# DEVELOPMENT AGREEMENT

THIS DEVELOPMENT AGREEMENT ("Agreement") is made and entered into as of the date of full execution of this Agreement, as indicated on the signature pages below, by and between **the City of Columbia, Missouri**, a municipal corporation of the State of Missouri ("City") and **The Brooks at Columbia, LLC** a Missouri limited liability company ("Owner"). The City and the Owner may hereinafter be collectively referred to as the Parties and individually as a Party.

## RECITALS

**WHEREAS,** Owner holds title to approximately 161.84 acres of land currently located in the unincorporated area of Boone County legally described in the attached **Exhibit A.** (the "Subject Property"); and

**WHEREAS,** the Subject Property is now located in the unincorporated area of Boone County, Missouri ("County"). Owner has filed with the City a Petition for Annexation of the Subject Property into the geographic limits of the City ("Annexation Petition"), provided that the Subject Property is rezoned per owner's application that was submitted to the City on or about the 3rd of October, 2017, in Case No. 17-76 ("Owner's Zoning Application"); and

**WHEREAS,** Owner desires to develop the Subject Property for residential uses. The Owner's Zoning Application divides the Subject Property into a single zoning district, to wit, R-1, One-family Dwelling; and

**WHEREAS**, when fully developed, the Subject Property is anticipated to be subdivided and developed into approximately 388 lots for single-family housing units and various common lots; and

**WHEREAS**, the parties desire to set forth responsibility for the construction and dedication of certain public improvements associated with development of the Subject Property in this Agreement, it being the intent of this agreement to provide milestones for which the construction of such public improvements shall occur;

**NOW, THEREFORE,** in view of the foregoing Recitals and in consideration of the mutual promises, declarations, covenants and agreements of the City and Owner as hereinafter set forth, the Parties hereby agree as follows:

1. **Contingencies**. This Agreement is contingent upon Owner's Petition for Annexation and Zoning Application being granted by the City.

2. **Agreement to Run with the Land**. The provisions of this Agreement will constitute covenants running with the entirety of the Subject Property and each and every part of the Subject Property, and will bind the current Owner and all of such successors and assigns.

3. **Owner's Obligations for Development**.

a) State Route WW.

i. Owner will dedicate right of way for State Route WW ("WW") to provide a width of no less than fifty feet (50') when measured northward from the existing centerline of WW, as shown in the attached preliminary plat hereafter referred to as **Exhibit B**. The right of way for WW may be dedicated in phases. As the exterior lots closest to WW are platted in a final plat, the final plat shall contain the dedication of that WW right of way adjacent to the exterior lots contained in such final plat.

ii. Owner will grade an eight-foot (8') shoulder along the north side of WW, measured from the north edge of existing pavement along WW. Such shoulder shall be seeded and mulched in order to establish vegetative cover. The shoulder grading adjacent to WW shall occur as the adjacent exterior lots are included and platted in a final plat. The shoulder grading shall be completed prior to the acceptance of the street infrastructure within the same final plat as the exterior lots.

iii. Owner will construct, or shall cause to be constructed, an eight-foot (8') wide pedway along WW, as generally shown on **Exhibit B**. The pedway may be constructed in phases as part of the improvements subject to performance contracts associated with final plats containing lots adjacent to the WW right of way.

iv. In addition to the right of way dedication, Owner will dedicate a ten-foot (10') wide utility easement for a utility corridor along WW adjacent to the dedicated right of way.

b) Other Improvements.

i. Traffic Impact Study Improvements – Owner agrees to construct the following improvements identified in the January 23, 2017 Traffic Impact Study by CBB Transportation Engineers + Planners, which is attached hereto as **Exhibit C**. Street names herein are consistent with the street names shown on **Exhibit B,** but are the improvements identified in **Exhibit C**. Design for the improvements described in this section shall be prepared by Owner and approved by the City before construction may begin on any project. All projects listed below must be completed by Owner, at Owner's expense, before final platting of the seventy-fifth (75th) lot on the Subject Property:

A. Construct an eastbound left-turn lane on WW at Hoylake Drive.

B. Construct an eastbound left-turn lane on WW at Sagemoor Drive.

C. Install two exit lanes, a left-turn lane and a shared through/right-turn lane, for the southbound approach of Hoylake Drive at WW.

D. Remove vegetation along the north side of WW for the proposed street intersections of Hoylake Drive and Sagemoor Drive with WW in order to achieve a minimum MoDOT recommended adequate sight distance.

E. Design and activate a traffic signal at WW and the Elk Park/Hoylake Drive intersection, according to MoDOT requirements and specifications before the final platting of the seventy-fifth ($75^{th}$) lot on the Subject Property or the platting of the entire right of way for Hoylake Drive as shown on **Exhibit B**, whichever occurs first.

ii. Required Public Improvements – The construction of public improvements set forth herein and as otherwise required under the regulations of the City and as shown on any final plat of the Subject Property or related approved construction plans will be a material condition of this Agreement and the failure to timely construct any required public improvement will constitute a breach of this Agreement. Remedies for breach of this Agreement will be in addition to any other remedies

provided under City Code or other instrument executed by and between Owner and the City.

iii. Hoylake Drive shall be designed and constructed according to the City of Columbia street standards for a Major Collector (Standard Option) unless otherwise approved by the Public Works Department. Sagemoor Drive and Gaston Drive shall be designed and constructed according to the City of Columbia street standards for a Neighborhood Collector-Option A.

4. **Construction and Bonding of Improvements.** Except as otherwise expressly indicated herein, all public improvements required under the regulations of the City or this Agreement must be constructed in accordance with the City's Street, Storm Sewer, and Sanitary Sewer Specifications and Standards, as may be amended, or any successor specifications and standards adopted by the City together with any final construction plans approved by the City prior to construction of such facilities. In connection with construction, the Owner shall be required to post bonds or other security as required by the city code. Owner is responsible for obtaining all necessary easements to construct improvements related to Owner's Development of the Subject Property.

5. **Phasing Plan**. If any development of the Subject Property, including final platting, will be phased, then a plan which generally describes the sequence of development of the Subject Property ("Phasing Plan") must be submitted to the Director of Community Development ("Director") concurrently with the first application for a Final Plat on the Subject Property. The Phasing Plan shall become final and binding upon Owner upon approval of the first Final Plat on the Subject Property. Thereafter, development and platting of the Subject Property shall occur in the sequence established in the Phasing Plan. However, nothing contained in this paragraph shall be construed as precluding Owner from filing or developing more than one phase at a time. The Phasing Plan may not be amended except upon written approval of the Director, which shall not be unreasonably withheld. Once the Subject Property has been preliminary platted, no part of the Subject Property may be conveyed as a small area transfer or using a metes and bounds description. A conveyance of any part of the Subject Property may only occur after the Subject Property, or any applicable portion thereof, has been final platted in accordance with the City's Subdivision Regulations.

6. **Recording**. The Owner shall cause this Development Agreement to be recorded with the Recorder of Deeds of Boone County, Missouri, at the cost and

expense of the Owner. A copy of the recorded instrument shall be provided to the City by Owner.

7. **Amendments**. Any amendment to this Agreement must be in writing and must be executed by the City and the Owner, and any future owner of any part of the Subject Property who would otherwise be obligated to perform any of the requirements imposed upon the Owner by this Agreement. Oral modifications or amendments of this Agreement are of no force or effect.

8. **Remedies**. The parties to this Agreement may, either in law or equity, by suit, action, mandamus or other proceedings in court, seek declaratory relief, enforce and compel specific performance of this Agreement, provided that in no event will the City have any liability in damages, costs or any other monetary liability to Owner or any affiliate of Owner, any person claiming through Owner, or to their respective successors, assigns, heirs and personal representatives in respect of any suit, claim, or cause of action arising out of this Agreement or any of the actions or transactions contemplated herein.

9. **Third Party Actions**. Owner will have the right, but not the obligation to assume the costs of defense of any action or proceeding initiated by a third party challenging this Agreement, the annexation, the zoning or rezoning of the Subject Property, or any other actions or transactions contemplated by this Agreement (including, without limitation, to settle or compromise any claim or action for which Owner has assumed the defense) with counsel of Owner's choosing and the City and Owner agree that so long as no conflicts of interest exist between them, the same attorney or attorneys may simultaneously represent the City and Owner in any such proceeding. In no event will the City have any liability to Owner for damages or otherwise in the event that all or any part of this Agreement, the ordinances approving the annexation of the Subject Property, or the approval of a zoning request are declared invalid or unconstitutional in whole or in part by a final (as to which all rights of appeal have been exhausted or expired) judgment of a court of competent jurisdiction, and, in the event Owner elects not to assume such defense and costs, the City will have no obligation to defend or to assume the costs of defense of any such action.

10. **Notices**. All notices between the parties hereto must be in writing and must be sent by certified or registered mail, return receipt requested, by personal delivery against receipt or by overnight courier, will be deemed to have been validly served, given or delivered immediately when delivered against receipt or three (3) business days after deposit in the mail, postage prepaid, or one (1) business day after deposit with an overnight courier, and must be addressed as follows:

If to the City:

City of Columbia
Attn: City Manager
701 E. Broadway
Columbia, MO 65205

If to Owner:

The Brooks at Columbia, LLC
Attn: J. Quinn Bellmer, Manager
c/o JQB Construction, Inc.
6209 Upper Bridle Drive
Columbia, MO 65201

With a copy (which shall not constitute notice) to:

Caleb Colbert
Brown Willbrand, P.C.
601 E. Broadway, Ste. 203
Columbia, MO 65201

Each party will have the right to specify that notice is to be addressed to another address by giving to the other party ten (10) days written notice thereof.

11. **Insurance**. Owner must provide, at its sole expense, and maintain during all times in which Owner is constructing public improvements pursuant to this Agreement commercial general liability insurance with a reputable, qualified, and financially sound company licensed to do business in the State of Missouri, and unless otherwise approved by the City, with a rating by Best of not less than "A," that will protect the Owner, the City, and the City's officials, officers, and employees from claims which may arise from operations under this Agreement, whether such operations are by the Owner, its officers, directors, employees and agents, or any subcontractors of Owner. This liability insurance must include, but will not be limited to, protection against claims arising from bodily and personal injury and damage to property, resulting from all Owner operations, products, services or use of automobiles, or construction equipment. The amount of insurance required herein must be in no event less than the individual and combined sovereign immunity limits established by § 537.610 RSMo. for political subdivisions; provided that nothing herein will be deemed to waive the City's sovereign

immunity. An endorsement must be provided which states that the City is named as an additional insured and stating that the policy will not be cancelled or materially modified so as to be out of compliance with the requirements of this Section, or not renewed without 30 days advance written notice of such event being given to the City.

12. **Hold Harmless**. Owner at its sole cost and expense, hereby agrees to indemnify, protect, release, defend (with counsel acceptable to the City) and hold harmless the City, its municipal officials, elected officials, boards, commissions, officers, employees, attorneys, and agents from and against any and all causes of action, claims, demands, all contractual damages and losses, economic damages and losses, all other damages and losses, liabilities, fines, charges, penalties, administrative and judicial proceedings and orders, judgments, remedial actions of any kind, and all costs and expenses of any kind, including, without limitation, reasonable attorney's fees and costs of defense arising, directly or indirectly, in whole or in part, from the action or inaction of Owner, its agents, representatives, employees, contractors, subcontractors or any other person for whose acts Owner may be liable, in the activities performed, or failed to be performed, by Owner under this Agreement or in the development of the Subject property, except to the extent arising from or caused by the sole or gross negligence or willful misconduct of the City, its elected officials, officers, employees, agents or contractors. The indemnification, duty to defend and hold harmless obligations set forth in this Section will survive for a period of five (5) years from the date of expiration or termination of this Agreement.

13. **Sovereign Immunity**. Nothing in this Agreement shall constitute or be construed as a waiver of the City's governmental or official immunity or its officers or employees from liability or suit pursuant to Section 537.600 RSMo.

14. **No Third Party Beneficiaries**. There are no third party beneficiaries to this Agreement.

15. **Failure or Delay to Enforce**. No failure to exercise or delay in exercising any right hereunder on the part of any Party to this Agreement shall operate as a waiver thereof, and no single or partial exercise of any right of such Party shall preclude any other or further exercise of such right or the exercise of any other right.

16. **Power of the City.** Notwithstanding anything set forth in this Agreement to the contrary, no provision contained herein shall in any manner diminish or usurp the inherent rights and powers of the City to act in its capacity as a public body. Nothing herein shall relieve Owner from complying with all applicable laws and requirements.

17. **Inspection.** Upon reasonable prior notice, the City may conduct such periodic inspections of the projects herein, including any applicable phase, as may be generally provided in the applicable law or regulation for inspection thereof in order to confirm compliance with the terms of this Agreement. The Owner shall not deny the City and its officers and employees the right to inspect, upon reasonable prior written request, all engineering plans, construction contracts or other documents pertaining to the construction of the public infrastructure on the Subject Property. Notwithstanding the foregoing, Owner shall not be required to produce documents for inspection if such documents are attorney-client privileged or contain confidential, proprietary information or if production would violate the rights of any third parties.

18. **Governing Law**. This Agreement will be construed according to the laws of the State of Missouri. The Parties will comply with all local, state, and federal laws and regulations relating to the performance of this Agreement.

19. **Venue.** Any action at law, suit in equity, or other judicial proceeding to enforce or construe this Agreement, or regarding its alleged breach, must be instituted only in the Circuit Court of Boone County, Missouri.

20. **Entire Agreement**. This Agreement contains the entire and complete agreement between the City and the Owner with respect to the requirements imposed upon the Owner for the providing of certain rights-of-way and interests in land, and the construction and installation of certain improvements, all as hereinabove described in the Recitals for this Agreement and the above numbered paragraphs of this Agreement. Parties agree that this Agreement constitutes a lawful contract between the Parties and Owner hereby acknowledges and agrees that this Agreement and provisions of the City's Code of Ordinances applicable to this Agreement constitute lawful exercises of the City's authority and police power.

[SIGNATURE PAGES FOLLOW]

IN WITNESS WHEREOF, the Parties have executed this Agreement and shall be effective on the last day and year indicated below.

**CITY:**
**City of Columbia, Missouri**

By: _____
Mike Matthes, City Manager

Date: _____

ATTEST:

_____
Sheela Amin, City Clerk

Approved as to form:

_____
Nancy Thompson, City Counselor

**OWNER:**
**The Brooks at Columbia, LLC**

By: _____

Name Printed: J. Quinn Bellmer

Date 11/21/17

STATE OF MISSOURI )
) SS
COUNTY OF BOONE )

On this 21 day of NOVEMBER, 2017, before me appeared JQuinn Bellmer, to me personally known, who, being by me duly sworn did say that he or she is Owner of The Brooks at Columbia, LLC, a Missouri limited liability company, and that said instrument was signed on behalf of said limited liability corporation, acknowledged said instrument to be the free act and deed of said corporation and that he or she executed the same for the purposes therein stated.

IN TESTIMONY WHEREOF, I have hereunto affixed my hand and notarial seal at my office in the State and County aforesaid, on the day and year hereinabove first written.

Danielle Griffith
Notary Public

My commission expires: 10/28/2020

DANIELLE GRIFFITH
Notary Public – Notary Seal
STATE OF MISSOURI
Boone County
Commission Number 12409201
My commission expires October 28, 2020

# EXHIBIT A
# LEGAL DESCRIPTION

DESCRIPTION FOR ANNEXATION/ZONING BOUNDARY
FOR THE BROOKS AT COLUMBIA, LLC.
JOB # 150527

FEBRUARY 1, 2017

A TRACT OF LAND LOCATED IN THE NORTHWEST QUARTER OF SECTION 22, THE SOUTHWEST QUARTER OF SECTION 15 AND THE SOUTHEAST QUARTER OF SECTION 16, ALL OF TOWNSHIP 48 NORTH RANGE 12 WEST, BOONE COUNTY, MISSOURI AND BEING THE LAND DESCRIBED BY THE WARRANTY DEED RECORDED IN BOOK 4733, PAGE 181 AND THE QUIT-CLAIM DEED RECORDED IN BOOK 4733, PAGE 180 AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING ON THE NORTH RIGHT OF WAY LINE OF STATE ROUTE WW AT THE SOUTHWEST CORNER OF CEDAR GROVE SUBDIVISION AS SHOWN IN THE SURVEY RECORDED IN BOOK 374, PAGE 112 AND WITH THE NORTH LINE THEREOF, N 42°44'40"W, 212.13 FEET; THENCE N 41°45'45"W, 174.24 FEET; THENCE 275.26 FEET ALONG A 746.29-FOOT RADIUS CURVE TO THE LEFT, SAID CURVE HAVING A CHORD N 52°19'45"W, 273.70 FEET; THENCE N 62°53'40"W, 522.53 FEET; THENCE N 62°38'40"W, 774.62 FEET; THENCE N 59°47'00"W, 100.12 FEET; THENCE N 62°38'40"W, 234.35; THENCE N 64°51'15"W, 166.02 FEET THENCE N 63°07'40"W, 342.26 FEET; THENCE N 62°36'40"W, 597.41 FEET; THENCE 167.71 FEET ALONG A 1402.81-FOOT RADIUS CURVE TO THE RIGHT, SAID CURVE HAVING A CHORD N 59°11'10"W, 167.61 FEET; THENCE N 55°45'40"W, 161.21 FEET TO THE SOUTHEAST CORNER OF SURVEY RECORDED IN BOOK 829 PAGE 433; THENCE LEAVING SAID NORTH RIGHT OF WAY LINE AND WITH THE EAST LINE OF SAID SURVEY N 0°03'35"W, 708.70 FEET; THENCE N 1°08'35"E, 477.34 FEET; THENCE N 2°10'05"E, 128.92 FEET TO THE SOUTH WEST CORNER OF THE SURVEY RECORDED IN BOOK 4216 PAGE 23; THENCE LEAVING SAID EAST LINE AND WITH THE SOUTH LINE OF SAID SURVEY RECORDED IN BOOK 4216 PAGE 23, S 89°32'50"E, 1945.32 FEET TO THE EAST LINE OF SAID SECTION 16; THENCE WITH THE NORTH LINE OF SAID SOUTHWEST QUARTER OF SAID SECTION 15, S 89°57'25"E, 1317.11 FEET TO THE WEST LINE OF SAID CEDAR GROVE SUBDIVISION; THENCE LEAVING SAID NORTH LINE AND WITH SAID WEST LINE OF CEDAR GROVE SUBDIVISION S 1°35'25"W, 3181.37 FEET TO THE POINT OF BEGINNING AND CONTAINS 161.84 ACRES.

DAVID T. BUTCHER, PLS-2002014095

10/23/2017
DATE

STATE OF MISSOURI
DAVID THOMAS BUTCHER
NUMBER PLS-2002014095
PROFESSIONAL LAND SURVEYOR

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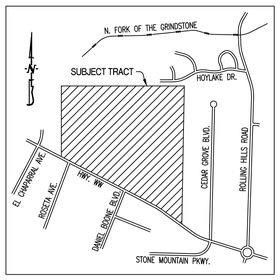
**EXHIBIT B**
**PRELIMINARY PLAT**

# THE BROOKS
# PRELIMINARY PLAT #2

A TRACT LOCATED IN SECTIONS 15, 16 & 22, TOWNSHIP 48 NORTH, RANGE 12 WEST
COLUMBIA, BOONE COUNTY, MISSOURI
CITY PROJECT #17-77




LOCATION MAP
NOT TO SCALE

## NOTES:

1. NO PART OF THIS TRACT LIES WITHIN THE 100 YEAR FLOODPLAIN AS ADOPTED BY THE CITY OF COLUMBIA AS SHOWN BY FIRM PANELS 29019C0285D & 29019C0295D DATED MARCH 17, 2011.
2. THERE SHALL BE A 10 FOOT UTILITY EASEMENT ALONG THE SIDE OF EACH LOT ADJACENT TO STREET RIGHT-OF-WAY.
3. NATURAL GAS DISTRIBUTION TO BE DESIGNED BY AMEREN UE.
4. WATER DISTRIBUTION TO BE DESIGNED BY BOONE COUNTY CPWSD #9.
5. ELECTRIC DISTRIBUTION TO BE DESIGNED BY THE BOONE ELECTRIC COOPERATIVE.
6. LOT NUMBERS SHOWN ARE FOR INVENTORY PURPOSES ONLY.
7. THE EXISTING ZONING OF THIS TRACT IS COUNTY A-R. (PENDING ANNEXATION/ZONING INTO THE CITY OF COLUMBIA TO R-1).
8. THIS PLAT CONTAINS 161.8 ACRES.
9. A MINIMUM OF 25% OF THE TREES CLASSIFIED AS CLIMAX FOREST AND LOCATED ON THIS TRACT SHALL BE PRESERVED. A TREE PRESERVATION PLAN SHALL BE SUBMITTED AND APPROVED BY THE CITY ARBORIST PRIOR TO LAND DISTURBANCE.
10. (A) PROPOSED COMMON LOT FOR BIORETENTION.
11. LOT C5 OF THE BROOKS, PLAT No. 1 WAS RESERVED AS A COMMON LOT WITH THE OPTION TO BE DEDICATED TO THE CITY OF COLUMIBA FOR RIGHT-OF-WAY PURPOSES TO ACCESS THE BROOKS, PHASE 2 AS NEEDED.
12. THERE SHALL BE NO DRIEVEWAY ACCESS FROM ANY RESIDENTIAL LOT DIRECTLY ONTO HOYLAKE DRIVE, EXCPET FOR LOTS 194 THRU 200 WHICH SHALL HAVE ACCESS ONLY FROM THE LOOP STREET PORTION OF HOYLAKE DRIVE.
13. HOYLAKE DRIVE SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE TO THE CITY OF COLUMBIA STREET STANDARDS FOR A MAJOR COLLECTOR (STANDARD OPTION) UNLESS OTHERWISE APPROVED BY THE PUBLIC WORKS DEPARTMENT.
14. SAGEMOOR DRIVE AND PRAIRIE DUNES DRIVE SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE TO THE CITY OF COLUMBIA STREET STANDARDS FOR A NEIGHBORHOOD COLLECTOR-OPTION A.
15. ALL COMMON LOTS ARE TO BE DEDICATED TO THE HOMEOWNER'S ASSOCIATION.
16. IT IS THE INTENT OF LOT 242 TO BE USED FOR NEIGHBORHOOD AMENITIES. AMENITIES MAY INCLUDE A POOL, CLUBHOUSE, SPORT COURTS, ETC.
17. REGULATED STREAM BUFFER IS IDENTIFIED ON THIS TRACT BY ARTICLE X, CHAPTER 12A OF THE CITY CODE OF ORDINANCES AND AS SHOWN BY THE COLUMBIA USGS QUADRANGLE.

| CLIMAX FOREST CALCULATIONS: | |
|---|---|
| TOTAL EXISTING CLIMAX FOREST | 37.2 AC.± |
| CLIMAX FOREST TO BE PRESERVED | 9.3 AC.± (25% MIN.) |

## LEGAL DESCRIPTION:

A TRACT OF LAND LOCATED IN THE NORTHWEST QUARTER OF SECTION 22, THE SOUTHWEST QUARTER OF SECTION 15 AND THE SOUTHEAST QUARTER OF SECTION 16, ALL OF TOWNSHIP 48 NORTH RANGE 12 WEST, BOONE COUNTY, MISSOURI AND BEING THE LAND DESCRIBED BY THE WARRANTY DEED RECORDED IN BOOK 3889, PAGE 50 AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

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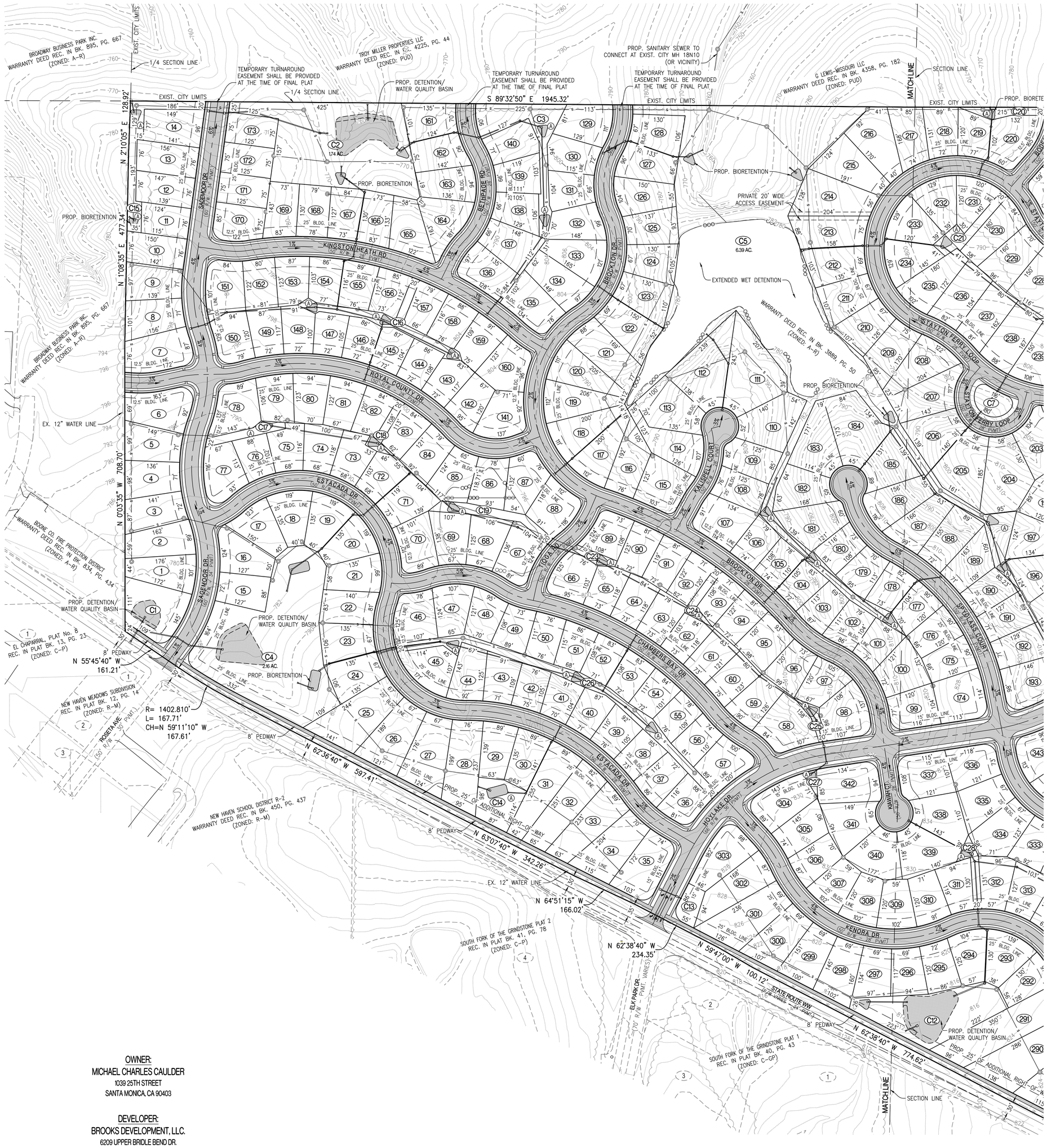



LEGEND:

- EXISTING 2FT CONTOUR
- EXISTING 10FT CONTOUR
- CURB
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER
- MANHOLE/CLEANOUT
- PROPOSED WATERLINE
- PROPOSED LIGHT POLE
- PROPOSED FIRE HYDRANT
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- BUILDING LINE
- EASEMENT
- LOT NUMBER
- PROPOSED PAVEMENT
- PROPOSED DETENTION/BIORETENTION
- EXISTING TREELINE

SCALE: 1"=100'
0 50 100 200

OWNER:
MICHAEL CHARLES CAULDER
1039 25TH STREET
SANTA MONICA, CA 90403

DEVELOPER:
BROOKS DEVELOPMENT, LLC.
6209 UPPER BRIDLE BEND DR.
COLUMBIA, MO 65201

STATE OF MISSOURI
TIMOTHY D. CROCKETT
NUMBER PE-2004000775
PROFESSIONAL ENGINEER

11/20/2017
TIMOTHY D. CROCKETT - PE-2004000775

SITE/CIVIL ENGINEER:
CROCKETT
ENGINEERING CONSULTANTS
1000 W. Nifong Blvd., Bldg. 1
Columbia, Missouri 65203
(573) 447-0292
www.crockettengineering.com
Crockett Engineering Consultants, LLC
Missouri Certificate of Authority
#2000151301

APPROVED BY THE CITY OF COLUMBIA PLANNING AND ZONING COMMISSION THIS _____ DAY OF _____, 2017.

_____
RUSTY STRODTMAN - CHAIRPERSON

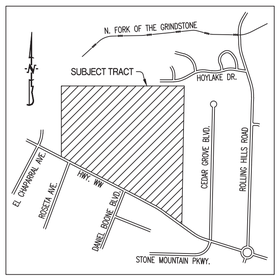
11/20/2017 COMMENTS
02/01/2017 ORIGINAL

150527

THE BROOKS, PHASE 2 - PRELIMINARY PLAT

# THE BROOKS
# PRELIMINARY PLAT #2

A TRACT LOCATED IN SECTIONS 15, 16 & 22, TOWNSHIP 48 NORTH, RANGE 12 WEST
COLUMBIA, BOONE COUNTY, MISSOURI
CITY PROJECT #17-77




LOCATION MAP
NOT TO SCALE

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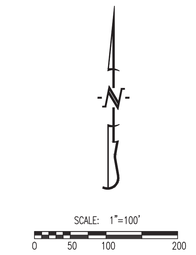
11. LOT C5 OF THE BROOKS, PLAT No. 1 WAS RESERVED AS A COMMON LOT WITH THE OPTION TO BE DEDICATED TO THE CITY OF COLUMIBA FOR RIGHT-OF-WAY PURPOSES TO ACCESS THE BROOKS, PHASE 2 AS NEEDED.
12. THERE SHALL BE NO DRIEVEWAY ACCESS FROM ANY RESIDENTIAL LOT DIRECTLY ONTO HOYLAKE DRIVE, EXCPET FOR LOTS 194 THRU 200 WHICH SHALL HAVE ACCESS ONLY FROM THE LOOP STREET PORTION OF HOYLAKE DRIVE.
13. HOYLAKE DRIVE SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE TO THE CITY OF COLUMBIA STREET STANDARDS FOR A MAJOR COLLECTOR (STANDARD OPTION) UNLESS OTHERWISE APPROVED BY THE PUBLIC WORKS DEPARTMENT.
14. SAGEMOOR DRIVE AND PRAIRIE DUNES DRIVE SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE TO THE CITY OF COLUMBIA STREET STANDARDS FOR A NEIGHBORHOOD COLLECTOR-OPTION A.
15. ALL COMMON LOTS ARE TO BE DEDICATED TO THE HOMEOWNER'S ASSOCIATION.
16. IT IS THE INTENT OF LOT 242 TO BE USED FOR NEIGHBORHOOD AMENITIES. AMENITIES MAY INCLUDE A POOL, CLUBHOUSE, SPORT COURTS, ETC.
17. REGULATED STREAM BUFFER IS IDENTIFIED ON THIS TRACT BY ARTICLE X, CHAPTER 12A OF THE CITY CODE OF ORDINANCES AND AS SHOWN BY THE COLUMBIA USGS QUADRANGLE.

| CLIMAX FOREST CALCULATIONS: | |
|---|---|
| TOTAL EXISTING CLIMAX FOREST | 37.2 AC.± |
| CLIMAX FOREST TO BE PRESERVED | 9.3 AC.± (25% MIN.) |

## LEGAL DESCRIPTION:

A TRACT OF LAND LOCATED IN THE NORTHWEST QUARTER OF SECTION 22, THE SOUTHWEST QUARTER OF SECTION 15 AND THE SOUTHEAST QUARTER OF SECTION 16, ALL OF TOWNSHIP 48 NORTH RANGE 12 WEST, BOONE COUNTY, MISSOURI AND BEING THE LAND DESCRIBED BY THE WARRANTY DEED RECORDED IN BOOK 3889, PAGE 50 AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING ON THE NORTH RIGHT OF WAY LINE OF STATE ROUTE WW AT THE SOUTHWEST CORNER OF CEDAR GROVE SUBDIVISION AS SHOWN IN THE SURVEY RECORDED IN BOOK 374, PAGE 112 AND WITH THE NORTH LINE THEREOF, N 42°44'40"W, 212.13 FEET; THENCE N 41°45'45"W, 174.24 FEET; THENCE 275.26 FEET ALONG A 746.29-FOOT RADIUS CURVE TO THE LEFT, SAID CURVE HAVING A CHORD N 52°19'45"W, 273.70 FEET; THENCE N 62°53'40"W, 522.53 FEET; THENCE N 62°38'40"W, 774.62 FEET; THENCE N 59°47'00"W, 100.12 FEET; THENCE N 62°38'40"W, 234.35; THENCE N 64°51'15"W, 166.02 FEET THENCE N 63°07'40"W, 342.26 FEET; THENCE N 62°36'40"W, 597.41 FEET; THENCE 167.71 FEET ALONG A 1402.81-FOOT RADIUS CURVE TO THE RIGHT, SAID CURVE HAVING A CHORD N 59°11'10"W, 167.61 FEET; THENCE N 55°45'40"W, 161.21 FEET TO THE SOUTHEAST CORNER OF SURVEY RECORDED IN BOOK 829 PAGE 433; THENCE LEAVING SAID NORTH RIGHT OF WAY LINE AND WITH THE EAST LINE OF SAID SURVEY N 0°03'35"W, 708.70 FEET; THENCE N 1°08'35"E, 477.34 FEET; THENCE N 2°10'05"E, 128.92 FEET TO THE SOUTH WEST CORNER OF THE SURVEY RECORDED IN BOOK 4216 PAGE 23; THENCE LEAVING SAID EAST LINE AND WITH THE SOUTH LINE OF SAID SURVEY RECORDED IN BOOK 4216 PAGE 23, S 89°32'50"E, 1945.32 FEET TO THE EAST LINE OF SAID SECTION 16; THENCE WITH THE NORTH LINE OF SAID SOUTHWEST QUARTER OF SAID SECTION 15, S 89°57'25"E, 1317.11 FEET TO THE WEST LINE OF SAID CEDAR GROVE SUBDIVISION; THENCE LEAVING SAID NORTH LINE AND WITH SAID WEST LINE OF CEDAR GROVE SUBDIVISION S 1°35'25"W, 3181.37 FEET TO THE POINT OF BEGINNING AND CONTAINS 161.84 ACRES.


LEGEND:

- EXISTING 2FT CONTOUR
- EXISTING 10FT CONTOUR
- CURB
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER
- MANHOLE/CLEANOUT
- PROPOSED WATERLINE
- PROPOSED LIGHT POLE
- PROPOSED FIRE HYDRANT
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- BUILDING LINE
- EASEMENT
- (XX) LOT NUMBER
- PROPOSED PAVEMENT
- PROPOSED DETENTION/BIORETENTION
- EXISTING TREELINE

OWNER:
MICHAEL CHARLES CAULDER
1039 25TH STREET
SANTA MONICA, CA 90403

DEVELOPER:
BROOKS DEVELOPMENT, LLC.
6209 UPPER BRIDLE BEND DR.
COLUMBIA, MO 65201

STATE OF MISSOURI
TIMOTHY D CROCKETT
NUMBER PE-2004000775
PROFESSIONAL ENGINEER

11/20/2017
TIMOTHY D. CROCKETT - PE-2004000775

APPROVED BY THE CITY OF COLUMBIA PLANNING AND ZONING COMMISSION THIS _____ DAY OF _____, 2017.

_____
RUSTY STRODTMAN - CHAIRPERSON

11/20/2017 COMMENTS
02/01/2017 ORIGINAL

150527

**EXHIBIT C**
**TRAFFIC IMPACT STUDY**

January 23, 2017

Mr. Tim Crockett. P.E.
Crockett Engineering
2608 North Stadium Drive
Columbia, MO 65202

RE: Traffic Impact Study
Proposed Residential Development – The Brooks Phase 2
Columbia, Missouri
CBB Job No. 113-16

Dear Mr. Crockett:

As requested, CBB has completed a traffic impact study pertaining to the proposed residential development, known as The Brooks Phase 2, in Columbia, Missouri. The subject property is located north of Highway WW between Roseta Avenue and Rolling Hills Road. The location of the site in relation to the surrounding road system is depicted in **Figure 1**.

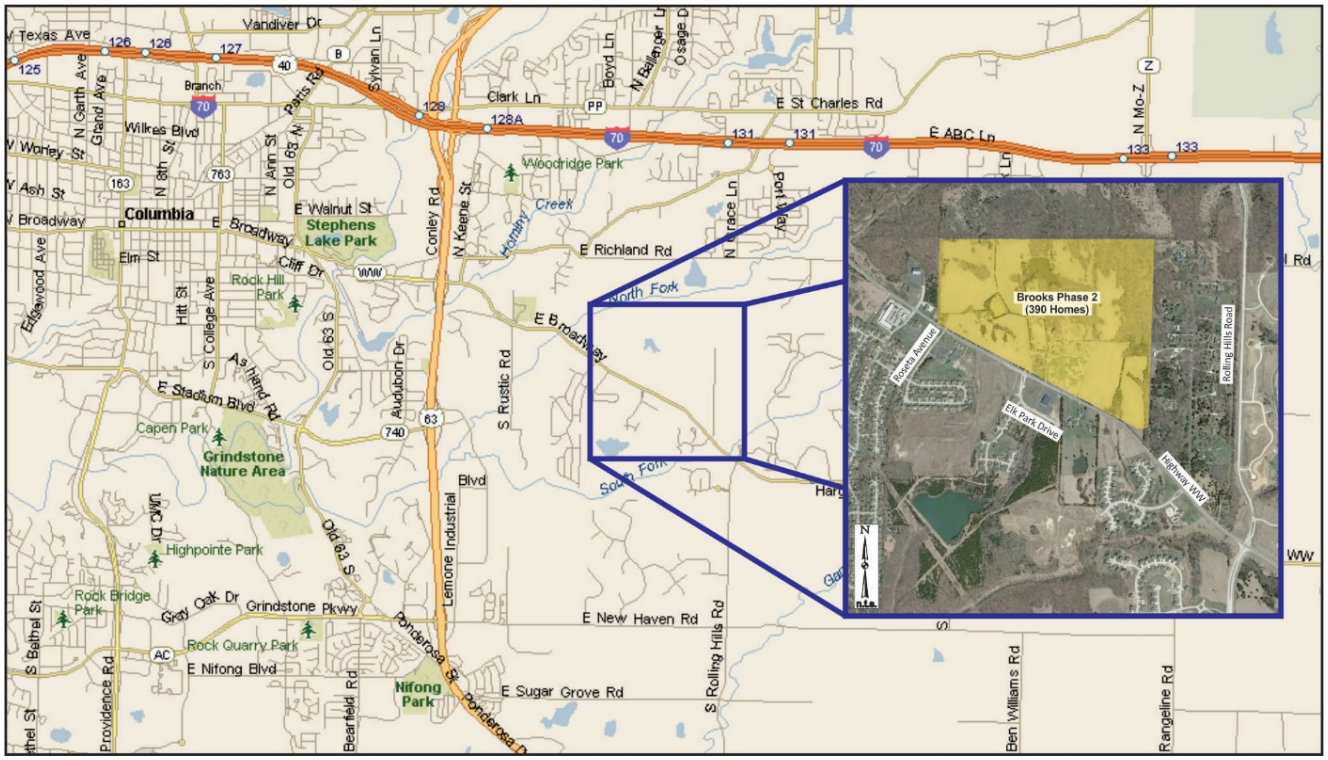



Figure 1: Project Location Map

Based on the site plan provided at the commencement of the study, the proposed development would consist of approximately 390 single family homes. Access to the proposed subdivision would be provided via two new roads on Highway WW; one opposite Elk Park Drive and one opposite Roseta Avenue. A schematic of the concept plan provided is shown in **Figure 2**.


Figure 2: The Brooks Phase 2 Concept Plan (Provided by Crockett Engineering)

As part of the project, a collector road would be built through the proposed subdivision from Highway WW, opposite Elk Park Drive, to the north where it would tie into the east/west collector road, Hoylake Drive, currently under construction through the new subdivision to the

northeast of the proposed site, The Brooks Phase I. This would provide a collector road between Highway WW and Rolling Hills Road.

The purpose of this study was to determine the number of additional trips that would be generated by the proposed development, evaluate the impact on the operating conditions for the adjacent roadways, and determine the ability of motorists to safely enter and exit the site. If necessary, roadway improvements (lane additions and/or traffic control modifications) are recommended to mitigate the impact of the development and to accommodate the additional traffic. The focus of this study was the AM and PM peak hours of a typical weekday.

CBB discussed the scope of work for this traffic study with the Missouri Department of Transportation (MoDOT) and the City of Columbia at the commencement of the traffic study process. CBB also provided MoDOT and the City a Technical Memo summarizing the proposed site trip generation and directional distribution estimates, as well as the 20-year background traffic growth assumptions and gained their consensus on the assumptions prior to completing the traffic analyses.

As requested by MoDOT and the City, the following intersections were included in the study:

- Highway WW and El Chaparral Avenue;
- Highway WW and Roseta Avenue;
- Highway WW and Elk Park Drive;
- Highway WW and Rolling Hills Road; and
- Rolling Hills Road and east/west collector road.

As requested by MoDOT and the City, the following analysis scenarios were considered:

- 2016 Base Conditions (2016 existing traffic volumes plus The Brooks Phase 1);
- 2016 Build Conditions;
  - 2016 Base plus proposed Brooks Phase 2 development
- 2036 No-Build Conditions;
  - 2016 Base plus 20 years background growth and future adjacent developments
- 2036 Build Conditions; and
  - 2036 No-Build plus proposed Brooks Phase 2 development

The following report presents the methodology and findings relative to the Base, 2016 Build, and Design Year conditions.

## EXISTING CONDITIONS

**Area Roadway System: Highway WW** (East Broadway) is a minor arterial roadway that runs primarily east-west through the study area. Highway WW is owned and maintained by MoDOT. Within the study area, Highway WW provides two travel lanes, one in each direction. The posted speed limit adjacent to the site is 45 miles per hour (mph); to the east of the site, the posted speed increases to 55 mph. No sidewalks are provided along Highway WW through the study area. Paved shoulders are provided to the east of Cedar Grove Boulevard/Stone Mountain Parkway.

**Rolling Hills Road** is a collector road that runs north-south. Within the study area, Rolling Hills Road provides two travel lanes, one in each direction. The posted speed limit is 45 mph. Sidewalks are provided along the east side of the roadway north of Highway WW and along both sides of the roadway south of Highway WW.

**Elk Park Drive** is a local road that runs north-south at the intersection with Highway WW and curves to the east south of Highway WW. Elk Park Drive provides two travel lanes, one in each direction. The posted speed limit is 30 mph. Sidewalks are provided along the west side of the roadway south of Highway WW and along the north side of the east-west section.

**Roseta Avenue** is a local road that runs north-south. Roseta Avenue provides two travel lanes, one in each direction. The posted speed limit is 20 mph. Sidewalks are not provided along the roadway.

**El Chaparral Avenue** is a local road that runs north-south. El Chaparral Avenue provides two travel lanes, one in each direction. The posted speed limit is 20 mph. Sidewalks are not provided along the roadway.

The intersection of Highway WW and Rolling Hills Road is controlled by a roundabout. The eastbound and westbound approaches consist of one entering lane, and the northbound and southbound approaches consist of two entering lanes. Pedestrian crosswalks are provided within the roundabout.

The three-legged intersection of Highway WW and Elk Park Drive is controlled by a side-street stop. There is a traffic signal at the intersection, but it is currently non-operational (dark). It is our understanding that the traffic signal would be turned on when the traffic volumes meet warrants for a traffic signal. The eastbound approach consists of one left-turn lane and one through lane, the westbound approach consists of a through lane and a right-turn lane, and the northbound approach consists of one left-turn lane and one right-turn lane. **Figure 3** provides an aerial view of the intersection.


Figure 3: Highway WW at Elk Park Drive

The three-legged intersection of Highway WW and Roseta Avenue is controlled by a side-street stop. The eastbound, westbound, and northbound approaches consist of one lane each. **Figure 4** provides an aerial view of the intersection.


Figure 4: Highway WW at Roseta Avenue

The intersection of Highway WW and El Chaparral Avenue is controlled by a side-street stop. The eastbound, westbound, and southbound approaches consist of one lane each. The northbound approach consists of one left-turn lane and one right-turn lane. **Figure 5** provides an aerial view of the intersection.


Figure 5: Highway WW at El Chaparral Avenue

**Existing Traffic Volumes:** In order to establish existing traffic conditions, manual peak period traffic counts were conducted at the following intersections within the study area:

- Highway WW and El Chaparral Avenue;
- Highway WW and Roseta Avenue;
- Highway WW and Elk Park Drive; and
- Highway WW and Rolling Hills Road.

These counts were conducted from 7:00 to 9:00 a.m. and from 4:00 to 6:00 p.m. the first week of December 2016. Both the University of Columbia and the Columbia public school academic calendars were reviewed to ensure that the data was collected during normal school operations. These counts were supplemented with traffic counts collected by CBB in May 2014 along Rolling Hills Road, north of Highway WW. Based on the counts, the weekday AM peak hour occurred from 7:15 to 8:15 a.m. while the weekday PM peak hour occurred from 4:45 to

5:45 p.m. The existing weekday AM and PM peak hour traffic volumes are summarized in **Exhibit 1**.

Given the traffic characteristics in the area and the anticipated trip generation for the proposed development, the weekday AM and PM peak periods would represent a "worst-case scenario" with regards to the traffic impact. If traffic operations are acceptable during these peak periods, it can be reasoned that conditions would be acceptable throughout the remainder of the day.

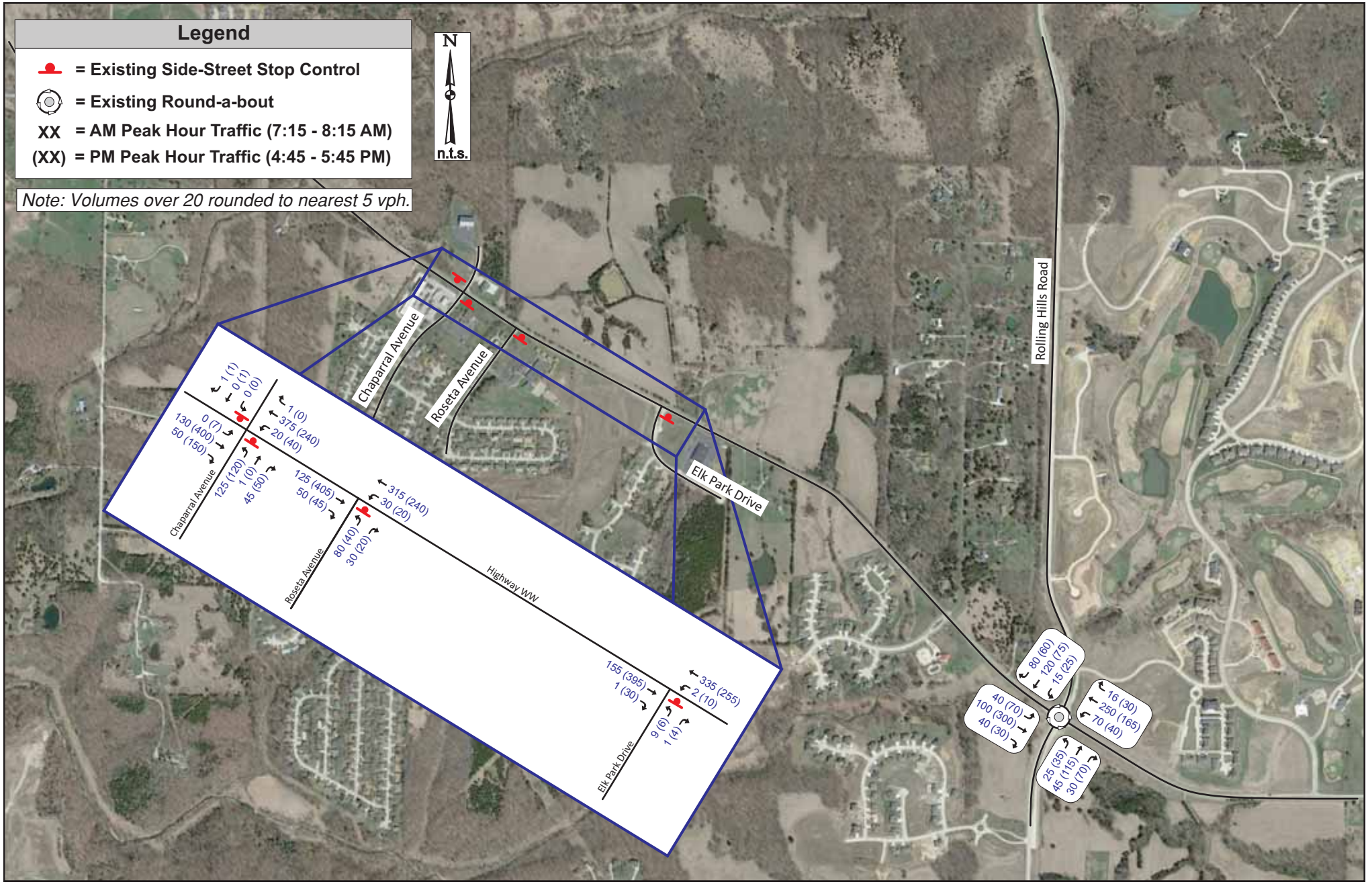



Exhibit 1: Existing Traffic Volumes

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## APPROVED DEVELOPMENT – THE BROOKS PHASE 1

CBB previously completed a Traffic Impact Study in June 2014 for The Brooks Phase I residential development off Rolling Hills Road just northeast of the site. The Brooks Phase 1 consists of 83 single-family homes. The project is currently under construction, but there are no homes built to date. As detailed in the June 2014 Traffic Impact Study, the trips associated with The Brooks Phase 1 are shown in **Figure 6**. These trips were assigned assuming the provision of a collector street through the Brooks Phase 2 development. The Brooks Phase 1 trips (Figure 6) were added to the existing traffic volumes (Exhibit 1) to develop the 2016 Base, or 2016 No Build, traffic volumes shown in **Exhibit 2**.

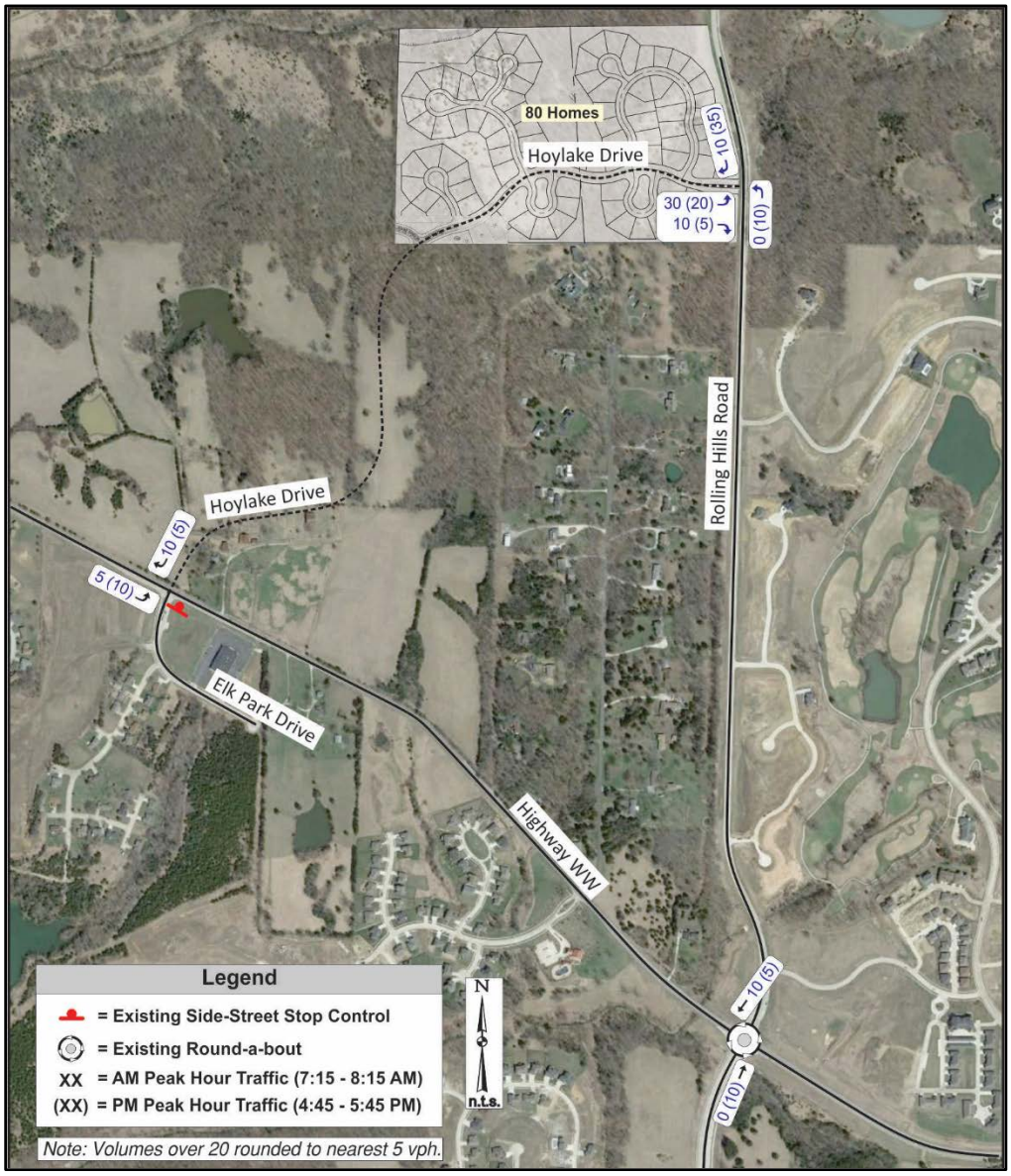


Figure 6: The Brooks Phase 1 Site Trips (from CBB June 2014 Traffic Impact Study)

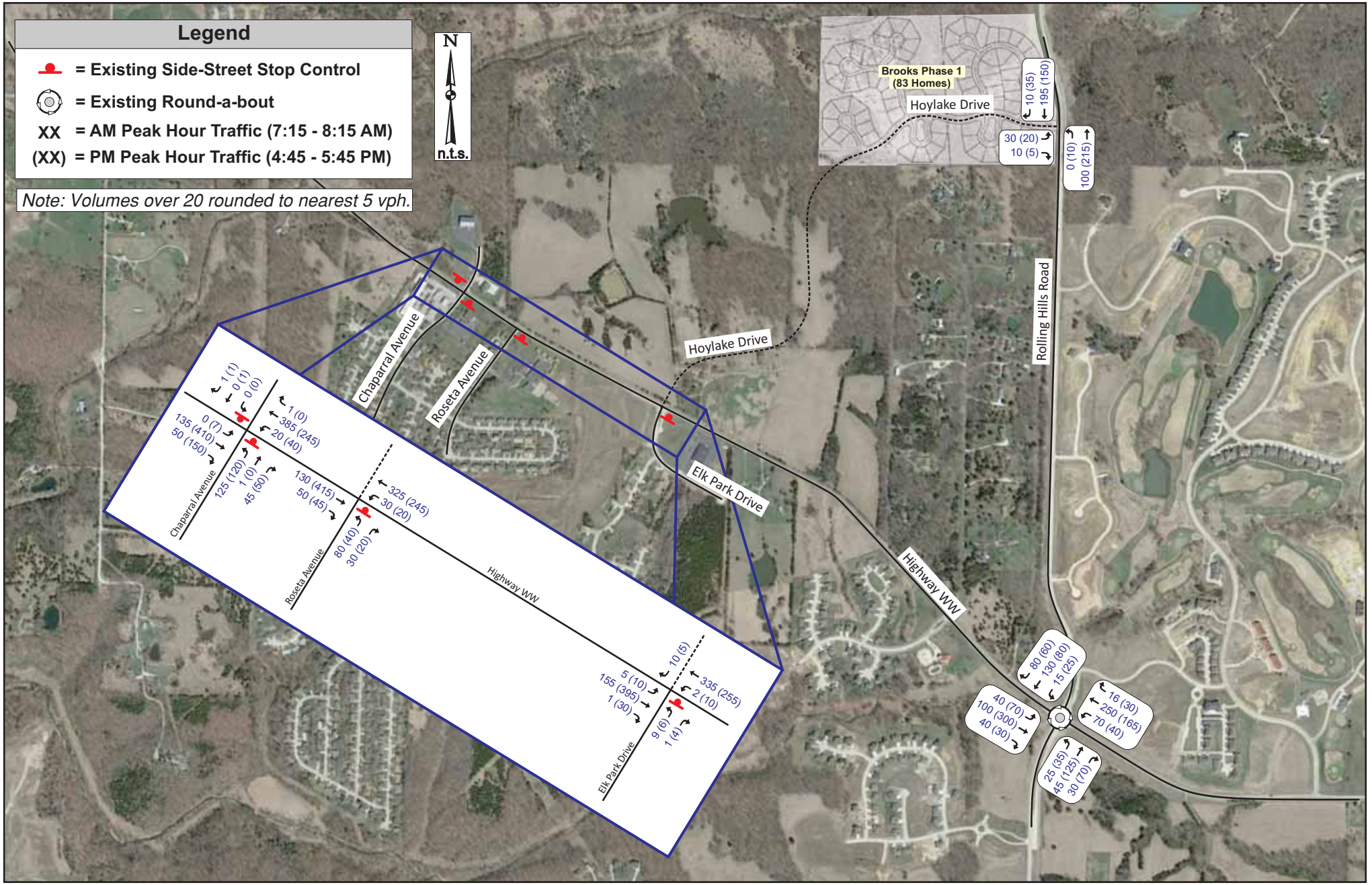


Exhibit 2: 2016 No-Build Traffic Volumes

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## PROPOSED SITE

Once the base traffic volumes within the study area were established, we then considered the traffic associated with the proposed Brooks Phase 2 development.

**Proposed Land Use:** Based upon the concept plan provided by Crockett Engineering Consultants, previously shown in Figure 2, a single-family residential development is proposed north of Highway WW near Elk Park Drive. The site would consist of approximately 390 single family homes.

**Site Access:** As shown on the concept plan, access to the proposed subdivision would be provided via two new roads on Highway WW; one opposite Elk Park Drive which would be an extension of Hoylake Drive from The Brooks Phase 1 development through The Brooks Phase 2 development and one opposite Roseta Avenue, named Sunningdale Drive.

As part of the project, the existing Hoylake Drive collector road currently under construction through The Brooks Phase I site would be extended through the proposed subdivision and tie into Highway WW, opposite Elk Park Drive. This would provide a collector road between Highway WW and Rolling Hills Road.

**Intersection Sight Distance:** The sight distance for the proposed site drive opposite Roseta Avenue was compared to the guidelines found in *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO), commonly referred to as the Green Book. Adequate sight distance is necessary at intersections to allow drivers to perceive potentially conflicting vehicles and allow those motorists sufficient time to adjust their speed to avoid a collision or make a choice of when to cross or enter the mainline traffic flow. All drivers approaching or stopped at the intersection should have an unobstructed view of the entire intersection so that potential collisions can be avoided.

The Green Book's guidelines for minimum safe sight distance for entrances reflect the design speed of the major road and the gap time required for a vehicle on the minor road to enter or cross the major road. The intersection sight distance is computed according to the following formula:

*ISD = 1.47*Design Speed (mph)*Design Gap (sec)*

A design speed of 50 mph (45 mph posted + 5 mph) was used for Highway WW. The minimum design gap time for a passenger car is typically assumed to be 7.5 seconds plus 0.5 seconds for each additional lane crossing. Based on these criteria, the recommended Intersection Sight Distance on Highway WW is 555 feet.

When measuring sight distance, the driver's eye for the side street vehicle is typically assumed to be 14.5 feet back from the edge of pavement. **Figure 7** depicts the sight distance for the proposed site drive opposite Roseta Avenue at Highway WW assuming the driver's eye is located close to 14.5 feet from the edge of Highway WW. Given the existing ditch and vegetation, and the fact that the proposed street is not constructed yet, it was not possible to measure the sight distance exactly 14.5 from the edge of pavement. However, it is apparent from the photos in Figure 7, that the existing vegetation along the north side of Highway WW, east and west of Roseta Avenue, will need to be removed to achieve adequate sight distance.

*Looking East (~14.5 feet back)*

*Looking West (~14.5 feet back)*

Figure 7: Sight Distance for Proposed Drive Opposite Roseta Avenue – 14.5 feet Back from Highway WW

The sight distance for the proposed site drive opposite Roseta Avenue was measured in the field assuming the driver's eye is located closer to the edge of Highway WW (to account for the removal of the existing vegetation). The intersection sight distance to the east was measured in the field at 800 feet, while the intersection sight distance to the west was measured in the field at 670 feet, both of which exceed the required 555 feet. However, as the design progresses, the area within the sight distance triangle must be cleared of any vegetation that would obstruct the sight distance.

Furthermore, careful consideration should be given to sight distance obstructions when planning any future aesthetics enhancements, such as berms, fencing and landscaping for the proposed Brooks Phase 2 development to ensure that these improvements do not obstruct the view of entering and exiting traffic at the proposed entrances onto Highway WW. It is generally recommended that all improvements higher than 3.5 feet above the elevation of the nearest pavement edge be held back at least 20 feet from the traveled roadway.

**Trip Generation:** As a primary step in this analysis, forecasts were prepared to estimate the amount of traffic that the proposed development would generate during the weekday AM and PM peak periods. These forecasts were based upon information provided in the latest edition of the *Trip Generation Manual*. Estimates for the proposed development were based upon Land Use: 210 – Single-Family Detached Housing.

The data provided for Peak Hour of the Adjacent Street was used for the traditional weekday AM and PM peak hour forecasts. Based on this data, the trip generation forecast for the proposed Brooks Phase 2 development is shown in **Table 1**. As shown, the proposed Brooks Phase 2 development would generate a total of 285 trips during the weekday AM peak hour and 355 trips during the weekday PM peak hour.

Table 1: Trip Estimate – The Brooks Phase 2

| *ITE Code* | *Land Use* | *Unit* | *ADT (VPD)* | *Weekday AM Peak Hour* | | | *Weekday PM Peak Hour* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *In* | *Out* | *Total* | *In* | *Out* | *Total* |
| 210 | Single-Family Homes | 390 Homes | 3,675 | 70 | 215 | 285 | 225 | 130 | 355 |
| The Brooks Phase 2 Total Trips | | | 3,675 | 70 | 215 | 285 | 225 | 130 | 355 |

**Trip Distribution*:*** The site-generated trips for the proposed development were then assigned into and out of the site based upon an estimated directional distribution. Based upon the existing travel patterns in the area, it is anticipated that the distribution of site-generated trips for The Brooks Phase 2 development would be as follows:

- To/from the north on Rolling Hills Road ..... 35%
- To/from the south on Rolling Hills Road ..... 10%
- To/from the east on Highway WW ..... 3%
- To/from the west on Highway WW ..... 52%

The site-generated traffic volumes for the weekday AM and PM peak hour are shown in **Exhibit 3.**

**2016 Build Traffic Volumes (2016 No Build plus Brooks Phase 2):** The assigned traffic volumes resulting from the trip distribution for the proposed Brooks Phase 2 development were added to the 2016 No Build traffic volumes to determine the total volumes in the forecasted scenario. The forecasted, 2016 Build, traffic volumes for the AM and PM peak hours are shown in **Exhibit 4.**

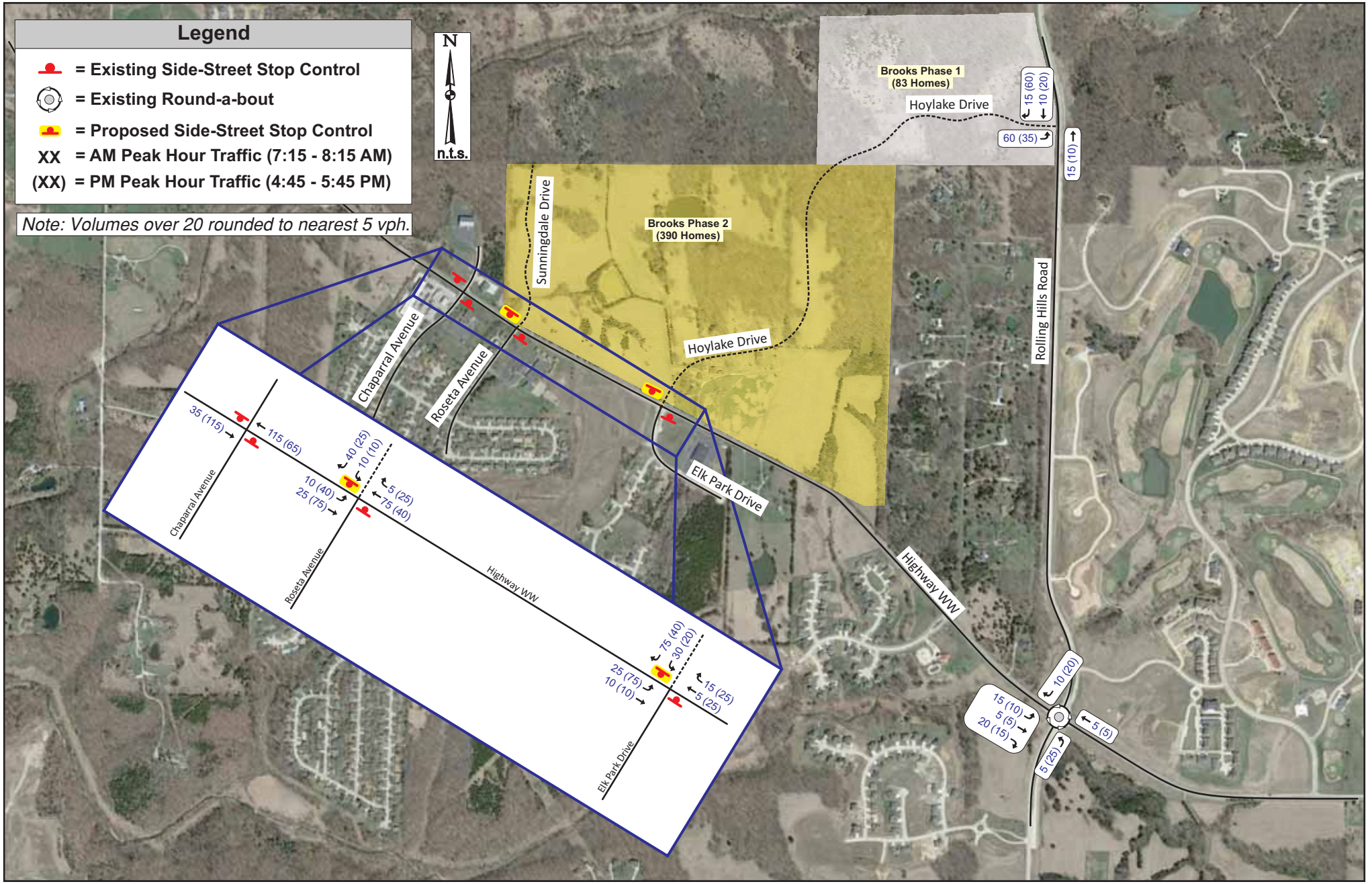


Exhibit 3: Site-Generated Trips - The Brooks Phase 2

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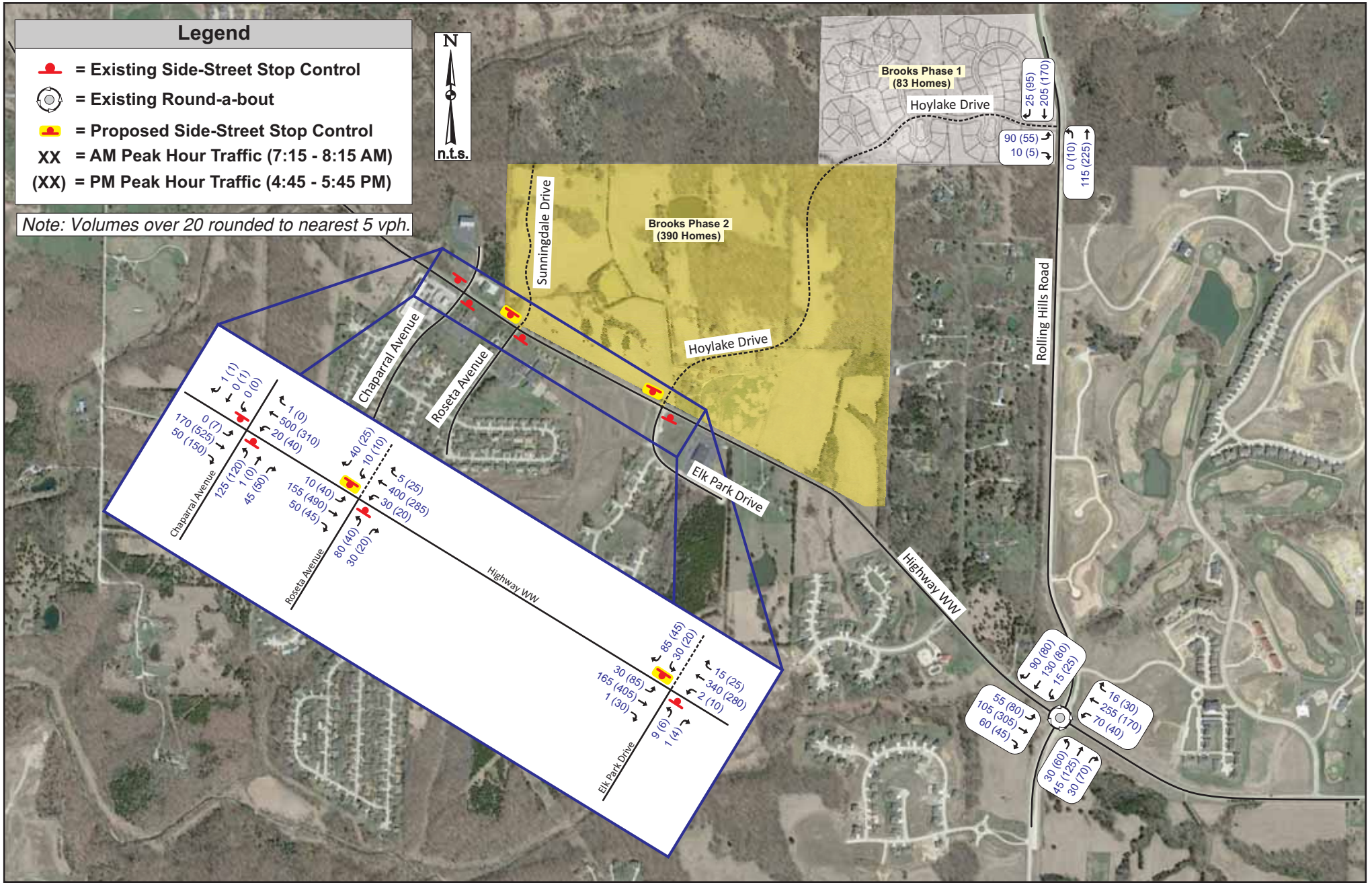


Exhibit 4: 2016 Build Traffic Volumes

Job# 113-16
01/23/17

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## 2016 TRAFFIC ANALYSIS

**Study Procedures:** The 2016 No Build and 2016 Build operating conditions were analyzed using SYNCHRO 8, a macro-level analytical traffic flow model. SIDRA was used to analyze the roundabout intersections. SYNCHRO and SIDRA are based on study procedures outlined in the *Highway Capacity Manual*, published by the Transportation Research Board. This manual, which is used universally by traffic engineers to measure roadway capacity, establishes six levels of traffic service: Level A ("Free Flow"), to Level F ("Fully Saturated"). Levels of service (LOS) are measures of traffic flow, which consider such factors as speed, delay, traffic interruptions, safety, driver comfort, and convenience. Level C, which is normally used for highway design, represents a roadway with volumes ranging from 70% to 80% of its capacity. However, Level D is considered acceptable for peak period conditions in urban and suburban areas.

The thresholds that define level of service at an intersection are based upon the type of control used (i.e., whether it is signalized or unsignalized) and the calculated delay. For signalized and all-way stop intersections, the average control delay per vehicle is estimated for each movement and aggregated for each approach and then the intersection as a whole. At intersections with partial (side-street) stop control, delay is calculated for the minor movements only since motorists on the main road are not required to stop.

Level of service is directly related to control delay. At signalized intersections, the level of service criteria differ from that at unsignalized intersections primarily because different transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes, and consequently may experience greater delay than an unsignalized intersection. **Table 2** summarizes the thresholds used in the analysis for signalized and unsignalized intersections.

Table 2: Level of Service Thresholds

| *Level of Service (LOS)* | Control Delay per Vehicle (sec/veh) | |
|---|---|---|
| | *Signalized Intersections* | *Unsignalized Intersections* |
| A | ≤ 10 | 0-10 |
| B | > 10-20 | > 10-15 |
| C | > 20-35 | > 15-25 |
| D | > 35-55 | > 25-35 |
| E | > 55-80 | > 35-50 |
| F | > 80 | > 50 |

**2016 Build Auxiliary Turn Lane Needs*:*** The need for separate westbound right-turn lanes and eastbound left-turn lanes on Highway WW were evaluated using MoDOT's Access Management Guidelines (AMG). These guidelines consider auxiliary lanes an asset in promoting safety and improved traffic flow at relatively high conflict locations. Separate turn lanes are intended to remove turning vehicles from the through lanes to reduce the potential number of rear-end collisions at intersections. The MoDOT method provides volume guidelines for the consideration of separate turn lanes by comparing the total advancing volume (which includes all turning traffic) to the number of right and left-turns during the design hour with respect to a given major road speed.

Utilizing MoDOT's AMG *Right-Turn Lane Guideline for Two-lane Roadway* nomograph, separate right-turn lanes are not warranted on Highway WW at either site drive. Utilizing MoDOT's AMG *Left-Turn Lane Guideline for Two-lane Roadway (45 mph)* nomograph, separate left-turn lanes are warranted on Highway WW at both the west drive opposite Roseta Avenue, Sunningdale Drive, and the main drive opposite Elk Park Drive, Hoylake Drive.

**2016 Build Signal Warrant Analysis:** As mentioned previously, traffic signal equipment is present at the intersection of Highway WW and Elk Park Drive; however, the traffic signal is non-operational (dark). It is our understanding that the traffic signal would be turned on when the traffic volumes meet warrants for a traffic signal. Thus, the need for a traffic signal at Highway WW and Elk Park Drive was evaluated using criteria outlined in the *Manual on Uniform Traffic Control Devices* (MUTCD), published by the Federal Highway Administration, United States Department of Transportation. Part Four of the MUTCD provides eight different warrants for signalization that are based on hourly traffic volumes, traffic operations, pedestrian volumes or accident experience. The Manual further states that a traffic signal should not be installed unless one or more warrants are satisfied, an engineering study indicates that the installation will improve the overall safety and/or operation of the intersection, and that a traffic signal will not seriously disrupt progressive traffic flow.

Warrant 1 has two conditions, "A" and "B". Condition "A" (Minimum Vehicular Volume) is intended for application where a large volume of intersecting traffic is the principal reason to consider a signal. Condition "B" (Interruption of Continuous Traffic) is intended for application where traffic volumes on a major street are so heavy that traffic on the minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. The minimum volume requirements are shown in **Figure 8**.

Reduced warrants are applicable at locations where the speed of the major street exceeds 40 mph. In this case the posted speed on Highway WW is 45 mph, so the traffic volumes in the 70% column of the table shown in Figure 8 may be used.

**Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume**

**Condition A—Minimum Vehicular Volume**

| Number of lanes for moving traffic on each approach | | Vehicles per hour on major street (total of both approaches) | | | | Vehicles per hour on higher-volume minor-street approach (one direction only) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Major Street | Minor Street | 100%[a] | 80%[b] | 70%[c] | 56%[d] | 100%[a] | 80%[b] | 70%[c] | 56%[d] |
| 1 | 1 | 500 | 400 | 350 | 280 | 150 | 120 | 105 | 84 |
| 2 or more | 1 | 600 | 480 | 420 | 336 | 150 | 120 | 105 | 84 |
| 2 or more | 2 or more | 600 | 480 | 420 | 336 | 200 | 160 | 140 | 112 |
| 1 | 2 or more | 500 | 400 | 350 | 280 | 200 | 160 | 140 | 112 |

**Condition B—Interruption of Continuous Traffic**

| Number of lanes for moving traffic on each approach | | Vehicles per hour on major street (total of both approaches) | | | | Vehicles per hour on higher-volume minor-street approach (one direction only) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Major Street | Minor Street | 100%[a] | 80%[b] | 70%[c] | 56%[d] | 100%[a] | 80%[b] | 70%[c] | 56%[d] |
| 1 | 1 | 750 | 600 | 525 | 420 | 75 | 60 | 53 | 42 |
| 2 or more | 1 | 900 | 720 | 630 | 504 | 75 | 60 | 53 | 42 |
| 2 or more | 2 or more | 900 | 720 | 630 | 504 | 100 | 80 | 70 | 56 |
| 1 | 2 or more | 750 | 600 | 525 | 420 | 100 | 80 | 70 | 56 |

[a] Basic minimum hourly volume
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures
[c] May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Figure 8: MUTCD Warrant 1, Eight Hour Vehicular Volume

Using the 70% reduced warrant thresholds, Warrant 1A (Minimum Vehicular Volume) requires hourly approach volumes of at least 350 vehicles per hour (vph) on the major street for any eight hours of a typical day. During this same period, the volume of traffic entering from the minor street must exceed 105 vph (assuming a single lane approach). Warrant 1B requires approach volumes of at least 525 vph on the major street with a minimum of 53 vph on the minor street. The major street volume includes both directions, while the minor street volume includes only the heavier side-street approach. Elk Park Drive consists of a two lane approach (a left-turn lane and a shared through/right-turn lane). Likewise, the proposed subdivision street was assumed to consist of a two lane approach (a left-turn lane and a shared through/right-turn lane). Thus, the right-turn movements would commonly be reduced from the traffic analysis since they have a separate lane to get around any vehicles waiting to turn left. Thus, only the left-turn volume, in a single lane, was considered for the 2016 Build traffic signal warrant analysis since the through volume would be very low, effectively allowing for a separate right-turn lane.

In the absence of eight-hour traffic counts, the 8$^{th}$ highest hourly volumes are commonly estimated as 55% of peak hour traffic. As indicated by the 2016 Build traffic volumes (Exhibit 4), the total approach volume on Highway WW is forecasted at 835 vph during the weekday PM peak hour, while the approach volume on the side street (discounting the right-turn volume) is forecasted at 20 vph. At 55% of the peak hour, the 8$^{th}$ highest hourly volume is estimated to be approximately 460 vph on Highway WW and 11 vph on the side street

approach. As a result, the 2016 Build traffic volumes would not even satisfy one hour of the required eight hours. Thus, a traffic signal at Highway WW and Elk Park Drive is not warranted in the 2016 Build conditions.

**2016 Operating Conditions:** The study intersections were evaluated using the methodologies described above. The recommended eastbound left-turn lanes on Highway WW at both Sunningdale Drive, opposite Roseta Avenue, and Hoylake Drive, opposite Elk Park Drive, are reflected in the Build analyses. Hoylake Drive was assumed to have two lanes exiting (a left-turn lane and a shared through/right-turn lane) and one lane entering. Sunningdale Drive was assumed to have one lane exiting and one lane entering. **Table 3** summarizes the results of this analysis, which reflects the 2016 No Build and Build operating conditions and average delays during the AM and PM peak hours.

The 2016 No Build operating conditions reflect the anticipated operating conditions upon the full build-out of The Brooks Phase 1 development. As shown in **Table 3**, all of the study intersections and individual approaches operate at desirable levels of service (i.e., LOS C or better) during the peak hours with the exception of the northbound approach of El Chaparral Avenue at Highway WW which operates at LOS D during the PM peak hour.

The study intersections were re-evaluated for the 2016 Build conditions using the same methodologies. This analysis includes the full build-out of The Brooks Phase 2 development. As shown in **Table 3**, all of the study intersections and individual approaches are forecasted to operate at acceptable levels of service (i.e. LOS D or better) in the 2016 Build conditions with the exception of the northbound approach of El Chaparral Avenue at Highway WW which is forecasted to operate at LOS E during the PM peak hour.

As mentioned previously, a traffic signal at Highway WW and Elk Park Drive is not warranted in the 2016 Build conditions, and given the favorable level of service forecasted for the intersection, it is not recommended that the traffic signal be turned on until such time that the side street volume merits signalization.

Table 3: 2016 Capacity Analysis Summary

| *Intersection/Movement* | *AM Peak Hour* | | *PM Peak Hour* | |
|---|---|---|---|---|
| | *2016 No Build Conditions* | *2016 Build Conditions* | *2016 No Build Conditions* | *2016 Build Conditions* |
| *Highway WW and Chaparral Avenue (Side-Street STOP)* | | | | |
| Eastbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Westbound Highway WW Approach | A (<1.0) | A (<1.0) | A (1.7) | A (1.6) |
| Northbound Chaparral Ave Approach | C (16.7) | C (22.2) | D (27.8) | E (48.4) |
| Southbound Fire Station Approach | B (10.7) | B (11.7) | B (15.0) | C (17.6) |
| *Highway WW and Roseta Avenue/Proposed Sunningdale Drive (Side-Street STOP)* | | | | |
| Eastbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Westbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Northbound Roseta Ave Approach | B (13.8) | C (20.3) | C (15.5) | D (25.0) |
| Southbound Sunningdale Drive Approach | | B (12.7) | | B (14.6) |
| *Highway WW and Elk Park Drive/Proposed Hoylake Drive (Side-Street STOP)* | | | | |
| Eastbound Highway WW Left-Turn | A (8.0) | A (8.2) | A (7.8) | A (8.2) |
| Westbound Highway WW Left-Turn | A (7.6) | A (7.6) | A (8.3) | A (8.3) |
| Northbound Elk Park Drive Approach | B (13.1) | C (16.8) | B (14.3) | C (18.9) |
| Southbound Hoylake Drive Approach | B (10.4) | B (12.3) | A (9.8) | B (14.4) |
| *Highway WW and Rolling Hills Road (Roundabout)* | | | | |
| Eastbound Highway WW Approach | A (6.0) | A (6.5) | A (8.8) | A (7.6) |
| Westbound Highway WW Approach | A (7.4) | A (7.7) | A (6.8) | A (7.2) |
| Northbound Rolling Hills Road Approach | A (4.6) | A (4.7) | A (8.3) | A (7.2) |
| Southbound Rolling Hills Road Approach | A (8.2) | A (8.6) | A (5.9) | A (6.5) |
| *Overall* | *A (7.0)* | *A (7.3)* | *A (7.8)* | *A (7.2)* |
| *Rolling Hills Road and Hoylake Drive (Side-Street STOP)* | | | | |
| Eastbound Hoylake Drive Approach | B (10.5) | B (11.6) | B (11.1) | B (12.6) |
| Northbound Rolling Hills Road Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Southbound Rolling Hills Road Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |

X (XX.X) - Level of Service (Vehicular delay in seconds per vehicle)

## 20-YEAR DESIGN HORIZON

Based on prior discussions with the City of Columbia, it is likely that the vacant tracts to the north (referred to as the North Tract), west (referred to as the El Chaparral Tract) and south (referred to as the Elk Park Tract) of the subject site will develop within the next 20 years. These tracts are depicted in **Figure 9**. As such, the 20 year conditions considered these future development areas along with the build-out of the approved Brooks Phase 1 development and the proposed Brooks Phase 2 development.


Figure 9: Adjacent Tracts Assumed to Develop by 2036

**2036 No Build Traffic Volumes:** A series of volume assignments were estimated to determine the 20-year No Build traffic volumes. As a first step, the existing traffic volumes were increased by an annual growth rate of 1.5% to account for 20 years of background growth as depicted in the Appendix in **Exhibit A-1**.

Next, the trips associated with the North Tract, El Chaparral Tract, and Elk Park Tract were estimated and assigned to the roadways. Based on a review of the vacant tracts developable land area, it was estimated that the adjacent tracts would develop as follows:

The North Tract

- 85 single-family homes

El Chaparral Tract

- 40 single-family homes

Elk Park Tract

- Residential *(noted in orange in Figure 9)*
  - 120 single-family homes
- Neighborhood Commercial *(noted in yellow in Figure 9)*
  - 55,000 ft$^2$ of neighborhood commercial space

Traffic forecasts for the North Tract, El Chaparral Tract, and Elk Park Tract were developed using data provided in the *Trip Generation Manual* as depicted in **Table 4.**

Table 4: Trip Generation Estimate – Adjacent Tracts

| *ITE Code* | *Land Use* | *Unit* | *ADT (VPD)* | *Weekday AM Peak Hour* | | | *Weekday PM Peak Hour* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *In* | *Out* | *Total* | *In* | *Out* | *Total* |
| North Tract | | | | | | | | | |
| 210 | Single-Family Homes | 85 Homes | 905 | 20 | 50 | 70 | 55 | 35 | 90 |
| El Chaparral Tract | | | | | | | | | |
| 210 | Single-Family Homes | 40 Homes | 450 | 10 | 30 | 40 | 30 | 15 | 45 |
| Elk Park Residential Tract | | | | | | | | | |
| 210 | Single-Family Homes | 120 Homes | 1,240 | 25 | 70 | 95 | 80 | 45 | 125 |
| Elk Park Commercial Tract | | | | | | | | | |
| 820 | Neighborhood Retail | 55,000 ft$^2$ | 4,605 | 65 | 40 | 105 | 195 | 205 | 400 |

*the numbers in the table have been rounded to the nearest 5

As shown in the table, the North Tract is estimated to generate a total of 70 trips during the weekday AM peak hour and 90 trips during the weekday PM peak hour. The El Chaparral Tract

is estimated to generate a total of 40 trips during the weekday AM peak hour and 45 trips during the weekday PM peak hour. The Elk Park residential tract is estimated to generate a total of 95 trips during the weekday AM peak hour and 125 trips during the weekday PM peak hour. The Elk Park commercial tract is estimated to generate a total of 105 trips during the weekday AM peak hour and 400 trips during the weekday PM peak hour.

The anticipated distribution of site generated traffic for the adjacent residential tracts was consistent with that assumed for the Brooks Phase 1 and 2 developments. The anticipated distribution of site generated traffic for the adjacent commercial tract was assumed to be more uniform to the surrounding residential areas. The North Tract, El Chaparral Tract, and Elk Park Tract site-generated traffic volumes for the weekday AM and PM peak hour are shown in **Exhibit A-2.**

The North Tract, El Chaparral Tract, and Elk Park Tract site-generated traffic volumes (Exhibit A-2) were then added to the Exhibit A-1 volumes to determine the total volumes in the 20 Year No Build scenario. The 2036 No Build traffic volumes for the AM and PM peak hours are shown in **Exhibit 5.**

**2036 No Build Signal Warrant Analysis:** The need for a traffic signal at Highway WW and Elk Park Drive was re-evaluated using the same criteria as before for the 2036 No Builds conditions.

As mentioned previously, using the 70% reduced warrant thresholds, Warrant 1A requires hourly approach volumes of at least 350 vph on the major street for any eight hours of a typical day. During this same period, the volume of traffic entering from the minor street must exceed 105 vph (assuming a single lane approach). Warrant 1B requires approach volumes of at least 525 vph on the major street with a minimum of 53 vph on the minor street (assuming one lane) and 70 vph on the minor street (assuming two lanes). The major street volume includes both directions, while the minor street volume includes only the heavier side-street approach.

Elk Park Drive consists of a two lane approach (a left-turn lane and a shared through/right-turn lane). Likewise, the proposed subdivision street would consist of a two lane approach (a left-turn lane and a shared through/right-turn lane). The signal warrant analysis considered two alternatives; only the left-turn volume in a single lane and the total approach volume in two lanes.

In the absence of eight-hour traffic counts, the 8$^{th}$ highest hourly volumes are commonly estimated as 55% of peak hour traffic. As indicated by the 2036 No Build traffic volumes (Exhibit 5), the total approach volume on Highway WW is forecasted at 1,145 vph during the weekday PM peak hour, while the approach volume on the side street is forecasted at 90 vph in a single lane or 265 vph in two lanes. At 55% of the peak hour, the 8$^{th}$ highest hourly volume is estimated to be approximately 630 vph on Highway WW and 50 vph in a single lane or 145 vph in two lanes on the side street approach.

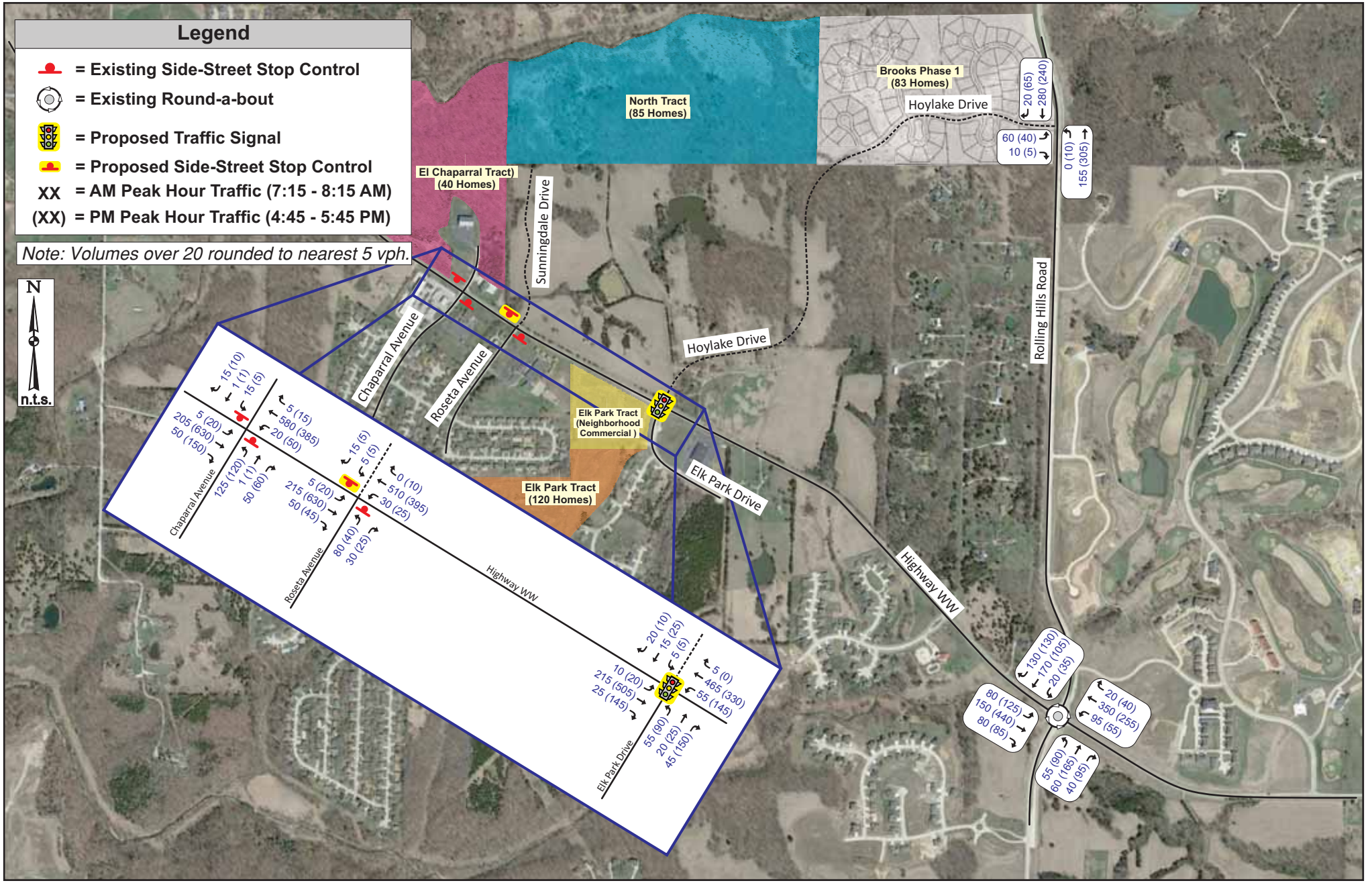


Exhibit 5: 2036 No-Build Traffic Volumes

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As a result, the 2036 No Build traffic volumes would satisfy both Warrant 1A and 1B for the required eight hours. Thus, the traffic signal at Highway WW and Elk Park Drive will be necessary to accommodate the 2036 No Build traffic volumes, and specifically the development of the Elk Park Tract.

**2036 Build Traffic Volumes:** The proposed Brooks Phase 2 site trips (Exhibit 3) were added to the 2036 No Build traffic volumes (Exhibit 5) to determine the total volumes in the 2036 Build scenario. The 2036 Build traffic volumes for the AM and PM peak hours are shown in **Exhibit 6.**

**2036 Build Auxiliary Turn Lane Needs*:*** The need for separate westbound right-turn lanes on Highway WW were re-evaluated using MoDOT's Access Management Guidelines (AMG). Utilizing MoDOT's AMG *Right-Turn Lane Guideline for Two-lane Roadway* nomograph, separate right-turn lanes are not warranted on Highway WW at either site drive in the 20 year build conditions.

**2036 Traffic Analysis:** The study intersections were re-evaluated using the methodologies previously described. **Table 5** summarizes the results of this analysis, which reflects the 2036 No Build and 2036 Build operating conditions and average delays during the AM and PM peak hours. The recommended eastbound left-turn lanes on Highway WW at both Sunningdale Drive, opposite Roseta Avenue, and Hoylake Drive, opposite Elk Park Drive, are reflected in the Build analyses. Hoylake Drive was assumed to have two lanes exiting (a left-turn lane and a shared through/right-turn lane) and one lane entering. Sunningdale Drive was assumed to have one lane exiting and one lane entering.

In addition, based on the signal warrant analysis for the 2036 No Build conditions, it was assumed that the traffic signal at the Highway WW and Elk Park Drive intersection would be operational in the 20-year conditions. It is recommended that the Highway WW and Elk Park Drive/side-street left-turn movements operate under protected-plus-permissive control. It was assumed that the signal would operate free (actuated-uncoordinated).

The 2036 No Build operating conditions reflect the anticipated operating conditions 20 years into the future based on the assumptions described previously. As shown in **Table 5**, all of the study intersections and individual approaches are forecasted to operate at acceptable levels of service (i.e., LOS D or better) during the peak hours with the exception of the northbound approach of El Chaparral Avenue at Highway WW which is forecasted to operate at LOS F during the PM peak hour and the northbound approach of Roseta Avenue at Highway WW which is forecasted to operate at LOS E during the PM peak hour.

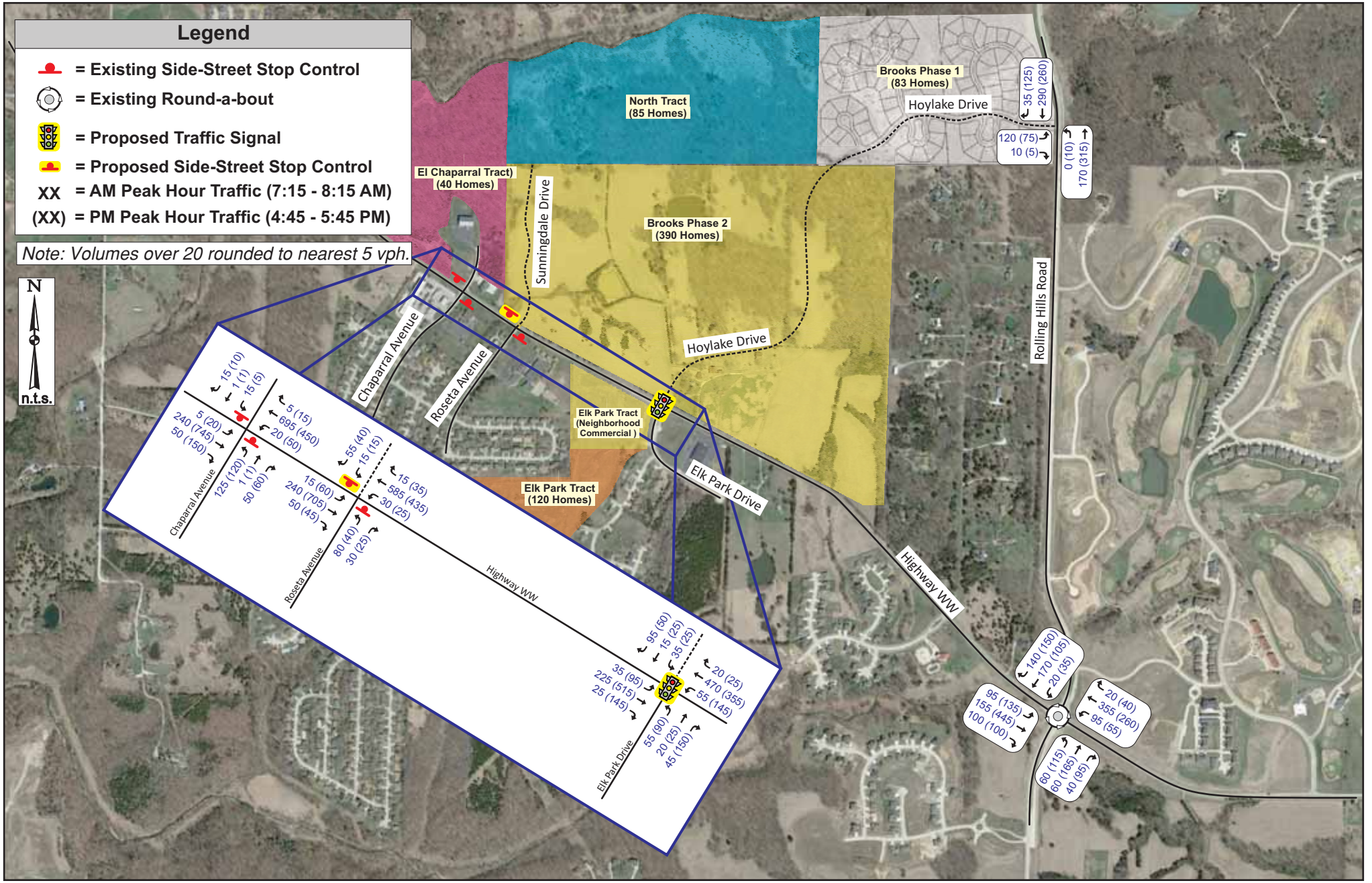


Exhibit 6: 2036 Build Traffic Volumes

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Table 5: 2036 Capacity Analysis Summary

| *Intersection/Movement* | *AM Peak Hour* | | *PM Peak Hour* | |
|---|---|---|---|---|
| | *2036 No Build Conditions* | *2036 Build Conditions* | *2036 No Build Conditions* | *2036 Build Conditions* |
| *Highway WW and Chaparral Avenue (Side-Street STOP)* | | | | |
| Eastbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Westbound Highway WW Approach | A (<1.0) | A (<1.0) | A (1.9) | A (2.1) |
| Northbound Chaparral Ave Approach | D (33.2) | F (56.8) | F (135.4) | F (>200) |
| Southbound Fire Station Approach | C (19.3) | C (23.7) | C (24.6) | D (32.4) |
| *Highway WW and Roseta Avenue/Proposed Sunningdale Drive (Side-Street STOP)* | | | | |
| Eastbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Westbound Highway WW Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Northbound Roseta Ave Approach | C (24.9) | E (43.8) | E (35.4) | F (69.7) |
| Southbound Sunningdale Drive Approach | B (14.4) | C (17.6) | C (17.0) | D (25.5) |
| *Highway WW and Elk Park Drive/Proposed Hoylake Drive (Signalized)* | | | | |
| Eastbound Highway WW Approach | B (13.5) | B (13.7) | B (19.9) | B (19.5) |
| Westbound Highway WW Approach | B (14.3) | C (20.1) | B (13.1) | B (17.5) |
| Northbound Elk Park Drive Approach | B (12.8) | B (14.6) | B (13.2) | B (14.1) |
| Southbound Hoylake Drive Approach | B (16.1) | B (12.3) | C (23.0) | B (17.1) |
| *Overall* | *B (14.0)* | *B (16.8)* | *B (16.5)* | *B (17.8)* |
| *Highway WW and Rolling Hills Road (Roundabout)* | | | | |
| Eastbound Highway WW Approach | A (8.6) | A (9.4) | C (18.1) | C (20.1) |
| Westbound Highway WW Approach | B (10.8) | B (11.3) | B (10.6) | B (11.2) |
| Northbound Rolling Hills Road Approach | A (5.4) | A (5.6) | B (13.6) | B (13.9) |
| Southbound Rolling Hills Road Approach | B (13.9) | B (14.7) | A (9.3) | B (10.4) |
| *Overall* | *B (10.4)* | *B (10.9)* | *B (14.0)* | *C (15.2)* |
| *Rolling Hills Road and Hoylake Drive (Side-Street STOP)* | | | | |
| Eastbound Hoylake Drive Approach | B (12.4) | B (14.3) | B (13.9) | C (16.3) |
| Northbound Rolling Hills Road Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |
| Southbound Rolling Hills Road Approach | A (<1.0) | A (<1.0) | A (<1.0) | A (<1.0) |

X (XX.X) - Level of Service (Vehicular delay in seconds per vehicle)

The 2036 No Build operating conditions reflect the anticipated operating conditions 20 years into the future based on the assumptions described previously. As shown in **Table 5**, all of the study intersections and individual approaches operate at acceptable levels of service (i.e., LOS D or better) during the peak hours with the exception of the northbound approach of El Chaparral Avenue at Highway WW which is forecasted to operate at LOS F during the PM peak hour and the northbound approach of Roseta Avenue at Highway WW which is forecasted to operate at LOS E during the PM peak hour.

This poor level of service for the northbound approaches of El Chaparral Avenue and Roseta Avenue at Highway WW is attributed to the heavier traffic volumes on Highway WW during the PM peak hour. Separate left- and right-turn lanes are provided on El Chaparral Avenue to accommodate traffic turning onto Highway WW. Consequently, there are not any further improvements, short of a traffic signal and/or roundabout that would lessen the delay for motorists desiring to turn left from El Chaparral Avenue and Roseta Avenue onto Highway WW. Although not desirable, it is not unusual for motorists on the side streets to incur longer delays during the peak hours.

The study intersections were re-evaluated for the 2036 Build conditions using the same methodologies. This analysis includes the full build-out of The Brooks Phase 2 development on top of the 20 Year No build conditions. As shown in **Table 5**, all of the study intersections and individual approaches are forecasted to continuing operating at acceptable levels of service (i.e. LOS D or better) with the exception of the northbound approach of El Chaparral Avenue at Highway WW which is forecasted to operate at LOS F during the AM and PM peak hours and the northbound approach of Roseta Avenue at Highway WW which is forecasted to operate at LOS E during the AM peak hour and LOS F during the PM peak hour.

As stated previously, this poor level of service for the northbound approaches of El Chaparral Avenue and Roseta Avenue at Highway WW is attributed to the heavier traffic volumes on Highway WW during the peak hours. Any additional traffic along Highway WW will lessen the available gaps for left-turn traffic from the side streets and result in a decline in the level of service for the side-street approaches as depicted in the table. Again, in order to provide improved operations for the northbound approaches of El Chaparral Avenue and Roseta Avenue at Highway WW, a traffic signal and/or roundabout may be necessary in the future.

## CATSO ROADWAY PLAN

The proposed residential development was evaluated to determine if the proposed site plan provides an appropriate internal roadway network considering future developments and the City's CATSO Roadway Plan. Both Highway WW and Rolling Hills Road are designated as Minor Arterials in the CATSO Major Roadway Plan Map (August 2010) as depicted in **Figure 10**. Additionally, a Major Collector Road is identified in the vicinity of development area that would provide access between Rolling Hills Road and Highway WW.

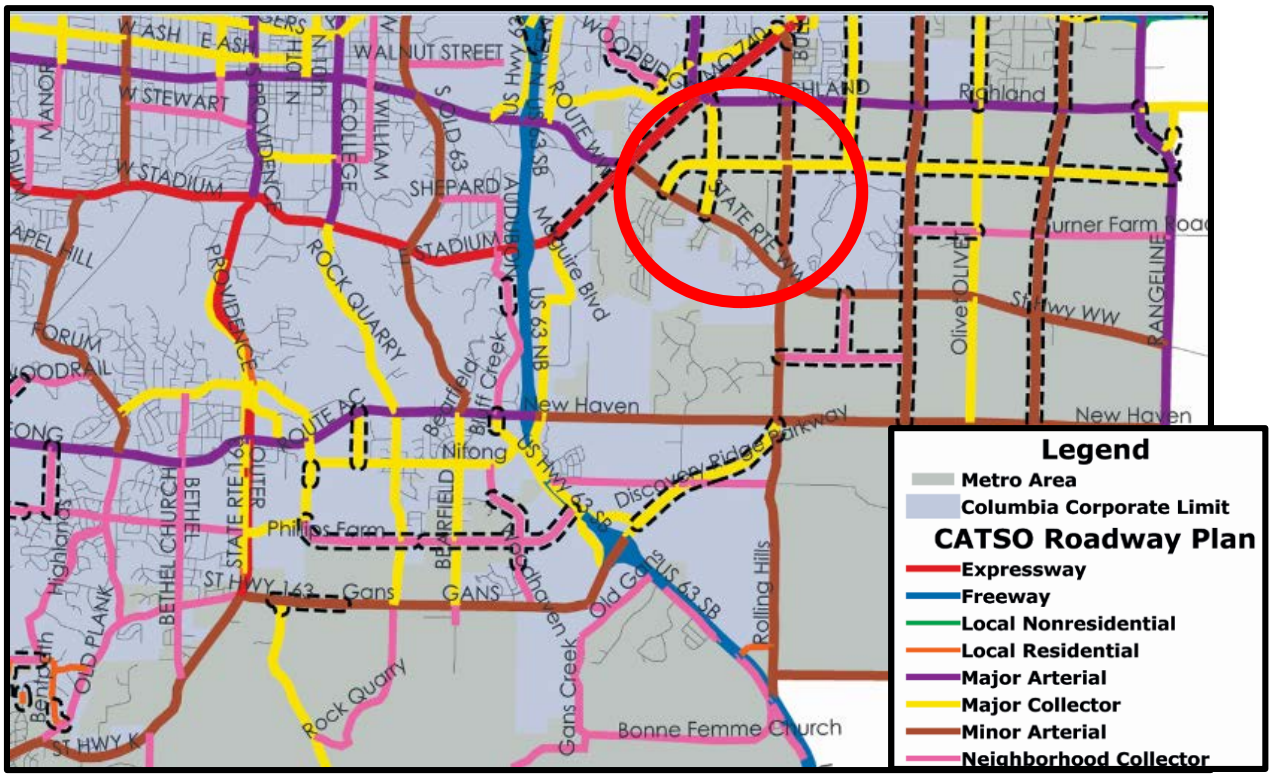


Figure 10: CATSO Major Roadway Plan Map (August 2010)

The collector road connecting Rolling Hills Road to Highway WW was added by the City to the Major Roadway Plan to provide a future roadway to ensure both access and circulation to support development. Although a collector road is also depicted from Highway WW to Richland Road, the presence of the North Fork of Grindstone Creek limits a future northern connection from Richland Road to this area.

As part of The Brooks Phase 1 development, Hoylake Drive is being constructed to collector standards from Rolling Hills Road to the west edge of the property. As part of The Brooks Phase 2 development, it is anticipated that this collector road would be continued The Brooks Phase 1 south through The Brooks Phase 2, connecting to Highway WW opposite Elk Park Drive. This collector road would adequately serve both the planned and future residential areas north of

Highway WW and west of Rolling Hills Road. **Figure 11** depicts the estimated average daily traffic (ADT) on the internal subdivision streets between Rolling Hills Road and Highway WW. The ADT forecasts are based on the previously assumed adjacent future developments. As shown, the estimated ADT on Hoylake Drive serving the residential area is 2,450 vehicles per day (vpd) which is within the City's Neighborhood Collector volume range of 1,500 to 3,500 vpd. It is recommended that this main road be designed to the City's Neighborhood Collector standards and that direct access to homes from this collector road be minimized.

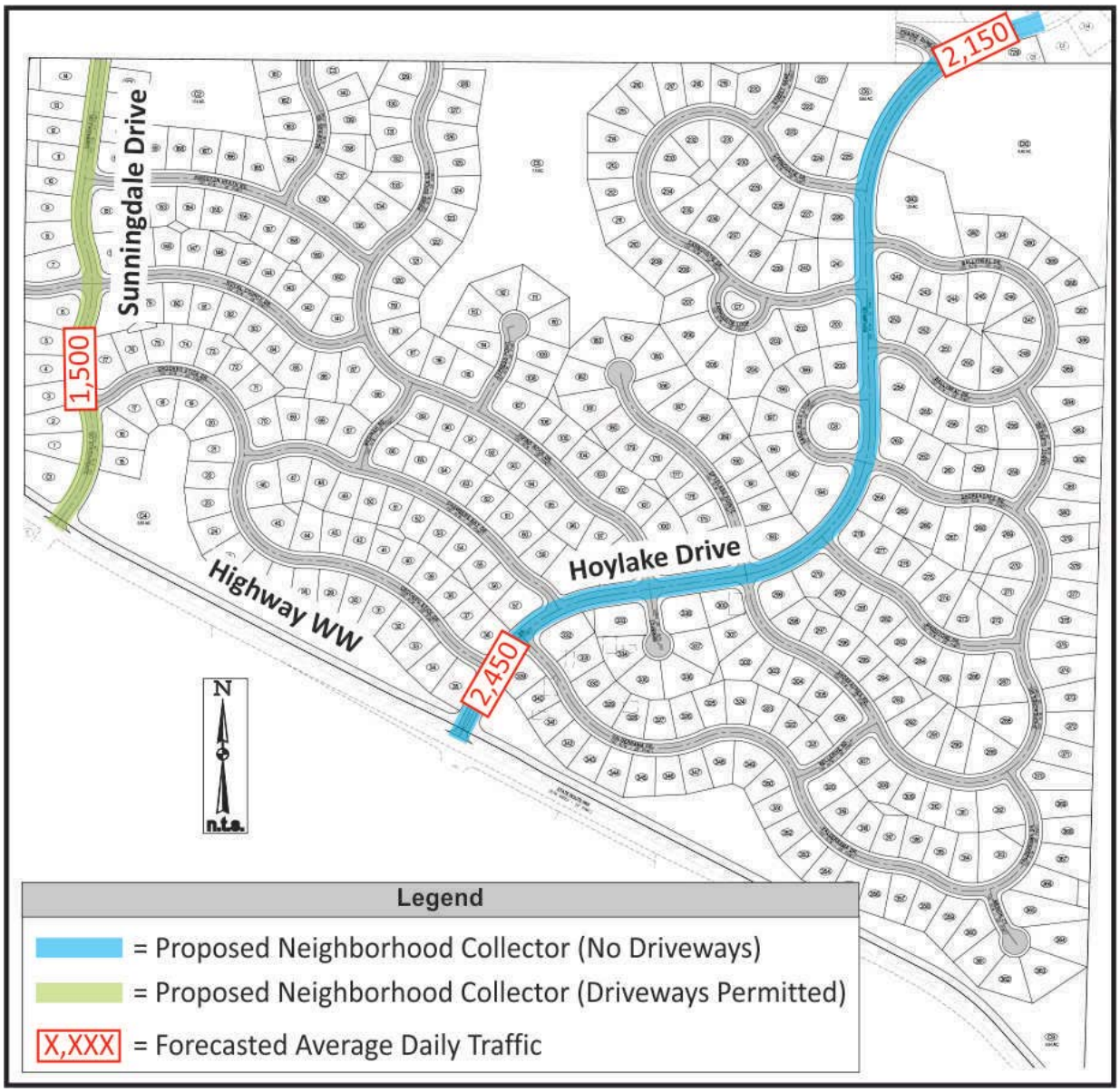


Figure 11: Average Daily Traffic Volumes on Primary Brooks Phase 2 Streets

The estimated ADT on Sunningdale Drive serving The Brooks Phase 2 residential area, opposite Roseta Avenue, is 1,500 vpd which is also within the City's Neighborhood Collector volume range of 1,500 to 3,500 vpd. Given the much lower traffic volumes forecasted, it is recommended that Sunningdale Drive also be designed to the City's Neighborhood Collector standards, though driveways could be permitted.

The estimated ADT on Hoylake Drive near Rolling Hills Road is 2,150 vpd which is consistent with the planned Neighborhood Collector currently under construction in conjunction with The Brooks Phase 1.

While it was assumed that the North Tract development area would develop in a manner consistent with The Brooks Phases 1 and 2, the ADT estimates were re-evaluated assuming the North Tract developed according to the maximum zoning allowed. The North Tract consists of 69 acres zoned for up to 4 units per acre for a total of up to 276 units. While it is very unlikely that the North Tract would develop with this many units due to the existing topography and surrounding subdivision characteristics, **Figure 12** depicts the estimated ADT on the internal subdivision streets between Rolling Hills Road and Highway WW if the North Tract developed with 276 units instead of the previously assumed 85 units.

As shown, the estimated ADT on Hoylake Drive would increase to is 3,110 vpd which is still within the City's Neighborhood Collector volume range of 1,500 to 3,500 vpd and would still adequately serve the North Tract as a Neighborhood Collector.

The estimated ADT on Sunningdale Drive would increase to 1,910 vpd which would also still be on the lower volume range for a Neighborhood Collector and would function acceptably as a Neighborhood Collector with driveways.

The estimated ADT on Hoylake Drive near Rolling Hills Road would increase to 2,700 vpd which is still consistent with the planned Neighborhood Collector currently under construction in conjunction with The Brooks Phase 1.

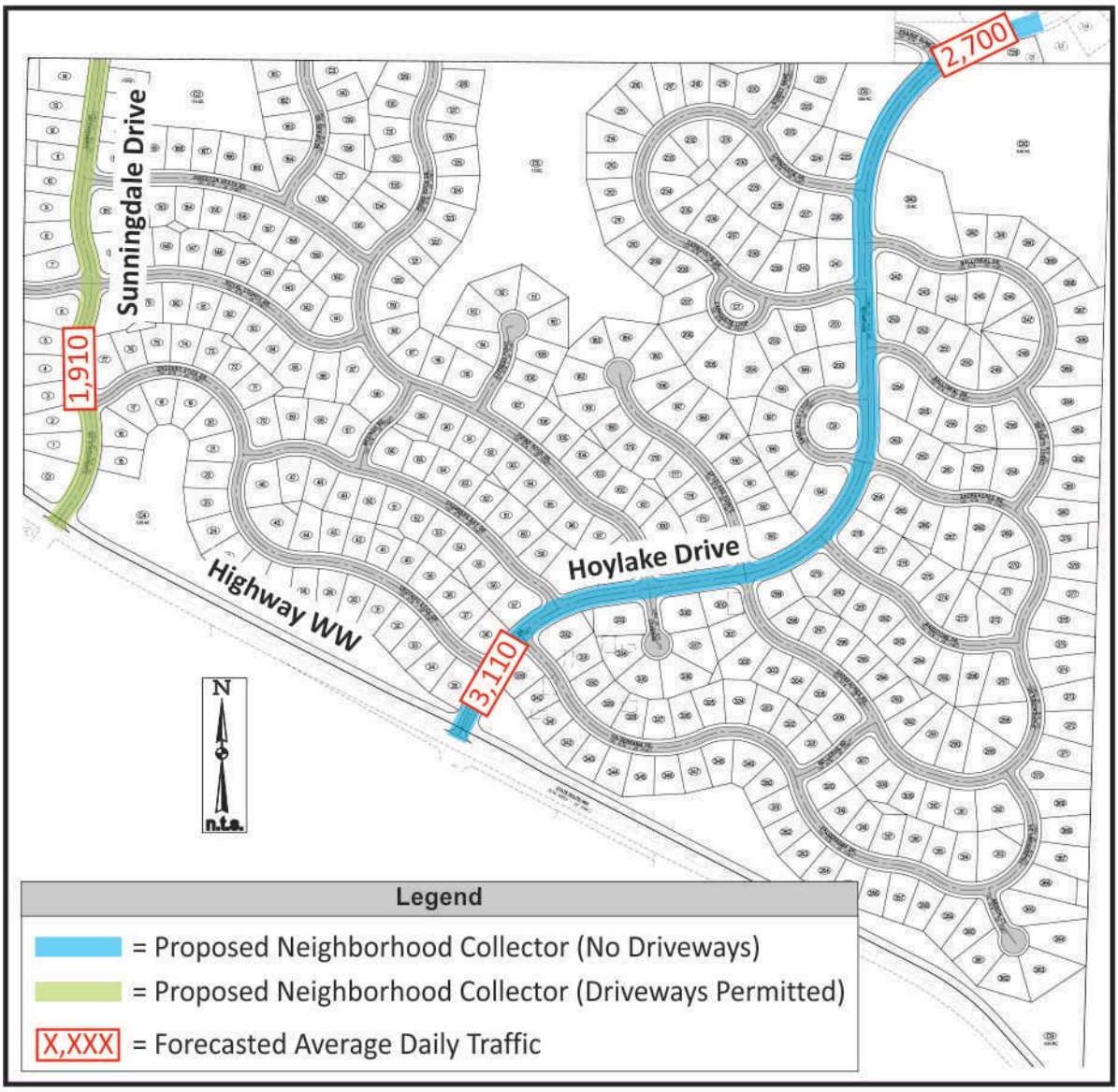


Figure 12: Average Daily Traffic Volumes on Primary Brooks Phase 2 Streets – Max Build Out of the North Tract

Thus, the proposed roadways within The Brooks Phase 2 development would adequately serve the proposed subdivision, in addition to the future development of the North Tract. The proposed extension of Hoylake Drive as a Neighborhood Collector through The Brooks Phase 2 would achieve the desired outcome of providing a 'Collector Road' between Highway WW and Rolling Hills Road to serve the entire residential development area between the creek and Highway WW.

Prior alignments of this 'Collector Road' have looked at tying into Highway WW at Elk Park Drive and at El Chaparral Avenue. Given the planned traffic signal at Elk Park Drive, it would be

advantageous to focus the residential traffic to Elk Park Drive to gain access to Highway WW via the currently planned traffic signal.

Furthermore, it is our opinion that the collector road, as proposed opposite Elk Park Drive, would lessen the likelihood of cut-thru traffic through the subdivision which is often a major concern of residents. If a more direct collector road is providing from Highway WW, near El Chaparral Avenue, to Rolling Hills Road it may become an attractive cut-thru route since the travel distance would be cut in half by using the collector road versus using Highway WW to Rolling Hills Road (i.e. it would be approximately one mile using the cut-thru road versus two miles by staying on Highway WW and Rolling Hills Road).

In addition, given the existing barriers of the creek to the north and west, Rolling Hills Road to the east and Highway WW to the south, the proposed Neighborhood Collector, Hoylake Drive, would only serve a relatively small residential development area and could be adequately accommodated with the proposed roadways. Additionally, although the CATSO model showed this collector road (Hoylake Drive) extending to the east of Rolling Hills Road, a collector road was not built through the adjacent Hawthorne development further supporting the fact that a 'straight' connection from Highway WW to Rolling Hills Road is not necessary.

In summary, the proposed residential development plan provides an appropriate internal roadway network considering future developments and the City's CATSO Roadway Plan.

## SUMMARY

CBB completed the preceding study to address the traffic impacts associated with the proposed residential development, known as The Brooks Phase 2, in Columbia, Missouri. The subject property is located north of Highway WW between Roseta Avenue and Rolling Hills Road.

The Brooks Phase 2 development would consist of approximately 390 single family homes. In conjunction with the proposed development, the existing Hoylake Drive collector road currently under construction through The Brooks Phase I site would be extended through the proposed subdivision and tie into Highway WW, opposite Elk Park Drive. This would provide a collector road between Highway WW and Rolling Hills Road. Access to the proposed Brooks Phase 2 development would be provided via two new roads on Highway WW; one opposite Elk Park Drive (the extension of Hoylake Drive) and one opposite Roseta Avenue (Sunningdale Drive).

The following improvements should be considered to better accommodate the proposed Brooks Phase 2 residential development (2016 Build):

- Construct a separate eastbound left-turn lane on Highway WW at Hoylake Drive (main site drive);
- Construct a separate eastbound left-turn lane on Highway WW at Sunningdale Drive (west site drive);
- Provide two lanes exiting (a left-turn lane and a shared through/right-turn lane) for the southbound approach of Hoylake Drive at Highway WW;
- Clear the existing vegetation along the north side of Highway WW to ensure that the area within the sight distance triangles for the proposed site drives is clear of any vegetation that would obstruct the sight distance;
- It is recommended that Hoylake Drive through The Brooks Phase 2 development be designed to the City's Neighborhood Collector standards and that direct access to homes from this collector road be minimized; and
- It is recommended that Sunningdale Drive through The Brooks Phase 2 development be designed to the City's Neighborhood Collector standards and that direct access to homes from this collector road be allowed.

The following additional improvements should be considered to better accommodate the 20 Year forecasted conditions (2036 Build):

- Turn on the traffic signal at the Highway WW at Elk Park Drive/Hoylake Drive intersection (would require signal modifications to accommodate the north leg);

- In order to provide improved operations for the northbound approaches of El Chaparral Avenue and Roseta Avenue at Highway WW, a traffic signal and/or roundabout may be necessary in the future.

We trust that this traffic study adequately describes the forecasted traffic conditions that should be expected in the vicinity of the proposed Brooks Phase 2 residential development. If additional information is desired, please feel free to contact me at 314-449-9572 or swhite@cbbtraffic.com.

Sincerely,

Shawn Lerai White, P.E., PTOE
Associate - Senior Traffic Engineer

# APPENDIX

## EXHIBITS A-1 THRU A-2

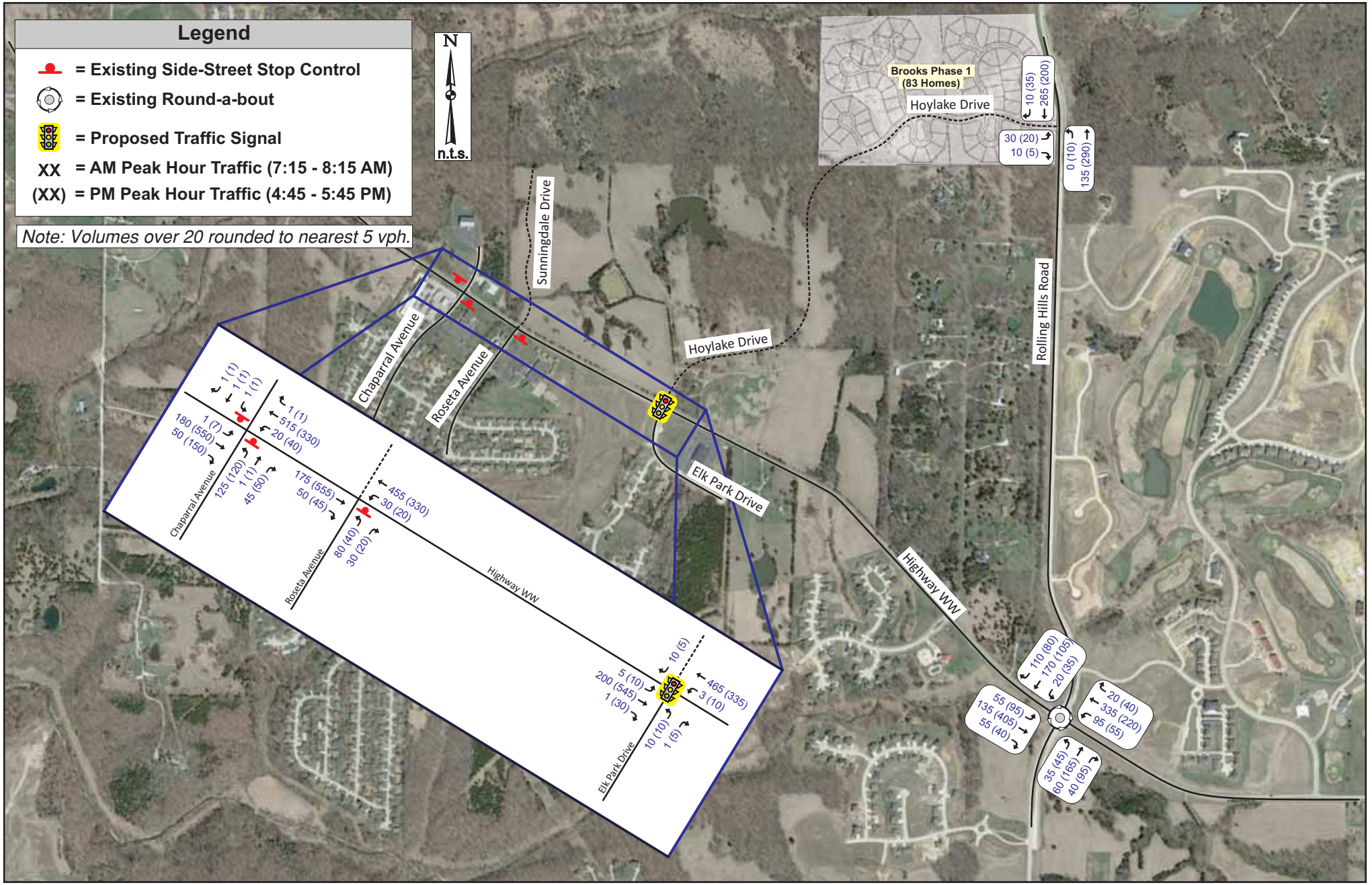


Exhibit A-1: Background Traffic Growth (annual rate of 1.5%)

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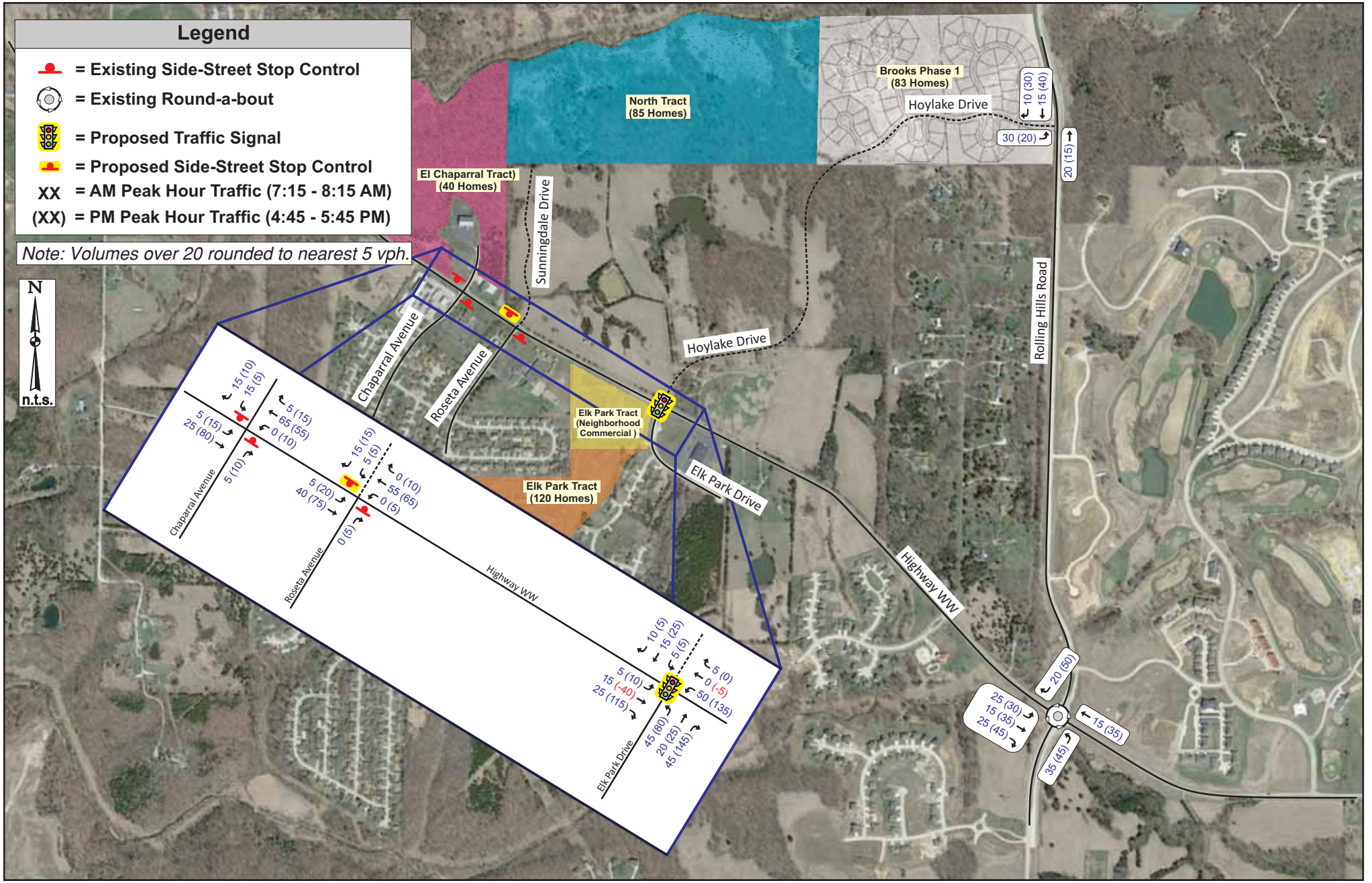


Exhibit A-2: Potential Adjacent Developments - Site Trips

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