West on the right.

Photo 7
Looking east at the southern boundary of the site. Note the ATCO gas pipeline crossing the site on the south.

Photo 8
Looking at the Bonavista wellsite located at 12-22-008-22 W4M on the south side of the site.

Photo 9
Land use to the north of the site: Copperwood Residential Subdivision.

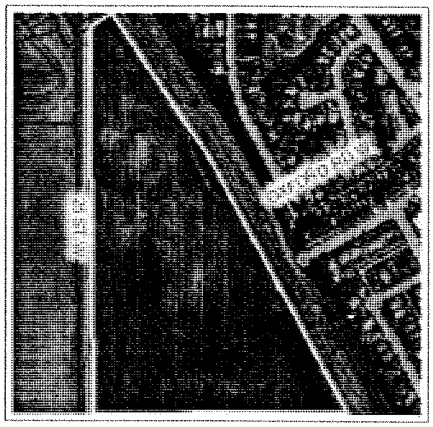
Photo 10
Land use to the east of the site: Mountain Heights Residential Subdivision.

Photo 11
Land use to the south: Agricultural land.

Photo 12
Land use to the west: Agricultural land.

APPENDIX

APPENDIX B REGULATORY INQUIRIES



* *Imagery: 2007 Ortho*

100 METIS TRAIL W

General Info

Roll Number:	2006501000001
Address:	100 METIS TRAIL W
Plan:	NOPLAN
Block:	
Lot:	
Legal:	MERIDIAN 4 RANGE 22 TOWNSHIP 8 SECTION 23 QUARTER NORTH WEST CONTAINING 64.7 HECTARES (160 ACRES) MORE OR LESS EXCEPTING THEREOUT: PLAN NUMBER HECTARES ACRES MORE OR LESS SUBDIVISION 7710684 52.32 REPLOTTING SCHEME 7710705 0.06 REPLOTTING SCHEME 7710882 71.57 REPLOTTTNG SCHEME 7810431 9.01 SUBDIVISION 0814827 0.101 0.25
Zoning:	R-CL UR

Census Info

- 100 METIS TRAIL W falls within **Census Tract 2008**

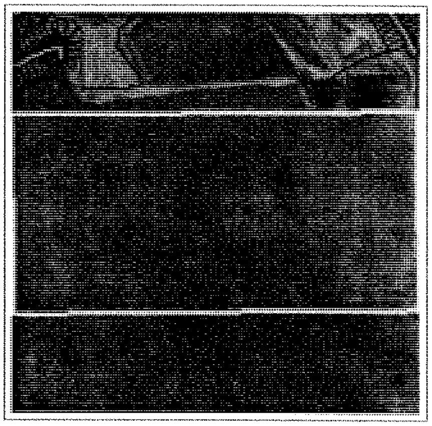
Summary

Male:	9
Female:	7
Total:	**16**

Demographics by Age & Sex

* *Statistics compiled from City of Lethbridge 2008 Census.*

Close



* Imagery: 2007 Ortho

2424 25 ST W

General Info

Roll Number:	2125024240001
Address:	2424 25 ST W
Plan:	NOPLAN
Block:	
Lot:	
Legal:	MERIDIAN 4 RANGE 22 TOWNSHIP 8 SECTION 22 QUARTER NORTH EAST CONTAINING 64.7 HECTARES(159.88 ACRES) MORE OR LESS EXCEPTING THEREOUT: PLAN NUMBER HECTARES ACRES MORE OR LESS SUBDIVISION 0512218 32.374 80.00
Zoning:	UR

Census Info

- 2424 25 ST W falls within **Census Tract 2008**

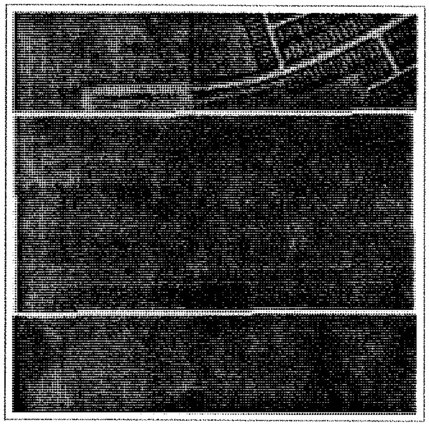
⊟ *Summary*

Male:	9
Female:	7
Total:	**16**

⊞ *Demographics by Age & Sex*

** Statistics compiled from City of Lethbridge 2008 Census.*

Close



* Imagery: 2007 Ortho

2425 30 ST W

General Info

Roll Number:	2130024250001
Address:	2425 30 ST W
Plan:	NOPLAN
Block:	
Lot:	
Legal:	MERIDIAN 4 RANGE 22 TOWNSHIP 8 SECTION 22 QUARTER NORTH WEST CONTAINING 64.7 HECTARES(160 ACRES) MORE OR LESS EXCEPTING THEREOUT: PLAN NUMBER HECTARES (ACRES) MORE OR LESS SUBDIVISION 0512143 32.393 80.04
Zoning:	DC P-B

Census Info

- 2425 30 ST W falls within **Census Tract 2008**

Summary

Male:	9
Female:	7
Total:	**16**

Demographics by Age & Sex

** Statistics compiled from City of Lethbridge 2008 Census.*

Close

HISTORICAL LAND TITLE CERTIFICATE

CURRENT TITLE WITH HISTORICAL DATA

S

LINC	SHORT LEGAL	TITLE NUMBER
0033 565 823	4;22;8;23;NW	081 411 298 +47

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 23
QUARTER NORTH WEST
CONTAINING 64.7 HECTARES (160 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	ACRES	MORE OR LESS
SUBDIVISION	7710684		52.32	
REPLOTTING SCHEME	7710705		0.06	
REPLOTTING SCHEME	7710882		71.57	
REPLOTTTNG SCHEME	7810431		9.01	
SUBDIVISION	0814827	0.101	0.25	

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 081 411 086 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
081 411 298	03/11/2008	SUBDIVISION PLAN		

OWNERS

THE CITY OF LETHBRIDGE.
OF 910 - 4TH AVENUE S., LETHBRIDGE
ALBERTA T1J 0P6

(CONTINUED)

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 003 252	10/01/1974	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE OLDMAN RIVER REGIONAL PLANNING COMMISSION.
771 055 709	04/05/1977	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE OLDMAN RIVER REGIONAL PLANNING COMMISSION.
071 444 489	05/09/2007	UTILITY RIGHT OF WAY GRANTEE - THE CITY OF LETHBRIDGE. 910 - 4TH AVE. SOUTH, LETHBRIDGE ALBERTA AS TO PORTION OR PLAN:0714451 UR/W "C"

TOTAL INSTRUMENTS: 003

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 12 DAY OF NOVEMBER, 2008 AT 01:43 P.M.

ORDER NUMBER:12731889

CUSTOMER FILE NUMBER: 6838506

END OF CERTIFICATE

HISTORICAL LAND TITLE CERTIFICATE

CURRENT TITLE WITH HISTORICAL DATA

S

LINC	SHORT LEGAL	TITLE NUMBER
0031 120 587	4;22;8;22;NE	051 220 164 +1

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 22
QUARTER NORTH EAST
CONTAINING 64.7 HECTARES(159.88 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	ACRES	MORE OR LESS
SUBDIVISION	0512218	32.374	80.00	

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 011 367 124

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
051 220 164	21/06/2005	SUBDIVISION PLAN		

OWNERS

SERDNA FARMS LTD..
OF 2213-24 AVENUE
COALDALE
ALBERTA T1M 1G8

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		NORTHERN IRRIGATION DISTRICT
751 004 557	17/01/1975	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
041 479 994	20/12/2004	CAVEAT RE : PURCHASE AGREEMENT CAVEATOR - DAYTONA LAND CORP.. 404, 10216-124 ST EDMONTON ALBERTA T5N4A3 AGENT - WAYNE R LOVATT
051 030 315	24/01/2005	CAVEAT RE : RIGHT OF FIRST REFUSAL CAVEATOR - DAYTONA LAND CORP.. C/O LOVATT OLSEN 404, 10216-124 ST EDMONTON ALBERTA T5N4A3 AGENT - PETER R SEMONICK
051 220 165	21/06/2005	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE CITY OF LETHBRIDGE. 910 - 4TH AVE. SOUTH, LETHBRIDGE ALBERTA
091 011 358	13/01/2009	CAVEAT RE : VENDOR'S LIEN CAVEATOR - DAYTONA LAND CORP.. 100, 10423-178 STREET EDMONTON ALBERTA T5S1R5 AGENT - WAYNE R LOVATT

(CONTINUED)

TOTAL INSTRUMENTS: 006

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 19 DAY OF FEBRUARY, 2009 AT 11:36 A.M.

ORDER NUMBER:13333762

CUSTOMER FILE NUMBER: 6838512

END OF CERTIFICATE

HISTORICAL LAND TITLE CERTIFICATE

CURRENT TITLE WITH HISTORICAL DATA

S

LINC	SHORT LEGAL	TITLE NUMBER
0031 114 648	4;22;8;22;NW	081 391 304

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 22 TOWNSHIP 8
SECTION 22
QUARTER NORTH WEST
CONTAINING 64.7 HECTARES(160 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	(ACRES) MORE OR LESS
SUBDIVISION	0512143	32.393	80.04

EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF LETHBRIDGE

REFERENCE NUMBER: 051 213 774 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
081 391 304	17/10/2008	TRANSFER OF LAND	$2,482,000	$2,482,000

OWNERS

DAYTONA URBAN DEVELOPMENT CORP..
OF 100, 10423 178 ST
EDMONTON
ALBERTA T5S 1R5

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		NORTHERN IRRIGATION DISTRICT
751 006 968	27/01/1975	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
791 209 303	11/12/1979	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
981 102 147	09/04/1998	CAVEAT RE : SURFACE LEASE UNDER 20 ACRES CAVEATOR - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 (DATA UPDATED BY: TRANSFER OF CAVEAT 991026304) (DATA UPDATED BY: TRANSFER OF CAVEAT 011228042) (DATA UPDATED BY: TRANSFER OF CAVEAT 041186908)
981 102 148	09/04/1998	CAVEAT RE : RIGHT OF WAY AGREEMENT CAVEATOR - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 AGENT - DIANE VANDER VEEN (DATA UPDATED BY: TRANSFER OF CAVEAT 991026304) (DATA UPDATED BY: TRANSFER OF CAVEAT 011238126) (DATA UPDATED BY: TRANSFER OF CAVEAT 041187481)
981 356 450	16/11/1998	UTILITY RIGHT OF WAY GRANTEE - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 "RE-ENTERED 30/03/01 BY 011084942" (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 011251218) (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 041220522)

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
991 026 304	28/01/1999	TRANSFER OF CAVEAT 981102147 AND CAVEAT 981102148 TRANSFEREE - ENCOUNTER ENERGY INC.. 1940, 540 5 AVE SW CALGARY ALBERTA T2P0M2
011 085 073	30/03/2001	DISCHARGE OF UTILITY RIGHT OF WAY 981356450 PARTIAL SEE INSTRUMENT
011 228 042	10/08/2001	TRANSFER OF CAVEAT 981102147 TRANSFEREE - BONAVISTA OIL & GAS LTD.. 1100, 321 - 6 AVENUE SW CALGARY ALBERTA T2P3H3
011 238 126	20/08/2001	TRANSFER OF CAVEAT 981102148 TRANSFEREE - BONAVISTA OIL & GAS LTD.. 1100, 321 - 6 AVENUE SW CALGARY ALBERTA T2P3H3
011 251 218	30/08/2001	TRANSFER OF UTILITY RIGHT OF WAY 981356450 TRANSFEREE - BONAVISTA OIL & GAS LTD..
041 186 908	25/05/2004	TRANSFER OF CAVEAT 981102147 TRANSFEREE - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5
041 187 481	25/05/2004	TRANSFER OF CAVEAT 981102148 TRANSFEREE - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 AGENT - DIANE VANDER VEEN
041 220 522	14/06/2004	TRANSFER OF UTILITY RIGHT OF WAY 981356450 TRANSFEREE - BONAVISTA PETROLEUM LTD.. P.O. BOX 22192,BANKERS HALL POSTAL OUTLET CALGARY ALBERTA T2P4H5 AGENT - DIANE VANDER VEEN

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
051 213 775	16/06/2005	CAVEAT RE : DEFERRED RESERVE CAVEATOR - THE CITY OF LETHBRIDGE. 910 4 TH AVENUE SOUTH LETHRIDGE ALBERTA
081 391 294	17/10/2008	CAVEAT RE : VENDOR'S LIEN CAVEATOR - JENNY ANN SKINNER CAVEATOR - BEVERLY GAY SKINNER CAVEATOR - SHARON HUBBARD ALL OF : C/O NORTH & COMPANY 600, 220 - 4TH STREET SOUTH LETHBRIDGE ALBERTA T1J4J7 AGENT - GLEN W WRIGHT
081 414 574	05/11/2008	DISCHARGE OF CAVEAT 081391294

TOTAL INSTRUMENTS: 017

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 19 DAY OF FEBRUARY, 2009 AT 11:36 A.M.

ORDER NUMBER:13333762

CUSTOMER FILE NUMBER: 6838512

END OF CERTIFICATE

(CONTINUED)

PETROLEUM TANK MANAGEMENT ASSOCIATION OF ALBERTA

Petroleum Tank Management
Association of Alberta
Suite 980, 10303 Jasper Avenue
Edmonton, Alberta T5J 3N6
PH: (780)425-8265 or 1-866-222-8265
FAX: (780)425-4722

February 12, 2009

Mireille Rigaux
EBA Engineering Consultants Ltd.
442 10 Street N
Lethbridge, AB
T1H 2C7

Dear Mireille Rigaux:

As per your request, the PTMAA has checked the registration of active tank sites and inventory of abandoned tank sites and there are no records for the properties with the legal land description:

N 22-8-22-W4, Lethbridge
NW 23-8-22-W4, Lethbridge

Please note that both databases are not complete. The main limitation of these databases is that they only include information reported through registration or a survey of abandoned sites completed in 1992 and should not be considered as a comprehensive inventory of all past or present storage tank sites. The PTMAA **cannot** guarantee that tanks do not or have not existed at this location. Information in the databases is based on information supplied by the owner and the PTMAA cannot guarantee its accuracy. Information on storage tanks or on past or present contaminant investigations may be filed with the local Fire Department or Alberta Environment.

Yours truly,

Connie Jacobsen
PTMAA

AbaData

N

Wellheads

- Abandoned Wellhead
- Suspended Gas Wellhead
- Suspended Oil Wellhead
- Flowing Gas Wellhead
- Location Wellhead
- Flowing Oil Wellhead
- Miscellaneous Wellhead
- Water Wellhead
- Well Downhole Location
- Newly Licenced Well
- Newly Spudded Well

High Pressure Pipelines

- Gas Pipeline
- Oil Pipeline
- Water Pipeline
- LVP/HVP Pipeline
- Foreign Pipeline (Only when a company is specified.)

Low Pressure Pipelines

- Gas Co-op Pipeline

ERCB DATA | ATTACHED FILES

Close Screen

WELL INFORMATION
CURRENT TO JANUARY 30, 2009

EVENT: 2

WELL ID:	00 / 12-22-008-22 W4 / 2		
LICENCE #:	0201406	**LICENCE DATE:**	MAY 16, 1997
WELL NAME:	BONAVISTA PENNY 12-22-8-22		
WITHIN:	12-22-008-22 W4	**H2S (mol/kmol):**	NOT AVAILABLE
LICENCEE:	BONAVISTA PETROLEUM LTD.		
SPUD DATE:	JULY 9, 1997	**FINAL DRILL DATE:**	JULY 13, 1997
STATUS:	GAS FLOW	**ABANDONED DATE:**	
SURFACE:		**DOWNHOLE:**	
OFFSETS:	S 750 E 314.9	OFFSETS:	S 750 E 314.9
LATITUDE:	49.662477	LATITUDE:	49.662477
LONGITUDE:	112.910089	LONGITUDE:	112.910089
GROUND ELEVATION:	936.3 m 3072 '	TOTAL DEPTH:	1160 m 3806 '
WELL TYPE:	NOT AVAILABLE	**SUBSTANCE:**	NOT AVAILABLE

OPTIONS

Open Well Plat

Request Divestco Log

Create CBM Report

Add To Custom Well List

Print Screen

MORE INFO

Select Info to View

ERCB DATA | ATTACHED FILES

Close Screen

ERCB PIPELINE INFORMATION
CURRENT TO JANUARY 30, 2009

LICENCE/LINE #:	30255 - 3		**PERMIT DATE:**	SEPTEMBER 4, 1997	
ABACUS #:			**LICENCE DATE:**	MARCH 4, 1998	
COMPANY:	BONAVISTA OIL & GAS LTD.				
FROM LOCATION:	12-22-008-22 W4M WE		**TO LOCATION:**	09-21-008-22 W4M PL	
LENGTH:	0.7 kms	0.43 mi	**STATUS:**	O	
SUBSTANCE:	NG		**H2S:**	0 mol/kmol	0 ppm
OD:	114.3 mm	4.50 "	**WT:**	3.18 mm	0.13 "
MATERIAL:	S		**TYPE:**	Z245.1	
GRADE:	2901		**MOP:**	4960 kPa	719 psi
JOINTS:	W		**INTL COATING:**	U	
STRESS LEVEL:	31 %		**ENVIRONMENT:**		
ORIGINAL PERMIT DATE:	SEPTEMBER 4, 1997		**CONST. DATE:**		
ORIGINAL LICENCE/LINE #:	30255 - 3				

OPTIONS

View Company Info

View Installation Info

View Entire Licence

View Licence Ticket

View Spill Incidents

Highlight Line

Highlight Entire Licence

Print Screen

ERCB DATA | ATTACHED FILES

Close Screen

ERCB PIPELINE INFORMATION
CURRENT TO JANUARY 30, 2009

LICENCE/LINE #:	30255 - 5		**PERMIT DATE:**	NOVEMBER 13, 1998	
ABACUS #:			**LICENCE DATE:**	MAY 13, 1999	
COMPANY:	BONAVISTA OIL & GAS LTD.				
FROM LOCATION:	13-15-008-22 W4M WE		**TO LOCATION:**	12-22-008-22 W4M PL	
LENGTH:	1.2 kms	0.75 mi	**STATUS:**	O	
SUBSTANCE:	NG		**H2S:**	0 mol/kmol	0 ppm
OD:	88.9 mm	3.50 "	**WT:**	3.18 mm	0.13 "
MATERIAL:	S		**TYPE:**	Z245.1	
GRADE:	2901		**MOP:**	4960 kPa	719 psi
JOINTS:	W		**INTL COATING:**	U	
STRESS LEVEL:	24 %		**ENVIRONMENT:**		
ORIGINAL PERMIT DATE:	NOVEMBER 13, 1998		**CONST. DATE:**		
ORIGINAL LICENCE/LINE #:	30255 - 5				

OPTIONS

View Company Info

View Installation Info

View Entire Licence

View Licence Ticket

View Spill Incidents

Highlight Line

Highlight Entire Licence

Print Screen

protection
&
enforcement

Last Update/Review: **April 1, 2000**

Authorization /Approval Viewer

For advanced search help see: Authorization / Approval Viewer Help

The search used the following values:

Legal Land Location: M: 4 Rge: 22 Twp: 8 Sec: 22 QS: NE

Show Inactive Authorizations / Approvals: No

The resulting Authorizations / Approvals based on the search criteria will be displayed below. A will appear next to the Authorization / Approval when documentation is available for viewing or downloading. **Please click Authorization / Approval Viewer Help if you encounter problems viewing the approval document.**

The documents referenced from this page are in Adobe Acrobat Writer (.pdf) format. Click on Get Acrobat Reader to download Adobe Acrobat Reader.

No records match the search criteria.

Back to Search Page | Protection and Enforcement | Water | Top of Page

Comments regarding the Alberta Environment Authorization / Approval Viewer page may be directed to the Regulatory Approvals Centre RAC.Environment@gov.ab.ca

Alberta Connects

protection
&
enforcement

Alberta
ENVIRONMENT

Last Update/Review: **April 1, 2000**

Authorization /Approval Viewer

For advanced search help see: Authorization / Approval Viewer Help

The search used the following values: **Legal Land Location:** M: 4 Rge: 22 Twp: 8 Sec: 22 QS: NW **Show Inactive Authorizations / Approvals:** No

The resulting Authorizations / Approvals based on the search criteria will be displayed below. A will appear next to the Authorization / Approval when documentation is available for viewing or downloading. **Please click Authorization / Approval Viewer Help if you encounter problems viewing the approval document.**

The documents referenced from this page are in Adobe Acrobat Writer (.pdf) format. Click on Get Acrobat Reader to download Adobe Acrobat Reader.

No records match the search criteria.

Back to Search Page | Protection and Enforcement | Water | Top of Page

Comments regarding the Alberta Environment Authorization / Approval Viewer page may be directed to the Regulatory Approvals Centre RAC.Environment@gov.ab.ca

Alberta Connects

Alberta
GOVERNMENT OF ALBERTA

protection & enforcement

Alberta ENVIRONMENT

Last Update/Review: **April 1, 2000**

Authorization /Approval Viewer

For advanced search help see: Authorization / Approval Viewer Help

The search used the following values:
Legal Land Location: M: 4 Rge: 22 Twp: 8 Sec: 23 QS: NW
Show Inactive Authorizations / Approvals: No

The resulting Authorizations / Approvals based on the search criteria will be displayed below. A will appear next to the Authorization / Approval when documentation is available for viewing or downloading. **Please click Authorization / Approval Viewer Help if you encounter problems viewing the approval document.**

The documents referenced from this page are in Adobe Acrobat Writer (.pdf) format. Click on Get Acrobat Reader to download Adobe Acrobat Reader.

No records match the search criteria.

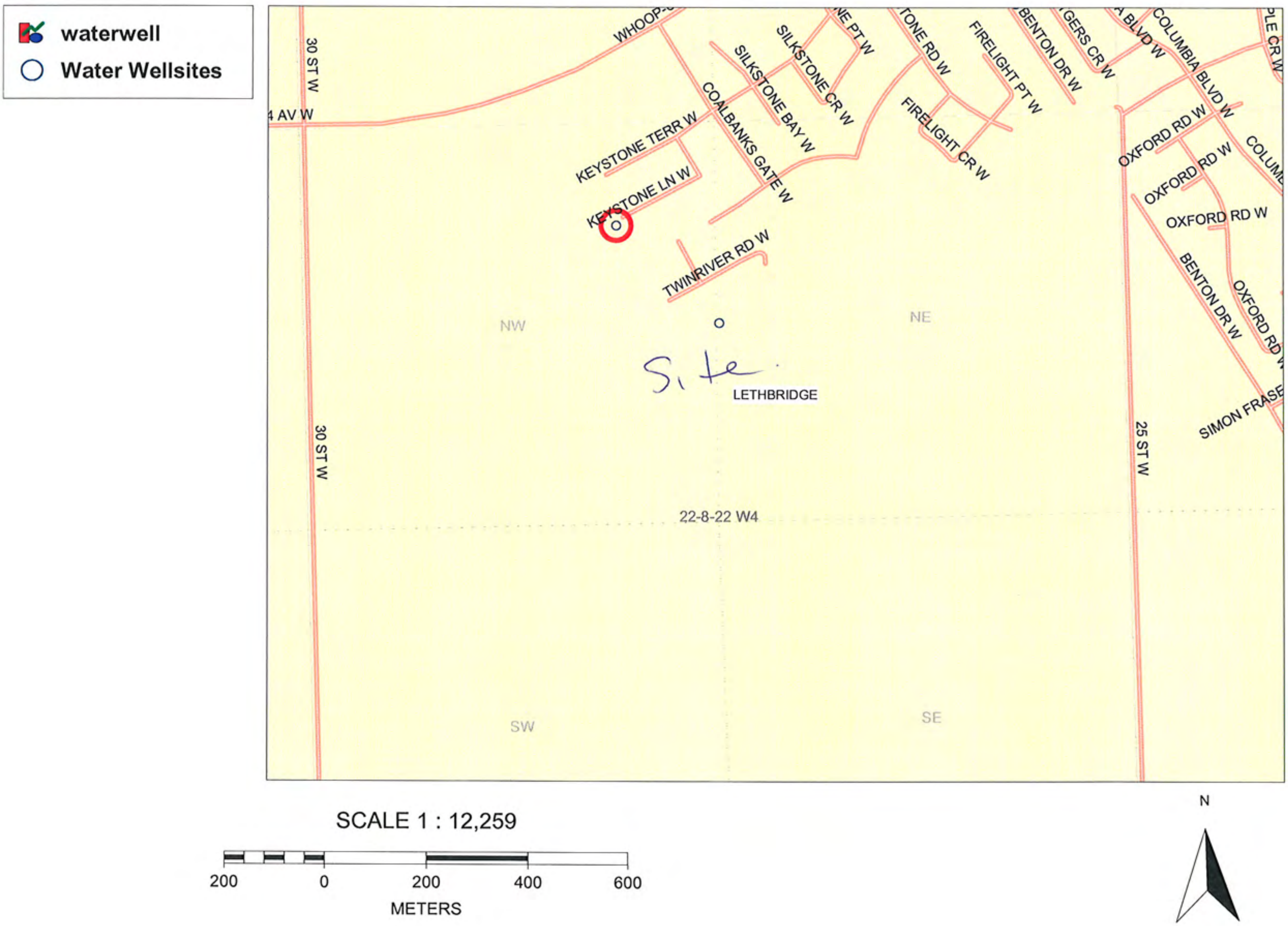
Back to Search Page | Protection and Enforcement | Water | Top of Page

Comments regarding the Alberta Environment Authorization / Approval Viewer page may be directed to the Regulatory Approvals Centre RAC.Environment@gov.ab.ca

Alberta Connects

Alberta GOVERNMENT OF ALBERTA

TELUS Geomatics - Alberta Map



SCALE 1 : 12,259

200 0 200 400 600
METERS

Water Well Drilling Report

Alberta Environment

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0118430
Map Verified: Field
Date Report Received: 1965/02/01
Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLER
Drilling Company Approval No.: 99999
Mailing Address: UNKNOWN
City or Town: UNKNOWN AB CA
Postal Code:
WellOwner's Name: ARC
Well Location Identifier:
P.O. Box Number:
Mailing Address:
Postal Code:
City:
Province:
Country:

2. Well Location

1/4 or LSD	Sec	Twp	Rge	Westof M
NH	22	008	22	4

Location in Quarter
0 FT from Boundary
0 FT from Boundary
Lot Block Plan
Well Elev: 3078 FT
How Obtain: Estimated

3. Drilling Information

Type of Work: Well Inventory
Reclaimed Well
Date Reclaimed:
Materials Used:
Method of Drilling: Drilled
Flowing Well:
Rate: Gallons
Gas Present: No
Oil Present: No
Proposed well use: Unknown
Anticipated Water Requirements/day 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:
Test Method:
Non pumping static level: FT
Rate of water removal: Gallons/Min
Depth of pump intake: FT
Water level at end of pumping: FT
Distance from top of casing to ground level: Inches

Depth To water level (feet) Drawdown	Elapsed Time Minutes:Sec	Recovery

Total Drawdown: FT
If water removal was less than 2 hr duration, reason why:
Recommended pumping rate: Gallons/Min
Recommended pump intake: FT
Type pump installed
Pump type:
Pump model:
H.P.:
Any further pumptest information?

4. Formation Log

Depth from ground level (feet)	Lithology Description
335	Glacial Drift
1030	Unknown
1450	Formost Formation
1560	Pakowki Formation
1823	Unknown
3243	Shale
3735	Sandy Shale
4551	Unknown

5. Well Completion

Date Started(yyyy/mm/dd):
Date Completed(yyyy/mm/dd): 1932/02/27
Well Depth: 4580 FT
Borehole Diameter: 0 Inches
Casing Type:
Liner Type:
Size OD: 0 Inches
Size OD: 0 Inches
Wall Thickness: 0 Inches
Wall Thickness: 0 Inches
Bottom at: 0 FT
Top: 0 FT Bottom: 0 FT
Perforations
from: 0 FT to: 0 FT
from: 0 FT to: 0 FT
from: 0 FT to: 0 FT
Perforations Size:
0 Inches x 0 Inches
0 Inches x 0 Inches
0 Inches x 0 Inches
Perforated by:
Seal:
from: 0 FT to: 0 FT
Seal:
from: 0 FT to: 0 FT
Seal:
from: 0 FT to: 0 FT
Screen Type:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
Slot Size: 0 Inches
Screen Type:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
Slot Size: 0 Inches
Screen Installation Method:
Fittings
Top:
Bottom:
Pack:
Grain Size:
Amount:
Geophysical Log Taken:
Retained on Files:
Additional Test and/or Pump Data
Chemistries taken By Driller: No
Held: 0
Documents Held: 1
Pitless Adapter Type:
Drop Pipe Type:
Length:
Diameter:
Comments:

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
Certification No.:
This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
Signature Yr Mo Day

Report 1

Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0118429
Map Verified: Field
Date Report Received: 1937/01/01
Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLER
Drilling Company Approval No.: 99999
Mailing Address: UNKNOWN
City or Town: UNKNOWN AB CA
Postal Code:
WellOwner's Name: IMPERIAL OIL
Well Location Identifier:
P.O. Box Number:
Mailing Address:
Postal Code:
City:
Province:
Country:

2. Well Location

1/4 or LSD	Sec	Twp	Rge	Westof M
14	22	008	22	4

Location in Quarter
0 FT from Boundary
0 FT from Boundary
Lot Block Plan
Well Elev: 3077 FT
How Obtain: Estimated

3. Drilling Information

Type of Work: Federal Well Survey
Reclaimed Well
Date Reclaimed:
Materials Used:
Method of Drilling: Drilled
Flowing Well:
Rate: Gallons
Gas Present: No
Oil Present: No
Proposed well use: Industrial
Anticipated Water Requirements/day
0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:
Test Method:
Non pumping static level: FT
Rate of water removal: Gallons/Min
Depth of pump intake: FT
Water level at end of pumping: FT
Distance from top of casing to ground level: Inches

Depth To water level (feet) Drawdown	Elapsed Time Minutes:Sec	Recovery

Total Drawdown: FT
If water removal was less than 2 hr duration, reason why:
Recommended pumping rate: Gallons/Min
Recommended pump intake: FT
Type pump installed
Pump type:
Pump model:
H.P.:
Any further pumptest information?

4. Formation Log

Depth from ground level (feet)	Lithology Description

5. Well Completion

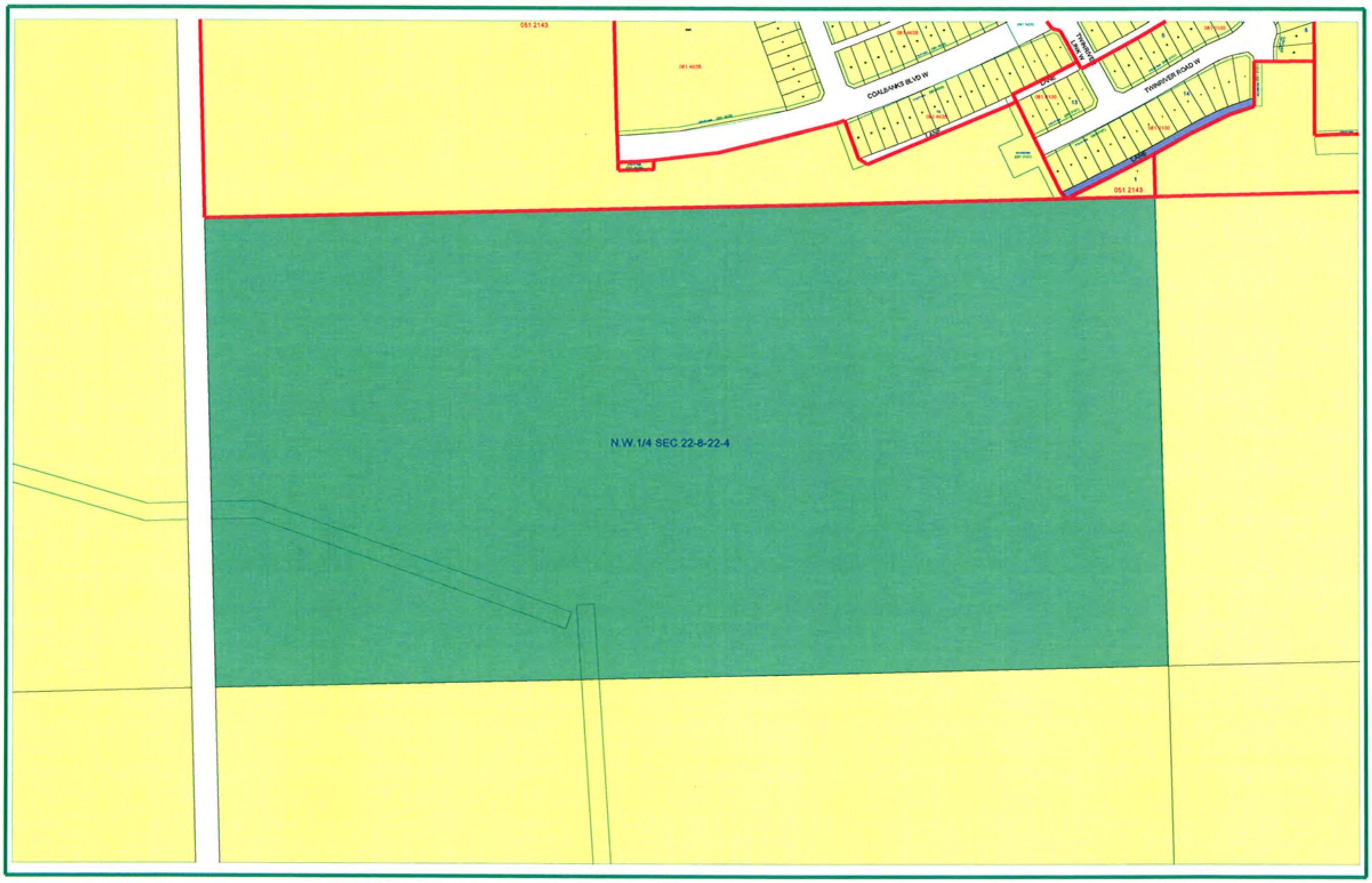
Date Started(yyyy/mm/dd):
Date Completed(yyyy/mm/dd):
Well Depth: 4578 FT
Borehole Diameter: 0 Inches
Casing Type:
Liner Type:
Size OD: 0 Inches
Size OD: 0 Inches
Wall Thickness: 0 Inches
Wall Thickness: 0 Inches
Bottom at: 0 FT
Top: 0 FT Bottom: 0 FT
Perforations
from: 0 FT to: 0 FT — 0 Inches x 0 Inches
from: 0 FT to: 0 FT — 0 Inches x 0 Inches
from: 0 FT to: 0 FT — 0 Inches x 0 Inches
(Perforations Size)
Perforated by:
Seal:
from: 0 FT to: 0 FT
Seal:
from: 0 FT to: 0 FT
Seal:
from: 0 FT to: 0 FT
Screen Type:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
Slot Size: 0 Inches
Screen Type:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
Slot Size: 0 Inches
Screen Installation Method:
Fittings
Top:
Bottom:
Pack:
Grain Size:
Amount:
Geophysical Log Taken:
Retained on Files:
Additional Test and/or Pump Data
Chemistries taken By Driller: No
Held: 0
Documents Held: 1
Pitless Adapter Type:
Drop Pipe Type:
Length:
Diameter:
Comments:

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
Certification No.:
This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
Signature Yr Mo Day

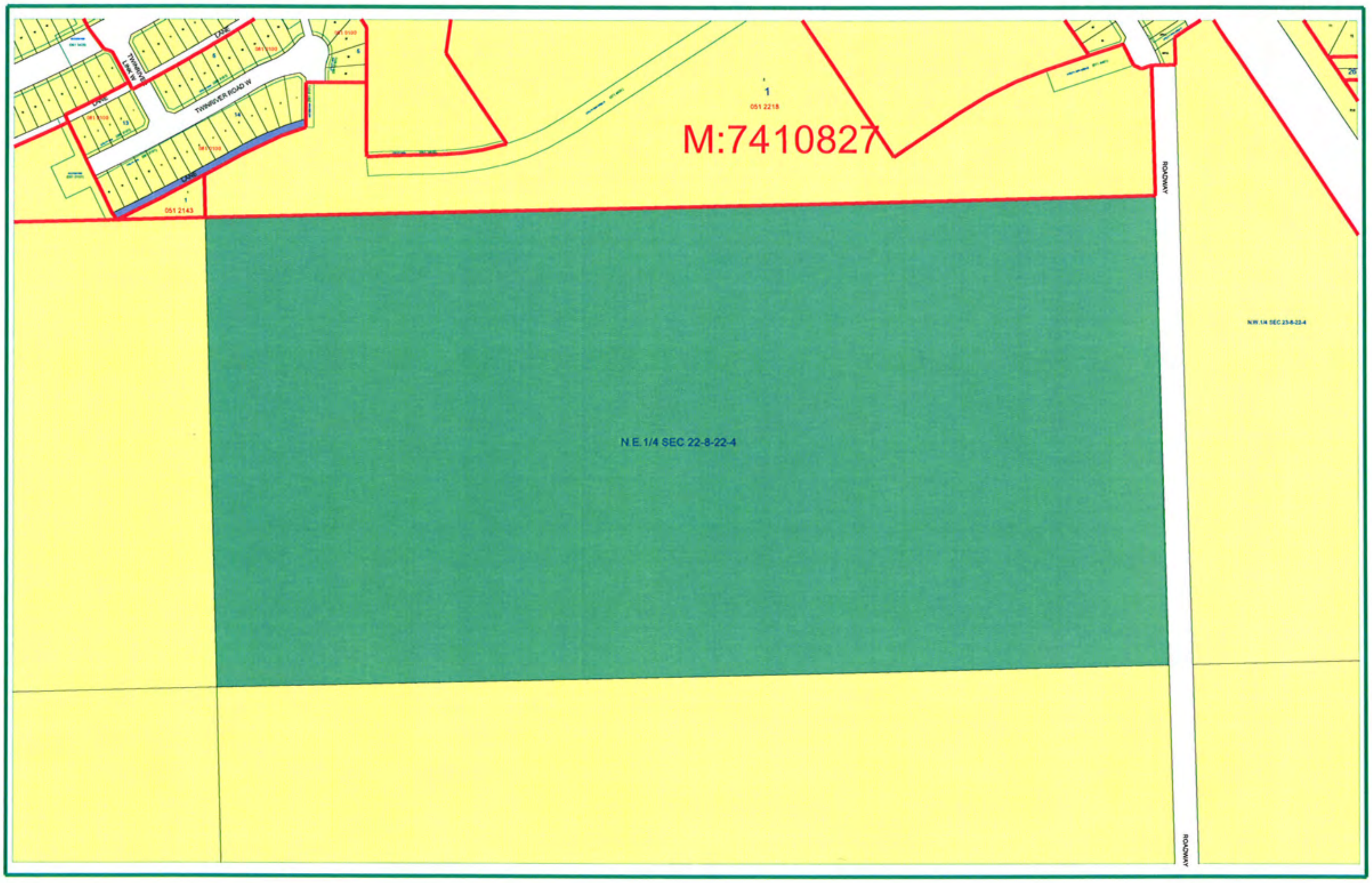
Report 1

Alberta Spatial Information System



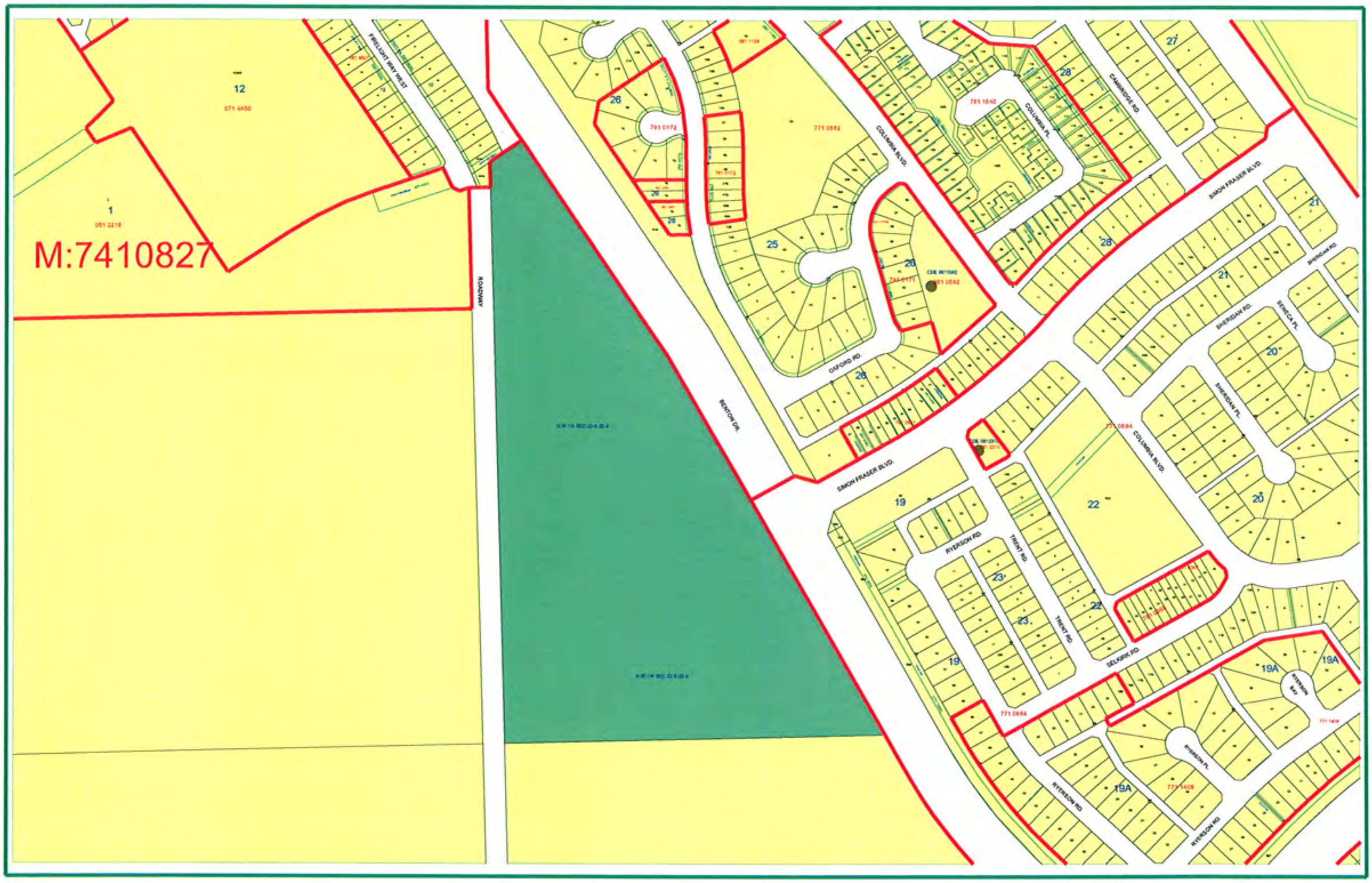
10:42AM Thursday February 12, 2009

Alberta Spatial Information System

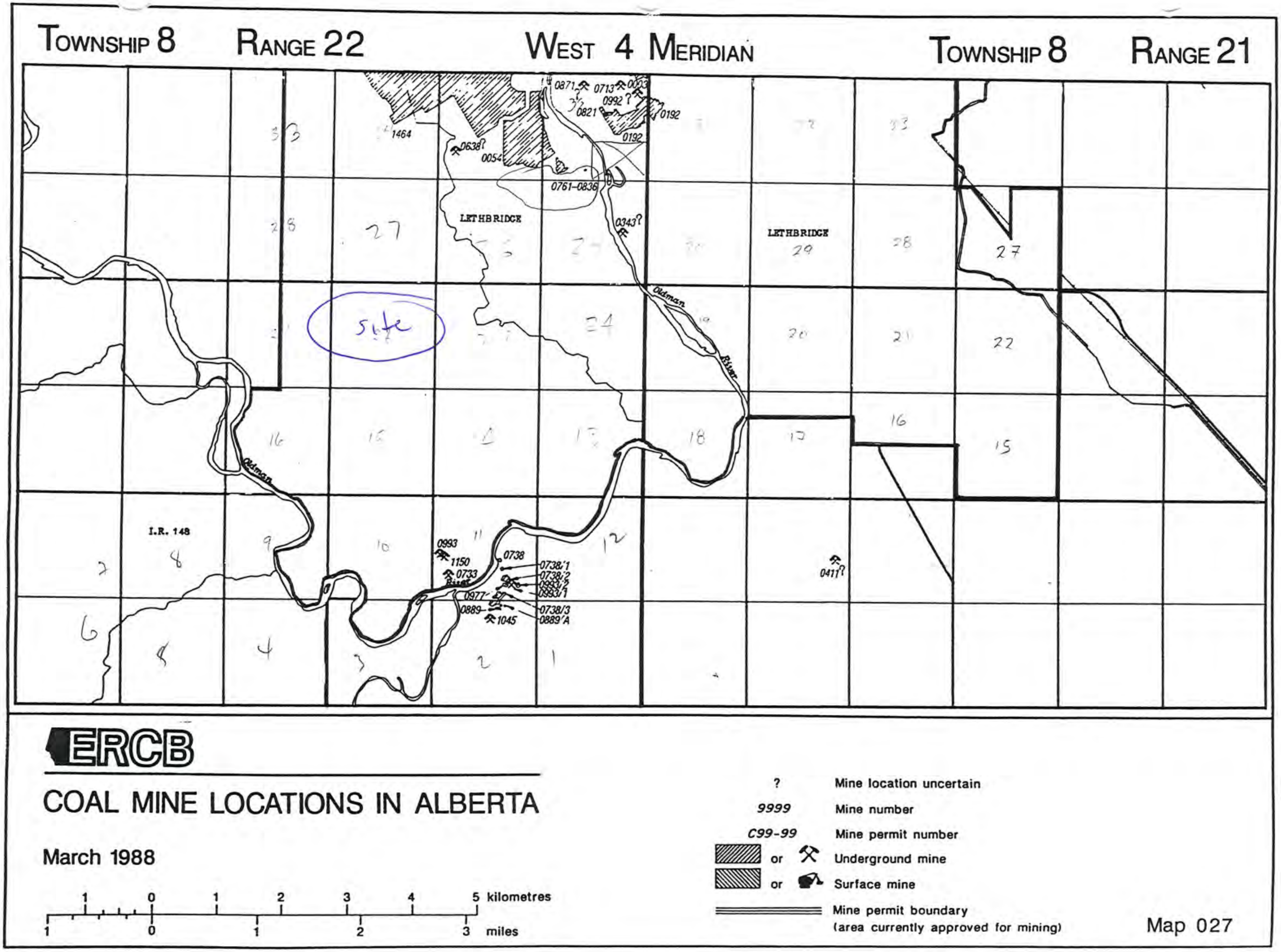


10:41AM Thursday February 12, 2009

Alberta Spatial Information System



10:43AM Thursday February 12, 2009


Township 8
Range 22
West 4 Meridian
Township 8
Range 21
LETHBRIDGE
LETHBRIDGE
I.R. 148
Oldman
Oldman River
1464
0638?
0054
0871
0713
0003
0992 ?
0821
0192
0192
0761-0836
0343?
0993
1150
0733
0738
0738/1
0738/2
0993/2
0993/1
0977
0889
1045
0738/3
0889/A
0411?
site
ERCB
COAL MINE LOCATIONS IN ALBERTA
March 1988
5 kilometres
3 miles
? Mine location uncertain
9999 Mine number
C99-99 Mine permit number
or Underground mine
or Surface mine
Mine permit boundary
(area currently approved for mining)
Map 027

APPENDIX

APPENDIX C SPECIAL ATTENTION ITEMS – BACKGROUND INFORMATION

BACKGROUND INFORMATION

C1 ASBESTOS

Construction materials used prior to the late 1970s were known to possibly contain asbestos (i.e., ceiling or floor tiles, drywall, and insulation for the walls, boiler, piping, and/or ducts). Asbestos is considered a health hazard if it is friable, airborne, and exposed to humans.

C2 POLYCHLORINATED BIPHENYLS (PCBs)

The federal Environmental Contaminants Act (1976) has restricted the use and controlled the phase out of polychlorinated biphenyls (PCBs) in Canada. Additionally, the storage and disposal of PCBs is regulated. The Act prohibited the use of PCBs in electrical equipment installed after July 1, 1980. PCBs are commonly found in light ballasts, electrical transformers (pole- or ground-mounted) and various other types of electrical equipment (i.e., rectifiers) dating back to the early 1980s or earlier.

PCB containing light ballasts or electrical equipment should be disposed of appropriately at the end of their useful life.

C3 OZONE-DEPLETING SUBSTANCES (ODS)

In December of 1998, The Government of Canada enacted the Ozone-depleting Substances (ODS) Regulations, which governs the use, handling and release of ODS. ODS may include, but are not limited to, chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl bromide. ODS are usually associated with operations such as: fire extinguishing systems; foam manufacturing; fumigant and pesticide application; prescription metered dose inhalers; refrigeration and air conditioning units; and solvent cleaning and degreasing facilities. ODS are not a health issue for people in the building, but are more a maintenance issue to limit or prevent their release. This is accomplished by regular maintenance by trained personnel.

C4 LEAD

Lead can be associated with paints, plumbing solder, pipes, and other products such as wall shielding in x-ray rooms. Lead-based paint was withdrawn from the market in the late 1970s. If present, lead-based paint is typically concealed beneath multiple layers of paint applied over the years during renovations. Lead-based paint and plumbing equipment are not a direct health risk when concealed (sealed behind layers of non-lead paint) and/or in good condition. It should, however, be considered when planning future renovations, when particles from lead-based paint could be released and/or ingested in the course of the work.

C5 UREA FORMALDEHYDE FOAM INSULATION (UFFI)

Insulation materials used during the 1970s and 1980s were known to possibly contain urea formaldehyde foam insulation (UFFI). UFFI was banned in 1980 under the federal Hazardous Products Act.

C6 RADON

Radon gas is a product of the decay series that begins with uranium. Radon is produced directly from radium that is often found in bedrock that contains black shale and/or granite. The gas and its by-products occur naturally everywhere, in soil, water, and air, but usually in concentrations too low to pose a threat. Radon gas can migrate through the ground and enter buildings through porous concrete or fractures. Certain building materials including concrete and gyprock can also release radon. Natural radon concentrations are low in Alberta and radon gas concentrations are usually well below target limits set for Canada. Potential anthropogenic sources of radon gas should be considered.

C7 METHANE

Methane gas is a product of anaerobic decomposition of organic material (e.g., buried fill high in organic material). Methane is also associated with natural gas deposits. Methane gas can migrate through the ground and enter buildings through porous concrete, joints or fractures. Methane presents a potential explosive hazard when it accumulates to concentrations greater than the lower explosive limit (LEL) in the presence of an ignition source.

C8 MOULD

Mould can be found anywhere in a building; however, it is usually associated with enclosed, damp areas. If the personnel interviewed indicated that they were not aware of complaints related to potential mould in the building, and/or there were no obvious signs of mould (i.e., visible mould growth larger than 1 m^2) observed during the site visit, a mould assessment is not typically conducted the scope of a Phase I ESA.

APPENDIX

APPENDIX D GEOENVIRONMENTAL REPORT – GENERAL CONDITIONS

GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by EBA in its reasonably exercised discretion.

May 4, 2009 EBA File: L22101248.001

Stantec Consulting Ltd.
290, 220 – 4 Street South
Lethbridge Alberta T1J 4J7

Attention: Mr. Jason Kellock

Dear Sir:

Subject: Phase I ESA – Supplementary Information
Portions of N 22-008-22 W4M and a Portion of NW 23-008-22 W4M
Lethbridge, Alberta

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Stantec Consulting Ltd. (Stantec) to provide supplemental information to a Phase I ESA issued in March 2009.

EBA's 2009 Phase I ESA report identified an active oil/gas lease site and associated pipelines belonging to Bonavista Petroleum Ltd. and Bonavista Oil & Gas Ltd., respectively (Bonavista) on the southwest side of the site at 12-22-008-22 W4M. The Phase I ESA report recommended that the Bonavista wellsite be assessed for drilling waste disposal (DWD) areas, well centre and potential drilling flare pit. Supplemental information was collected to determine if former facilities on the Bonavista wellsite potentially affected soil and groundwater at the site.

Additional information collected included a Tour Report from the Energy Resources Conservation Board (ERCB) and information from Abacus Datagraphics (AbaData). With the information collected, Alberta Environment's (AENV's) Compliance Option 2 Checklist with barite and salinity calculations was completed.

Mr. Jason Kellock of Stantec provided written authorization to Ms. Mireille Rigaux of EBA on April 3, 2009 to proceed with gathering and reporting the supplemental information.

2.0 INFORMATION REVIEW AND DISCUSSION

The Tour Report indicated that several drilling mud additives such as caustic soda, lime, soda ash, gypsum and Enviro-Floc were used while drilling this wellsite.

EBA Engineering Consultants Ltd.
p. 403.329.9009 • f. 403.328.8817
442 - 10 Street N • Lethbridge, Alberta T1H 2C7 • CANADA

According to AENV's Assessing Drilling Waste Disposal Areas: Compliance Options for Reclamation Certification, drilling mud additives such as caustic soda, lime, soda ash, gypsum and Enviro-Floc could affect soil and groundwater at the site. Since this wellsite was constructed and drilled prior to the ERCB's Directive 50: Drilling Waste Management, a Directive 50 drilling waste disposal report was not prepared. As such, AENV's compliance Option 2 Checklist is required to determine if the DWD area requires assessment.

Calculations for salinity were conducted for the total amounts of the drilling mud additives used to drill the well. The calculations and salinity met the Compliance Option 2 Checklist criteria.

ERCB information of the Bonavista wellsite was reviewed to determine if drill stem tests were conducted while drilling the well. According to the ERCB, the well was drilled on July 9, 1997 and the final drill date was July 13, 1997. Drill stem tests were not documented in the information provided. Based on this information, soil and groundwater quality would likely not have been affected at the well bore or in a potential flare pit area at the time of drilling.

3.0 CONCLUSION AND RECOMMENDATIONS

Based on the information provided, there were no obvious potential environmental concerns to the site related to drilling activities. However; please note that this is an active, gas producing wellsite.

No further work (i.e. Phase II ESA) is warranted at this time.

4.0 LIMITATIONS OF LIABILITY

This report and its contents are intended for the sole use Stantec Consulting Ltd. and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Stantec Consulting Ltd. or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Geo-Environmental Report General Conditions are attached.

5.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.
Respectfully Submitted
EBA Engineering Consultants Ltd.

PROFESSIONAL ENGINEER ALBERTA
H.P. CARRIERE
May 4, 2009

Prepared by:
Mireille Rigaux, B.Sc.
Environmental Scientist

Henri Carrière, P.Eng., M.N.R.M
Project Director

/sdt

Attachments: References
AbaData Information
AENV Compliance Option 2 Checklist and Calculations
Geo-Environmental Report – General Conditions

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date May 4, 09
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

REFERENCES

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Alberta Environment. 2009. Assessing Drilling Waste Disposal Areas: Compliance Options for Reclamation Certification.

EBA Engineering Consultants Ltd. 2009. Phase I Environmental Site Assessment. Portions of N-22-008-22 W4M and a Portion of NW-23-008-22 W4M (EBA File No. L22101248).

Excalibur Drilling Ltd. Daily Drilling Report, 100/12-22-008-22 W4/00

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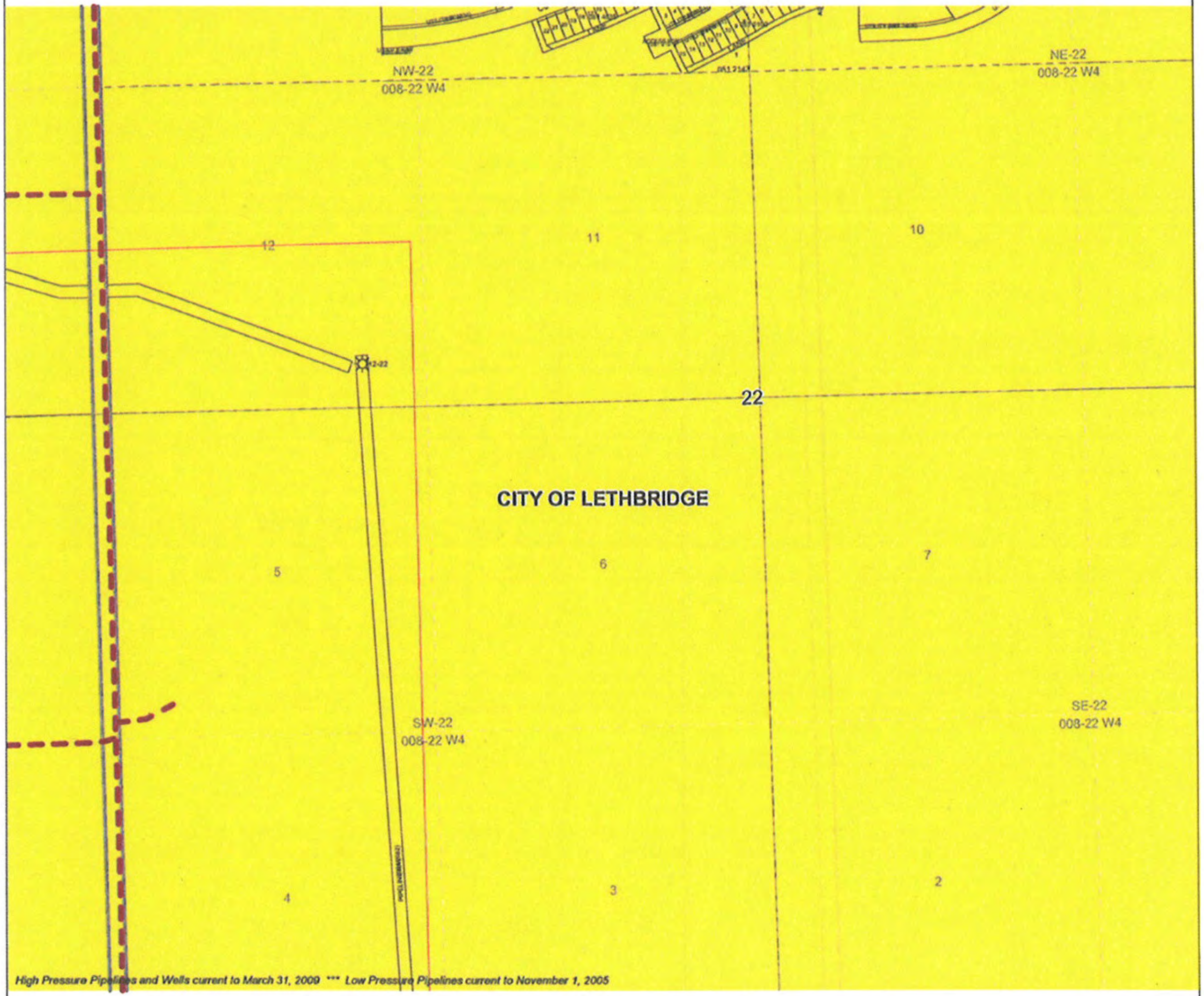
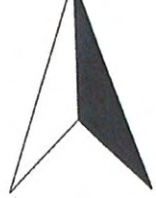
AbaData





Wellheads
- Abandoned Wellhead
- Suspended Gas Wellhead
- Suspended Oil Wellhead
- Flowing Gas Wellhead
- Location Wellhead
- Flowing Oil Wellhead
- Miscellaneous Wellhead
- Water Wellhead
- Well Downhole Location
- [L] Newly Licenced Well
- [S] Newly Spudded Well

High Pressure Pipelines
- Gas Pipeline
- Oil Pipeline
- Water Pipeline
- LVP/HVP Pipeline
- Foreign Pipeline (Only when a company is specified.)

Low Pressure Pipelines
- Gas Co-op Pipeline

ERCB DATA | ATTACHED FILES

Close Screen

WELL INFORMATION
CURRENT TO MARCH 31, 2009

EVENT: 2

WELL ID:	00 / 12-22-008-22 W4 / 2		
LICENCE #:	0201406	**LICENCE DATE:**	MAY 16, 1997
WELL NAME:	BONAVISTA PENNY 12-22-8-22		
WITHIN:	12-22-008-22 W4	**H2S (mol/kmol):**	NOT AVAILABLE
LICENCEE:	BONAVISTA PETROLEUM LTD.		
SPUD DATE:	JULY 9, 1997	**FINAL DRILL DATE:**	JULY 13, 1997
STATUS:	GAS FLOW	**ABANDONED DATE:**	
SURFACE:		**DOWNHOLE:**	
OFFSETS:	S 750 E 314.9	OFFSETS:	S 750 E 314.9
LATITUDE:	49.662477	LATITUDE:	49.662477
LONGITUDE:	112.910089	LONGITUDE:	112.910089
GROUND ELEVATION:	936.3 m 3072 '	TOTAL DEPTH:	1160 m 3806 '
WELL TYPE:	NOT AVAILABLE	**SUBSTANCE:**	NOT AVAILABLE

OPTIONS

Open Well Plat

Request Divestco Log

Create CBM Report

Add To Custom Well List

Print Screen

MORE INFO

Select Info to View

GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

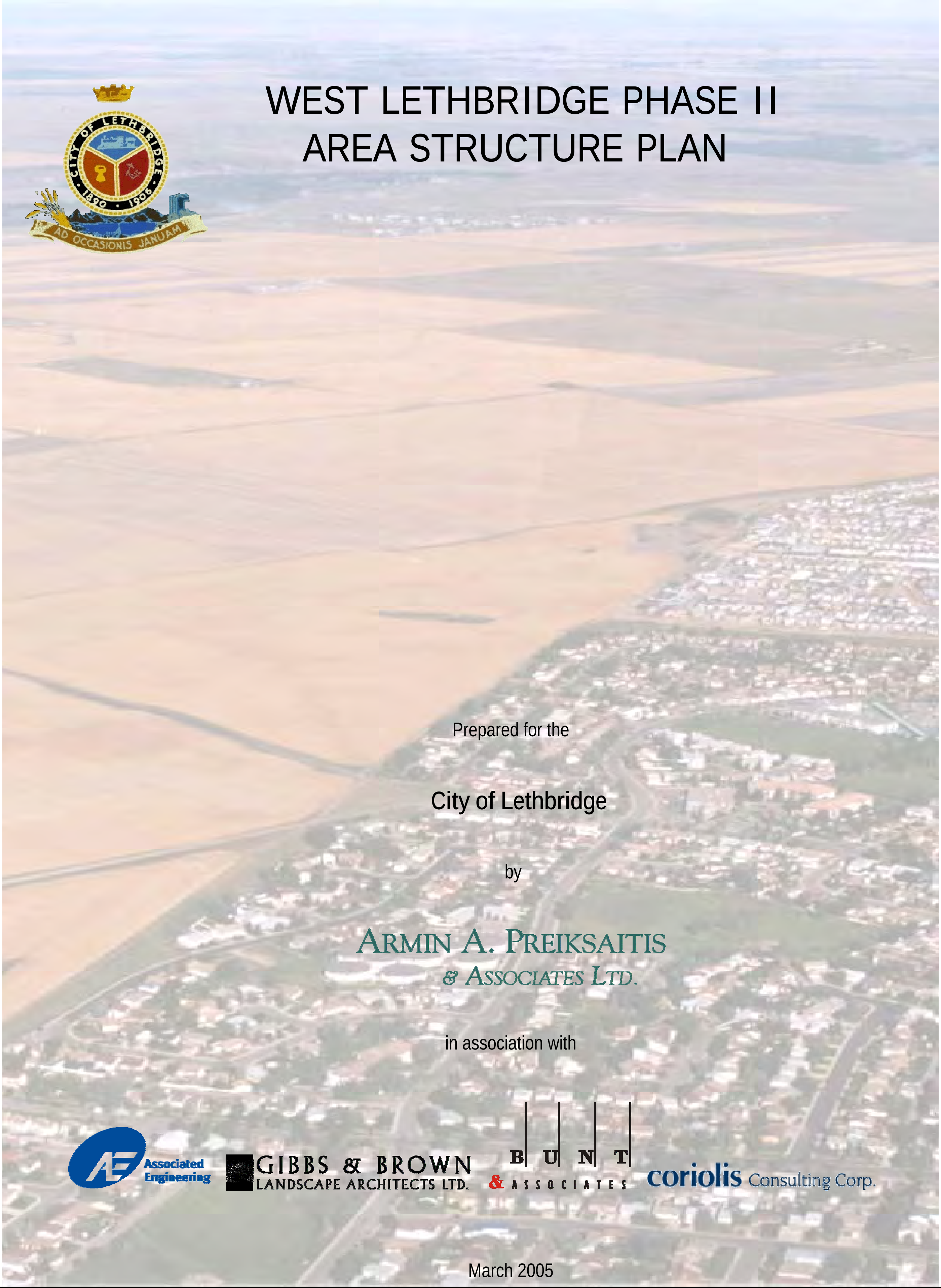
3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by EBA in its reasonably exercised discretion.

COPPERWOOD
Daytona Urban Development Corp.

APPENDIX E

Historical Resources Impact Assessment



WEST LETHBRIDGE PHASE II
AREA STRUCTURE PLAN

Prepared for the

City of Lethbridge

by

ARMIN A. PREIKSAITIS
& ASSOCIATES LTD.

in association with

Associated Engineering
GIBBS & BROWN LANDSCAPE ARCHITECTS LTD.
BUNT & ASSOCIATES
coriolis Consulting Corp.

March 2005

2.0 EXISTING CONDITIONS & DEVELOPMENT CONSIDERATIONS

2.1 Existing Conditions

2.1.1 Physical Environment

The ASP area is well suited for urban development in terms of geology, soils, topography and overall drainage conditions. The sands of the Buffalo Lake till in west Lethbridge are high, which may affect deep foundations (such as those for underground parking structures of two-levels or more), but with respect to the level of urban development anticipated for the ASP area (e.g. with piles and/or shallow foundations) no geotechnical issues are anticipated for the ASP area.

The ASP area is generally an undulating plain with elevation that ranges from 930m to 945m. Map 2 shows existing drainage patterns and existing prominent views in the ASP area.

2.1.2 Land Uses

The majority of land in the ASP area is currently cultivated for agricultural purposes. Farmsteads are located in on the following lands: SW ¼ Section 34-8-22-4, SE ¼ Section 33-8-22-4, NE ¼ 28-8-22-4 and SW ¼ Section 23-8-22-4. Several sweet gas wells and gas lines are also found within the ASP area.

To the north, south and west of the ASP area, non-urbanized agricultural lands constitute the main surrounding land use. Three villages – Indian Battle Heights, Varsity Village and Mountain Heights – form the eastern boundary of the ASP area. These neighborhoods offer a wide range of housing types and densities, with Varsity Village offering higher density housing units due to its proximity to the University of Lethbridge, a prominent surrounding land use.

There are also a number of neighborhood parks and schools in these adjacent residential neighborhoods, such as the Nicholas Sheran Park located in Varsity Village. The Coal Banks Regional Trail runs through Indian Battle Heights and Varsity Village.

2.1.3 Historical and Archaeological Resources

The Cultural Facilities and Historical Resources Division (CFHRD) of Alberta Community Development determined that a Historical Resources Impact Assessment was not required and *Historical Resources Act* clearance has been given for the West Lethbridge Phase II ASP.

Alberta
COMMUNITY DEVELOPMENT

Cultural Facilities and
Historical Resources
Heritage Resource Management

Old St. Stephen's College
8820 - 112 Street
Edmonton, Alberta
Canada T6G 2P8
www.cd.gov.ab.ca/hrm

Telephone 780/431-2300
Fax 780/427-5598

August 3, 2004

Project File: 4835-04-134

Mr. Armin Preiksaitis
Armin A. Preiksaitis & Associates Ltd.
#408 The Boardwalk
10310 – 102 Avenue
Edmonton, AB T5J 2X6

Dear Mr. Preiksaitis:

**SUBJECT: ARMIN A. PREIKSAITIS & ASSOCIATES LTD.
WEST LETHBRIDGE AREA STRUCTURE PLAN
SECTIONS 21, 22, 23, 27, 28, 33, & 34, TOWNSHIP 8, RANGE 22, W4M
HISTORICAL RESOURCES ACT REQUIREMENTS**

The Cultural Facilities and Historical Resources Division ("CFHRD") of Alberta Community Development has completed the review of the WEST LETHBRIDGE AREA STRUCTURE PLAN. **A Historical Resources Impact Assessment is not required.** Therefore, Armin A. Preiksaitis & Associates Ltd. has *Historical Resources Act* clearance for the WEST LETHBRIDGE AREA STRUCTURE PLAN.

HISTORICAL RESOURCES ACT REQUIREMENTS

Pursuant to Section 31 of the *Historical Resources Act*, should any historic resources be encountered during construction activities, please contact George Chalut, Resource Management Planner, Cultural Facilities and Historical Resources Division, Alberta Community Development, 8820 – 112 Street, Edmonton, Alberta, T6G 2P8; telephone at (780) 431-2329 or fax (780) 427-3956. It will then be necessary for the CFHRD to issue further instructions regarding the documentation of these resources. On behalf of the Cultural Facilities and Historical Resources Division, I would like to thank you and officials of the Armin A. Preiksaitis & Associates Ltd. for your continued cooperation in our endeavour to conserve Alberta's past.

Sincerely,

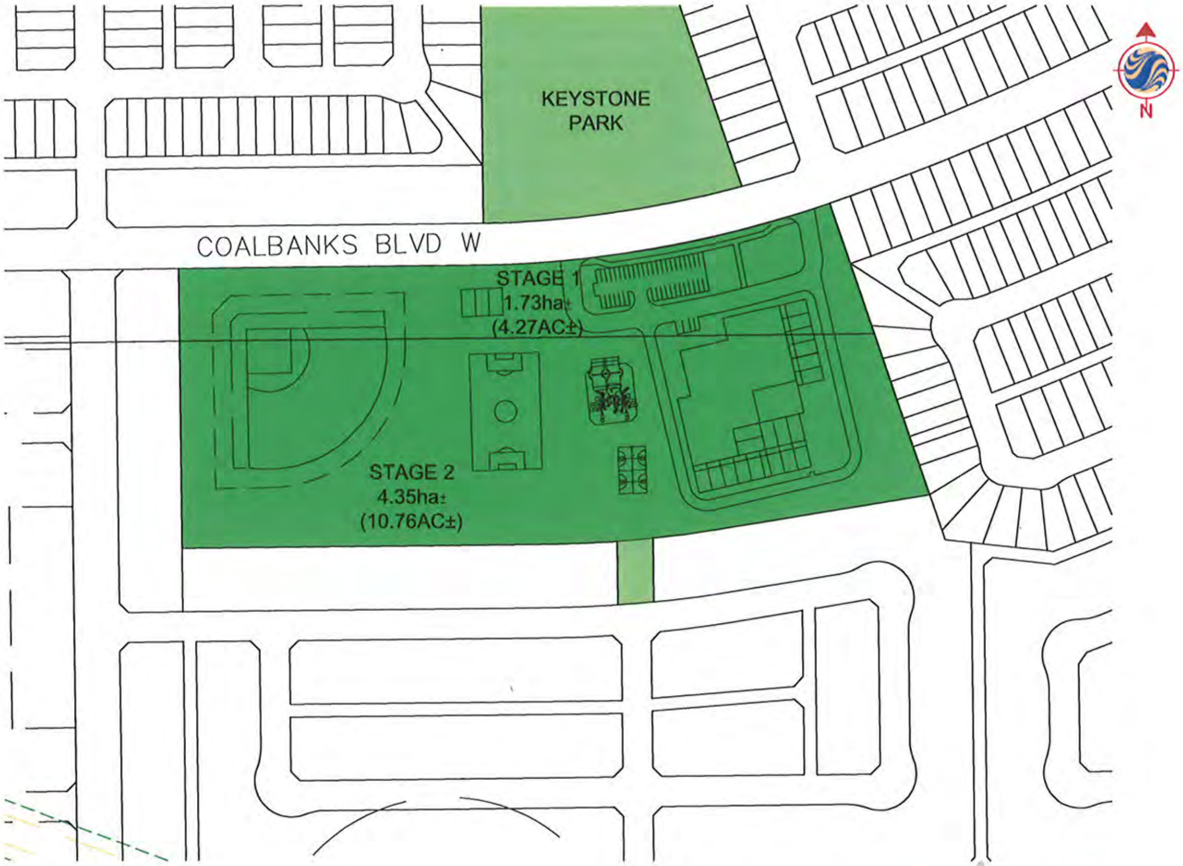
George Chalut
Resource Management Planner
Protection & Stewardship Section

APPENDIX F

Lethbridge Northern Irrigation District Water Conveyance Letter

APPENDIX G

Lethbridge School District Layout



Notes:

Site Area 6.08ha

Building Footprint.......4,620m²

Facilities :

Design Basis: "Design Development Report" A.I.T.

Capacity ......700+ students

Core Classrooms....10
Modular Classrooms....19

Library

Gymnasium

Administration

Site Features:

Youth Soccer Pitch

Play surface

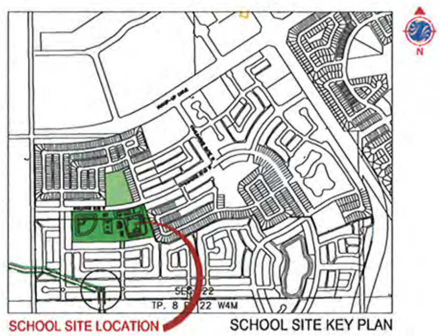
Playground

Fire Lane

Parking Lot - based on City of Lethbridge, Land Use By-law requirements

Garbage pick-up area

Preschool (ECS) Building



SCHOOL SITE KEY PLAN
NTS

NOTE: LAYOUT IS CONCEPTUAL AND IS SUBJECT TO CHANGE PENDING DETAILED DESIGN. THE CONCEPT HAS BEEN PREPARED TO HIGHLIGHT THE SITE'S SUITABILITY FOR A TYPICAL ELEMENTARY SCHOOL LAYOUT.

MAY 2011
112944453

CONCEPTUAL SITE LAYOUT APPROVED BY:

PRINT NAME: DON LUSSIER

SIGN NAME:

SCHOOL DISTRICT: Lethbridge School District 51

Stantec

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2011-05-27 09:03AM By: sbourgoin

Client/Project

Daytona Urban Development Corp.

COPPERWOOD Stage 2 Outline Plan

Figure No.
C

Title

Copperwood Elementary School Site Concept

APPENDIX H

High Intensity Fire Response Analysis
City of Lethbridge Sign-Off

CITY OF
Lethbridge

OFFICE OF
PLANNING & DEVELOPMENT SERVICES DEPARTMENT
PLANNING SECTION
Telephone No. 320-3920

March 28, 2012

RE: Fire Response Times – Copperwood 2 Outline Plan

The above referenced Outline Plan was evaluated to determine the extent to which it is located within the fire department's ten minute response area. This evaluation only considers what areas will or will not be within the fire department's ten minute response area at its ultimate "build-out".

Fire response times can increase or decrease depending on the phasing of new subdivisions and the actual construction of new road segments into an area. As such, subdivision applications submitted to the Subdivision Authority will also be assessed to verify whether the proposed lots are within the fire department's ten minute response area.

Areas that do not fall within the fire department's ten minute response area must address the level of fire protection that is required on exterior walls and the distance between adjacent structures, as outlined by the Alberta Building Code Sub-Sections 9.10.14 & 9.10.15.

Yours Truly,

Senior Subdivision Planner
City of Lethbridge

cc. Chief, Fire and EMS
Chief, Fire Marshall
Building Safety & Inspection Services Manager

APPENDIX I

Gate 1 Sign-Off and Document

Gate 1 - Information Gate

1 Project Team

- Developers: Daytona Urban Development Corp.
- Landowners: Daytona Urban Development Corp.
- Consultants: Stantec Consulting Ltd. (Lead)
  EBA Engineering Consultants Ltd. (Geotechnical)
- City of Lethbridge: Development Review Committee (DRC)

2 Confirmation of Gated Process Template

- Gated Plan / Master Servicing Plans Gated Process Template, September 25, 2008 (attached)
- The Gated Outline Plan Process Guidelines, September 25, 2008, Gate 3, 4th bullet should read: *"Figure showing park and pathway/bikeway network classification and playground locations"*

3 Authority / Permission to Proceed with Planning

- September 18th, 2008 meeting with the landowner, consultant and DRC

4 Area to be Planned

- Project Limits provided on *Figure 1.0 Copperwood Stage 2 Outline Plan Limits*
- Project Legal Description: NE & NW-22-8-22-W4M
- Area to be shadow planned is shown on *Figure 1.0 Copperwood Stage 2 Outline Plan Limits*

5 Potential Connection Points

- Transportation - Shown on *Figure 1.0*. City has not approved an alignment for Chinook Trail, City stated that Chinook Trail alignment should not encroach into the West Lethbridge Phase 2 ASP boundary. There is one connection to Benton Drive, the remaining connections within the plan area connect to neighbourhood collector roadways.
- Water - Shown on *Figure 1.0*
- Sewer - Shown of *Figure 1.0*
- Storm - See Item 7 (below)

6 Existing Reference Plans

- *West Lethbridge Stage II Area Structure Plan*
- Adjacent Outline Plan: *The Crossings*
- Adjacent Outine Plan: *Copperwood Outline Plan*

7 Servicing Constraints / Opportunities

- Sanitary Sewer - No service can be provided until downstream sanitary trunk sewer upgrades are completed. The development cannot connect to existing sewers through Simon Fraser Trunk. A trunk system using the Whoop-Up Drive Trunk will be required to service these lands.
- Stormwater - May change discharge to a location different than the planning in the ASP. N. Evans will work through any changes to the regional servicing plan parallel to the OLP process. The lands will require an interim solution that fits within the regional plan since the land will be developed prior to completion of the ultimate system.
- Water - The new west side reservoir is not a contrainst to this project at this time.

Gate 1 - Information Gate

8 Supporting Studies Required

- Traffic Impact Assessment (TIA) - Will be primarily focused on trip generation within the lands and trip assignment to the ASP collector network.
- Geotechnical Investigation
- Environmental Site Assessment (ESA) - *Upstream Phase 1 Required*
- Historical Resources Impact Assessment (HRIA) - *Not Required, clearance granted under the ASP planning*.

9 Agreed Change Process

- Change to a previous gate decision must be requested
- Request must document all impacts of the change
- City to review request and determine if it is deemed either inconsequential or requires more supporting analysis and the impact to subsequent gate approvals

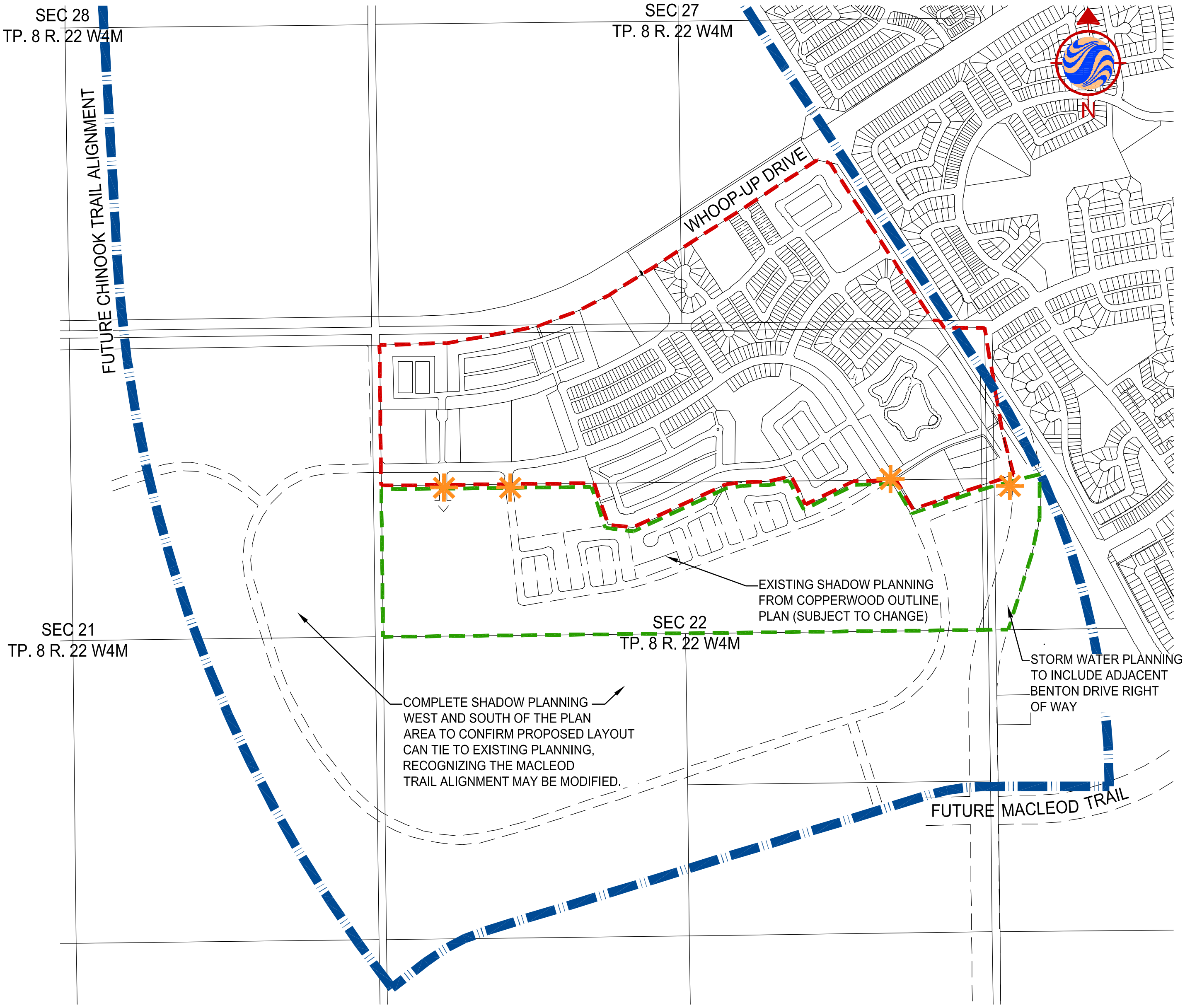
10 Schedule / Timelines

- Development review Committee meetings will occur on every Thursday at 1:00 pm. Articles to be taken up in meetings are to be submitted two weeks prior to the meeting date.

Gate 1 Sign Off: [signature] City of Lethbridge — Barry Peat (Print Name) — 11/17/08 (Date)

Gate 1 Sign Off: [signature] Daytona Urban Development Corp. — Matt Girardo (Print Name) — 11/12/08 (Date)

FIG. 1.0 COPPERWOOD STAGE 2 PLANNING LIMITS



LEGEND

- EXISTING COPPERWOOD OUTLINE PLAN BOUNDARY
- COPPERWOOD STAGE 2 OUTLINE PLAN BOUNDARY
- WEST LETHBRIDGE PHASE 2 AREA STRUCTURE PLAN BOUNDARY
- POTENTIAL SERVICING CONNECTION POINTS

OCTOBER 24, 2008

Stantec

Outline Plan/Master Servicing Plans
Gated Process Template

Preface

The Gated Process Template outlines a general format to follow in developing and processing an Outline Plan or Master Servicing Plan within the City of Lethbridge. The proposed Gates provide a systematic approach to the formulation and review of a new community plan in preparation for presentation to the Municipal Planning Commission. The Gates may be modified by joint agreement between the City of Lethbridge and the Developer as is suitable for a specific project. The joint team approach should be one of continuous involvement during the planning stage with an attitude of cooperation by all parties enhanced by an ongoing level of communication and interaction.

Process Review and Evaluation

The Gate Outline Plan Process has been provided to assist in organizing the work into more manageable components. It is provided as a guideline at this stage and will be formally reviewed and updated for possible inclusion in future Design Standards. The review will include input from both the City of Lethbridge and development industry stakeholders.

Roles and Responsibilities

The leader of the Outline Planning process is the Senior Subdivision Planner who is responsible for coordinating the process. In addition the City of Lethbridge involvement will include representatives from the following business units: Urban Construction (coordinates master servicing), Planning, Water and Waste Water, Transportation, Community Services (Parks), Electric, Transit and the Fire Department. City of Lethbridge business units have a stake in the outline plan because they are either charged with building a City based on community values (Planning) or they become the owners of the systems, responsible for maintenance (Water and Transportation).

In addition, external stakeholders will be consulted as required, these could include the school boards, adjacent neighborhoods, and shallow utilities.

At each gate, the chairman of the DRC (Senior Subdivision Planner) will confirm that the City Stakeholders agree with the gate documentation and that they do not require revisions. The Chairman will then counter sign the gate document.

The Area Developer or Developers and their Consultants will make up the second half of the project team.

Typical Process to Reach a Gate
The process leading to sign off on each gate will take the following form:

1) Meetings and discussions to gather information and make decisions required at that stage of the process
2) Development of a gate document / checklist which details the information gathered, decisions made, requirements and those items which still are undecided or that retain flexibility. The gate document will also record any agreed upon tradeoffs made. Documentation of variances from city standards and reasons for changes shall be provided within the applicable gate.
3) Once both sides agree there will be a sign off by the DRC Chairman (Senior Subdivision Planner) on behalf of each area (Planning, Infrastructure, Community Services and the Developer / Consulting Team) ***The sign off will indicate that the work making up the gate is acceptable as a basis the next stage***.

The gated process does not work well if it is entered into part way through. So even if the process is partially completed before the decision to use the gated process is made an effort should be made to document each proceeding gate and gain agreement and sign off. This will ensure fundamental assumptions and the basis of the current decisions are aligned before the decisions are made.

Change Process
One of the objectives of the gated process is ***to provide certainty around prior decisions*** so that late changes do not create significant rework. There will be times, however, when a change is required that effect decisions made in a previous gate.

A process is therefore required that will evaluate proposed changes to determine if they are beneficial before they are implemented and prevent unnecessary or non beneficial changes from being made.

Guidelines for a change process include:
1) Formal requests should be made to change information agreed to in previous gates
2) An evaluation of the requested change should be made and agreed to by the stakeholders
3) All change requests should be closed (either accepted or rejected)

An example of a change process is the one commonly used on construction projects. Typically, this takes the form of 1) contemplated change request, 2) evaluation of the change request, 3) approval of the change, followed by 4) a change order.

Gate Outline
The following outline describes the work completed in advance of each gate.

Gate #1
Information Gate

- Definition of project team – Developer(s), landowner(s), consultants, City of Lethbridge DRC (Provide names and contact information)
- Confirm/modify Gated Process Template
- Authority/Permission to proceed with planning
- Area to be planned (primary area and shadow plan area)
- Potential connection points
- Existing plans (MDP, ASP)
- Servicing constraints/opportunities
- Establish supporting studies that will be required for the site (historical resources, geotechnical, environmental impact assessment, etc.)
- Agreed change process
- Establish time lines

Gate#2
Land Use Layout Gate

- Confirm previous gate
- Establish need for, and type of, public consultation
- Developer's vision and principles for the area
- Conceptual Land Use – bubble plan level of detail
- Conceptual layout for parks, pathways and open space
- Conceptual road network connections and internal circulation
- Conceptual zoning districts - multiple options, if appropriate
- Confirm conformance to governing documents (ASP, MDP, adjacent outline plans)
- Confirm design criteria (trip generation rates, water demand rates, sewage generation rates, storm release rates)

Gate #3
Draft Design Gate

- Confirm previous gate
- Refine Land Use Plan to gross parcel sizes (with dwelling unit / population estimates in table format)
- Figure showing transportation network layout and showing preliminary road classification
- Figure showing pathway/bikeway network classification and playground locations

- Figures showing storm drainage catchments (minor & major), wastewater sewer-sheds and water supply zones
- Figure showing transit routes and stops
- Figure showing Infrastructure and transportation connection point details (locations, flow rates, capacities)
- Table showing wastewater flows
- Figures & tables showing major storm system flow routes, major and minor storm system flows, storm pond sizing
- Figure showing future adjacent service area – services to be provided
- Documentation of all variances from design standards and standard practice
- Agreement on final document outline/format

Check List:

- Daily traffic volumes relative to roadway classification
- Design assumptions for minor and major drainage systems
- Design assumptions for sanitary system
- Do the proposed systems and facilities conform with accepted practice, standards, regulations and guideline
- Has the same population and land use been used for all analysis
- Conformance with standard practice, previous documents, studies, master plans and reports
- Have you highlighted anything that does not conform with standard practice, previous documents, studies, master plans and reports

Gate #4
Draft Plan Gate – First Draft of Outline Plan

- Confirm previous gate
- Provide draft TIA
- Provide draft Stormwater Management Plan
- Location & size/capacity of major facilities (roads, storm, sanitary, water, parks)
- Connection points and their characteristics for existing and future areas (roads, storm, sanitary, water, pathways)
- Offsite servicing requirements (indicate facilities to be funded by offsite levy)
- All supporting documentation (geotechnical, environmental, historical resources, etc.) and information from all previous gates.
- Proposed staging - order of development/construction
- Public consultation

Gate #5
Final Submission

- Confirm previous gate
- Presentation & review of final document
- Set MPC date

APPENDIX J

Gate 2 Sign-Off and Document

City of Lethbridge
Outline Plan - Gated Review Process
Sign-Off Templates

Stantec Consulting Ltd.
Project: Copperwood Stage II OLP
Submittal Date: March 2, 2010

Gate 2 - Preliminary Land Use

File: 112944452

1 **Confirmation of Previous Gate**
- Gate 1 completed and signed off on November 17th, 2008.

2 **Public Consultation**
- The public consultation component will be a one night Open House near the site.

3 **Developer's Vision**
- The theme of Copperwood's initial development phase establishes the connection between Lethbridge and its historical relationship to the coal mining era.
- As the development moves to the second stage, we expand on, and complement, the original mining theme.
- The image and theme of a rehabilitated open pit mine or quarry now containing a fresh pool of water surrounded by different rock and mineral material and vegetation is visioned for Stage II.

4 **Conceptual Land Use**
- Figure 1.0 Context Plan
- Figure 2.0 Opportunities & Constraints Plan
- Figure 3.0 Land Use Concept

5 **Conceptual Open Space Layout**
- Figure 3.0 Land Use Concept

6 **Conceptual Road Network**
- Figure 3.0 Land Use Concept

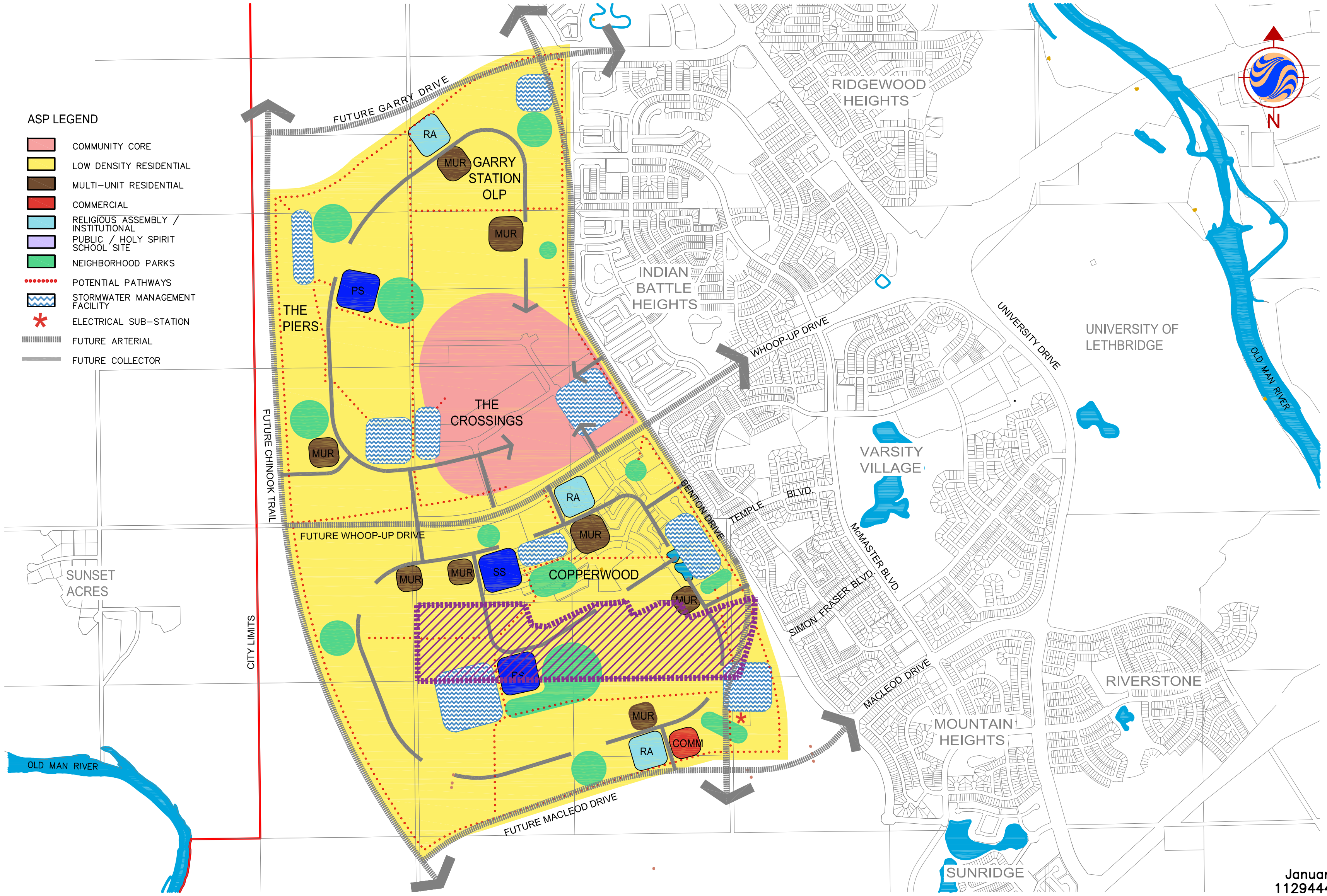
7 **Conceptual Zoning Districts**
- Figure 3.0 Land Use Concept

8 **Conformance to Governing Documents**
- Area Structure Plan: *West Lethbridge Phase 2*
- Adjacent Outline Plan: *Copperwood*

9 **Design Criteria**
- Trip Generation Rates (see attached)
- Water demand / sewage generation rates as per current City of Lethrbidge Standards (see attached)
- Storm release rates as per current City of Lethbridge Standards (see attached)

Gate 2 Sign Off: [signature] City of Lethbridge — Barry Peat, Print Name — Mar 4/10, Date

Gate 2 Sign Off: [signature] Daytona Urban Development Corp. — Matt Girardo, Print Name — 3/2/10, Date



January 2010
112944452.250

Legend

WEST LETHBRIDGE PHASE II AREA STRUCTURE PLAN BOUNDARY

COPPERWOOD STAGE II OUTLINE PLAN BOUNDARY

Stantec

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2010-01-29 09:47AM By: sbourgoin

Client/Project

DAYTONA URBAN DEVELOPMENT CORP.

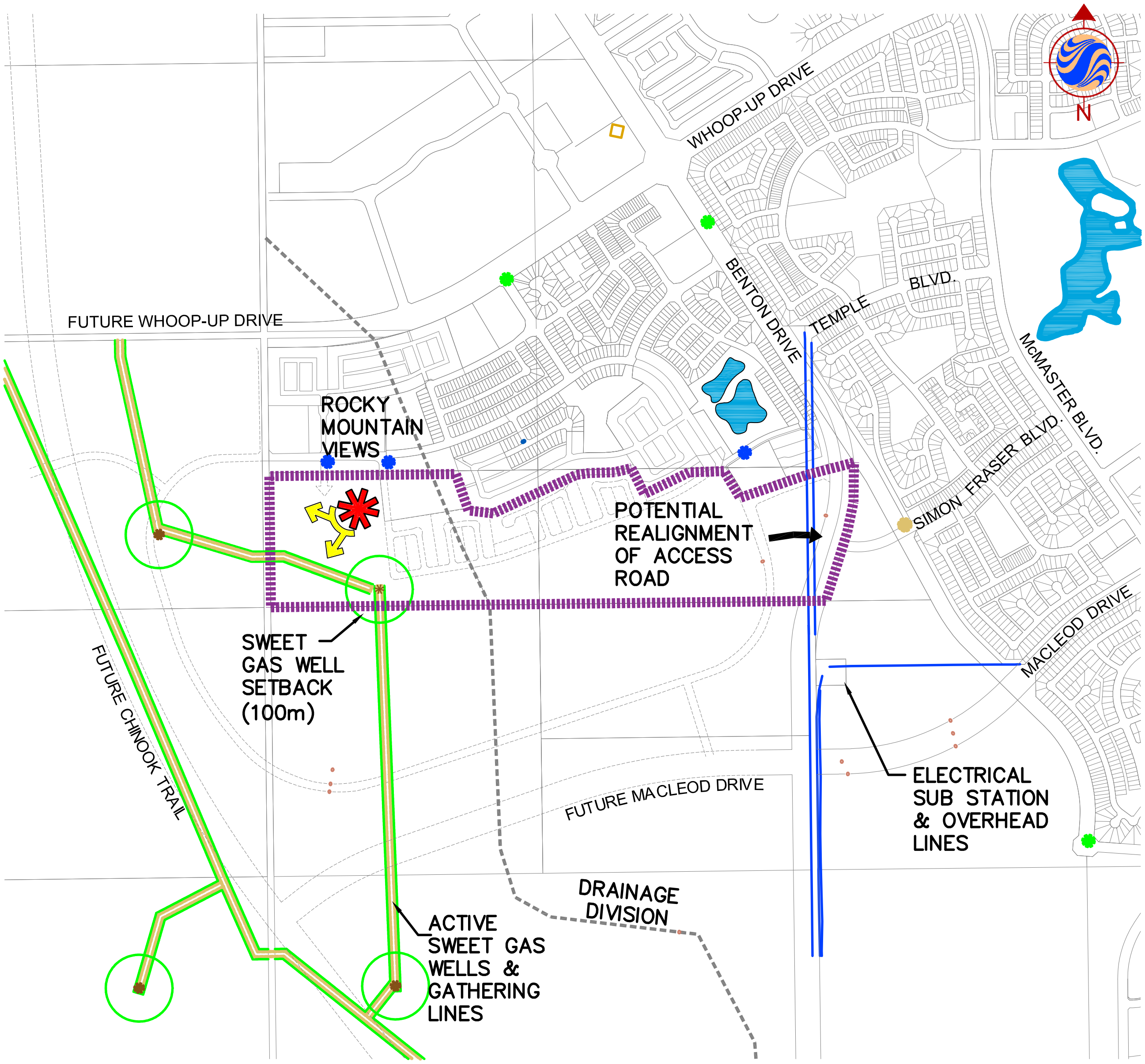
COPPERWOOD STAGE II OUTLINE PLAN

Figure No.

1.0

Title

CONTEXT PLAN



OPPORTUNITIES:

- BREAK-UP SWMF INTO 2 SMALLER UNITS – ECONOMICS
- CREATE MORE RETURN ON INVESTMENT OPPORTUNITY. IE. MORE DEVELOPABLE AREA -> SCHOOL (PS) TO SHADOW PLAN SITE
- CREATE OPEN SPACE 'COMPLEX" – COMBINE SWMF/SCHOOL SITE/OPEN SPACE --> LOOK FOR OPPORTUNITY TO MAKE MORE PEDESTRIAN FRIENDLY
- USE 2ND SWMF + OPEN SPACE AS A FEATURE & PARK AREA
- USE LINEAR OPEN SPACE SYSTEM FOR OPTIMAL CONNECTIONS TO OPEN SPACES OR ROADWAY (SIDEWALKS) AS ALTERNATE.
- USE INNOVATION LANDUSE ZONES FOR FLEXIBILITY
- QUARRY THEMED AREA FOR ALTERNATE MARKET

NOTES:

OUTLINE PLAN AREA: 63.1 ha (155.94 ac.)

January 2010
112944452.250

LEGEND:

- POSSIBLE WATER SERVICING LOCATION
- POSSIBLE SANITARY SERVICING LOCATION
- POSSIBLE STORM SERVICING LOCATION
- ROCKY MOUNTAIN VIEWS
- OVERHEAD ELECTRICAL LINES
- SWEET GAS WELL
- COPPERWOOD STAGE II OUTLINE PLAN BOUNDARY

Stantec

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2010-01-29 09:52AM By: sbourgoin

Client/Project

DAYTONA URBAN DEVELOPMENT CORP.

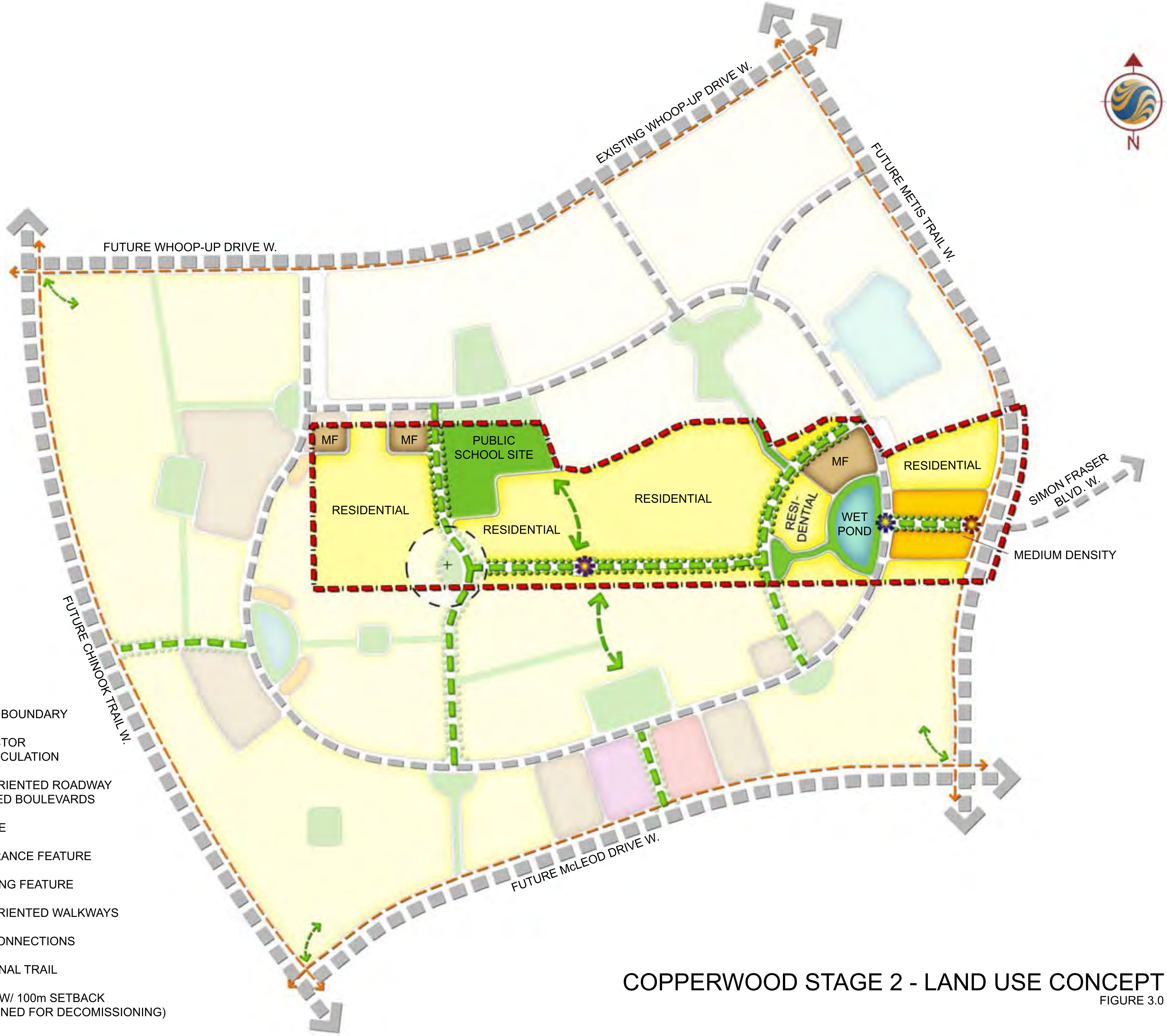
COPPERWOOD STAGE II OUTLINE PLAN

Figure No.

2.0

Title

OPPORTUNITIES & CONSTRAINTS PLAN



LEGEND

OUTLINE PLAN BOUNDARY

MAJOR COLLECTOR VEHICULAR CIRCULATION

PEDESTRIAN ORIENTED ROADWAY WITH TREE LINED BOULEVARDS

ENTRY FEATURE

GATEWAY ENTRANCE FEATURE

TRAFFIC CALMING FEATURE

PEDESTRIAN ORIENTED WALKWAYS

PEDESTRIAN CONNECTIONS

FUTURE REGIONAL TRAIL

GAS WELLSITE W/ 100m SETBACK (SHADOW PLANNED FOR DECOMISSIONING)

COPPERWOOD STAGE 2 - LAND USE CONCEPT

FIGURE 3.0

Copperwood
Stage II Outline Plan
Stantec Ref. No. 112944452
Gate 2 Submission
Municipal Services Design Criteria Summary

Stormwater

The area structure plan indicates "zero discharge" of stormwater from the Stage 2 area. Stormwater management pond 9 shall contain the total volume of runoff from a 1:100yr, 24 hour storm on site in an active storage range of 1.5m. Generalized stormwater design criteria from City of Lethbridge:

- Minor system design flow 90 l / s / ha
- Major system design flow 200 l / s / ha
- Active stormwater storage volume 1,000 cu. m / ha

Sanitary Sewage

Land Use	Average Daily Dry Weather Flow	Peaking Factor	Average Daily Wet Weather Inflow	Infiltration Allowance	Source
Residential (per person)	400 litres / capita / day	Determined using Harmon equation based on estimated population	500 litres / capita / day (0.18 l/s/ha)	150 litres / capita / day (0.05 l/s/ha)	City of Lethbridge Design Standards
Institutional (Elementary, Junior High, and Church)	20 cu. m / ha / day or 70 litres / student / day based on expected wastewater generation rates for elementary or junior high from Alberta Environment.	Peaking factor based on hours building occupied per day, i.e. 24/8 = 3 (school)	7.5 cu. m / ha / day (0.086 l/s/ha)	2.25 cu. m / ha / day (0.026 l/s/ha)	City of Lethbridge Design Standards except as noted

All sanitary wastewater from the Copperwood Stage 2 OLP area will be discharged to the existing 300mm diameter sanitary sewer system on Firelight Way West and will flow via Benton Drive and Whoop-Up Drive to the West Lethbridge sanitary sewerage siphons.

Notes:

Assumed density in Area Structure Plan is approximately 31 persons / ha.
PDF = (ADD_{dry} * PF) + (Avg Inflow) + Infiltration
Alberta Environment recommends combined inflow and infiltration allowance of 0.28 l/s/ha (24.2 cu. m/ha/day).

Potable Water Demand

Land Use	Average Daily Demand	Max. Day Demand	Peak Hour Demand	Source
Residential (per person)	415 litres / capita / day	915 litres / capita / day (2.2*ADD)	1,450 litres / capita / day (3.5*ADD)	City of Lethbridge Design Standards
Elementary / Junior High	70 litres per student per day	N/A	630	Average daily demand equal to expected wastewater generation rates from Alberta Environment. Peak hour factor of 9 used per Water Resources Engineering, Larry W. Mays.

Notes:

- Assumed density in Area Structure Plan is approximately 31 persons / ha. Outline Plan for Copperwood Stage 1 assumed uniform distribution of water demands across network based on estimated gross population.
- Fire flow of 75l/s (1,200USgpm) to be used for low-density residential areas. Flows for schools and multi-units to be determined on a case-by-case basis.

Transportation

Land Use	Peak Period	Total Trip Ends (trips/du)	Inbound (trips/du)	Outbound (trips/du)	Inbound Trips	Outbound Trips	Total Trips
Low Density Residential (xxx units)	AM (PM)	0.77 (1.02)	0.20 (0.65)	0.57 (0.37)	xx (xx)	xx (xx)	**xx (xx)**
Medium Density Residential (xxx units)	AM (PM)	0.75 (0.92)	0.22 (0.56)	0.53 (0.36)	xx (xx)	xx (xx)	**xx (xx)**
Elementary school site (ITE code 520, per student)	AM (PM)	0.42 (0.28)	0.23 (0.13)	0.19 (0.15)	xx (xx)	xx (xx)	**1.29 per student**
Junior high school site (ITE code 522, per student)	AM (PM)	0.53 (0.30)	0.29 (0.14)	0.24 (0.16)	xx (xx)	xx (xx)	**1.45 per student**
Total					***xx (xx)***	***xx (xx)***	***xx (xx)***

Note:

- Splits between inbound and outbound traffic for residential areas per City of Lethbridge Traffic Impact Assessment Guidelines.

Daytona Urban Development Corp.

APPENDIX K

Gate 3 Sign-Off and Document

City of Lethbridge
Outline Plan – Gated Review Process
Sign-Off Template

Stantec Consulting Ltd.
Project: Copperwood Stage 2
Outline Plan
Submittal Date: December, 2011

GATE 3 – Initial Concept

File: 112944453

1. **Confirm Previous Gate**
   - Gate 2 completed and signed off on March 4, 2010
   - Figure 2.1 Area Context Plan
   - Figure 2.2 Future Area Context Plan
   - Lethbridge School District Figure and Sign-Off – Appendix G

2. **Refined Land Use Plan**
   - Figure 7.1 Proposed Land Use Designations
   - Land Use Parcel Sizes, Dwelling Unit Projections and Population Estimates identified in Table 7.1 in *Section 7 Residential Land Use & Density* of Copperwood Stage 2 Gate 3 document (attached)

3. **Transportation Network Layout and Preliminary Road Classifications**
   - Figure 9.1 Preliminary Transportation Network
   - Figure 9.2 Roundabouts: Lotting Concept and Restrictions
   - Figure 10.1 Preliminary Transit & Bus Stops

4. **Park and Pathway Network Classification**
   - Figure 6.1 Open Space Network
   - Figure 6.2 Proposed School Site
   - Figure 6.3 Conceptual Cross Sections
   - Figure 6.4 Open Space Context Plan

5. **Infrastructure and Transportation Connection Point Details**
   - Figure 6.1 Open Space Network
   - Figure 9.1 Preliminary Transportation Network
   - Figure 10.1 Preliminary Transit & Bus Stops
   - Figure 11.1 Storm Water Management & Connection Points
   - Figure 11.2 Sanitary Servicing & Connection Points
   - Figure 11.3 Water Servicing & Connection Points

6. **Preliminary Sewage Generation, Storm Pond Size, Storm Overland Routes**
   - Figure 11.1 Storm Water Management & Connection Points
   - Figure 11.2 Sanitary Servicing & Connection Points
   - Figure 11.3 Water Servicing & Connection Points
   - Refer to Copperwood Stage 2 Gate 3 Document, *Section 11 Site Servicing* (attached)

7. **Agreement on Final Document Format**
   - Document format finalized at initiation of Gate 3.

Gate 3 Sign-Off	[signature] City of Lethbridge	Barry Peat Print Name	Jan 5/12 Date
Gate 3 Sign-Off	[signature] Daytona Urban Development Corp	Matt Girardo Print Name	12/7/11 Date