

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

**OFFICE OF DESIGN POLICY & SUPPORT
INTERDEPARTMENTAL CORRESPONDENCE**

FILE P.I. # 0007838 **OFFICE** Design Policy & Support
CSSTP-0007-00(838)
Fulton County
GDOT District 7 - Metro Atlanta **DATE** 9/16/2014
SR 9 Widening From Windward Parkway
To Forsyth County Line

FROM  for Brent Story, State Design Policy Engineer

TO SEE DISTRIBUTION

SUBJECT APPROVED CONCEPT REPORT

Attached is the approved Concept Report for the above subject project.

Attachment

DISTRIBUTION:

Glenn Bowman, Director of Engineering
Joe Carpenter, Director of P3/Program Delivery
Genetha Rice-Singleton, Assistant Director of P3/Program Delivery
Albert Shelby, State Program Delivery Engineer
Bobby Hilliard, Program Control Administrator
Cindy VanDyke, State Transportation Planning Administrator
Hiral Patel, State Environmental Administrator
Ben Rabun, State Bridge Engineer
Kathy Zahul, State Traffic Engineer
Angela Robinson, Financial Management Administrator
Lisa Myers, State Project Review Engineer
Charles "Chuck" Hasty, State Materials Engineer
Mike Bolden, State Utilities Engineer
Jeff Fletcher, Statewide Location Bureau Chief
Rachel Brown, District Engineer
Scott Lee, District Preconstruction Engineer
Patrick Allen, District Utilities Engineer
Derrick Brown, Project Manager
BOARD MEMBER - 6th Congressional District

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
PROJECT CONCEPT REPORT**

Project Type: <u>Widening</u>	P.I. Number: <u>0007838</u>
GDOT District: <u>7</u>	County: <u>Fulton County</u>
Federal Route Number: <u>N/A</u>	State Route Number: <u>SR 9</u>
Project Number: _____	CSSTP-0007-00(838)

This is roadway capacity project that will widen SR9/Cumming Hwy from Windward Pkwy to the Forsyth County line to a four lane divided roadway with a raised median.

Submitted for approval:

<u>Kevin Skinner POND & Co.</u>	<u>7/7/14</u>
Consultant Designer & Firm or GDOT Concept/Design Phase Office Head & Office	DATE
<u>N/A</u>	
Local Government (if applicable)	DATE
<u>Albert Shelby</u>	<u>7-11-14</u>
State Program Delivery Engineer	DATE
<u>[Signature]</u>	<u>7/10/14</u>
GDOT Project Manager	DATE

Recommendation for approval:

Program Control Administrator	DATE
<u>Hiral Patel /DKP</u>	<u>07/30/2014</u>
State Environmental Administrator	DATE
<u>Kathy Zahul /DKP</u>	<u>08/05/2014</u>
State Traffic Engineer	DATE
<u>Lisa Myers /DKP</u>	<u>07/17/2014</u>
Project Review Engineer	DATE
<u>Jun Birnkammer /DKP</u>	<u>07/21/2014</u>
for State Utilities Engineer	DATE
District Engineer	DATE
<u>Ben Rabun /DKP</u>	<u>07/21/2014</u>
State Bridge Engineer	DATE

The concept as presented herein and submitted for approval is consistent with that which is included in the Regional Transportation Plan (RTP) and/or the State Transportation Improvement Program (STIP).

<u>Cynthia L. Van Dyke /DKP</u>	<u>7/21/2014</u>
State Transportation Planning Administrator	DATE

PROJECT LOCATION MAP



SR 9 WIDENING AND RECONSTRUCTION FROM WINDWARD PKWY TO FORSYTH COUNTY LINE

Project Number: 0007838

PLANNING & BACKGROUND DATA

PROJECT JUSTIFICATION STATEMENT:

This document is prepared for GDOT Office of Planning by Pond & Company since the original Project Justification Statement (PJS) provided by GDOT at the moment it was prepared had non-approved traffic data and the project termini was not determined.

SR 9 is a major north-south roadway that links the cities of Sandy Springs, Roswell, Alpharetta and Milton, as well as providing access from Forsyth and north Fulton County to I-285 and downtown Atlanta. SR 9 is also the major arterial that runs parallel to GA 400. With the increasing population growth in the northern part of Fulton County over the last twenty years and especially in the last ten years, SR 9 has become a major transportation corridor for vehicles traveling on and off of SR 400. The population within the City of Milton grew 110% from 2005 to 2009. This section of SR 9 includes shopping centers, such as the Deerfield Place Development of Regional Impact (DRI), alongside large neighborhood areas. As a result of the large growth in the area, along with destinations for work and play, the existing SR 9 two-lane corridor from Windward Parkway to the Forsyth County line is in need of improvement.

The current (2013) Average Annual Daily Traffic (AADT) along SR 9, from Windward Parkway to McFarland Road ranges from 22,000 VPD (LOS "E"), on the southern portion of the project between Windward Parkway and Bethany Bend, to 17,230 VPD (LOS "E"), on the northern portion of the project, from Bethany Bend to the Fulton/Forsyth County line.

Design traffic volumes for the year 2042 have been approved by GDOT. Recent traffic counts and previously approved volumes for traffic concept studies north and south of the PI 0007838 segment of SR 9 were used to forecast these design volumes. Estimated daily volumes between Windward Parkway and Deerfield Parkway approach 31,000 VPD while volumes north of Deerfield Parkway could exceed 32,000 VPD which is indicative of significant over-capacity conditions with the current two-lane road (LOS "F"). Traffic volumes north of Bethany Bend are also forecasted to be approximately 25,000 VPD. The current conditions on the highway from Windward Parkway to the Forsyth/Fulton county line are congested at peak times, especially near the intersections of Windward Parkway, Deerfield Parkway and Bethany Bend. Congestion is defined as LOS "E" or "F" conditions in an urbanized area, such as the SR 9 corridor. A secondary concern affecting capacity are the frequent access points which occur along the corridor at spacings less than those prescribed in the GDOT Driveway & Encroachment Control Regulations.

The southern project termini is located at the intersection of SR 9 and Windward Parkway, which is also the city limits of Milton and Alpharetta; this is also the location of termini of the proposed project PI 721780. The northern termini will be the Fulton/Forsyth County line which will tie into the proposed project PI 0007843 (SR 9/Atlanta Highway from Fulton County Line to CR 458/McFarland Road).

This section of SR 9 is experiencing an increasing trend in crash rates, the 2009-2013 have progressively increase to the point where the 2012 crash rate has exceeded the statewide average for a Non-NHS Urban Minor Arterial Street. For the years 2009-2013 the crash rates were 166, 300, 468, 533, and 684 (per 100MVMT) respectively, versus the statewide average of 463, 464, 482, 486 for the 2009-2012 years; the statewide average for the 2013 year is not available.

Addressing current congestion and planning for expected increase in vehicular demand on SR9 is the primary purpose of this project. The project also looks to address other issues in the corridor identified by previous studies such as the City of Milton's Comprehensive Transportation Plan which identified the SR9 corridor as one of three primary travel corridors without access control. The lack of access management creates the problem of crash frequency and severity of accidents. The route has been identified as a significant pedestrian and bicycle route in the *Atlanta Region Bicycle Transportation and Pedestrian Walkways Plan*; the North Fulton CTP also identified the SR 9 corridor as a pedestrian and bicycle route. Reconstruction of SR 9 will provide opportunities to include design elements which will benefit pedestrians and cyclists. These opportunities include improving sidewalk connectivity, providing adequate pedestrian crossings, providing a border area that can accommodate cyclists, and linking residential areas to retail, community centers and Milton schools. Improving facilities for alternative modes of travel is also in line with the goals and objectives set forth in the City of Milton Comprehensive Transportation Plan from 2008.

The project is listed in Atlanta Regional Commission's Plan 2040 Regional Transportation Plan (FN-222). The corridor has also been identified in the City of Milton's Comprehensive Transportation Plan. The proposed SR 9 project, PI 0008738 is included in the Atlanta Regional Transportation Plan (RTP), the Metropolitan Planning Organization (MPO) for the project area.

EXISTING CONDITIONS:

Currently, the existing typical section is two lanes with the left and right turn lanes at various driveway and intersection locations along the corridor. The corridor's southern section, from Windward Pkwy to Bethany Bend Rd, is characterized by an urban setting with curb and gutter on both sides of the road and sidewalk through almost all of the west side of the road. This southern section has sidewalk on the eastern side of the road up to Deerfield Pkwy. The corridor's northern section, from Bethany Bend Rd to the Forsyth County line has a mostly rural cross section with short spans of curb and gutter and sidewalk added by recent site developments.

OTHER PROJECTS IN THE AREA:

The overall corridor stretches from project PI 721780, SR 9 at Academy Street in downtown Alpharetta to PI 141890 which ends in Cumming at SR 306. This corridor is broken into multiple projects that will tie into each other. Other projects within the area include:

- PI721780 – The four-lane context sensitive urban design would widen and reconstruct SR 9 from Upper Hembree Road to Windward Parkway. The improvement consist of side roads reconfiguration, signal upgrades, multi-use path, on-street parking, brick pavers sidewalk, raised and flush medians, ornament landscape trees and pedestrian lighting. Twinned with PI#721790, PI#721780 begins at the intersection of Main Street/Academy Street and ends at the intersection of North Main Street/Windward Parkway. This portion of the project would increase the existing two-lane urban roadway to a four lane context sensitive roadway.
- PI 0012625 – This is project is located at the intersection of SR 9 and Bethany Bend Road to evaluate concept alternatives that would correct the adverse skew of the approach.
- PI007843- This project consists in widening SR 9/ Atlanta Hwy from the Fulton County line to CR 458/McFarland Road to a four lane divided roadway with raised median.
- PI0012881 – This project will evaluate potential for multi-use connections in the Windward Parkway activity center and surrounding areas; will connect existing facilities on Bethany Bend and State Route 9 to Cogburn Road/Windward Parkway.

MPO: Atlanta Regional Commission (ARC)

MPO Project ID FN-222

Regional Commission: Atlanta Regional Commission

RC Project ID FN-222

Congressional District(s): 6

Federal Oversight: Full Oversight Exempt State Funded Other

Projected Traffic: ADT

Current Year (2013): 21,350 Open Year (2022): 24,950 Design Year (2042): 34,250
 Traffic Projections Performed by: Pond & Company

Functional Classification (Mainline): Urban Minor Arterial Street

Urban Minor Arterial Street	Urban Collector Street	Urban Local Road	Rural Local Road
SR 9/Alpharetta Hwy	Windward Pkwy	Webb Road	5 Acre Road
Bethany Bend	Bethany Bend	Windward Village Pkwy	
		Genesis Way	
		Marrywood Drive	
		Deerfield Parkway	
		Oakside Circle	
		Sonely Court	
		Keyingham Way	

Urban Minor Arterial Street	Urban Collector Street	Urban Local Road	Rural Local Road
		Woodlake Drive	
		Creek Club Drive	
		Krobot Way	
		Sunfish Bend	
		Kennewick Road	

Complete Streets - Bicycle, Pedestrian, and/or Transit Warrants:

Warrants met: None Bicycle Pedestrian Transit

This corridor is on the approved 1995 Fulton County Bicycle and Pedestrian, requiring Class II bicycle facility (on road). Deviance from this plan will require letter from Milton requesting alternate layout.

Is this a 3R (Resurfacing, Restoration, & Rehabilitation) Project? No Yes

Pavement Evaluation and Recommendations

Preliminary Pavement Evaluation Summary Report Required? No Yes
 Preliminary Pavement Type Selection Report Required? No Yes
 Feasible Pavement Alternatives: HMA PCC HMA & PCC

DESIGN AND STRUCTURAL

DESCRIPTION OF THE PROPOSED PROJECT:

The proposed project would widen SR 9 from Windward Parkway to the Fulton/Forsyth County Line in Fulton County to a continuous four lane urban roadway (two lanes in each direction) separated by a raised median. Besides widening, the proposed project consists of the reconfiguration of side roads, addition of pedestrian and bicycle facilities, traffic and operational improvements, and signal upgrades. The existing traffic signals will be upgraded, and new signals will be added at Sonely Court and Keyingham Way, Five Acre Road, and Creek Club Drive. The intersection at Bethany Bend will be re-aligned to correct the skew; however, the different alternatives for this intersection are being evaluated under PI 0012625. Left and right turn lanes will be provided at all major intersections. The length of the proposed project is 3.04 miles.

The raised median ranges from 16 to 28 feet. The raised median is typically 16 feet wide but is widened to 20 feet wide at non-signalized median openings to facilitate the left turning movements; furthermore, the median is also widen to 28 feet wide at intersections with dual left turns such as Bethany Bend and Deerfield Parkway.

The City has expressed that they would like to evaluate reducing the posted speed from 45 mph to 35 mph; however all roadway elements are designed to meet 45 mph. They also requested that this be a walk-able corridor. There is the possibility for the City of Milton to enter into agreement with GDOT for maintenance of pedestrian lighting, if lighting where to be included as part of this project. GDOT compliant landscaping may also be included in the final plans.

The existing right of way on SR 9 is approximately 80 to 100 feet. An average of 101 feet to a maximum of 134 feet would be required which would mean an additional 2 to 54 feet would be needed through the corridor.

Major Structures:

Structure	Existing	Proposed
Bridges	None	None
Retaining walls	There are currently some existing retaining walls along the corridor	Retaining walls may be utilized to minimize right of way impacts.

Mainline Design Features: SR 9/Urban Minor Arterial

Feature	Existing	Standard*	Proposed
Typical Section			
- Number of Lanes	2	4	4
- Lane Width(s)	12	11-12 ft	11
- Median Width & Type	0-14	20-24 ft raised	16 ft raised
- Outside Shoulder or Border Area Width	n/a	10-16 ft	21 ft
- Outside Shoulder Slope	n/a	2%	2%
- Inside Shoulder Width	0	N/A	N/A
- Sidewalks	5ft	5 ft	10 ft
- Auxiliary Lanes			
- Bike Lanes	None	4 ft	
Posted Speed	45 mph		35/45 mph
Design Speed	45 mph	45 mph	45 mph
Min Horizontal Curve Radius	950 ft	711 ft	711 ft
Maximum Superelevation Rate	4%-6%	4.0 max	4.0 max
Maximum Grade	5%	7%	7%
Access Control	N/A	Permitted	Permitted
Right-of-Way Width			
Maximum Grade – Crossroad	8%	11-12%	11-12%
Design Vehicle	N/A	WB-67/BUS-40	WB-67/BUS-40
Pavement Type	HMA	N/A	HMA

*According to current GDOT design policy if applicable

Major Interchanges/Intersections:

Road Name	Interchange	Intersection
SR 9 at Windward Parkway		X
SR 9 at Kroger/Walmart		X
SR 9 at Fry's Electronics		X
SR 9 at Webb Road		X
SR 9 at Windward Village Parkway		X
SR 9 at Genesis Way		X
SR 9 at Marrywood Drive		X
SR 9 at Deerfield Parkway		X
SR 9 at Oakside Circle		X

Road Name	Interchange	Intersection
SR 9 at Sonely Court/Keyingham Way		X
**SR 9 at Bethany Bend		X
SR 9 at Woodlake Drive		X
SR 9 at 5 Acre Road		X
SR 9 at Creek Club Drive		X
SR 9 at Krobot Way		X
SR 9 at Sunfish Road		X
SR 9 at Kennewick Road		X

**The intersection at Bethany Bend will be re-aligned by either this project or PI0012625

Lighting required: No Yes

Off-site Detours Anticipated: No Undetermined Yes

Transportation Management Plan [TMP] Required: No Yes
 If Yes: Project classified as: Non-Significant Significant
 TMP Components Anticipated: TTC TO PI

Design Exceptions to FHWA/AASHTO controlling criteria anticipated:

FHWA/AASHTO Controlling Criteria	No	Undetermined	Yes	Appvl Date (if applicable)
1. Design Speed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Lane Width	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Shoulder Width	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Bridge Width	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Horizontal Alignment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. Superelevation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7. Vertical Alignment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8. Grade	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9. Stopping Sight Distance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10. Cross Slope	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11. Vertical Clearance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
12. Lateral Offset to Obstruction	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13. Bridge Structural Capacity	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Design Variances to GDOT Standard Criteria anticipated:

GDOT Standard Criteria	Reviewing Office	No	Undetermined	Yes	Appvl Date (if applicable)
1. Access Control/Median Openings	DP&S	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2. Intersection Sight Distance	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Intersection Skew Angle	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Lateral Offset to Obstruction	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Rumble Strips	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. Safety Edge	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7. Median Usage	DP&S	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
8. Roundabout Illumination Levels	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9. Complete Streets	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

GDOT Standard Criteria	Reviewing Office	No	Undeter-- mined	Yes	Appvl Date (if applicable)
10. ADA & PROWAG	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11. GDOT Construction Standards	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
12. GDOT Drainage Manual	DP&S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13. GDOT Bridge & Structural Manual	Bridges	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

A design variance will be required for the proposed median width.

VE Study anticipated: No Yes Completed – Date:

UTILITY AND PROPERTY

Temporary State Route needed: No Yes Undetermined

Railroad Involvement: *There are no railroads within the project limits.*

Utility Involvements:

Utility Company	Type
Georgia Power Company	Electrical Distribution
Georgia Power Transmission	Electrical Transmission
Sawnee EMC	Electrical Distribution
Comcast	Telecommunications
AT&T Telecommunications	Telecommunications
Verizon Business	Telecommunications
Atlanta Gas Light Resources, Inc.	Natural Gas
Fiberlight	Telecommunications
Fulton Co. Public Works	Water and Sewer
Time Warner Telecom	Telecommunications
XO Communications	Telecommunications
Zayo	Telecommunications

SUE Required: No Yes Undetermined

Public Interest Determination Policy and Procedure recommended (Utilities)? No Yes

Right-of-Way (ROW): Existing width: See table below Proposed width: 106 ft

Required Right-of-Way anticipated: None Yes Undetermined

Easements anticipated: None Temporary Permanent Utility Other

Check all easement types that apply.

Anticipated total number of impacted parcels:	111
Displacements anticipated:	Businesses:
	Residences:
	Other:
Total Displacements:	1*

*Potential Displacement is dependent on preferred alternative for the realignment of Bethany Bend Rd.

Max Width of Right of Way	45'	50'	60'	65'	90'	100'	150'	N/A
Windward Parkway						X		
Webb Road					X			
Windward Village Parkway								X
Genesis Way				X				
Marrywood Drive								X
Deerfield Parkway – Right						X		
Deerfield Parkway – Left								X
Oakside Circle		X						
Sonely Court								X
Keyingham Way				X				
Bethany Bend					X			
Woodlake Drive	X							
5 Acre Road			X					
Creek Club Drive							X	
Krobot Way								X
Sunfish Road								X
Kennewick Road		X						

Location and Design approval: Not Required Required

CONTEXT SENSITIVE SOLUTIONS

Issues of Concern: During the Public Information Open House held on May 21, 2014, at the City of Milton City Hall, some business owners along the project corridor commented that they are against the restricted access due to the raised median.

Context Sensitive Solutions Proposed: The project team is continually collaborating with the City of Milton and the business owners to develop median access layout that provides access to parcels that are currently interconnected. Also, the use of directional median openings is under consideration at certain locations. Furthermore, to reduce right-of-way impacts it has been decided to use reduced lane widths, 16 foot wide raised median, and 24 inch curb and gutter.

ENVIRONMENTAL & PERMITS

Anticipated Environmental Document:

GEPA: NEPA: CE EA/FONSI EIS

MS4 Permit Compliance – Is the project located in a MS4 area? No Yes

Environmental Permits/Variations/Commitments/Coordination anticipated:

Permit/ Variance/ Commitment/ Coordination Anticipated	No	Yes	Remarks
1. U.S. Coast Guard Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2. Forest Service/Corps Land	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3. CWA Section 404 Permit	<input type="checkbox"/>	<input checked="" type="checkbox"/>	It is likely that a Nationwide or Regional 404 permit will be required

4. Tennessee Valley Authority Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5. Buffer Variance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
6. Coastal Zone Management Coordination	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
7. NPDES	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
8. FEMA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
9. Cemetery Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
10. Other Permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
11. Other Commitments	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Other commitments will be identified on the project green sheet.
12. Other Coordination	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Is a PAR required? No Yes Completed – Date:

Environmental Comments and Information:

NEPA/GEPA: An EA will be required for this project. In order to meet the requirements for Logical Termini, this project will be evaluated along with projects P.I. 121690, 0007834, 0007844, and 0008357.

Ecology: For P.I. 0007838, one water was identified that potentially would be considered a federal and buffered state water. It is anticipated that a Section 404 Nationwide or Regional Permit would be needed. A buffer variance is not anticipated. A delineation of wetlands and streams will need to be performed for the environmental assessment. It is also anticipated that a bat survey will need to be conducted during the appropriate survey season along with an aquatic survey, and seasonal plant surveys.

History: There are potentially eligible historic resources adjacent to SR 9. A survey for eligible historic resources and a SHPO approved Assessment of Effects will be required for the environmental assessment.

Archeology: It is not anticipated that there will be any cemeteries adjacent to SR 9 and impacted by the project. A survey for archaeological resources will be performed for the environmental assessment.

Air Quality:

Is the project located in a PM 2.5 Non-attainment area? No Yes
 Is the project located in an Ozone Non-attainment area? No Yes
 Is a Carbon Monoxide hotspot analysis required? No Yes

It is anticipated that the project will conform to federal and state air quality goals including CO, Ozone, PM 2.5, and MSATs. The project will be evaluated for air quality as part of the environmental assessment, prior to submittal of the EA.

Noise Effects: A Type I Noise Analysis will be performed for the environmental assessment, prior to submittal of the EA.

Public Involvement: A PIOH was held on May 21, 2014, at the City of Milton City Hall. A PHOH will be held following approval of the preliminary draft EA, but prior to approval of the final EA/FONSI.

Major stakeholders: Major stakeholders in the area include the traveling public, commuters that use this segment of SR 9 to travel to and from work, businesses in the area, and those residents that live on and along SR 9.

CONSTRUCTION

Issues potentially affecting constructability/construction schedule: *N/A*

Early Completion Incentives recommended for consideration: No Yes

COORDINATION, ACTIVITIES, RESPONSIBILITIES, AND COSTS

Initial Concept Meeting: *This meeting was held on Dec 4, 2013. See attachment for meeting minutes.*

Concept Meeting: *GDOT PM, Jeremy Busby, deemed the Initial Concept Team meeting would also serve as the Concept Meeting. See attachments for meeting minutes.*

Other coordination to date: *N/A*

Project Activity	Party Responsible for Performing Task(s)
Concept Development	Pond & Company
Design	Pond & Company
Right-of-Way Acquisition	GDOT
Utility Relocation	Utility Owner
Letting to Contract	GDOT
Construction Supervision	GDOT
Providing Material Pits	Contractor
Providing Detours	Contractor
Environmental Studies, Documents, & Permits	Kimley Horn & Associates
Environmental Mitigation	Kimley Horn & Associates
Construction Inspection & Materials Testing	GDOT

Project Cost Estimate Summary and Funding Responsibilities:

	Breakdown of PE	ROW	Reimbursable Utility	CST*	Environmental Mitigation	Total Cost
Funded By	GDOT	GDOT	GDOT	GDOT		
\$ Amount	\$2,112,353	\$7,570,000	\$0.00	\$21,528,976	N/A	\$31,211,329
Date of Estimate		12/2/2013	2/5/2014	8/26/2014	N/A	

*CST Cost includes: Construction, Engineering and Inspection, and Liquid AC Cost Adjustment.

ALTERNATIVES DISCUSSION

Alternative selection:

Preferred Alternative: *Build Alternative. This project is primarily a widening project of an existing road that abuts a highly developed area. SR 9 horizontal alignment will not deviate from the existing. The only side road that would potentially deviate from the existing alignment would be that of Bethany Bend which is being evaluated under a separate project (PI0012625).*

Estimated Property Impacts:	Undetermined	Estimated Total Cost:	\$31M
Estimated ROW Cost:	\$7.5M	Estimated CST Time:	24 months
Rationale:			

No-Build Alternative:

Estimated Property Impacts:	0	Estimated Total Cost:	0
Estimated ROW Cost:	0	Estimated CST Time:	0
Rationale:			

Comments: *None.*

LIST OF ATTACHMENTS/SUPPORTING DATA

1. Concept Layout
2. Typical sections
3. Detailed Cost Estimates:
 - a. Construction including Engineering and Inspection
 - b. Completed Fuel & Asphalt Price Adjustment forms
 - c. Right-of-Way
 - d. Utilities
4. Crash summaries
5. Traffic diagrams
6. Capacity analysis summary (*tabular format*)
7. Summary of TE Study and/or Signal Warrant Analysis
8. Minutes of Concept meetings
9. Minutes of any meetings that shows support or objection to the concept
10. Concept Level Hydrology Study For Ms4 Permit

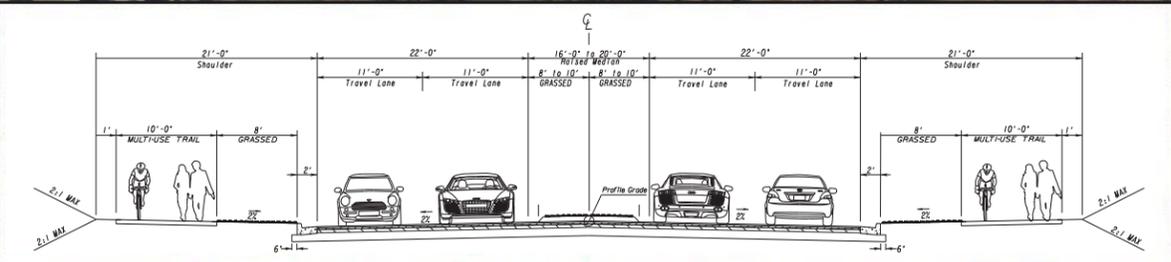
APPROVALS

Concur: 
 Director of Engineering

Approve: 
 Chief Engineer

9-9-19
 Date

Attachment 1
Concept Layout



PUBLIC INFORMATION OPEN HOUSE CONCEPT PLAN – MAY 2014
 SR 9 WIDENING AND RECONSTRUCTION FROM WINDWARD PKWY
 TO FORSYTH COUNTY LINE
 PROJECT NO.: 0007838

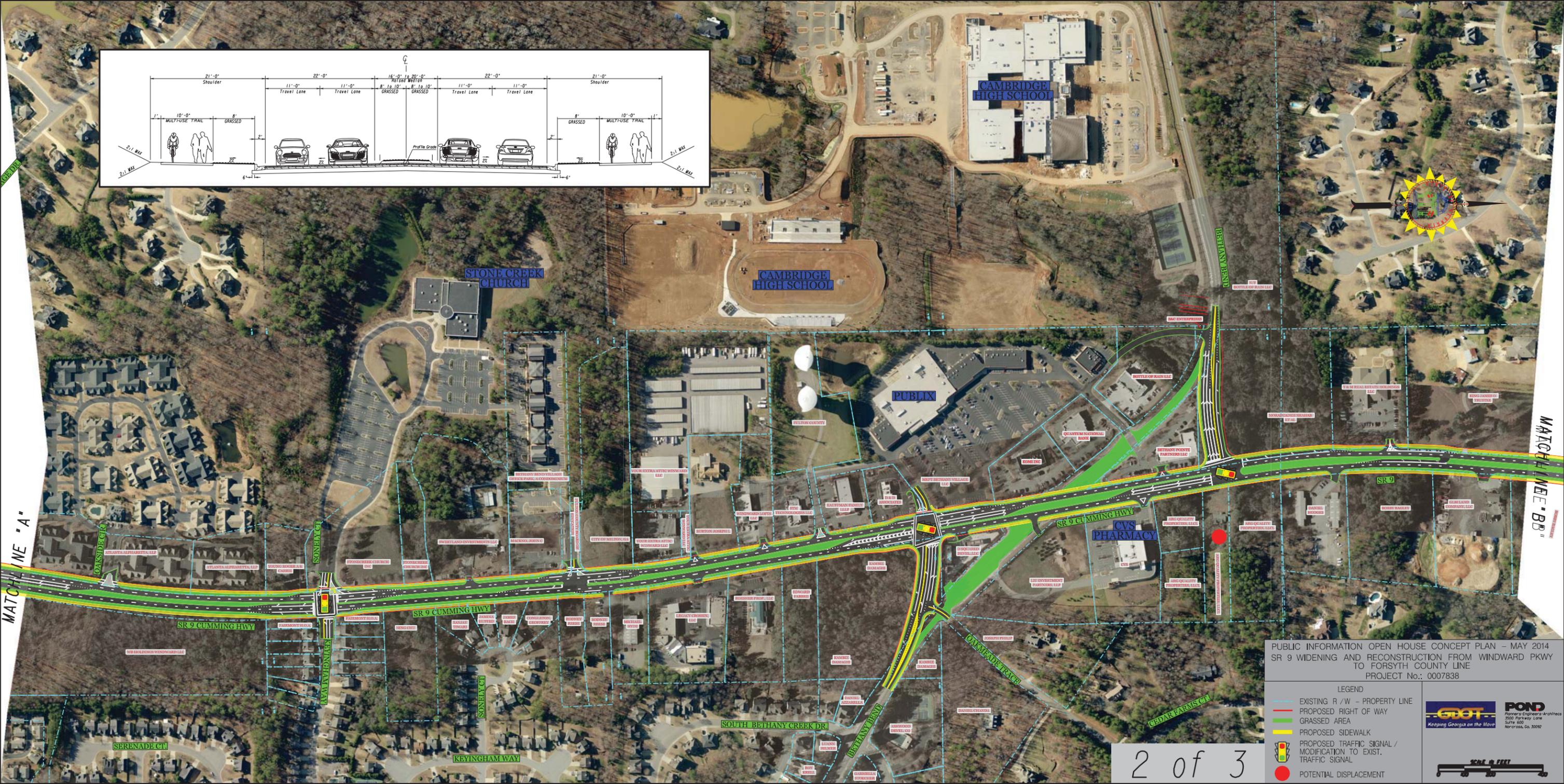
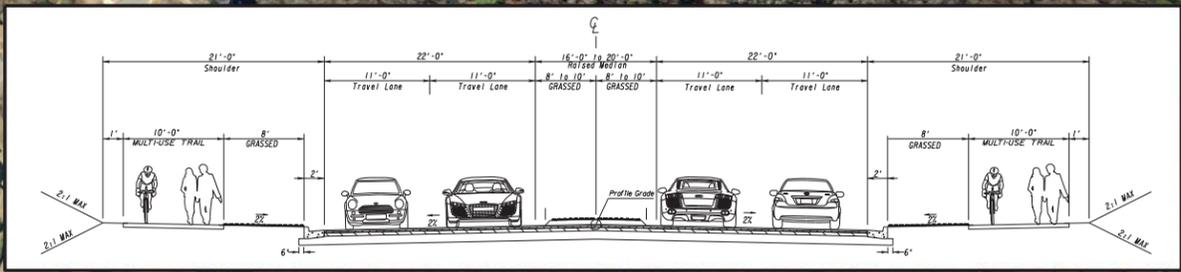
LEGEND

- EXISTING R / W - PROPERTY LINE
- PROPOSED RIGHT OF WAY
- GRASSED AREA
- PROPOSED SIDEWALK
- PROPOSED TRAFFIC SIGNAL / MODIFICATION TO EXIST. TRAFFIC SIGNAL

GDOT
 Keeping Georgia on the Move

POND
 Planners-Engineers-Architects
 500 Parkway Lane
 Suite 400
 Norcross, Ga. 30092

SCALE IN FEET
 0 100 200



PUBLIC INFORMATION OPEN HOUSE CONCEPT PLAN - MAY 2014
 SR 9 WIDENING AND RECONSTRUCTION FROM WINDWARD PKWY
 TO FORSYTH COUNTY LINE
 PROJECT No.: 0007838

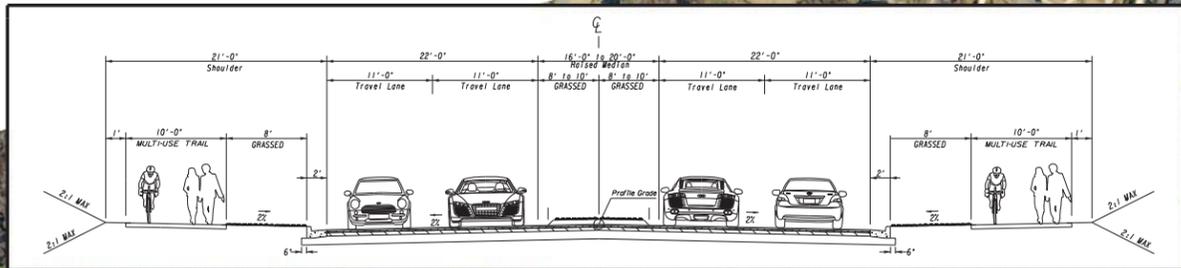
LEGEND

- EXISTING R / W - PROPERTY LINE
- PROPOSED RIGHT OF WAY
- GRASSED AREA
- PROPOSED SIDEWALK
- PROPOSED TRAFFIC SIGNAL / MODIFICATION TO EXIST. TRAFFIC SIGNAL
- POTENTIAL DISPLACEMENT

GDOT Keeping Georgia on the Move

POND POND Partners-Engineers-Architects
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 Suite 400
 Norcross, GA 30092

SCALE IN FEET
 0 100 200 300



PUBLIC INFORMATION OPEN HOUSE CONCEPT PLAN - MAY 2014
 SR 9 WIDENING AND RECONSTRUCTION FROM WINDWARD PKWY
 TO FORSYTH COUNTY LINE
 PROJECT No.: 0007838

LEGEND

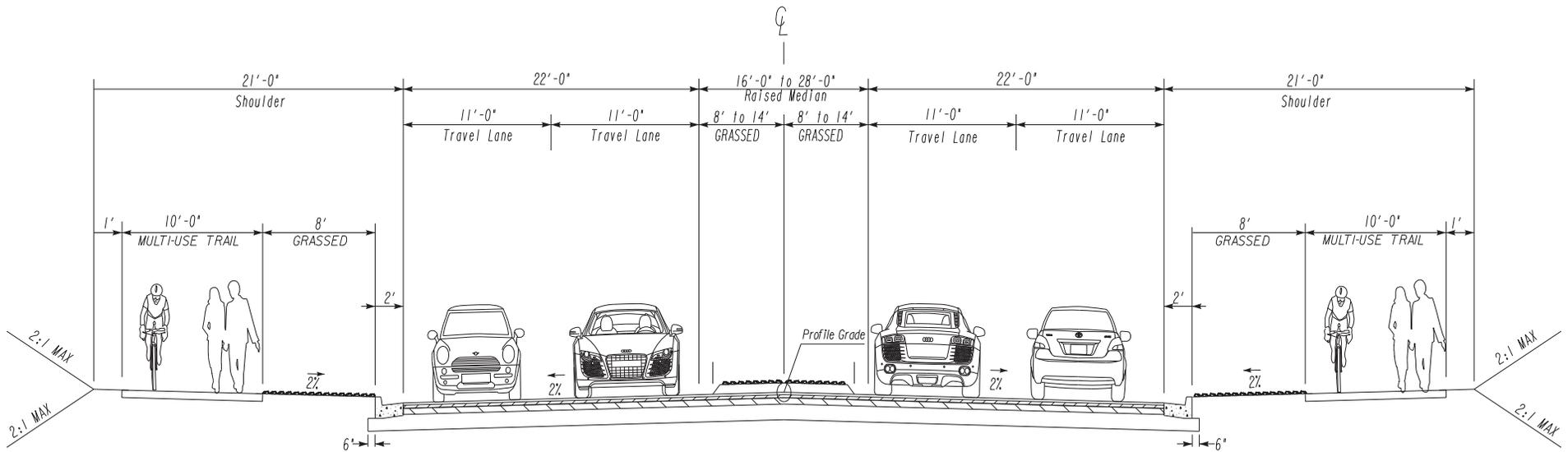
- EXISTING R / W - PROPERTY LINE
- PROPOSED RIGHT OF WAY
- GRASSED AREA
- PROPOSED SIDEWALK
- PROPOSED TRAFFIC SIGNAL / MODIFICATION TO EXIST. TRAFFIC SIGNAL

GDOT **POND**
 Keeping Georgia on the Move **POND**
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 Norcross, Ga. 30092

SCALE IN FEET
 0 100 200

3 of 3

Attachment 2
Typical sections



SR 9 WIDENING AND RECONSTRUCTION FROM WINDWARD PKWY
 TO FORSYTH COUNTY LINE
 PROJECT No.: 0007838

Attachment 3

Detailed Cost Estimates:

- a. Construction including Engineering and Inspection
- b. Completed Fuel & Asphalt Price Adjustment forms
- c. Right-of-Way
- d. Utilities

DATE : 08/26/2014
PAGE : 1

JOB ESTIMATE REPORT

JOB NUMBER : 0007838 SPEC YEAR: 01
DESCRIPTION: SR 9/CUMMING HWY FROM WINDWARD PKWY TO FORSYTH COUNTY LINE

ITEMS FOR JOB 0007838

LINE	ITEM	ALT	UNITS	DESCRIPTION	QUANTITY	PRICE	AMOUNT
0005	150-1000		LS	TRAFFIC CONTROL - LS	1.000	1000000.00	1000000.00
0010	153-1300		EA	FIELD ENGINEERS OFFICE TP 3	1.000	85538.24	85538.25
0015	210-0100		LS	GRADING COMPLETE - USER UNIT PRICE	1.000	3000000.00	3000000.00
0020	310-1101		TN	GR AGGR BASE CRS, INCL MATL	05215.000	17.52	1843708.75
0025	402-1812		TN	RECYL AC LEVELING, INC BM&HL	1500.000	76.30	114463.14
0030	402-3130		TN	RECYL AC 12.5MM SP, GP2, BM&HL	12580.000	66.74	839643.80
0035	402-3190		TN	RECYL AC 19 MM SP, GP 1 OR 2 , INC BM&HL	16773.000	64.12	1075631.69
0040	402-3121		TN	RECYL AC 25MM SP, GP1/2, BM&HL	67093.000	57.15	3834897.00
0045	413-1000		GL	BITUM TACK COAT	16010.000	2.54	40683.65
0050	432-5010		SY	MILL ASPH CONC PVMT, VARB DEPTH	09044.000	1.36	148427.42
0055	441-0104		SY	CONC SIDEWALK, 4 IN	33695.000	22.06	743493.65
0060	441-5002		LF	CONC HEADER CURB, 6", TP 2	31338.000	7.87	246706.52
0065	441-6216		LF	CONC CURB & GUTTER/ 8"X24"TP2	37890.000	14.62	553991.58
0070	446-1100		LF	PVMT REF FAB STRIPS, TP2, 18 INCH WIDTH	32000.000	3.36	107650.24
0075	641-1200		LF	GUARDRAIL, TP W	1400.000	18.26	25575.24
0080	641-5001		EA	GUARDRAIL ANCHORAGE, TP 1	3.000	861.25	2583.75
0085	641-5012		EA	GUARDRAIL ANCHORAGE, TP 12	3.000	2115.40	6346.23
0090	500-3201		CY	CL B CONC, RET WALL	100.000	630.32	63032.56
0095	500-9999		CY	CL B CONC, BASE OR PVMT WIDEN	500.000	155.47	77739.32
0100	550-1180		LF	STM DR PIPE 18", H 1-10	10731.000	35.37	379656.23
0105	550-1240		LF	STM DR PIPE 24", H 1-10	2146.000	44.06	94573.68
0110	550-1300		LF	STM DR PIPE 30", H 1-10	1073.000	57.71	61929.34
0115	550-1360		LF	STM DR PIPE 36", H 1-10	536.000	69.87	37453.78
0120	603-2181		SY	STN DUMPED RIP RAP, TP 3, 18"	120.000	45.60	5472.46
0125	603-2182		SY	STN DUMPED RIP RAP, TP 3, 24"	60.000	52.33	3140.06
0130	603-7000		SY	PLASTIC FILTER FABRIC	180.000	3.88	698.98
0135	668-1100		EA	CATCH BASIN, GP 1	74.000	2165.73	160264.62
0140	668-1110		LF	CATCH BASIN, GP 1, ADDL DEPTH	10.000	184.47	1844.71
0145	668-2100		EA	DROP INLET, GP 1	26.000	1848.35	48057.16
0150	668-2110		LF	DROP INLET, GP 1, ADDL DEPTH	5.000	169.19	846.00
0155	668-4300		EA	STORM SEW MANHOLE, TP 1	10.000	1868.53	18685.37
0160	647-1000		LS	TRAF SIGNAL INSTALLATION NO - WEBB RD	1.000	150000.00	150000.00
0165	647-1000		LS	TRAF SIGNAL INSTALLATION NO - DEERFIELD PKWY	1.000	150000.00	150000.00
0170	647-1000		LS	TRAF SIGNAL INSTALLATION NO - SONELY COURT/ KEYINGHAM WAY	1.000	150000.00	150000.00
0175	647-1000		LS	TRAF SIGNAL INSTALLATION NO - BETHANY BEND SOUTH	1.000	150000.00	150000.00
0180	647-1000		LS	TRAF SIGNAL INSTALLATION NO - BETHANY BEND NORTH	1.000	150000.00	150000.00
0185	647-1000		LS	TRAF SIGNAL INSTALLATION NO - FIVE ACRE RD	1.000	150000.00	150000.00

STATE HIGHWAY AGENCY

DATE : 08/26/2014

PAGE : 2

JOB ESTIMATE REPORT

0190	647-1000	LS	TRAF SIGNAL INSTALLATION NO - CREEK CLUB DRIVE	1.000	150000.00	150000.00
0195	636-1020	SF	HWY SGN, TP1MAT, REFL SH TP3	170.000	13.81	2349.13
0200	636-1033	SF	HWY SIGNS, TP1MAT, REFL SH TP 9	190.000	18.97	3605.83
0205	636-2070	LF	GALV STEEL POSTS, TP 7	477.000	6.52	3112.53
0210	653-0120	EA	THERM PVMT MARK, ARROW, TP 2	120.000	78.23	9388.70
0215	653-0170	EA	THERM PVMT MARK, ARROW, TP 7	6.000	103.20	619.26
0220	653-1501	LF	THERMO SOLID TRAF ST 5 IN, WHI	32000.000	0.37	12086.08
0225	653-1502	LF	THERMO SOLID TRAF ST, 5 IN YEL	32000.000	0.39	12694.08
0230	653-1704	LF	THERM SOLID TRAF STRIPE, 24", WH	996.000	5.92	5900.63
0235	653-3501	GLF	THERMO SKIP TRAF ST, 5 IN, WHI	32000.000	0.23	7679.36
0240	653-3502	GLF	THERMO SKIP TRAF ST, 5 IN, YEL	3500.000	0.26	940.49
0245	653-6004	SY	THERM TRAF STRIPING, WHITE	1000.000	3.50	3501.61
0250	653-6006	SY	THERM TRAF STRIPING, YELLOW	500.000	4.00	2004.00
0255	654-1001	EA	RAISED PVMT MARKERS TP 1	34.000	4.79	163.07
0260	654-1003	EA	RAISED PVMT MARKERS TP 3	400.000	3.21	1284.36
0265	700-6910	AC	PERMANENT GRASSING	12.000	954.10	11449.31
0270	163-0232	AC	TEMPORARY GRASSING	12.000	264.31	3171.77
0275	163-0240	TN	MULCH	240.000	181.44	43547.61
0280	700-7000	TN	AGRI CULTURAL LIME	15.000	102.98	1544.83
0285	700-8000	TN	FERTILIZER MIXED GRADE	12.000	539.10	6469.30
0290	700-8100	LB	FERTILIZER NITROGEN CONTENT	750.000	2.42	1822.30
0295	167-1000	EA	WATER QUALITY MONITORING AND SAMPLING	10.000	203.06	2030.63
0300	163-0550	EA	CONS & REM INLET SEDIMENT TRAP	87.000	124.34	10817.71
0305	163-0528	LF	CONSTR AND REM FAB CK DAM -TP C SLT FN	3200.000	3.26	10449.54
0310	171-0030	LF	TEMPORARY SILT FENCE, TYPE C	32000.000	2.70	86595.52
0315	165-0105	EA	MAINT OF INLET SEDIMENT TRAP	100.000	28.01	2801.60
0320	165-0041	LF	MAINT OF CHECK DAMS - ALL TYPES	3200.000	0.71	2280.70
0325	165-0030	LF	MAINT OF TEMP SILT FENCE, TP C	3200.000	0.62	2010.43
0330	165-0105	EA	MAINT OF INLET SEDIMENT TRAP	100.000	28.01	2801.60
0335	643-8200	LF	BARRIER FENCE (ORANGE), 4 FT	500.000	1.36	680.91
0340	716-2000	SY	EROSION CONTROL MATS, SLOPES	5000.000	1.19	5962.55
0345	163-0300	EA	CONSTRUCTION EXIT	3.000	1363.57	4090.73
0350	165-0101	EA	MAINT OF CONST EXIT	3.000	550.05	1650.17
0365	009-3500	LS	MISC LANDSCAPE ITEMS	1.000	1000000.00	1000000.00

ITEM TOTAL

16938241.53

INFLATED ITEM TOTAL

16938241.53

TOTALS FOR JOB 0007838

ESTIMATED COST:

16938241.53

CONTINGENCY PERCENT (10.0):

0.00

ESTIMATED TOTAL:

16938241.53

NOTE: The item totals include all alternate items. The estimated totals include only the low cost alternate items.

PROJ. NO. SR 9/CUMMING HWY FROM WINDWARD PKWY TO FORSYTH CC
P.I. NO. 0007838
DATE 8/26/2014

CALL NO. 9/29/2009

INDEX (TYPE)	DATE	INDEX
REG. UNLEADED	Aug-14	\$ 3.500
DIESEL		\$ 3.835
LIQUID AC		\$ 608.00

Link to Fuel and AC Index:
<http://www.dot.ga.gov/doingbusiness/Materials/Pages/asphaltcementindex.aspx>

LIQUID AC ADJUSTMENTS

PA=[((APM-APL)/APL)]xTMTxAPL

Asphalt

Price Adjustment (PA)				1780151.04	\$	1,780,151.04
Monthly Asphalt Cement Price month placed (APM)	Max. Cap	60%	\$	972.80		
Monthly Asphalt Cement Price month project let (APL)			\$	608.00		
Total Monthly Tonnage of asphalt cement (TMT)				4879.8		

ASPHALT	Tons	%AC	AC ton
Leveling	1150	5.0%	57.5
12.5 OGFC		5.0%	0
12.5 mm	12580	5.0%	629
9.5 mm SP		5.0%	0
25 mm SP	67093	5.0%	3354.65
19 mm SP	16773	5.0%	838.65
	97596		4879.8

BITUMINOUS TACK COAT

Price Adjustment (PA)				\$	185,156.56	\$	185,156.56
Monthly Asphalt Cement Price month placed (APM)	Max. Cap	60%	\$	972.80			
Monthly Asphalt Cement Price month project let (APL)			\$	608.00			
Total Monthly Tonnage of asphalt cement (TMT)				507.5563711			

Bitum Tack

Gals	gals/ton	tons
118171	232.8234	507.556371

BITUMINOUS TACK COAT (surface treatment)

Price Adjustment (PA)				\$	0	\$	-
Monthly Asphalt Cement Price month placed (APM)	Max. Cap	60%	\$	972.80			
Monthly Asphalt Cement Price month project let (APL)			\$	608.00			
Total Monthly Tonnage of asphalt cement (TMT)				0			

Bitum Tack	SY	Gals/SY	Gals	gals/ton	tons
Single Surf. Trmt.		0.20	0	232.8234	0
Double Surf.Trmt.		0.44	0	232.8234	0
Triple Surf. Trmt		0.71	0	232.8234	0

TOTAL LIQUID AC ADJUSTMENT \$ **1,965,307.60**

Attachment 4
Crash summaries

CRASH SUMMARY:

The crash rate on the Urban Minor Arterial section of SR 9 is lower than the statewide average from 2007 to 2009. The statewide average crash rates in 2009, 2008, and 2007 for Urban Minor Arterial that is Non-Freeway, Non-National Highway System was 463, 469, and 513 crashes per 100 million vehicle miles traveled. There were a total of 141 crashes during this period and 31.91% of these crashes involved injuries. There were no fatalities from 2007 to 2009.

There were a total of 141 crashes from 2007 to 2009 over the 2.98 mile stretch of SR 9. More than half (52.48%) of the crashes occurred in and around the intersection of SR 9 and Bethany Bend. During the years of 2007 to 2009, there were 53 angle collisions (37.59%) and 73 rear end collisions (51.77%). This was also the pattern for each year individually.

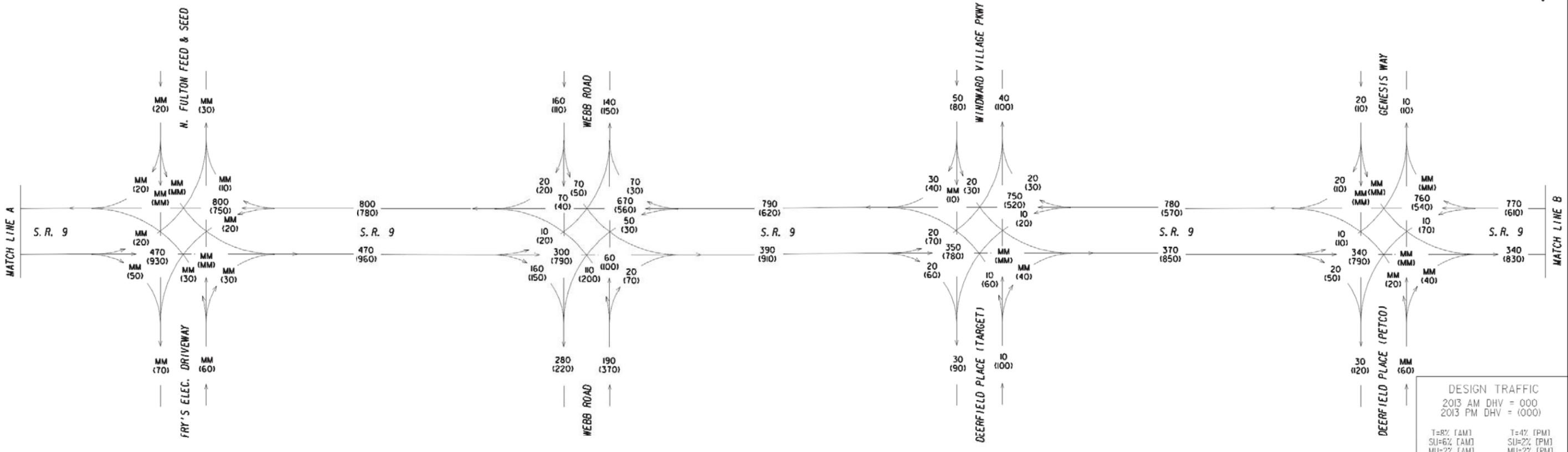
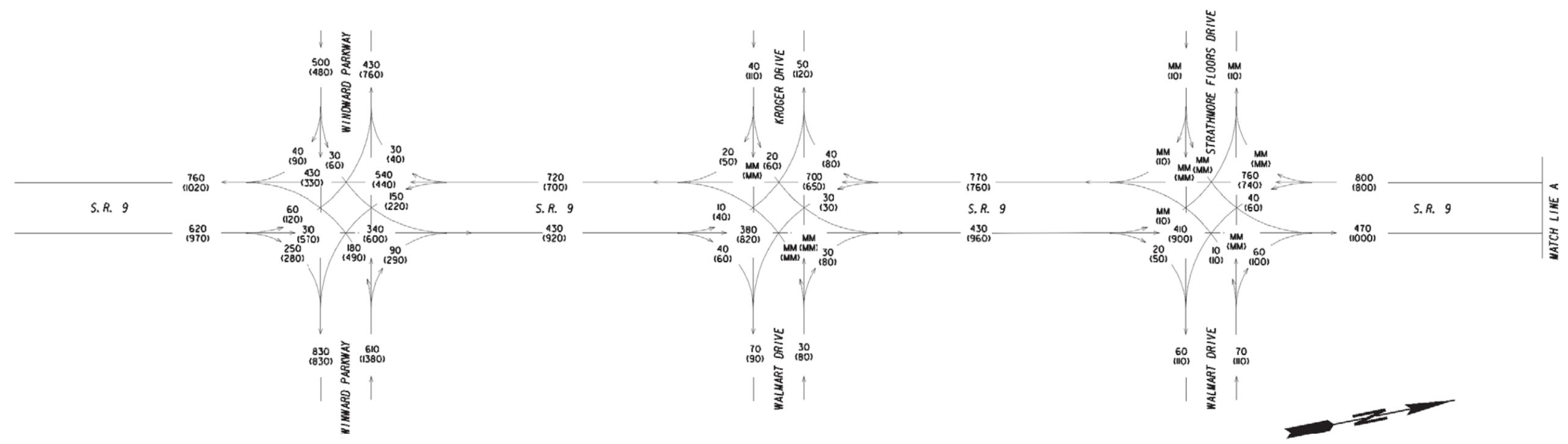
Urban Minor Arterial Road Crash Summary (mile post 26.81 - 29.79)

	2007	2008	2009
Total Accidents	58	53	30
SR 9 Corridor Accidents Per 100 MVMT	264	241	141
Statewide Accidents Per 100 MVMT	513	469	463

Urban Minor Arterial Road Crash Summary by Manner of Collision

Year	Injury	Fatal	Manner of Collision						Total Crashes
			Angle	Head On	Rear End	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Not a Collision with a Vehicle	
2007	18	0	24	0	27	1	1	5	58
2008	18	0	26	0	24	2	0	1	53
2009	9	0	3	1	22	1	0	3	30
Total	45	0	53	1	73	4	1	9	141

Attachment 5
Traffic diagrams



DESIGN TRAFFIC
 2013 AM DHV = 000
 2013 PM DHV = (000)

T=8% [AM]	T=4% [PM]
SU=6% [AM]	SU=2% [PM]
MU=2% [AM]	MU=2% [PM]

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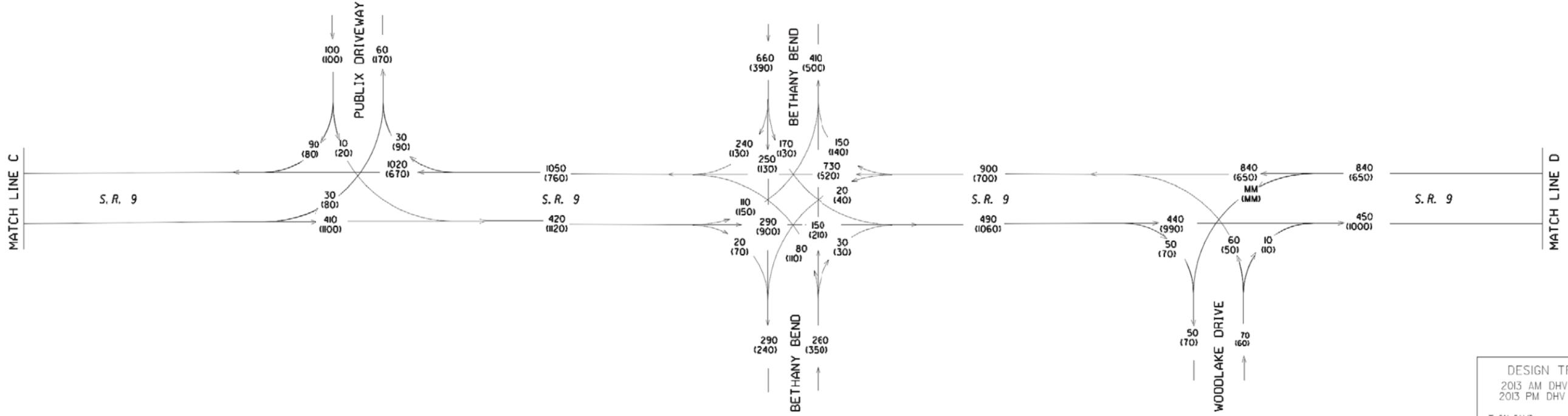
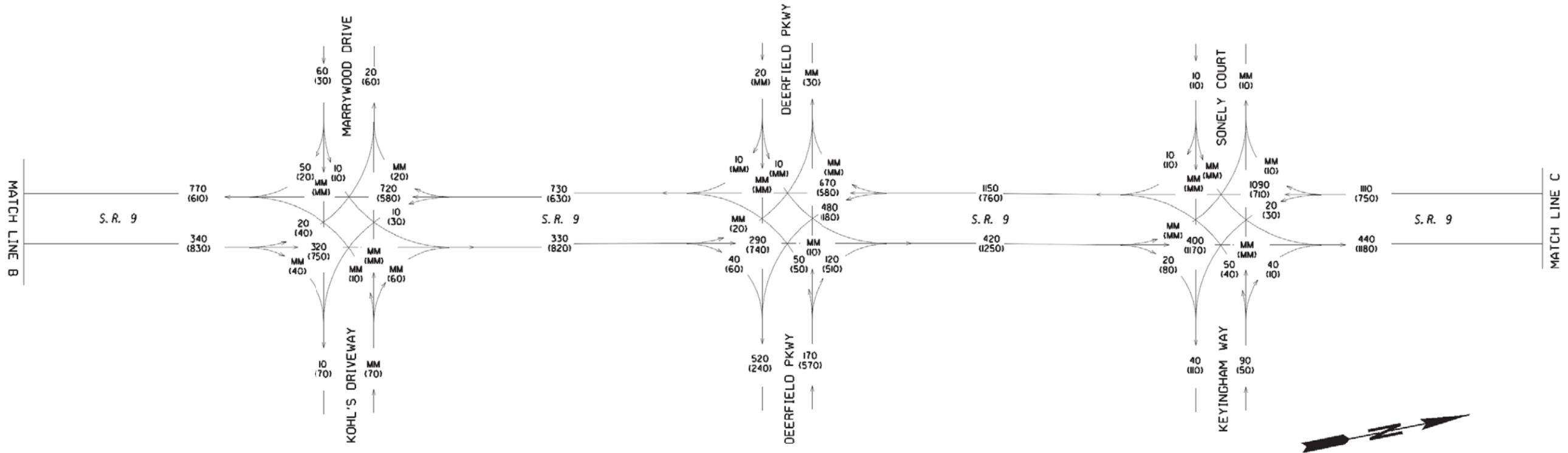
REVISION DATES

STATE OF GEORGIA
 DEPARTMENT OF TRANSPORTATION

OFFICE:

TRAFFIC DIAGRAM
 S.R. 9 (EXISTING CONDITIONS)
 FULTON COUNTY
 2013 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. 10-01



DESIGN TRAFFIC
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2013 PM DHV = (000)

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SU=6% [AM] SU=2% [PM]
MU=2% [AM] MU=2% [PM]

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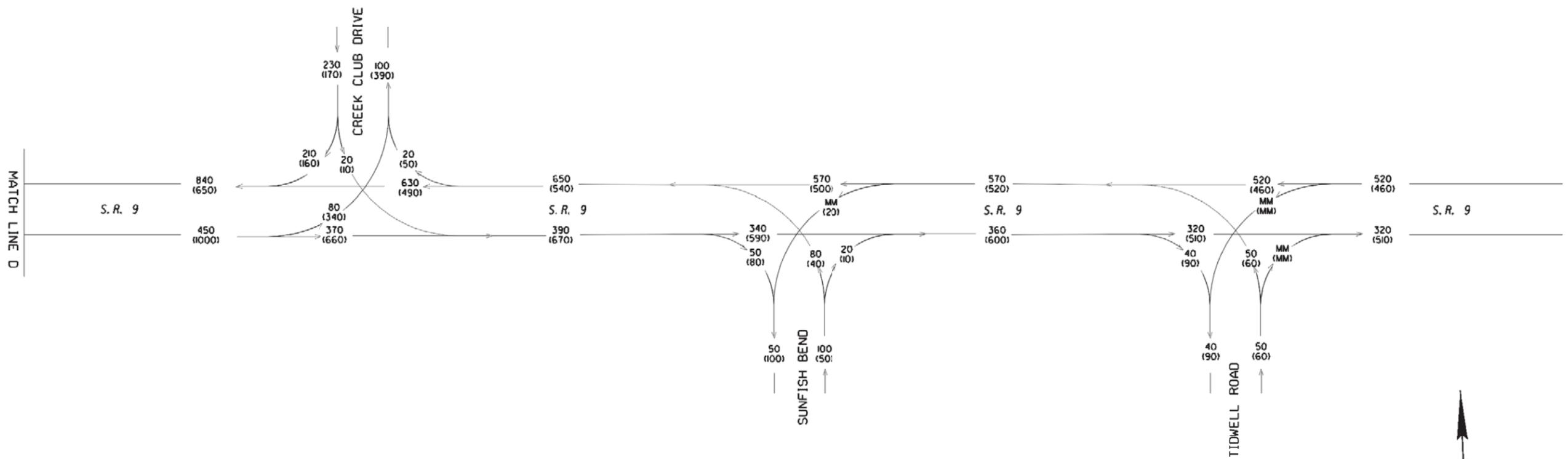
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FULTON COUNTY
2013 AM/PM DHV
SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. **10-02**



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 SU=6% [AM] SU=2% [PM]
 MU=2% [AM] MU=2% [PM]

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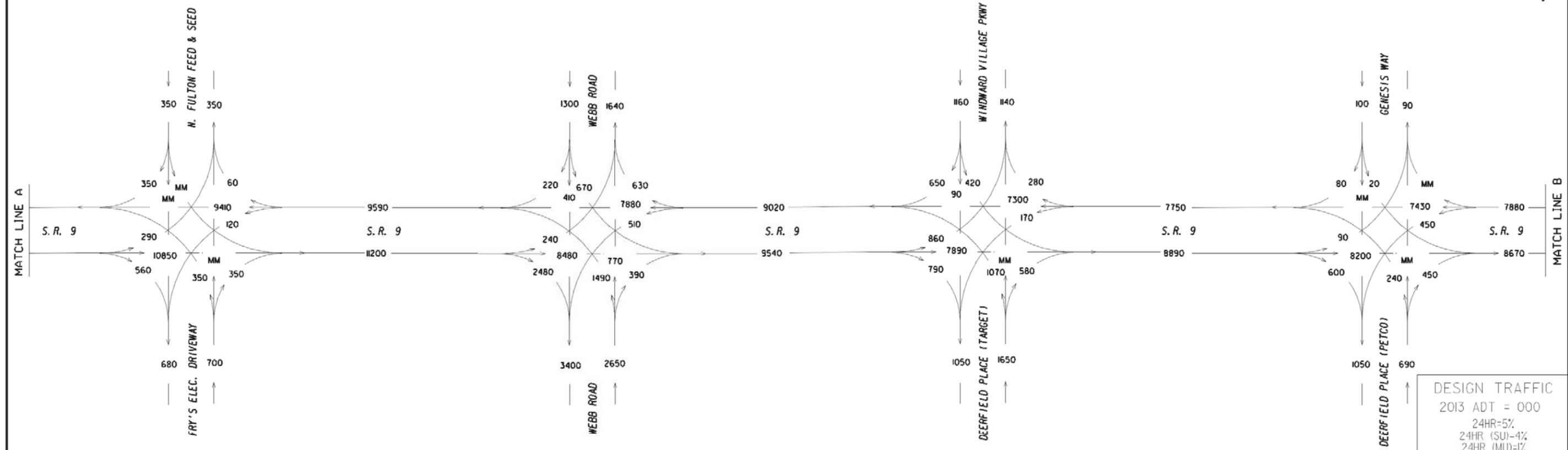
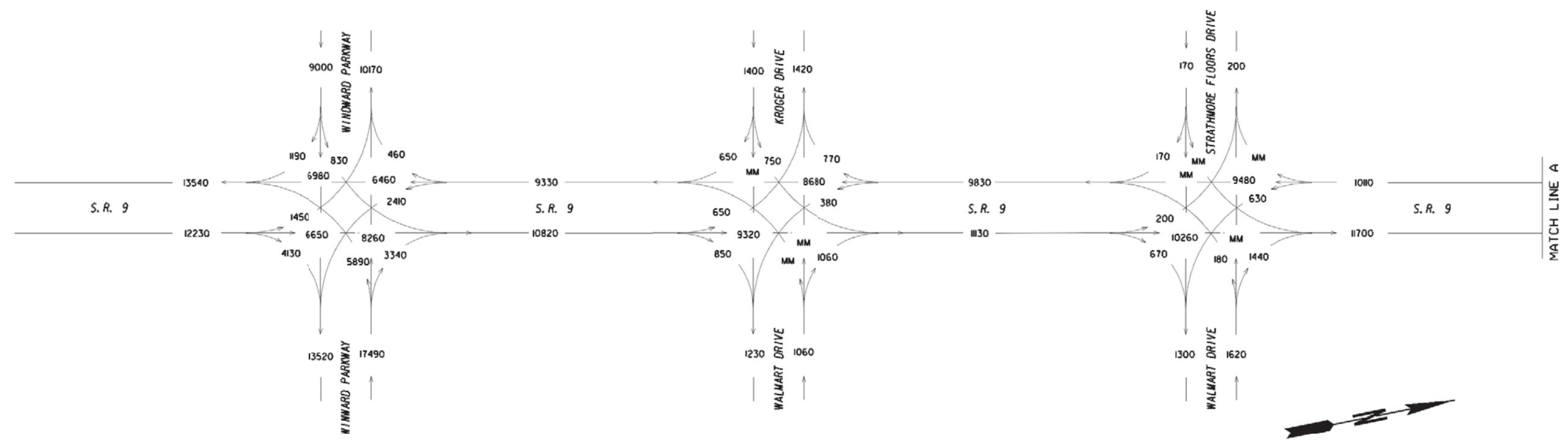
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DRAWING No. **10-03**



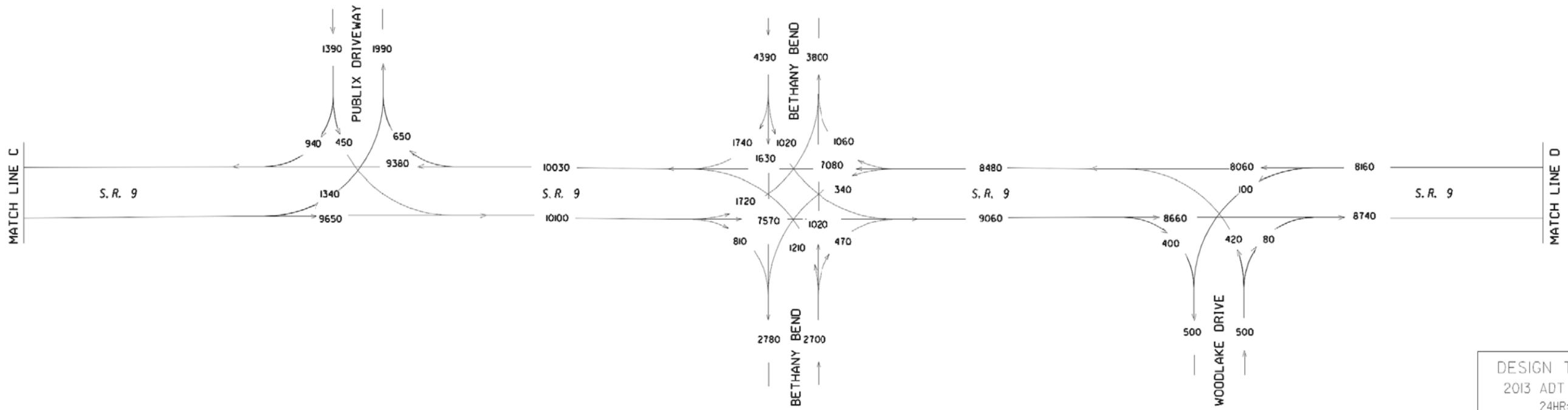
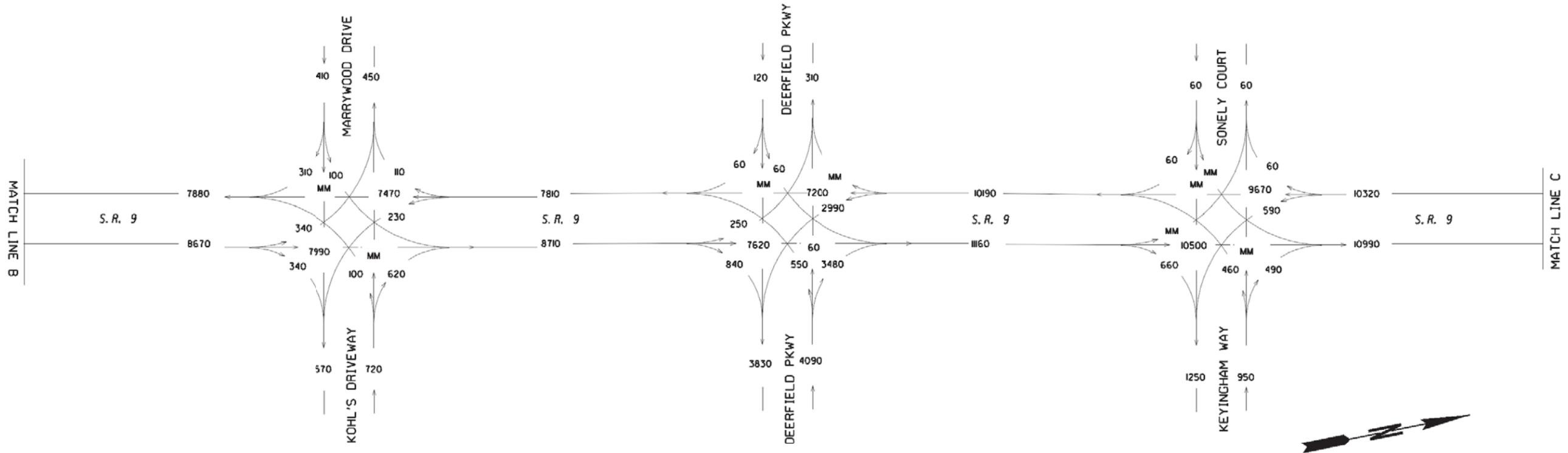
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24HR (SU)=4%
24HR (MU)=1%

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10-04



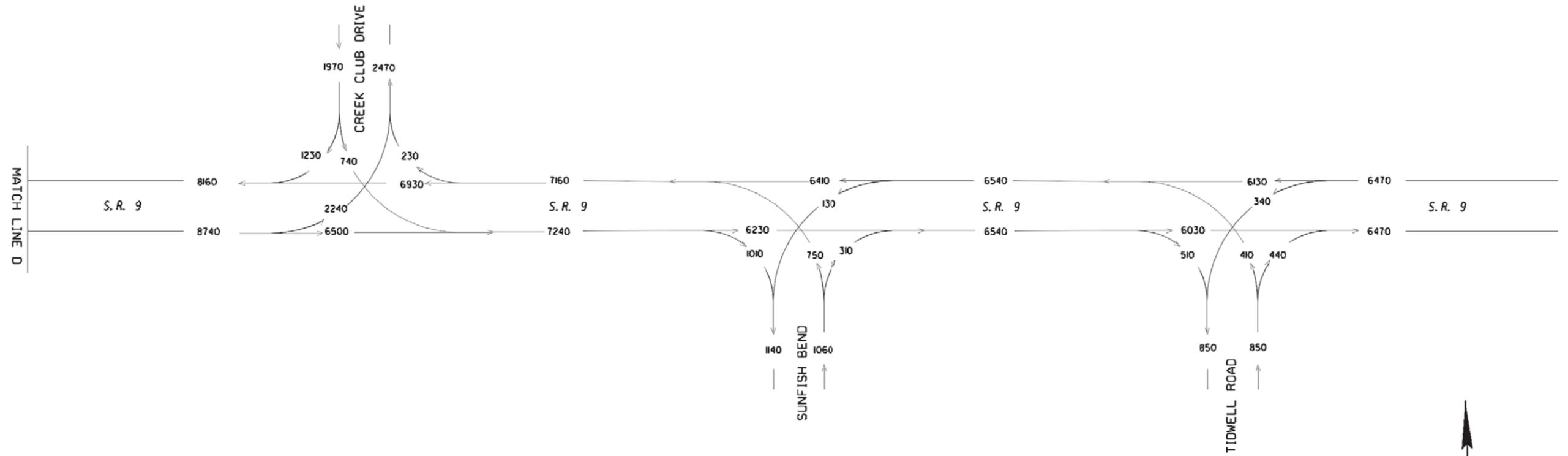
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24HR=5%
24HR (SU)=4%
24HR (MU)=1%

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FULTON COUNTY
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SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-05



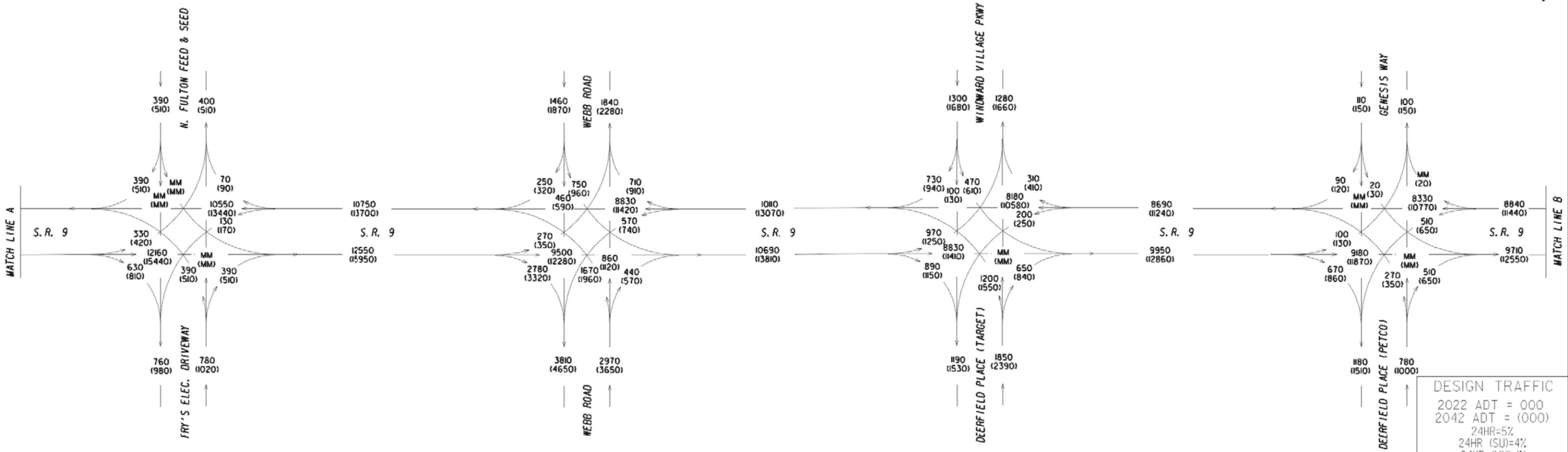
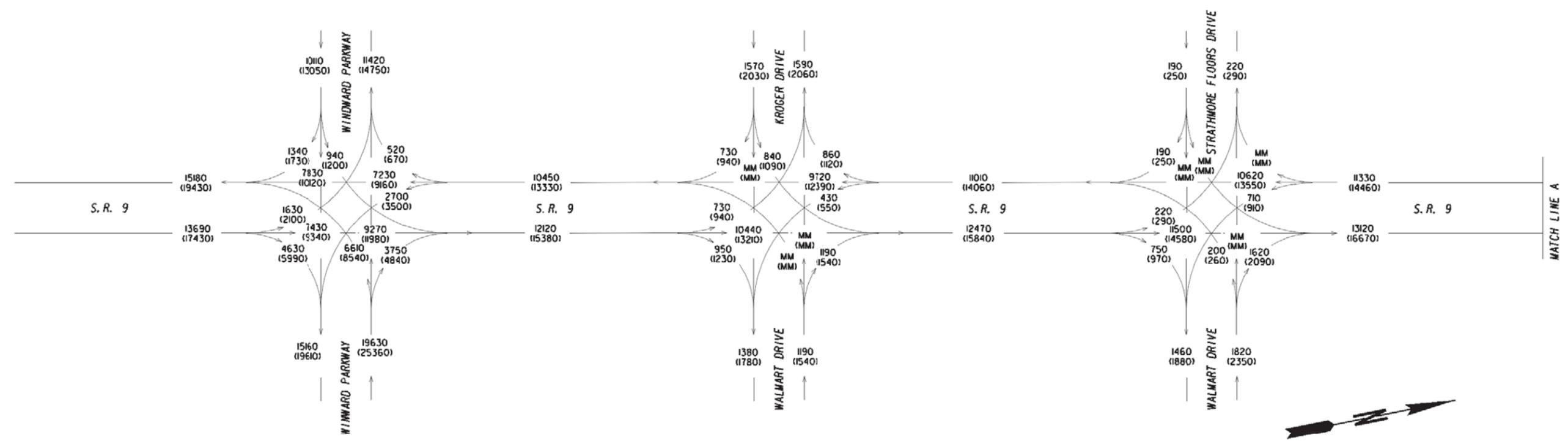
DESIGN TRAFFIC
2013 ADT = 000
24HR=5%
24HR (SU)=4%
24HR (MU)=1%

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FULTON COUNTY
2013 AADT
SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-06

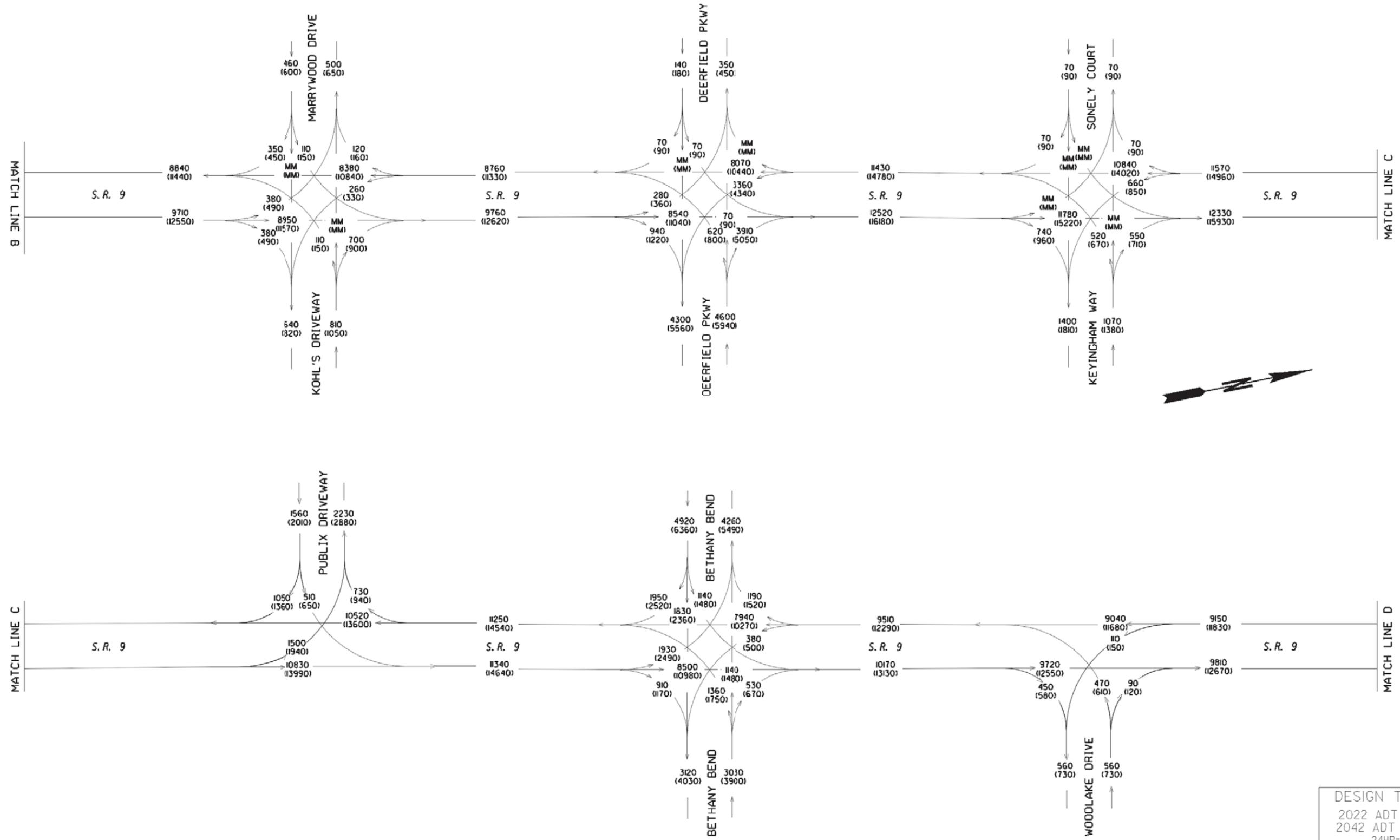


DESIGN TRAFFIC
 2022 ADT = 000
 2042 ADT = (000)
 24HR=5%
 24HR (SU)=4%
 24HR (MU)=1%

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 FULTON COUNTY
 2022 & 2042 AADT
 SR9 WIDENING - CITY OF MILTON, GA



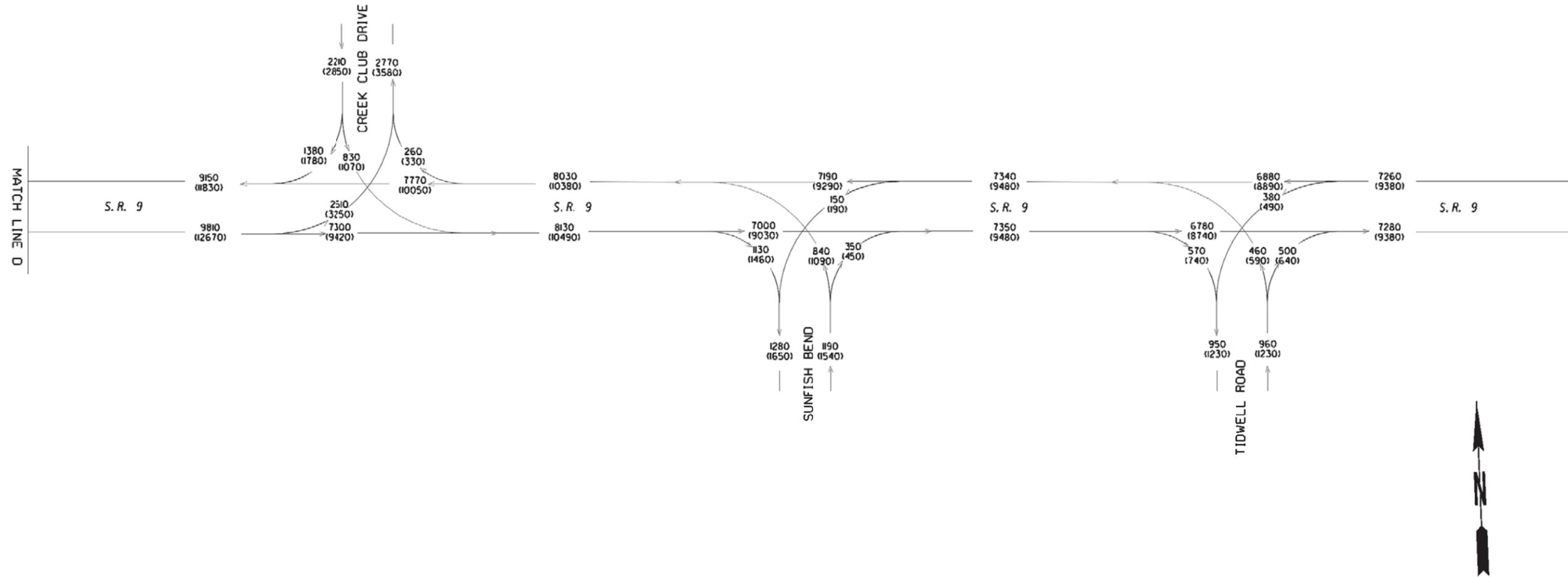
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 24HR (MU)=1%

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 2022 & 2042 AADT
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-08



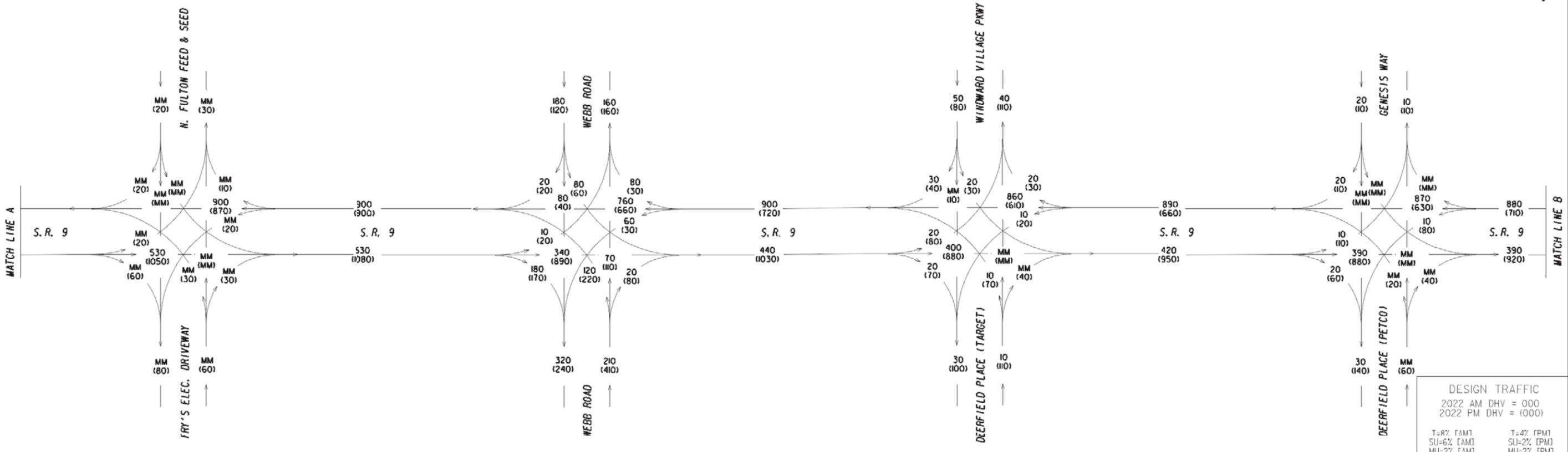
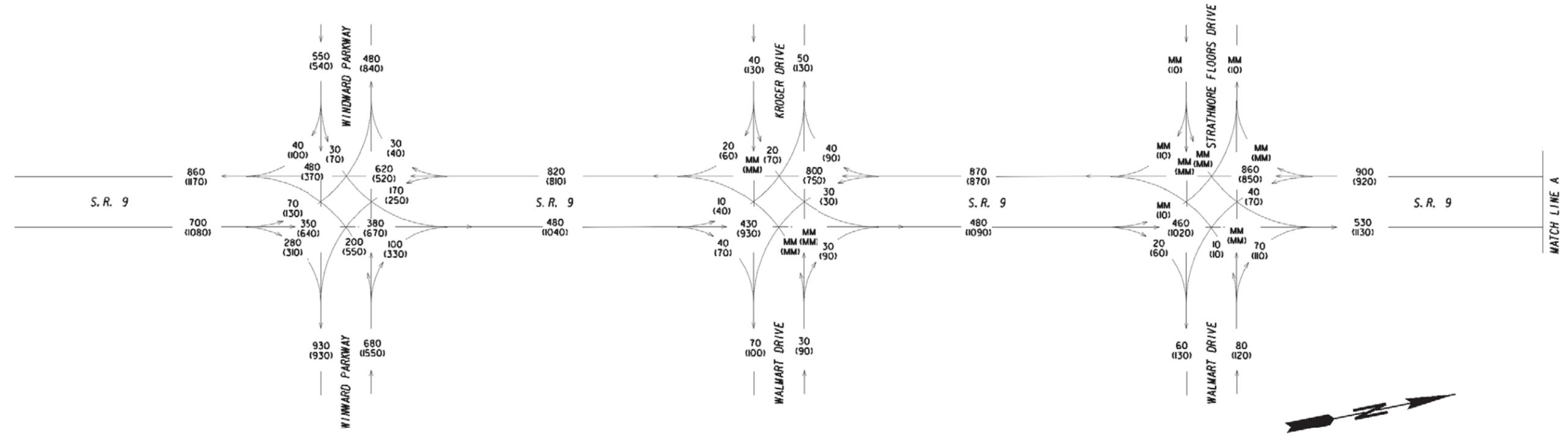
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 2042 ADT = (000)
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 FULTON COUNTY
 2022 & 2042 AADT
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-09



DESIGN TRAFFIC
 2022 AM DHV = 000
 2022 PM DHV = 000

T=7% F&M	T=4% F&M
SU=6% F&M	SU=2% F&M
MU=2% F&M	MU=2% F&M

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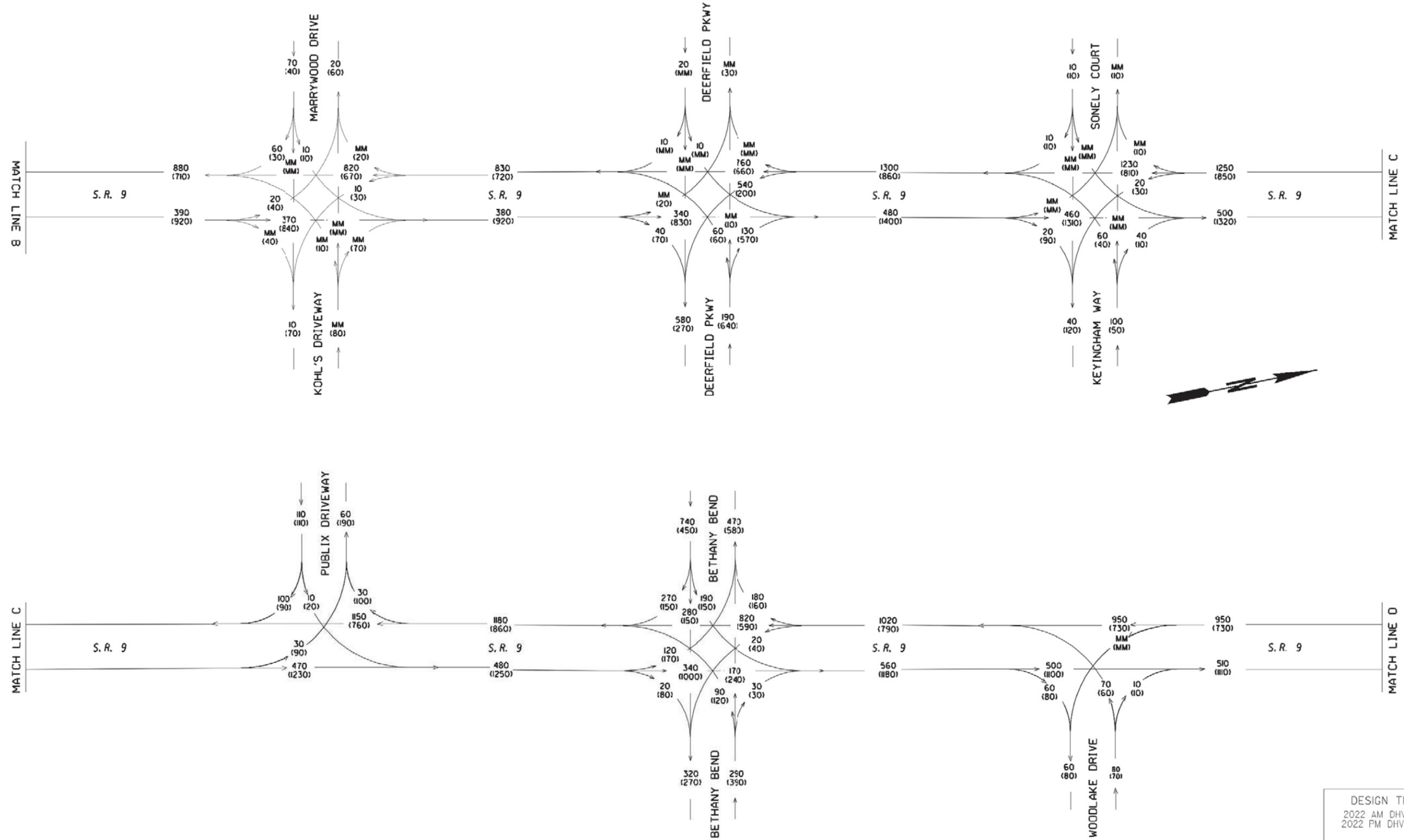
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TRAFFIC DIAGRAM
 S.R. 9 (EXISTING CONDITIONS)
 FULTON COUNTY
 2022 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. 10-10



DESIGN TRAFFIC
 2022 AM DHV = 000
 2022 PM DHV = (000)

T=8Z [AM] T=4Z [PM]
 SU=6Z [AM] SU=2Z [PM]
 MU=2Z [AM] MU=2Z [PM]

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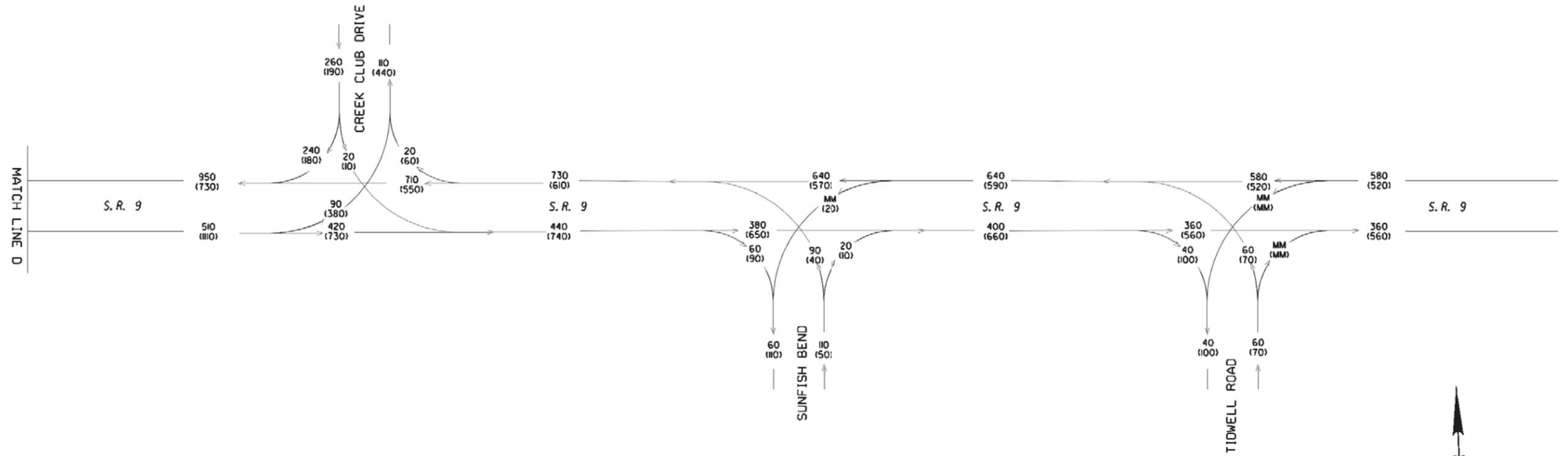
REVISION DATES

STATE OF GEORGIA
 DEPARTMENT OF TRANSPORTATION

OFFICE:

TRAFFIC DIAGRAM
 S.R. 9 (EXISTING CONDITIONS)
 FULTON COUNTY
 2022 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-11



DESIGN TRAFFIC
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2022 PM DHV = (000)

T=8% (AM) T=4% (PM)
SU=6% (AM) SU=2% (PM)
MU=2% (AM) MU=2% (PM)

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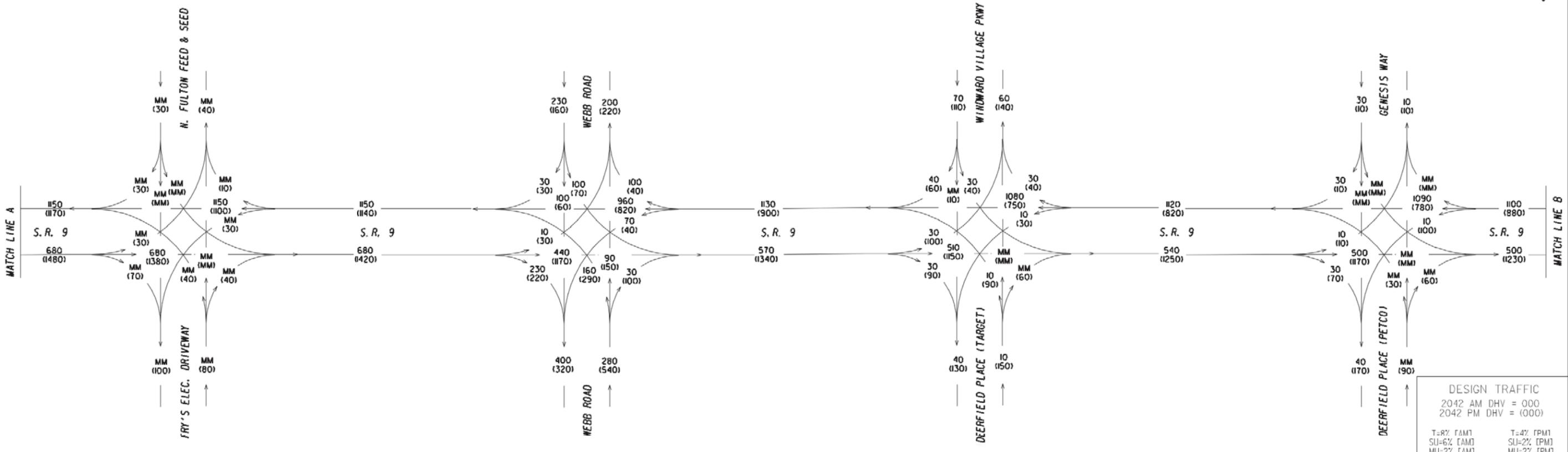
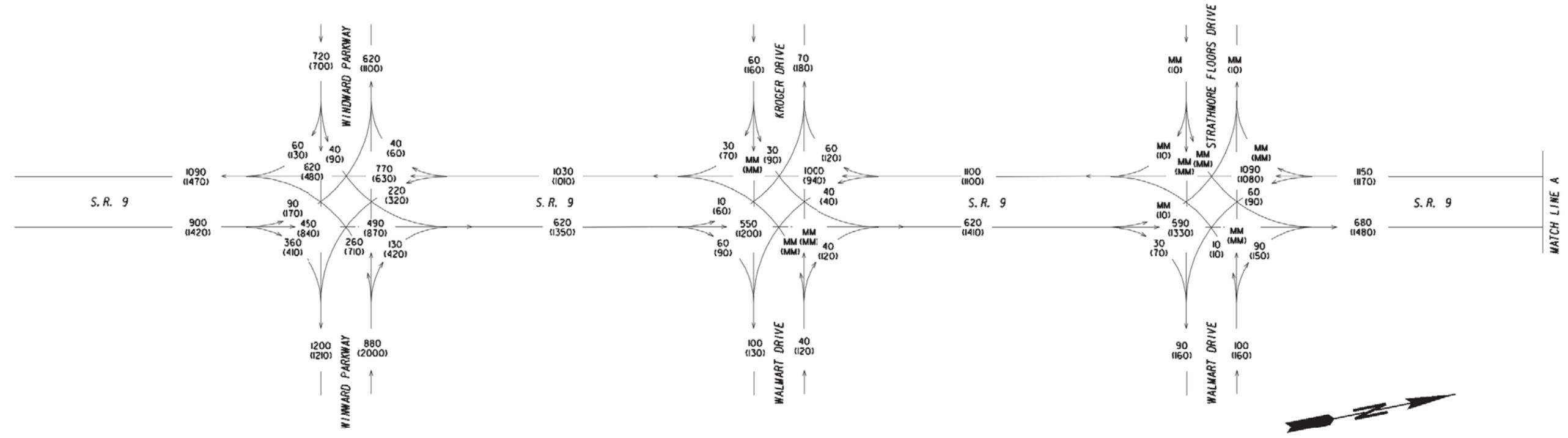
REVISION DATES	

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TRAFFIC DIAGRAM
S.R. 9 (EXISTING CONDITIONS)
FULTON COUNTY
2022 AM/PM DHV
SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. **10-12**



DESIGN TRAFFIC
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2042 PM DHV = (000)

T=7% FAM1	T=4% FPM1
SU=6% FAM1	SU=2% FPM1
MU=2% FAM1	MU=2% FPM1

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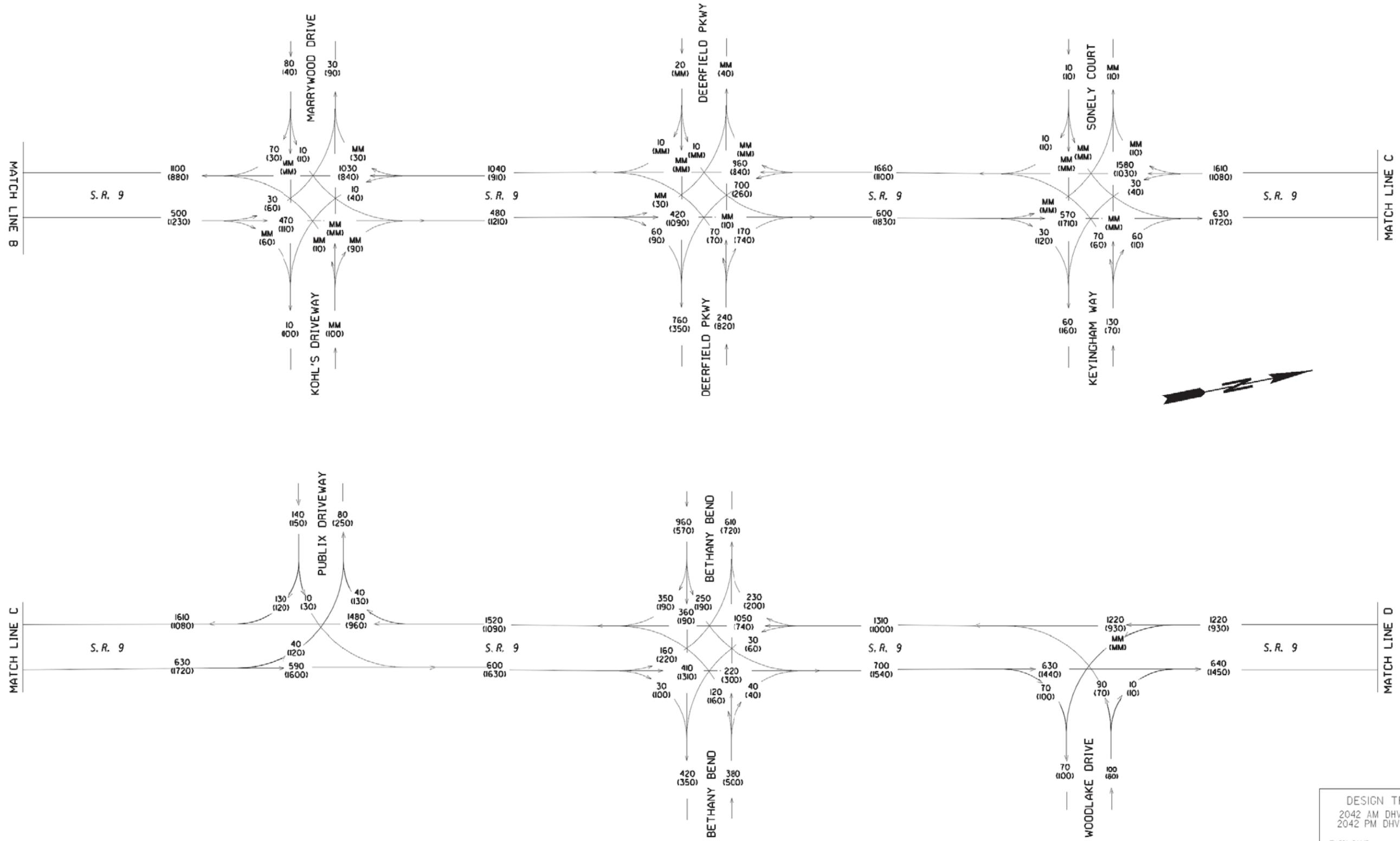
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TRAFFIC DIAGRAM
S.R. 9 (EXISTING CONDITIONS)
FULTON COUNTY
2042 AM/PM DHV
SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. 10-13



DESIGN TRAFFIC
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 2042 PM DHV = 1000

T=8% [AM] T=4% [PM]
 SU=6% [AM] SU=2% [PM]
 MU=2% [AM] MU=2% [PM]

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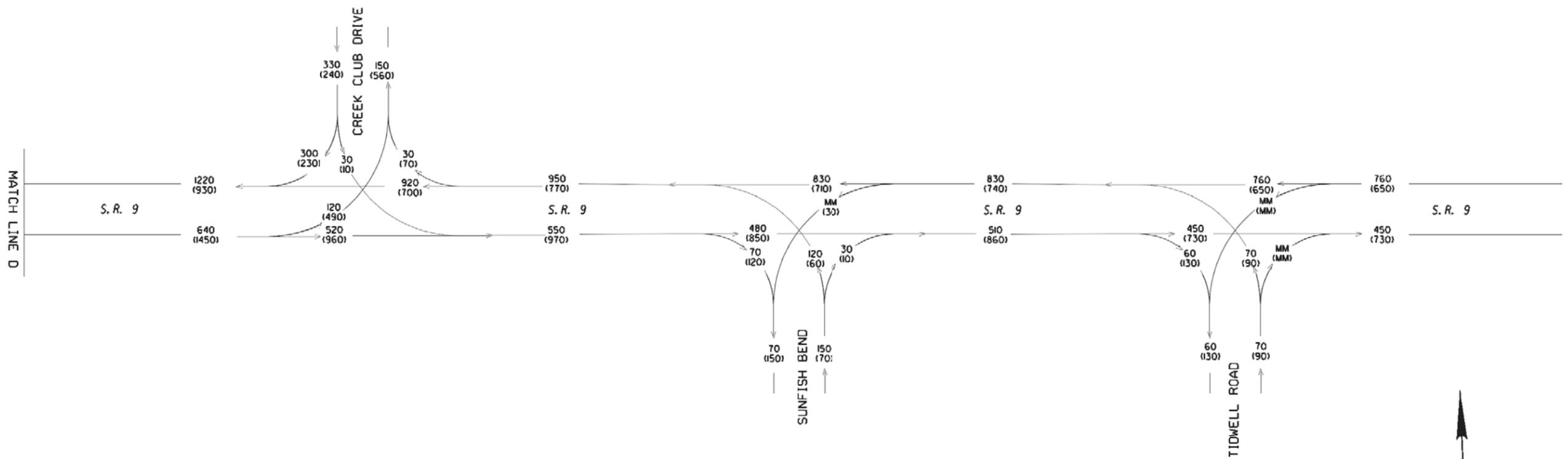
REVISION DATES

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OFFICE:

TRAFFIC DIAGRAM
 S.R. 9 (EXISTING CONDITIONS)
 FULTON COUNTY
 2042 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. **10-14**



MATCH LINE D

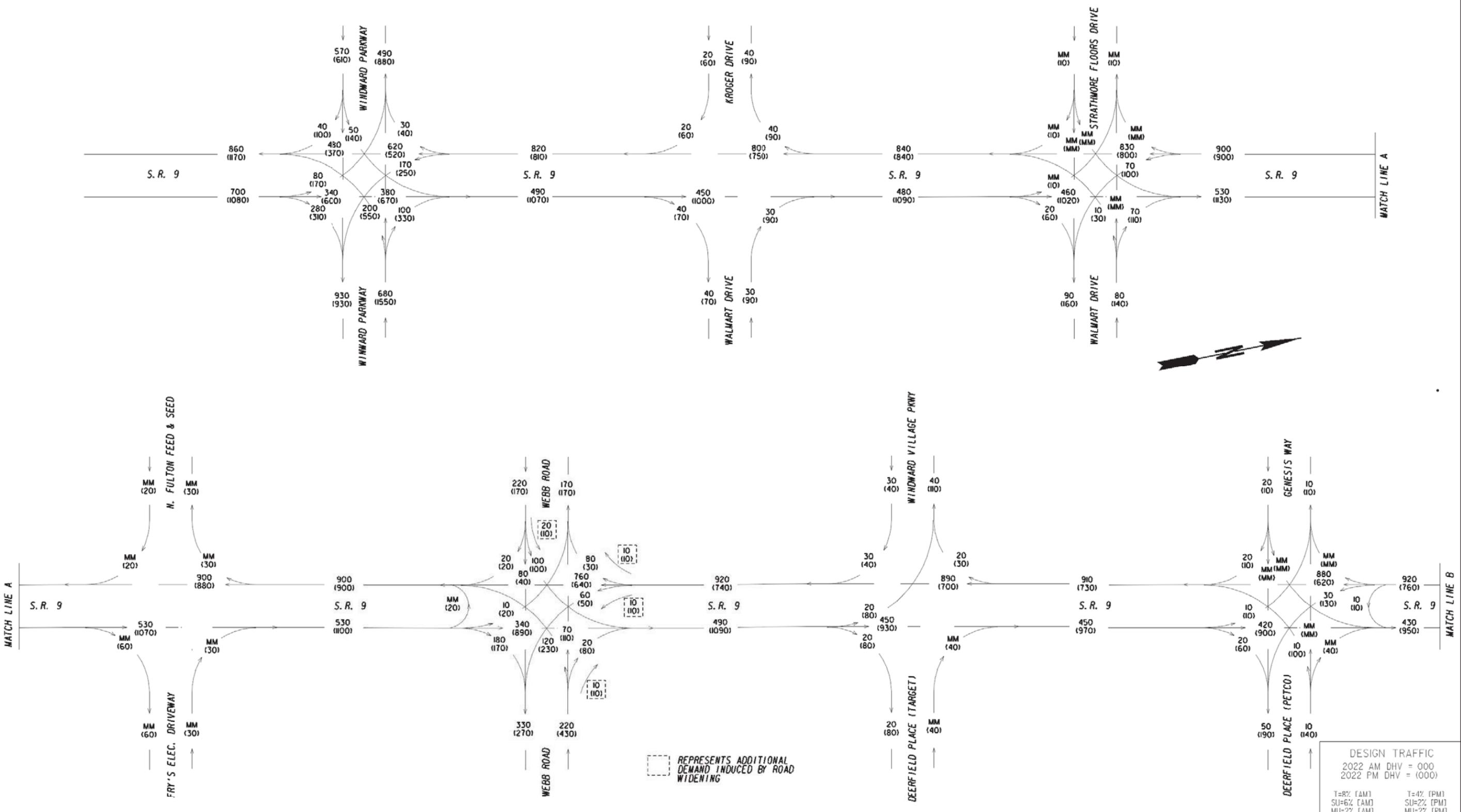
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 SU=6% (AM) SU=2% (PM)
 MU=2% (AM) MU=2% (PM)

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 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
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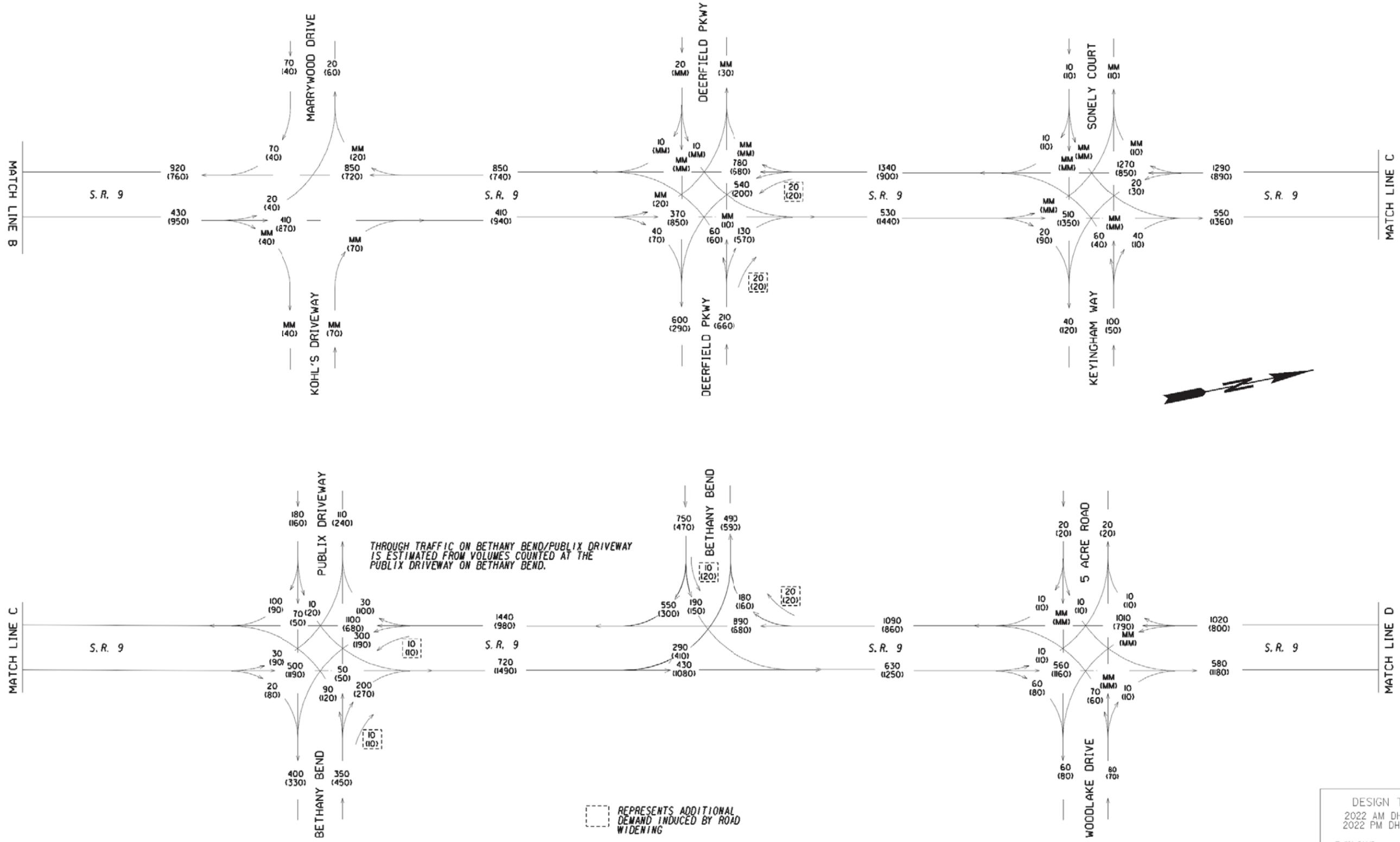
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 FULTON COUNTY
 2022 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. **10-16**

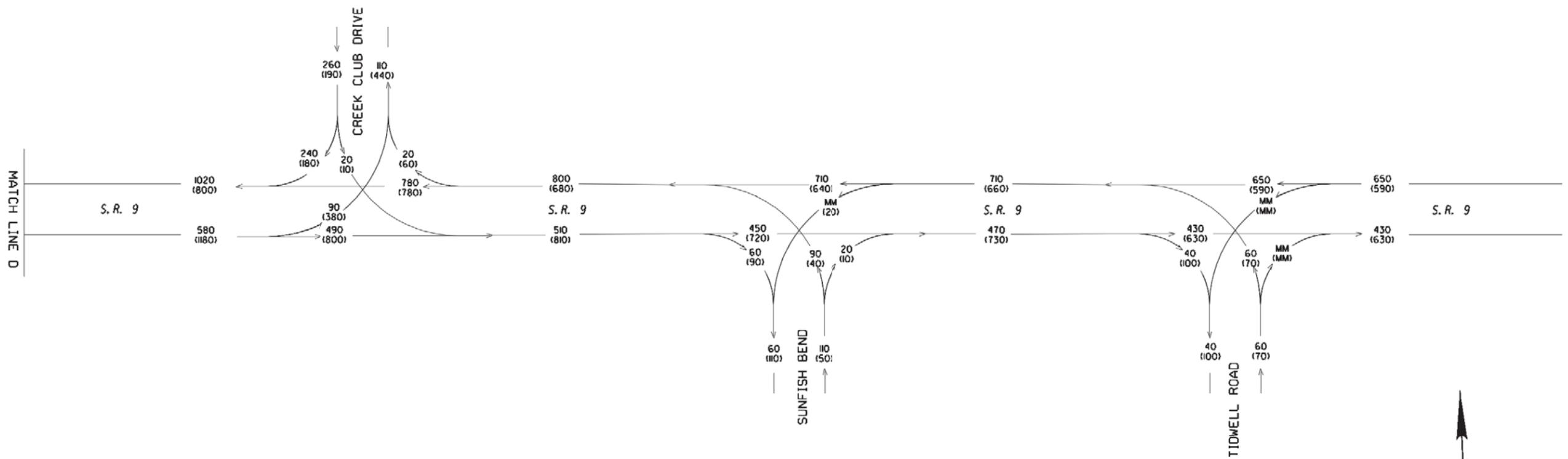


DESIGN TRAFFIC
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 SU=6% [AM] SU=2% [PM]
 MU=2% [AM] MU=2% [PM]

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 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2022 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA



DESIGN TRAFFIC
 2022 AM DHV = 000
 2022 PM DHV = (000)

T=8% (AM) T=4% (PM)
 SU=6% (AM) SU=2% (PM)
 MU=2% (AM) MU=2% (PM)

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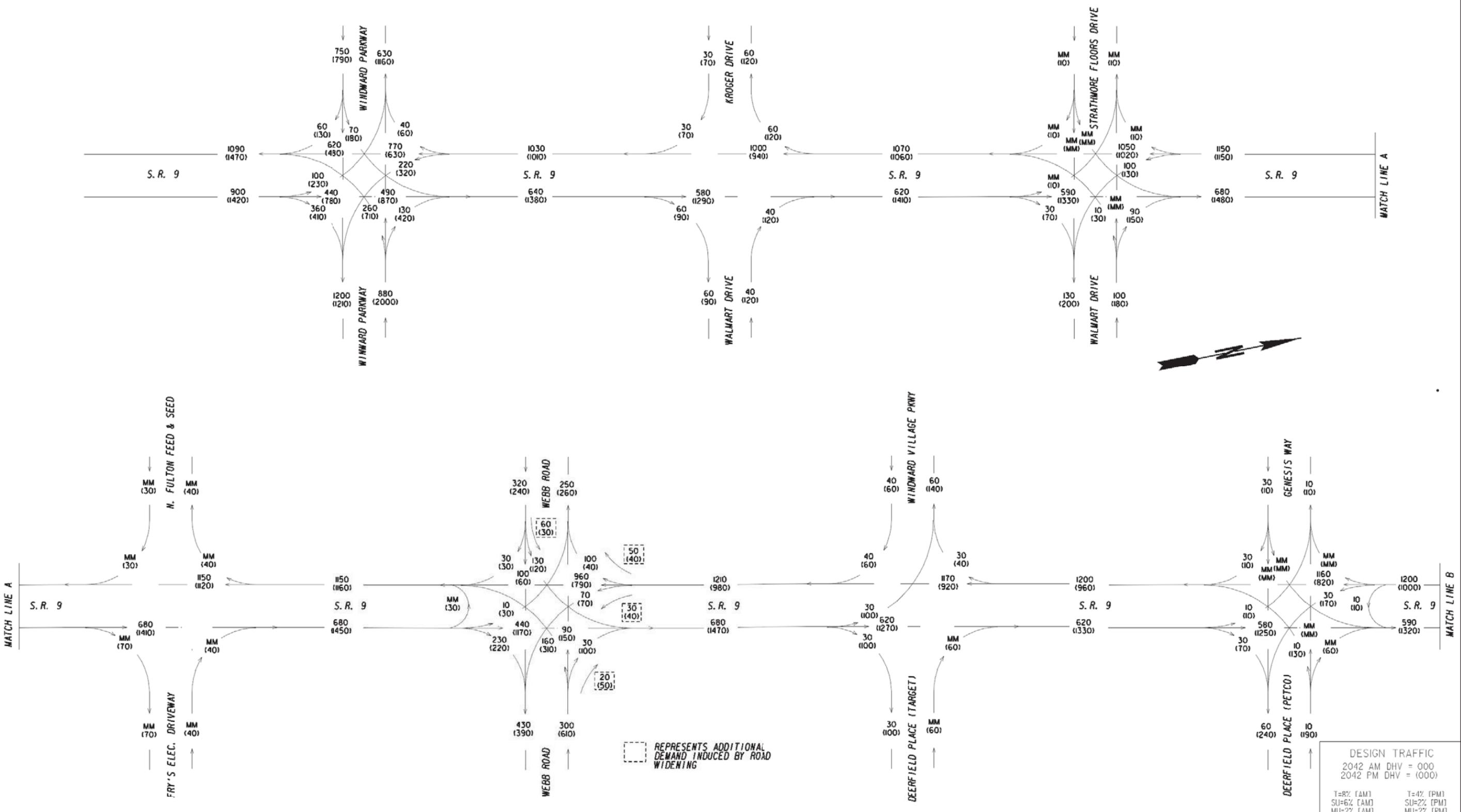
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 2022 AM/PM DHV
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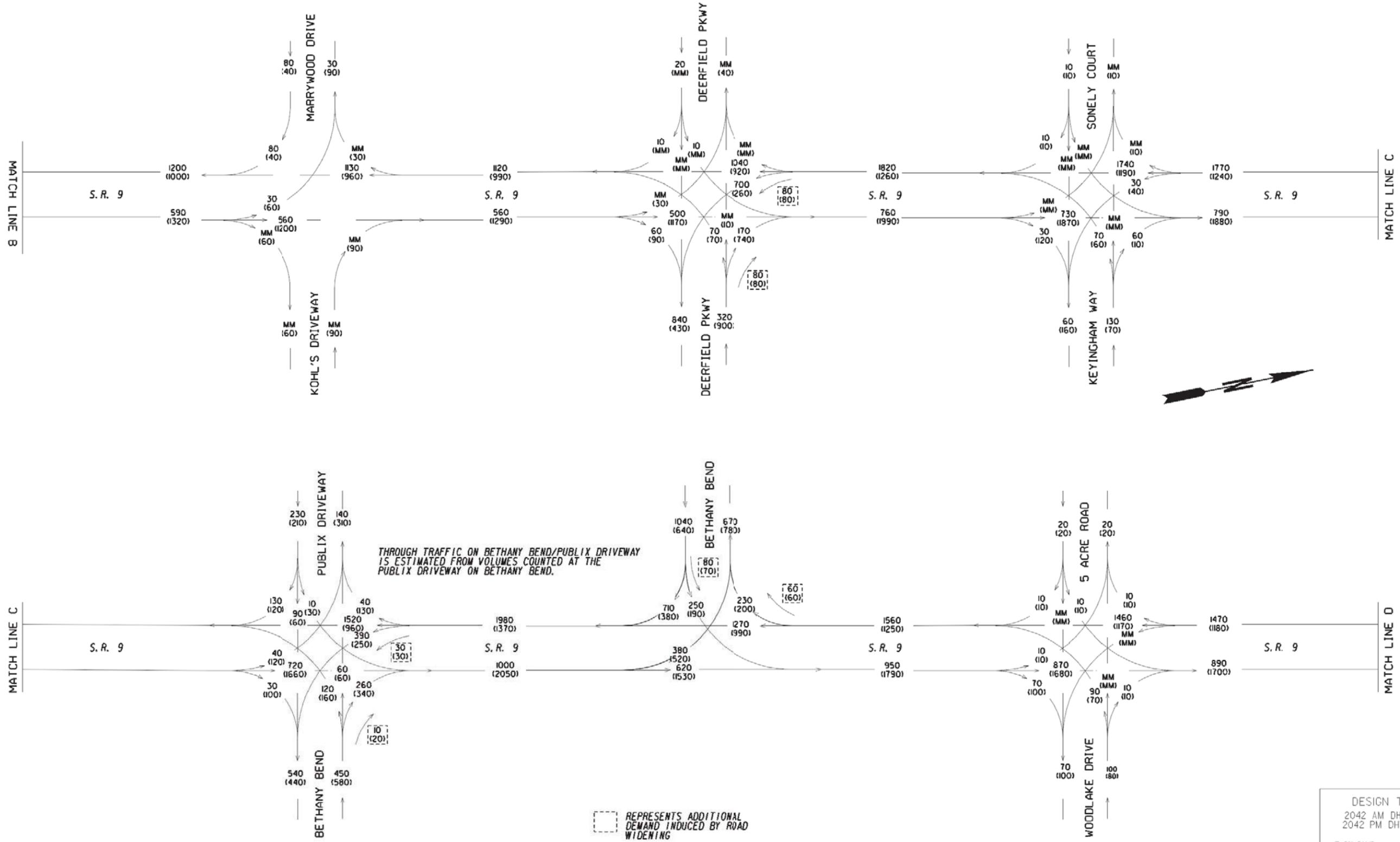
REVISION DATES

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TRAFFIC DIAGRAM
 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2042 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-19



DESIGN TRAFFIC
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 2042 PM DHV = (000)

T=8% (AM)	T=4% (PM)
SU=6% (AM)	SU=2% (PM)
MU=2% (AM)	MU=2% (PM)

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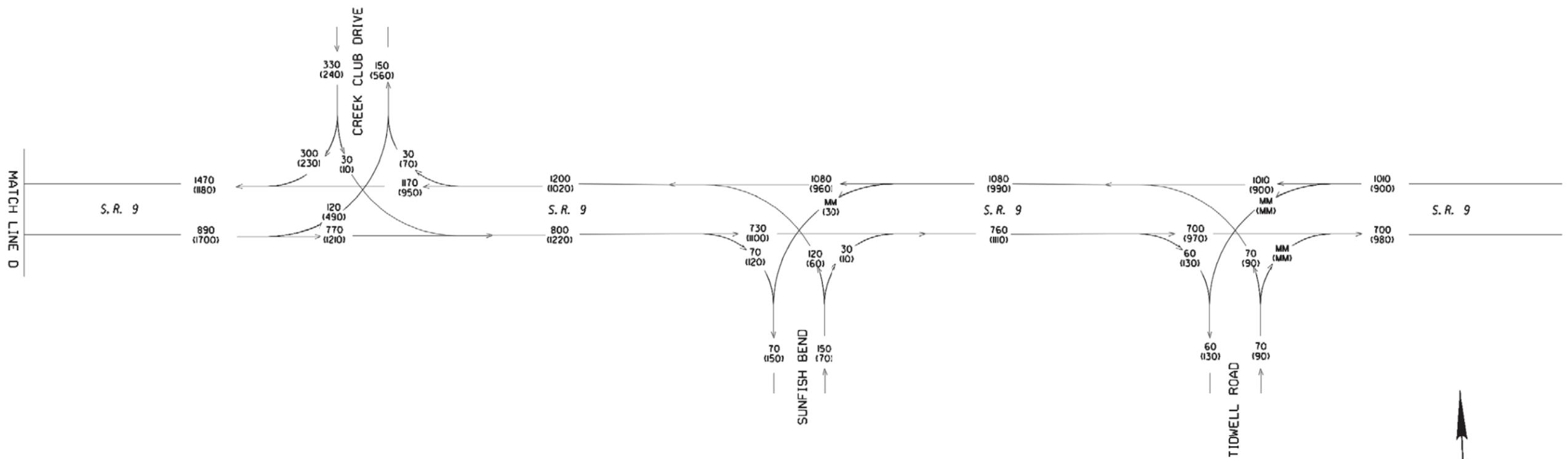
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 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2042 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No. 10-20



DESIGN TRAFFIC
 2042 AM DHV = 000
 2042 PM DHV = (000)

T=8% [AM] T=4% [PM]
 SU=6% [AM] SU=2% [PM]
 MU=2% [AM] MU=2% [PM]

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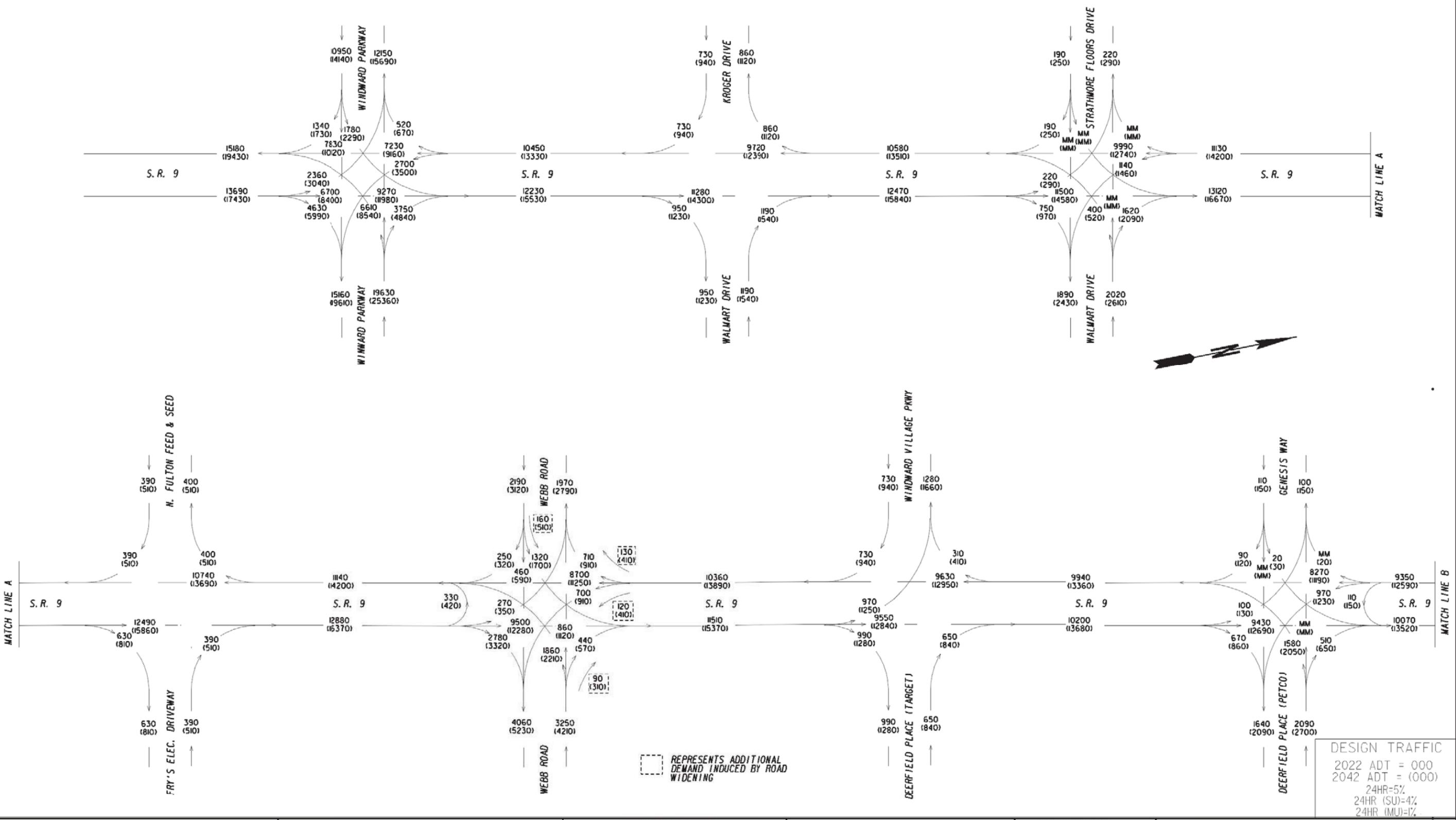
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 FULTON COUNTY
 2042 AM/PM DHV
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-21



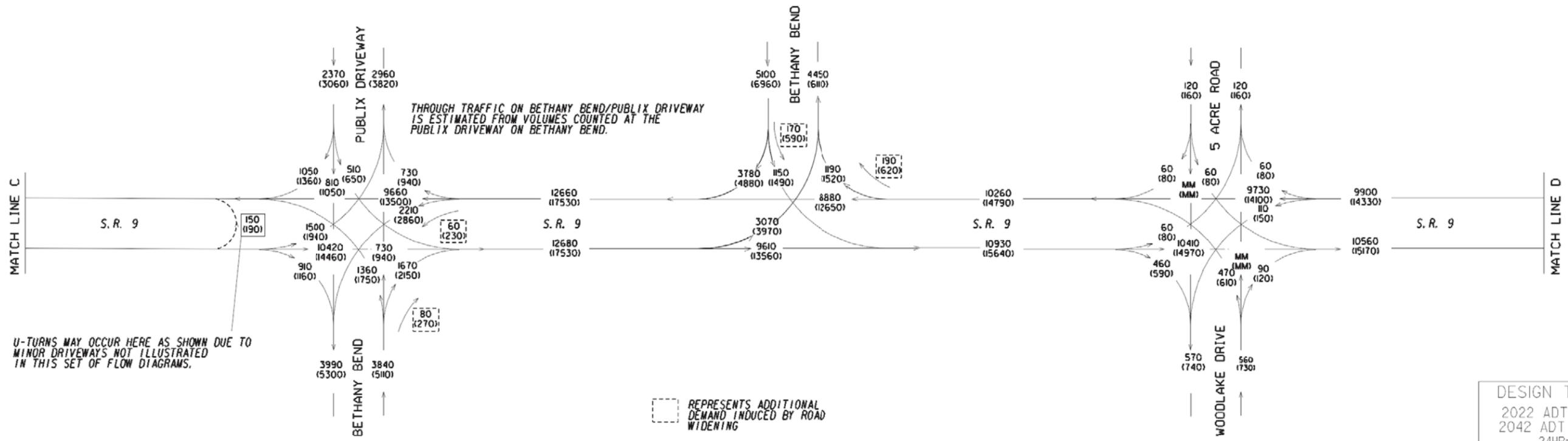
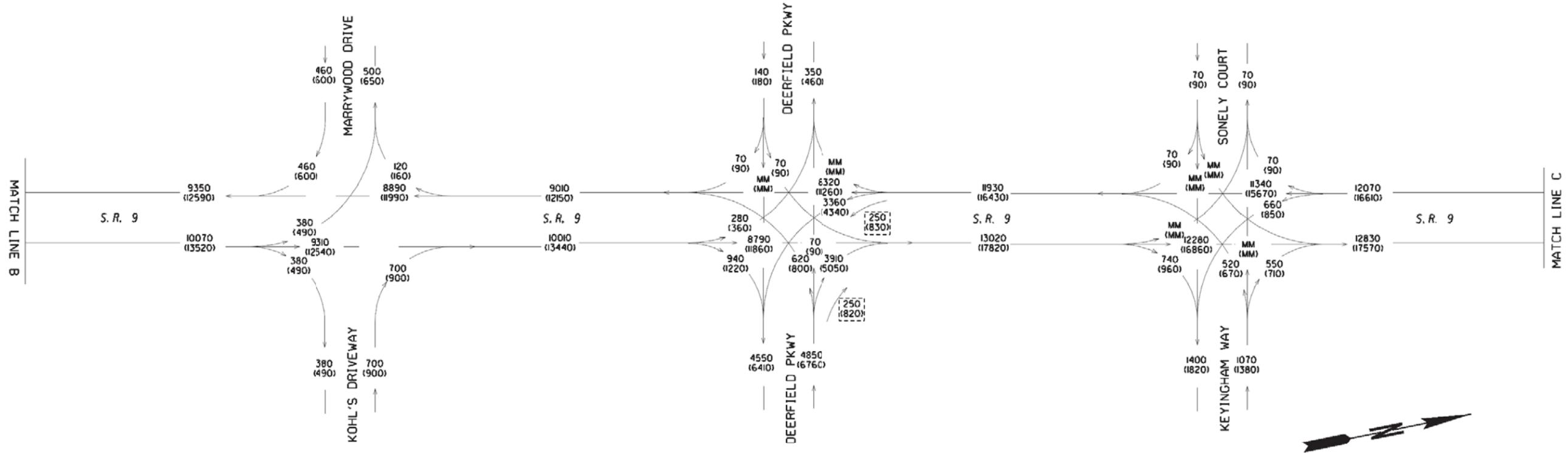
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 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2022/2042 ADT
 SR9 WIDENING - CITY OF MILTON, GA

DRAWING No.
10-22



U-TURNS MAY OCCUR HERE AS SHOWN DUE TO MINOR DRIVEWAYS NOT ILLUSTRATED IN THIS SET OF FLOW DIAGRAMS.

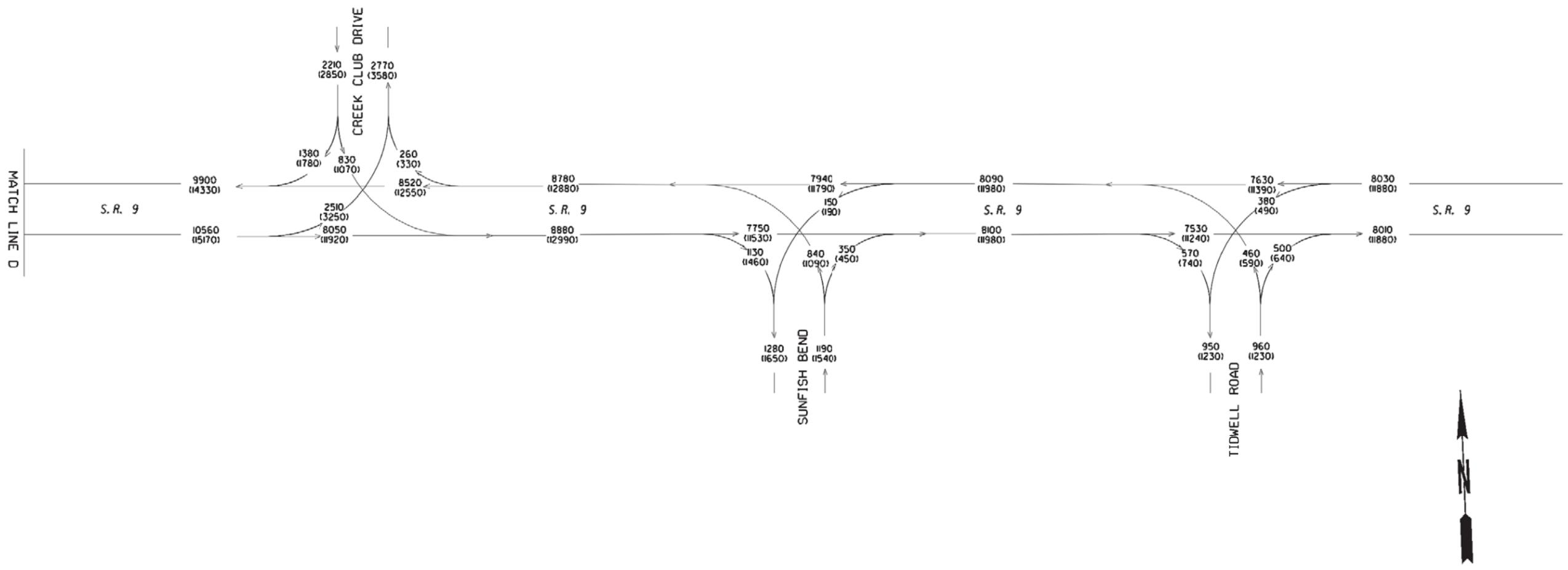
REPRESENTS ADDITIONAL DEMAND INDUCED BY ROAD WIDENING

DESIGN TRAFFIC
 2022 ADT = 000
 2042 ADT = (000)
 24HR=5%
 24HR (SU)=4%
 24HR (MU)=1%

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 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2022/2042 ADT
 SR9 WIDENING - CITY OF MILTON, GA



DESIGN TRAFFIC
 2022 ADT = 000
 2042 ADT = (000)
 24HR=5%
 24HR (SU)=4%
 24HR (MU)=1%

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TRAFFIC DIAGRAM
 S.R. 9 (BUILD CONDITIONS)
 FULTON COUNTY
 2022/2042 ADT
 SR9 WIDENING - CITY OF MILTON, GA

Attachment 6
Capacity analysis summary (*tabular format*)

PI 0007838 Capacity Analysis Summary Exist and No Build Summary

Intersection	2013				2022 No Build				2042 No Build			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	26.5	D	41.6	C	28	D	48.6	C	34.7	F	104
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled												
Eastbound left turn	A	9.3	A	9.2	A	9.7	A	9.7	B	10.7	B	10.9
Westbound left turn	A	8.2	A	9.9	A	8.4	B	10.5	A	8.8	B	12.4
Northbound approach	B	10.9	C	19.1	B	11.4	C	23.5	B	12.9	F	53.8
Southbound approach	D	25.6	F	>200	D	32.5	F	>00	F	82.3	F	>200
Strathmore Floors/Wal-Mart Drive at SR 9 – stop controlled												
Eastbound left turn	A	-	A	9.4	A	-	A	9.9	A	-	B	11.2
Westbound left turn	A	8.4	B	10.6	A	8.5	B	11.5	A	9.1	B	14.7
Northbound approach	C	15.3	D	31.3	C	16.8	E	45.9	C	23.9	F	180.5
Southbound approach	A	-	B	14.7	A	-	C	16.4	A	-	C	21.2
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled												
Northeast-bound left turn	A	-	A	9.6	A	-	B	10.1	A	-	B	11.5
Southwest-bound left turn	A	-	B	10.4	A	-	B	11.1	A	-	B	13.7
Northwest-bound approach	A	-	F	103.9	A	-	F	>200	A	-	F	>200
Southeast-bound approach	A	-	C	15.1	A	-	C	17.2	A	-	C	23.5
Webb Road at SR 9 – signalized	B	17.5	C	24.5	B	18.7	C	28.1	C	25.1	E	60.6
Windward Village Pkwy/Target at SR 9 - signalized	A	3.6	A	8.7	A	4	A	9.7	A	6.3	B	16.8
Genesis Way/Deerfield Place at SR 9 – stop controlled												
Northbound left turn	A	9.5	A	8.7	B	10	A	9	B	11.2	A	9.6
Southbound left turn	A	8.1	B	10.1	A	8.2	B	10.7	A	8.5	B	13.2
Eastbound approach	C	15.3	B	12.2	C	17.2	B	13.2	C	23.2	C	15.3
Westbound approach	A	-	D	34.8	A	-	F	52.3	A	-	F	>200
Marrywood Drive/Kohl's at SR 9 – stop controlled												
Northbound left turn	A	9.4	A	9	A	9.9	A	9.3	B	11.1	B	10.3
Southbound left turn	A	8	A	9.6	A	8.1	B	10	A	8.5	B	11.7
Eastbound approach	C	19.3	D	33.8	C	23.4	E	43.4	E	39.6	F	>200
Westbound approach	A	-	C	22.9	A	-	D	28.2	A	-	F	61.5
Deerfield Pkwy at SR 9 - signalized	A	5.5	A	4.4	A	8.6	A	5	C	24	B	10
Sonely Ct./Keyingham Way at SR 9 – stop controlled												
Northbound left turn	A	-	A	-	A	-	A	-	A	-	A	-
Southbound left turn	A	8.3	B	12	A	8.5	B	13.1	A	8.9	C	17.8
Eastbound approach	C	21.4	B	14.3	D	25.4	C	15.7	E	40.9	C	20
Westbound approach	F	108.3	F	406.3	F	>200	F	>200	F	>200	F	>200
Publix Drive at SR 9 – stop controlled												
Northbound left turn	B	11	A	9.6	B	11.9	B	10.1	B	14.9	B	11.7
Eastbound approach	E	39.5	F	102.5	F	65.9	F	>200	F	>200	F	>200
Bethany Bend at SR 9 - signalized	E	65.2	E	57.1	F	80.9	E	72.4	F	158.1	E	150.2
Woodlake Drive at SR 9 – stop controlled												
Southbound left turn	A	-	A	-	A	-	A	-	A	-	A	-
Westbound approach	E	40.5	F	90.2	F	71.6	F	>200	F	>200	F	>200
Creek Club Drive at SR 9 – stop controlled												
Eastbound left turn	A	9.4	B	10.4	A	9.8	B	11.3	B	11.4	C	16
Southbound approach	C	21.8	C	20.5	D	30	D	26.3	F	120.1	F	78.4
Sunfish Bend at SR 9 – stop controlled												
Westbound left turn	A	-	A	8.9	A	-	A	9.1	A	-	B	10.1
Northbound approach	C	22.8	D	26.9	D	29.8	D	33.4	F	102.7	F	112.9
Kennewick Road at SR 9 – stop controlled												
Westbound left turn	A	8.1	A	8.9	A	8.4	A	9.4	A	8.6	B	10.1
Northbound approach	C	15.7	C	19.8	C	21.1	D	27.5	D	30.5	E	45.2

PI 0007838 Capacity Analysis Summary Exist and No Build Summary

Intersection	2022 Build				Intersection	2042 Build			
	AM Peak		PM Peak			AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)		LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	30.3	D	40.2		C	34.6	D	49.7
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled									
Northbound approach	B	10	B	14.3		B	10.6	C	19.3
Southbound approach	B	11.6	B	11.8		B	13	B	13.3
Strathmore Floors/Wal-Mart Drive at SR 9 – signalized	B	13.4	B	13.7		B	14	B	18
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled									
Northwest-bound approach	A	-	B	13.5		A	-	C	16.9
Southeast-bound approach	A	-	B	12		A	-	B	13.9
Webb Road at SR 9 – signalized	B	16.1	B	19.8		C	22.6	C	31.6
Windward Village Pkwy/Target at SR 9 – stop controlled									
Northbound left turn	B	10.2	A	9.7		B	12.1	B	11.2
Eastbound approach	B	12.3	B	11.3		B	14.5	B	13
Westbound approach	A	-	B	12.7		A	-	C	16.1
Genesis Way/Deerfield Place at SR 9 - signalized	A	0.7	B	11.4		A	2.8	B	12.7
Marrywood Drive/Kohl's at SR 9 – stop controlled									
Northbound left turn	B	10.1	A	9.6		B	11.8	B	11
Eastbound approach	B	12.6	B	11.4		C	15.3	B	12.9
Westbound approach	A	-	B	12.8		A	-	C	16.5
Deerfield Pkwy at SR 9 - signalized	B	14.2	B	13.6		B	17.2	B	18.7
Sonely Ct./Keyingham Way at SR 9 – signalized	A	6.9	A	3.6		A	8.1	A	4.3
Publix Drive/Bethany Bend at SR 9 – signalized	C	20.5	C	25.1		C	28.9	D	39.1
Bethany Bend at SR 9 - signalized	C	25.2	C	21.1		D	35.9	C	26.4
Woodlake Drive/5 Acre Road at SR 9 – stop controlled									
Northbound left turn	B	10.8	A	9.7		B	14	B	11.8
Southbound left turn	A	-	A	-		A	-	A	-
Eastbound approach	C	19.5	C	17.9		D	33.3	D	28.3
Westbound approach	C	22	E	47		F	55	F	>200
Creek Club Drive at SR 9 – signalized	B	15.9	B	10.8		B	12.1	C	22.9
Sunfish Bend at SR 9 – signalized	B	15.6	B	14.1		A	6.7	A	7.6
Kennewick Road at SR 9 – stop controlled					signalized	A	7.6	A	4.5
Westbound left turn	A	8.4	A	9.4					
Northbound approach	B	12.6	B	14.4					

Attachment 7
Summary of TE Study and/or Signal Warrant Analysis

TRAFFIC STUDY FOR GDOT PROJECT P.I. #0007838: SR
9 WIDENING FROM WINDWARD PARKWAY TO
FULTON/FORSYTH CO. LINE

GEORGIA DEPARTMENT OF TRANSPORTATION
MILTON, GA

March 17, 2014



Architects ■ Engineers ■ Planners

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APPENDICES

- APPENDIX A: FORECASTING METHODOLOGY AND APPROVALS**
- APPENDIX B: BALANCED FLOW DIAGRAMS**
- APPENDIX C: SIGNAL WARRANT ANALYSIS RESULTS**
- APPENDIX D: 2040 SYNCHRO ANALYSIS RESULTS**
- APPENDIX E: ROUNABOUT ANALYSIS RESULTS**
- APPENDIX F: PRELIMINARY CONCEPT FOR BETHANY BEND REALIGNMENT**

INTRODUCTION

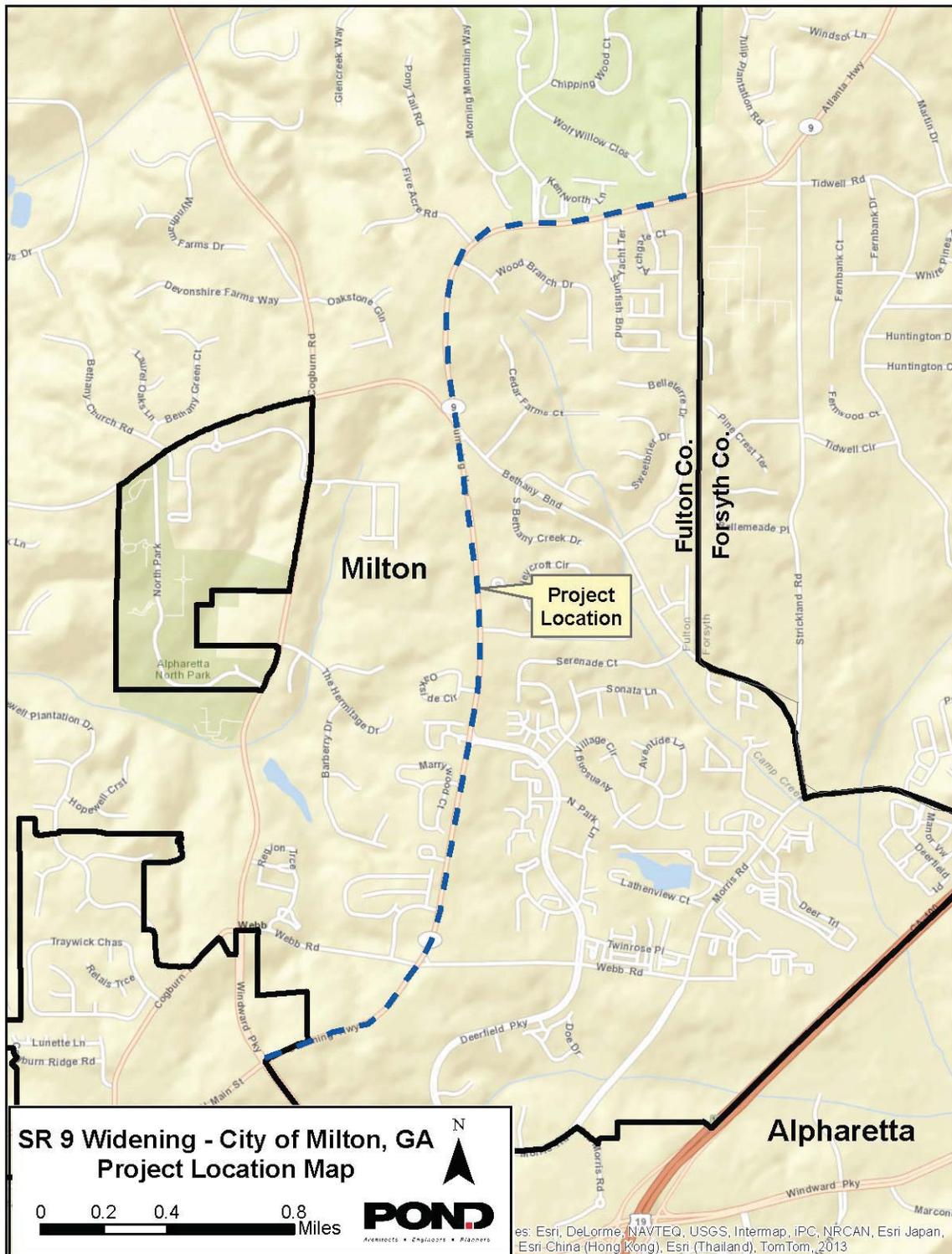
State Route 9 is a significant north-south arterial road in the northern metro-Atlanta region. The route is heavily travelled and the corridor runs through the heart of cities such as Milton, Alpharetta, and Roswell. State Route 9 parallels GA 400 and provides access to interchanges with the highway at McFarland Parkway and Windward Parkway. Due to the route's importance, it has been designated as a part of the Regional Thoroughfare Network by the Atlanta Regional Commission. See Figure 1 for the project's location.

The 3 mile segment of the corridor which lies within the city of Milton is a 2-lane road with left and right turn auxiliary lanes. The posted speed limit along the road is 45 mph. The southern segment is characterized as an urban setting with large retail developments and frequent driveway access points. Curb and gutter and sidewalk facilities exist on both sides of the road along the majority of this segment. North of Deerfield Parkway, residential neighborhoods are present, along with several commercial developments near the intersection of SR 9 at Bethany Bend. Gaps in sidewalks and curbs begin to develop as the setting becomes more rural to the north.

Traffic forecasts indicate that the current 2 lane road will not accommodate future demand in the area, and the route has been targeted for widening to a 4 lane road to meet these capacity needs. Even during current peak hour periods, the route experiences congestion, which is defined as LOS "E" or "F" in an urbanized area. The reconstruction of the road also provides an opportunity to engage the city of Milton's access management plan, with the inclusion of a raised median between directions of travel which will moderate access points and decrease conflicts along the corridor. The project is listed on ARC's long range plan as project #FN-222.

This study is intended to outline the methodology used and to report the results of the signalized intersection analysis that was conducted for the design year, and to recommend geometric design elements such as locations of needed turn lanes, and turn bay lengths.

Figure 1, Project Location Map



2013, 2022 AND 2042 BALANCED FLOW DIAGRAMS

Traffic counts were conducted at several locations along the corridor and were used to estimate future volumes and turning movements along SR 9. The yearly traffic growth along the corridor and in the city of Milton was determined through the examination of previous corridor studies for SR 9 in Forsyth County and in Alpharetta, as well as through examination of historical Georgia Department of Transportation (GDOT) counts and the growth projections found within the Atlanta Regional Commission's (ARC) travel demand model for the metro-Atlanta area. ***The methodology that was reviewed and approved by GDOT can be found in Appendix A.***

After the forecasting methodology was approved by GDOT, balanced flow diagrams were created. These diagrams illustrate daily, AM peak and PM peak volumes for the following scenarios:

- 2013 existing conditions volumes
- 2022 open date volumes under build and no-build conditions
- 2042 design year volumes under build and no-build conditions

The design volumes for each scenario were approved by GDOT on January 3, 2014. ***Final design volume sheets can be found in Appendix B.***

POTENTIAL SIGNALIZATION NEEDS

The segment of the SR 9 corridor within the Milton city limits currently has 5 signalized intersections. These signals are in place along SR 9 at intersections with Windward Parkway, Webb Road, Windward Village Parkway, Deerfield Parkway and Bethany Bend. With implementation of access management measures such as a raised median and restricted access points entering and exiting residential and commercial areas, traffic patterns are expected to be modified to make use of designed breaks in the raised median. New traffic signals at these median breaks may be warranted based on volumes at these median break locations. Signal warrant analyses are based on several criteria from the Manual on Uniform Traffic Control Devices (MUTCD). The latest update was published in 2009 by the Federal Highway Administration (FHWA).

The MUTCD states that an investigation of the need for a traffic control device shall include an analysis of the applicable factors contained in the following traffic signal warrants and other factors related to existing operation and safety at the study location. The warrants are as follows:

- Warrant 1, Eight hour vehicular volume
- Warrant 2, Four hour vehicular volume
- Warrant 3, Peak hour
- Warrant 4, Pedestrian volume
- Warrant 5, School crossing
- Warrant 6, Coordinated signal system
- Warrant 7, Crash experience
- Warrant 8, Roadway network
- Warrant 9, Intersection near a grade crossing

The proposed median breaks are placed at intervals along the corridor with guidance from the 2009 GDOT Driveway and Encroachment Control Regulations manual, which requires a minimum of 1000' spacing between signalized and unsignalized breaks in an urban setting. The proposed median breaks from south to north along SR 9 that were investigated for signal warranting were:

- SR 9 at Wal-Mart Driveway/Strathmore Floors
- SR 9 at Genesis Way/Deerfield Place
- SR 9 at Sonely Court/Keyingham Way
- SR 9 at Woodlake Drive/5 Acre Road (realigned)
- SR 9 at Creek Club Drive
- SR 9 at Sunfish Bend
- SR 9 at Kennewick Road

The results from these warrant analyses are found below in Table 1. Note that for the warrant analyses, a 100% right turn reduction was applied to all minor street volumes. Additionally, the speed limit used in the warrant analyses was 35 mph, and therefore, no reduction of volume thresholds was applied for Warrant 1. **Detailed warrant analysis results for each potential signal location can be found in Appendix C.**

Table 1, Signal Warrant Analyses, 2022 Build Alternative

Warrant Number	State Route 9 Intersections						
	Wal-Mart / Strathmore Floors	Genesis Way / Deerfield Place	Sonely Court / Keyingham Way	Woodlake Drive / 5 Acre Road	Creek Club Drive	Sunfish Bend	Kennewick Road
1	Met	Met	Not Met	Not Met	Met	Not Met	Not Met
2	Met	Met	Met	Not Met	Met	Met	Not Met
3	Met	Met	Met	Not Met	Met	Not Met	Not Met
4	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
7	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The table indicates that the three median breaks south of Bethany Bend all meet warrants for traffic signals by 2022. Additionally, the intersections of State Route 9 with Creek Club Drive and Sunfish Bend warrant signals.

Two additional warrant studies were conducted for design year at the two median breaks which did not need a traffic signal in the opening year. The results from these analyses can be found in Table 2. The intersection of SR 9 with Woodlake Drive/5 Acre Road did not warrant a signal by 2042, however the intersection of SR 9 with Kennewick Road did meet the Peak Hour Warrant #3 by satisfying one peak hour volume combination of major and minor street traffic. The signalization of this intersection should be considered by 2042 with a future warrant study.

The 2022 results of this signalization study were included in future year Synchro build-condition models. Five new signals were added to the 2022 model (and one signal was removed at the intersection of SR 9 with Windward Village Parkway/Deerfield Place). One additional signal at Kennewick Road was added to the 2042 build model.

Table 2, Signal Warrant Analyses, 2042 Build Alternative

Warrant Number	SR 9 Intersections	
	Woodlake Drive/ 5 Acre Road	Kennewick Road
1	Not Met	Not Met
2	Not Met	Not Met
3	Not Met	Met
4	Not Analyzed	Not Analyzed
5	N/A	N/A
6	Not Analyzed	Not Analyzed
7	Not Analyzed	Not Analyzed
8	N/A	N/A
9	N/A	N/A

INTERSECTION CAPACITY ANALYSIS

The capacity of major intersections along the corridor was studied for AM and PM peak hour weekday vehicular volumes. Capacity analyses were conducted for existing conditions, no-build and build scenarios using 2022 and 2042 predicted volumes. The analyses were completed using Synchro version 8 software, by Trafficware. The methodology used in the analyses was developed by the Transportation Research Board (TRB) and is found in the 2010 edition of the Highway Capacity Manual (HCM).

The HCM 2010 method analyzes signalized intersection approaches based on lane groups by assigning an individual level of service (LOS) to each group based on delay per vehicle through the peak hour. Unsignalized intersections are evaluated in a similar manner and are dependent on factors such as traffic volumes, driver gap-acceptance assumptions, potential conflicts, etc. Vehicle delay for unsignalized intersection approaches is then calculated to determine each movement's LOS. Only movements that are restricted by a stop control device or otherwise impaired by conflicting traffic (such as left turns from the uncontrolled major street) are evaluated at unsignalized intersections. ***Synchro reports for each scenario can be found in Appendix D of this document.***

2013 EXISTING CONDITIONS INTERSECTION ANALYSIS

The SR 9 corridor is currently a two lane major arterial road with auxiliary left and right turn lanes along the 3-mile extent of this project. Major intersections are controlled with traffic signals, while access points to minor residential developments, retail and other facilities are controlled by stop signs on the minor streets. Existing lane geometry and control devices are illustrated in Figure 2.

Table 2 highlights the overall LOS at each intersection under existing conditions.

Figure 2, Existing Lane Geometry and Control Devices

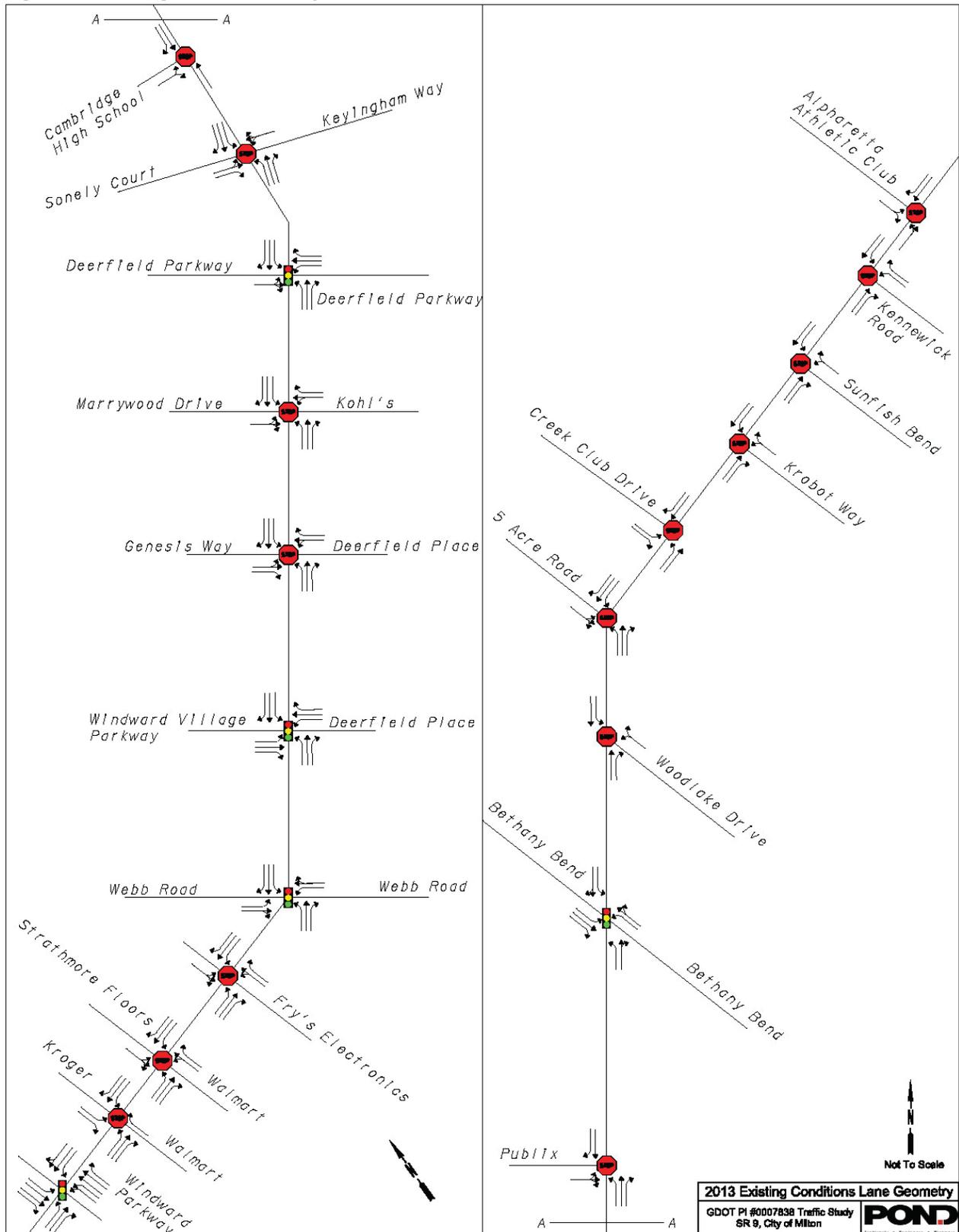


Table 2, Peak Hour Intersection LOS, 2013 Existing Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	26.5	D	41.6
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled				
Eastbound left turn	A	9.3	A	9.2
Westbound left turn	A	8.2	A	9.9
Northbound approach	B	10.9	C	19.1
Southbound approach	D	25.6	F	>200
Strathmore Floors/Wal-Mart Drive at SR 9 – stop controlled				
Eastbound left turn	A	-	A	9.4
Westbound left turn	A	8.4	B	10.6
Northbound approach	C	15.3	D	31.3
Southbound approach	A	-	B	14.7
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled				
Northeast-bound left turn	A	-	A	9.6
Southwest-bound left turn	A	-	B	10.4
Northwest-bound approach	A	-	F	103.9
Southeast-bound approach	A	-	C	15.1
Webb Road at SR 9 – signalized	B	17.5	C	24.5
Windward Village Pkwy/Target at SR 9 - signalized	A	3.6	A	8.7
Genesis Way/Deerfield Place at SR 9 – stop controlled				
Northbound left turn	A	9.5	A	8.7
Southbound left turn	A	8.1	B	10.1
Eastbound approach	C	15.3	B	12.2
Westbound approach	A	-	D	34.8
Marrywood Drive/Kohl's at SR 9 – stop controlled				
Northbound left turn	A	9.4	A	9.0
Southbound left turn	A	8.0	A	9.6
Eastbound approach	C	19.3	D	33.8
Westbound approach	A	-	C	22.9
Deerfield Pkwy at SR 9 - signalized	A	5.5	A	4.4
Sonely Ct./Keyingham Way at SR 9 – stop controlled				
Northbound left turn	A	-	A	-
Southbound left turn	A	8.3	B	12.0
Eastbound approach	C	21.4	B	14.3
Westbound approach	F	108.3	F	406.3
Publix Drive at SR 9 – stop controlled				
Northbound left turn	B	11.0	A	9.6
Eastbound approach	E	39.5	F	102.5
Bethany Bend at SR 9 - signalized	E	65.2	E	57.1
Woodlake Drive at SR 9 – stop controlled				
Southbound left turn	A	-	A	-
Westbound approach	E	40.5	F	90.2
Creek Club Drive at SR 9 – stop controlled				
Eastbound left turn	A	9.4	B	10.4
Southbound approach	C	21.8	C	20.5
Sunfish Bend at SR 9 – stop controlled				
Westbound left turn	A	-	A	8.9
Northbound approach	C	22.8	D	26.9
Kennewick Road at SR 9 – stop controlled				
Westbound left turn	A	8.1	A	8.9
Northbound approach	C	15.7	C	19.8

Existing conditions intersection analysis reveal that during the AM and PM peak hours, traffic volumes are heaviest in the through movement, and signal timings are adjusted to accommodate this north-south directional traffic. The one intersection that reaches over-capacity conditions at peak times is Bethany Bend at SR 9. Large residential areas east and west of the SR 9 corridor use Bethany Bend as a minor arterial road to reach SR 9, which then provides access to retail and GA 400 via Windward Parkway. A separate concept study, GDOT PI #0012635, is currently being conducted to investigate improvement alternatives for this intersection and is being coordinated with this corridor improvement project.

Traffic counts suggest that traffic on side streets at unsignalized intersections along the corridor either make a left or right turn onto SR 9. Through traffic across SR 9 at unsignalized intersections does not occur in large volumes. Therefore, minor street delays will come from left turns across high volumes of peak hour traffic traveling in one lane and right turns yielding to high volumes of traffic with inadequate gaps to complete the right turn maneuver.

Unsignalized intersection operations vary along the corridor. Left turns from the major street (SR 9) into retail and neighborhoods at unsignalized intersections operate within the LOS "A" to LOS "B" range during peak hours. Minor street approaches operate within the LOS "A" to LOS "D" range, with exceptions at the southbound Kroger driveway, the northwest-bound driveway leaving Fry's Electronics, the westbound approach at Keyingham Way, the eastbound Publix driveway, and the westbound approach of Woodlake Drive. These five approaches operate in the LOS "F" range at peak times. Model results suggest that at times, drivers making left or right turns from these minor streets can expect to wait a minute or more before adequate gaps appear in traffic on SR 9.

2022 OPENING YEAR INTERSECTION ANALYSIS

The projected opening date for the widening project is 2022. A no-build scenario using forecasted traffic volumes was conducted to compare operations with and without improvements. No modifications to lane geometry were represented in the 2022 no-build Synchro model, and only background traffic growth was used to estimate volumes. Results from this analysis are found in Table 3.

It is important to note that with no improvements, several unsignalized intersections begin to show excessive delays. While some intersections in the Synchro model are indicating delays in excess of 200 seconds for the minor street approaches, it is unlikely that these delays would actually be experienced in the study area. These approaches have been noted with delays ">200 seconds". Gaps in traffic caused by upstream traffic signals and other factors that affect vehicle platooning would likely create sufficient breaks to allow minor street turns to be made with less delay than what is shown in the model.

Table 3, Peak Hour Intersection LOS, 2022 No-Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	28.0	D	48.6
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled				
Eastbound left turn	A	9.7	A	9.7
Westbound left turn	A	8.4	B	10.5
Northbound approach	B	11.4	C	23.5
Southbound approach	D	32.5	F	>00
Strathmore Floors/Wal-Mart Drive at SR 9 – stop controlled				
Eastbound left turn	A	-	A	9.9
Westbound left turn	A	8.5	B	11.5
Northbound approach	C	16.8	E	45.9
Southbound approach	A	-	C	16.4
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled				
Northeast-bound left turn	A	-	B	10.1
Southwest-bound left turn	A	-	B	11.1
Northwest-bound approach	A	-	F	>200
Southeast-bound approach	A	-	C	17.2
Webb Road at SR 9 – signalized	B	18.7	C	28.1
Windward Village Pkwy/Target at SR 9 - signalized	A	4.0	A	9.7
Genesis Way/Deerfield Place at SR 9 – stop controlled				
Northbound left turn	B	10.0	A	9.0
Southbound left turn	A	8.2	B	10.7
Eastbound approach	C	17.2	B	13.2
Westbound approach	A	-	F	52.3
Marrywood Drive/Kohl's at SR 9 – stop controlled				
Northbound left turn	A	9.9	A	9.3
Southbound left turn	A	8.1	B	10.0
Eastbound approach	C	23.4	E	43.4
Westbound approach	A	-	D	28.2
Deerfield Pkwy at SR 9 - signalized	A	8.6	A	5.0
Sonely Ct./Keyingham Way at SR 9 – stop controlled				
Northbound left turn	A	-	A	-
Southbound left turn	A	8.5	B	13.1
Eastbound approach	D	25.4	C	15.7
Westbound approach	F	>200	F	>200
Publix Drive at SR 9 – stop controlled				
Northbound left turn	B	11.9	B	10.1
Eastbound approach	F	65.9	F	>200
Bethany Bend at SR 9 - signalized	F	80.9	E	72.4
Woodlake Drive at SR 9 – stop controlled				
Southbound left turn	A	-	A	-
Westbound approach	F	71.6	F	>200
Creek Club Drive at SR 9 – stop controlled				
Eastbound left turn	A	9.8	B	11.3
Southbound approach	D	30.0	D	26.3
Sunfish Bend at SR 9 – stop controlled				
Westbound left turn	A	-	A	9.1
Northbound approach	D	29.8	D	33.4
Kennewick Road at SR 9 – stop controlled				
Westbound left turn	A	8.4	A	9.4
Northbound approach	C	21.1	D	27.5

The corridor was also modeled as a 4-lane divided highway with median breaks at intervals no less than 1,000' to conform to GDOT's access management policy for urban streets found in the 2009 edition of the Driveway and Encroachment Control Regulations. Signals were added to the locations mentioned in the "Potential Signalization Needs" section of this document. Some modifications to existing lane geometry, such as adding minor street left and right turn lanes, were made to the build model and can be seen in Figure 3.

It should be noted that the intersection of SR 9 with Bethany Bend operates more efficiently with offset intersections, therefore, this geometric configuration is the recommended design for this intersection. Other alternative designs were studied as part of the concept study for PI #0012635, but use of offset intersections was found to be the most efficient configuration.

Changes to the models under build scenarios include:

- Additional through lane added along the length of SR 9 in each direction
- New access restrictions occur at Wal-Mart/Kroger, Fry's Electronics/N. Fulton Feed and Seed, Windward Village Parkway/Deerfield Place, and Marrywood Drive/Kohl's Driveway (note: other access restrictions occur at Oakside Circle and other minor streets into neighborhoods and business driveways but are not modeled in study)
- Dual southwest-bound left turn lanes added at Windward Parkway at SR 9
- New southwest-bound right turn lane at Windward Parkway at SR 9
- Northwest-bound right turn lane was changed from free flowing to yielding
- New eastbound and westbound right turn lanes on Webb Road at SR 9.
- Relocation of signal at Windward Village Parkway/Deerfield Place to Genesis Way/Deerfield Place
- Dual southbound left turn lanes at the intersection of SR 9 with Deerfield Parkway to accommodate heavy AM left turns
- Dual westbound right turn lanes at the intersection of SR 9 with Deerfield Parkway to accommodate heavy PM right turns. Right turns are protected and overlap with the southbound left turn lanes
- Realignment of Bethany Bend into offset intersections with dual left and right turn lanes (see Figure 3)
- Inclusion of proposed townhouse development north of Bethany Bend at northern proposed offset intersection location
- Signals were split-phased on the minor street approaches at both the northern and southern Bethany Bend intersections
- Realignment of 5 Acre Road to form a 4-legged intersection at Woodlake Drive
- WB U-turn lane added at Creek Club Drive at SR 9
- EB U-turn lane added at Sunfish Bend at SR 9
- Additional signals as identified by in the "Potential Signalization Needs" section of this document (note: signal not added at Kennewick Road in 2022 build models)
- Additional exclusive left turn lanes at new signalized minor-street approaches to accommodate options for protected left turns

Results from this analysis are shown in Table 4.

Figure 3, Proposed Lane Geometry and Control Devices

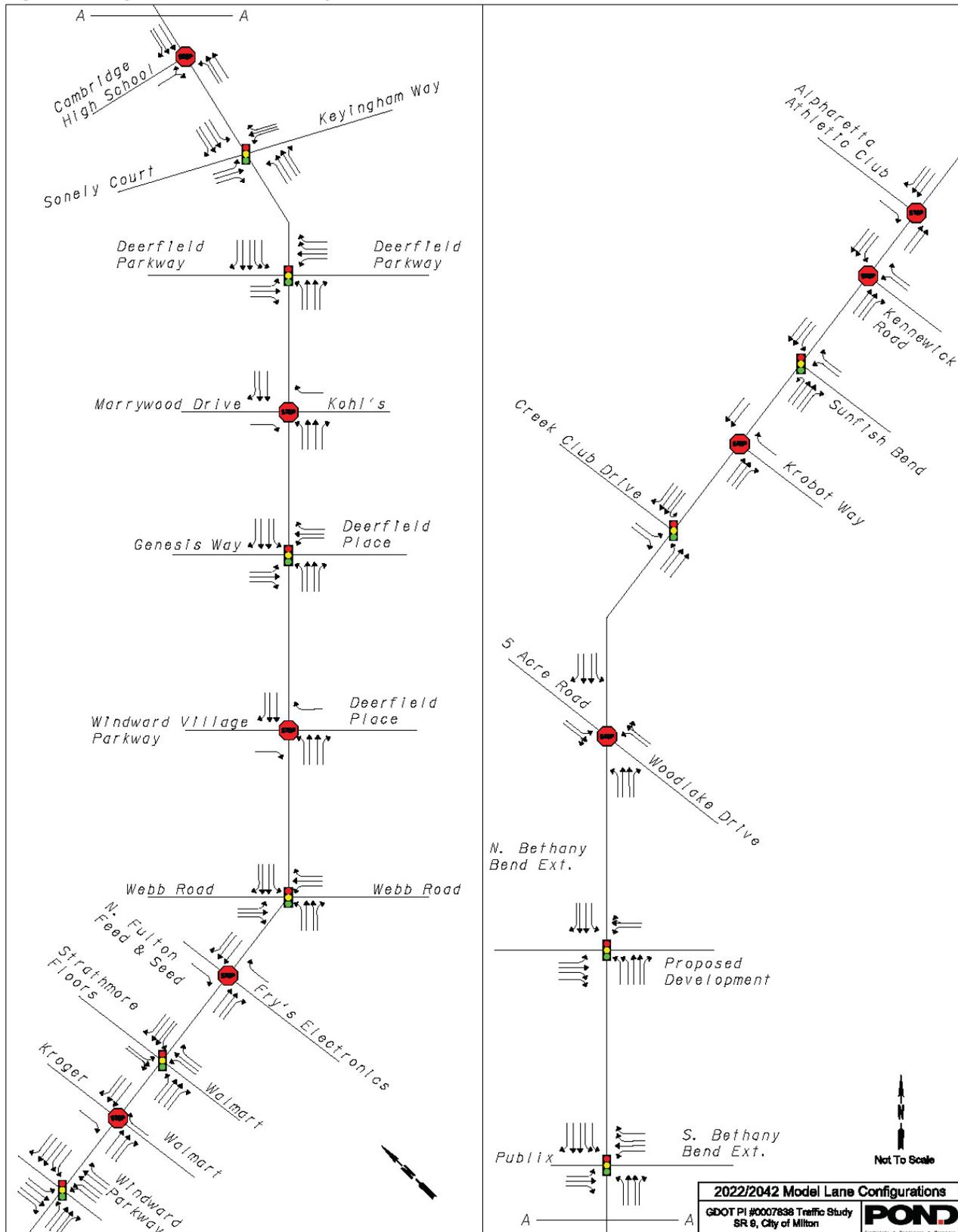


Table 4, Peak Hour Intersection LOS, 2022 Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	30.3	D	40.2
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled				
Northbound approach	B	10.0	B	14.3
Southbound approach	B	11.6	B	11.8
Strathmore Floors/Wal-Mart Drive at SR 9 – signalized	B	13.4	B	13.7
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled				
Northwest-bound approach	A	-	B	13.5
Southeast-bound approach	A	-	B	12.0
Webb Road at SR 9 – signalized	B	16.1	B	19.8
Windward Village Pkwy/Target at SR 9 – stop controlled				
Northbound left turn	B	10.2	A	9.7
Eastbound approach	B	12.3	B	11.3
Westbound approach	A	-	B	12.7
Genesis Way/Deerfield Place at SR 9 - signalized	A	0.7	B	11.4
Marrywood Drive/Kohl's at SR 9 – stop controlled				
Northbound left turn	B	10.1	A	9.6
Eastbound approach	B	12.6	B	11.4
Westbound approach	A	-	B	12.8
Deerfield Pkwy at SR 9 - signalized	B	14.2	B	13.6
Sonely Ct./Keyingham Way at SR 9 – signalized	A	6.9	A	3.6
Publix Drive/Bethany Bend at SR 9 – signalized	C	20.5	C	25.1
Bethany Bend at SR 9 - signalized	C	25.2	C	21.1
Woodlake Drive/5 Acre Road at SR 9 – stop controlled				
Northbound left turn	B	10.8	A	9.7
Southbound left turn	A	-	A	-
Eastbound approach	C	19.5	C	17.9
Westbound approach	C	22.0	E	47.0
Creek Club Drive at SR 9 – signalized	B	15.9	B	10.8
Sunfish Bend at SR 9 – signalized	B	15.6	B	14.1
Kennewick Road at SR 9 – stop controlled				
Westbound left turn	A	8.4	A	9.4
Northbound approach	B	12.6	B	14.4

2042 DESIGN YEAR INTERSECTION ANALYSIS

The design year for the widening project is 2042, which is a 20-year design timeframe. As with the 2022 no-build scenario, no changes in lane geometry were included in this model. Traffic volumes were increased according to the forecasted yearly background growth rate of 1.29% per year. The no-build condition model results are found below in Table 5.

The results from this 2042 no-build analysis suggest that with no improvements, conditions for minor street approaches will continue to degrade. Many side street approaches are predicted to operate with delays well in excess of 200 seconds per vehicle.

Table 5, Peak Hour Intersection LOS, 2042 No-Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	34.7	F	104.0
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled				
Eastbound left turn	B	10.7	B	10.9
Westbound left turn	A	8.8	B	12.4
Northbound approach	B	12.9	F	53.8
Southbound approach	F	82.3	F	>200
Strathmore Floors/Wal-Mart Drive at SR 9 – stop controlled				
Eastbound left turn	A	-	B	11.2
Westbound left turn	A	9.1	B	14.7
Northbound approach	C	23.9	F	180.5
Southbound approach	A	-	C	21.2
North Fulton Feed and Seed/Fry's Electronics at SR 9 – stop controlled				
Northeast-bound left turn	A	-	B	11.5
Southwest-bound left turn	A	-	B	13.7
Northwest-bound approach	A	-	F	>200
Southeast-bound approach	A	-	C	23.5
Webb Road at SR 9 – signalized	C	25.1	E	60.6
Windward Village Pkwy/Target at SR 9 - signalized	A	6.3	B	16.8
Genesis Way/Deerfield Place at SR 9 – stop controlled				
Northbound left turn	B	11.2	A	9.6
Southbound left turn	A	8.5	B	13.2
Eastbound approach	C	23.2	C	15.3
Westbound approach	A	-	F	>200
Marrywood Drive/Kohl's at SR 9 – stop controlled				
Northbound left turn	B	11.1	B	10.3
Southbound left turn	A	8.5	B	11.7
Eastbound approach	E	39.6	F	>200
Westbound approach	A	-	F	61.5
Deerfield Pkwy at SR 9 - signalized	C	24.0	B	10.0
Sonely Ct./Keyingham Way at SR 9 – stop controlled				
Northbound left turn	A	-	A	-
Southbound left turn	A	8.9	C	17.8
Eastbound approach	E	40.9	C	20.0
Westbound approach	F	>200	F	>200
Publix Drive at SR 9 – stop controlled				
Northbound left turn	B	14.9	B	11.7
Eastbound approach	F	>200	F	>200
Bethany Bend at SR 9 - signalized	F	158.1	E	150.2
Woodlake Drive at SR 9 – stop controlled				
Southbound left turn	A	-	A	-
Westbound approach	F	>200	F	>200
Creek Club Drive at SR 9 – stop controlled				
Eastbound left turn	B	11.4	C	16.0
Southbound approach	F	120.1	F	78.4
Sunfish Bend at SR 9 – stop controlled				
Westbound left turn	A	-	B	10.1
Northbound approach	F	102.7	F	112.9
Kennewick Road at SR 9 – stop controlled				
Westbound left turn	A	8.6	B	10.1
Northbound approach	D	30.5	E	45.2

The design year build scenario included all of the modifications made for the 2022 build scenario model, plus one minor addition shown below:

- Added a new signal at Kennewick Road based on findings in the “Potential Signalization Needs” section of this document

The results from the 2042 build scenario model are shown in Table 6. The results suggest that the capacity improvements are adequately handling the predicted demand on SR 9 in 2042. All signalized intersections operate with an LOS of “D” or better for both weekday peak times. Additionally, unsignalized intersections operate with LOS of “D” or better for each approach due to the restrictions on turning movements at these locations. The one exception is at the intersection of Woodlake Drive/5 Acre Road (realigned) with SR 9. The westbound approach from Woodlake Drive is projected to experience high delays, however, because of the low side street volumes at this location, a signal is not warranted. If conditions at this intersection deteriorate, a future traffic signal study can be conducted here to reevaluate if a signal is needed.

Table 6, Peak Hour Intersection LOS, 2042 Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Windward Parkway at SR 9 - signalized	C	34.6	D	49.7
Wal-Mart Drive/Kroger Drive at SR 9 – stop controlled				
Northbound approach	B	10.6	C	19.3
Southbound approach	B	13.0	B	13.3
Strathmore Floors/Wal-Mart Drive at SR 9 – signalized	B	14.0	B	18.0
North Fulton Feed and Seed/Fry’s Electronics at SR 9 – stop controlled				
Northwest-bound approach	A	-	C	16.9
Southeast-bound approach	A	-	B	13.9
Webb Road at SR 9 – signalized	C	22.6	C	31.6
Windward Village Pkwy/Target at SR 9 – stop controlled				
Northbound left turn	B	12.1	B	11.2
Eastbound approach	B	14.5	B	13.0
Westbound approach	A	-	C	16.1
Genesis Way/Deerfield Place at SR 9 - signalized	A	2.8	B	12.7
Marrywood Drive/Kohl’s at SR 9 – stop controlled				
Northbound left turn	B	11.8	B	11.0
Eastbound approach	C	15.3	B	12.9
Westbound approach	A	-	C	16.5
Deerfield Pkwy at SR 9 - signalized	B	17.2	B	18.7
Sonely Ct./Keyingham Way at SR 9 – signalized	A	8.1	A	4.3
Publix Drive/Bethany Bend at SR 9 – signalized	C	28.9	D	39.1
Bethany Bend at SR 9 - signalized	D	35.9	C	26.4
Woodlake Drive/5 Acre Road at SR 9 – stop controlled				
Northbound left turn	B	14.0	B	11.8
Southbound left turn	A	-	A	-
Eastbound approach	D	33.3	D	28.3
Westbound approach	F	55.0	F	>200
Creek Club Drive at SR 9 – signalized	B	12.1	C	22.9
Sunfish Bend at SR 9 – signalized	A	6.7	A	7.6
Kennewick Road at SR 9 – signalized	A	7.6	A	4.5

ROUNDBABOUT CAPACITY ANALYSIS

GDOT offers guidance on the consideration of roundabouts in the *Design Policy Manual version 2.0*. The manual states that roundabouts shall be considered at new or reconstructed intersections or where a request for a traffic signal has been made. A planning-level analysis was conducted at each median break location based on the thresholds from Table 8.1 of the *Design Policy Manual* (pg. 8-7). The manual advises that multi-lane roundabout operations will be optimal when total entering volume is less than 45,000 vpd and when less than 90% of the total entering volume occurs on the major road. Results are shown in Table 7.

Table 7, Planning-level Roundabout Results

SR 9 Intersections	Design Year ADT		% Traffic on Major Road (Opening & Design Years)
	Major Street	Minor Street	
Wal-Mart Drive/Strathmore Floors Drive	30,040	2,860	91
Webb Road	30,260	7,330	81
Genesis Way/Deerfield Place	26,270	2,850	90
Deerfield Pkwy	30,050	6,940	81
Sonely Ct./Keyingham Way	34,800	1,470	96
Woodlake Drive/5 Acre Road	29,970	890	97
Creek Club Drive	28,140	2,850	91
Sunfish Bend	25,060	1,540	94
Kennewick Road	23,960	780	97

The intersections of SR 9 at Webb Road and at Deerfield Parkway both satisfy the preliminary planning-level analysis requirements.

An operational analysis was conducted for both roundabouts using GDOT's Roundabout Analysis Tool using design year volumes. Assumed geometry at each roundabout consisted of multiple lanes on the major street approaches and single lanes on the minor street approaches. Right turn bypass lanes were considered on each approach. The calibrated model results were used for the analyses and are shown in Table 8.

Table 8, Roundabout LOS Analysis, 2042 Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Webb Road at SR 9				
Northbound approach	A	6.8	C	15.1
Southbound approach	B	11.0	B	14.9
Eastbound approach	C	21.7	C	17.3
Westbound approach	A	7.7	F	137.1
Deerfield Parkway at SR 9				
Northbound approach	C	16.5	C	16.8
Southbound approach	C	18.8	A	9.6
Eastbound approach	C	16.5	A	8.6
Westbound approach	A	7.9	F	249.9

The analyses suggest that the eastbound approach at each intersection fails in the PM peak hour. These operations levels are worse than the LOS for signalized approaches, therefore, further

consideration was not given to the use of roundabouts at these locations. ***Roundabout analysis printouts can be found in Appendix E of this document.***

Although the other intersections examined for potential roundabouts did not meet the criteria from the *Design Policy Manual* for recommended volume percentages on the major road, the intersections north of Bethany Bend were examined with the GDOT Roundabout Analysis Tool because they are well within the volume guidelines for total entering volume. Operational LOS for the intersections of SR 9 and Woodlake Drive, Creek Club Drive, Sunfish Bend, and Kennewick Road are acceptable and therefore, could potentially be designed as a system of roundabouts that would extend from north of Bethany Bend to McFarland Parkway. Approach results from each potential roundabout location are shown in Table 9.

Table 9, Roundabout LOS Analysis North of Bethany Bend, 2042 Build Conditions

Intersection	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
Woodlake Drive/5 Acre Road (realigned) at SR 9				
Northbound approach	A	6.0	B	10.9
Southbound approach	B	12.6	A	8.3
Eastbound approach	B	10.6	A	8.7
Westbound approach	A	7.9	C	20.1
Creek Club Drive at SR 9				
Southbound approach	C	17.7	B	10.5
Eastbound approach	A	6.4	B	11.4
Westbound approach	A	9.5	C	15.2
Sunfish Bend at SR 9				
Northbound approach	A	6.9	A	8.3
Eastbound approach	A	5.2	A	6.8
Westbound approach	A	8.8	A	6.9
Kennewick Road at SR 9				
Northbound approach	A	6.2	A	6.9
Eastbound approach	A	5.5	A	7.0
Westbound approach	A	7.7	A	6.7

DESIGN RECOMMENDATIONS

The intent of this study is to analyze operations along the corridor and to make recommendations on signalization needs, turn lane needs, and turn lane bay lengths to effectively accommodate projected traffic.

TURN LANE NEEDS AND STORAGE LENGTHS

The *GDOT Regulations for Driveway and Encroachment Control* manual, Table 4-6, states that right turn deceleration lanes should be constructed on main roads of 4 lanes with a posted speed limit of 35 mph when AADT is greater than 10,000 vehicles per day (vpd) and when right turn volumes exceed 100 vehicles in a day. Therefore, it is recommended that all right-turn deceleration lanes along the length of the SR 9 corridor be retained at existing driveways and intersections.

The same GDOT manual, Table 4-7a, states that exclusive left turn lanes should be constructed on main roads of 4 lanes with a posted speed limit of 35 mph when AADT is greater than 10,000 vpd and when left turn volumes exceed 300 vehicles in a day. Median break locations that do not satisfy this criterion are:

- Eastbound left turns into Strathmore Floors
- Northbound left turns onto Genesis Way
- Northbound left turns onto Sonely Court
- Northbound left turns onto 5 Acre Road
- Southbound left turns onto Woodlake Drive
- Westbound left turns onto Sunfish Bend

Guidance from the *NCHRP Report 457, Evaluating Intersection Improvements: An Engineering Study Guide*, states that left turns across median-divided highways should be considered at any median crossover point. Therefore, it is recommended that left turn lanes be installed within the median at each median break point, regardless of projected turning movement volumes.

Turn lane lengths were also determined based on 2042 volumes. Each turn lane should be sized to adequately accommodate projected peak hour queues for turning movements. Three criteria were considered for turn lane bay storage lengths:

- GDOT Minimum Storage: the *GDOT Regulations for Driveway and Encroachment Control* manual states that minimum storage lengths for left- and right-turn lanes should be based on the roadway's posted speed limit. These values are provided in Tables 4-8 and 4-9.
- Storage for Arrivals in 1.5 Signal Cycles: Recommended storage lengths for the turn lanes at each intersection were also analyzed based on proposed 2040 Build scenario signal timings. For signalized intersections, the *GDOT Regulations for Driveway and Encroachment Control* manual states that "the storage should be sufficient to accommodate the number of vehicles arriving during 1.5 signal cycles, using peak hour volumes." For stop-controlled intersections, guidance provided states that "storage is typically based on the number of vehicles arriving during a two-minute period within the peak hour."
- Traffic Operational Analysis: The Synchro analysis of AM and PM peak hours provide estimated queue lengths for turning movements. Storage lengths are also determined based on these model results.

The longest storage length from each criteria is the recommended length at each turn bay location. Note that recommended turn bay lengths in this report are in addition to a 50' long taper. Additionally, driveway turn lane lengths were not held to the GDOT minimum storage length, as they are not considered to be part of the state route. The results of these analyses are found in Tables 10-24.

Table 10, Wal-Mart and Kroger Driveways, Recommended Turn Lane Lengths

Approach	SR 9 (EB)	SR 9 (WB)
Turning Movement	RT	RT
Number of Turn Lanes	1	1
GDOT Minimum Storage Length	100	100
Synchro Queue Length	0	0
1.5 Arrivals per Cycle Length	60	120
Recommended Length	100	120

Table 11, SR 9 at Wal-Mart/Strathmore Floors Driveways, Recommended Turn Lane Lengths

Approach	SR 9 (EB)		SR 9 (WB)		Wal-Mart (NB)		S.F. (SB)	
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT/TH
Number of Turn Lanes	1	1	1	1	1	1	1	-
GDOT Minimum Storage Length	160	100	160	100	-	-	-	-
Synchro Queue Length	15	29	163	0	56	0	0	-
1.5 Arrivals per Cycle Length	12	82	152	12	35	175	0	-
Recommended Length	160	100	163	100	56	175	50	-

Table 12, N. Fulton Feed & Seed/Fry's Electronics Driveways, Recommended Turn Lane Lengths

Approach	SR 9 (NB)	SR 9 (SB)
Turning Movement	RT	RT
Number of Turn Lanes	1	1
GDOT Minimum Storage Length	100	100
Synchro Queue Length	0	0
1.5 Arrivals per Cycle Length	82	35
Recommended Length	100	100

Table 13, SR 9 at Webb Road, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Webb Rd. (EB)		Webb Rd. (WB)	
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT
Number of Turn Lanes	1	1	1	1	1	1	1	1
GDOT Minimum Storage Length	160	100	160	100	160	100	160	100
Synchro Queue Length	70	219	192	71	197	0	322	63
1.5 Arrivals per Cycle Length	70	268	128	175	222	35	362	175
Recommended Length	160	268	192	175	222	100	362	175

Table 14, SR 9 at Windward Village Parkway/Deerfield Place, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)
Turning Movement	LT	RT	RT
Number of Turn Lanes	1	1	1
GDOT Minimum Storage Length	160	100	100
Synchro Queue Length	13	0	0
1.5 Arrivals per Cycle Length	117	117	47
Recommended Length	160	117	100

Table 15, SR 9 at Genesis Way/Deerfield Place, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Genesis Way (EB)		Deerfield Place (WB)	
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT
Number of Turn Lanes	1	1	1	1	1	1	1	1
GDOT Minimum Storage Length	160	100	160	100	-	-	-	-
Synchro Queue Length	15	28	272	0	0	0	31	0
1.5 Arrivals per Cycle Length	12	82	210	0	0	35	152	70
Recommended Length	160	100	272	100	50	50	152	70

Table 16, SR 9 at Marrywood Drive/Kohl's Driveway, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)
	LT	RT	RT
Turning Movement	LT	RT	RT
Number of Turn Lanes	1	1	1
GDOT Minimum Storage Length	160	100	100
Synchro Queue Length	7	0	0
1.5 Arrivals per Cycle Length	70	70	35
Recommended Length	160	100	100

Table 17, SR 9 at Deerfield Parkway, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Deerfield Pkwy (EB)		Deerfield Pkwy (WB)	
	LT	RT	LT	RT	LT	RT	LT	RT
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT
Number of Turn Lanes	1	1	2	1	1	1	1	2
GDOT Minimum Storage Length	160	100	160	100	-	-	100	160
Synchro Queue Length	30	47	446*	0	31	0	106	295*
1.5 Arrivals per Cycle Length	35	105	467*	0	12	12	82	479*
Recommended Length	160	105	467	100	50	50	106	479

*denotes dual turn lane length

Table 18, SR 9 at Sonely Court/Keyingham Way, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Sonely Ct (EB)		Keyingham W. (WB)	
	LT	RT	LT	RT	LT	RT	LT	RT
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT
Number of Turn Lanes	1	1	1	1	1	1	1	1
GDOT Minimum Storage Length	160	100	160	100	-	-	-	-
Synchro Queue Length	24	49	145	0	0	0	110	17
1.5 Arrivals per Cycle Length	23	140	105	12	0	12	82	70
Recommended Length	160	140	145	100	50	50	110	70

Table 19, SR 9 at S. Bethany Bend Ext./Publix Driveway, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Publix (EB)		Bethany Bend (WB)	
	LT	RT	LT	RT	LT	RT	LT	RT
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT
Number of Turn Lanes	1	1	2	1	1	1	1	2
GDOT Minimum Storage Length	160	100	160	100	-	-	100	160
Synchro Queue Length	226	52	255*	47	61	93	256	78*
1.5 Arrivals per Cycle Length	198	117	245*	152	35	152	187	210*
Recommended Length	226	117	255	152	61	152	256	210

*denotes dual turn lane length

Table 20, SR 9 at N. Bethany Bend Ext./Proposed Development, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		Bethany Bend (EB)		Prop. Dev. (WB)	
	LT	RT	LT	RT	LT	RT	LT	RT/TH
Turning Movement	LT	RT	LT	RT	LT	RT	LT	RT/TH
Number of Turn Lanes	1	1	1	1	1	2	1	-
GDOT Minimum Storage Length	160	100	160	100	160	100	-	-
Synchro Queue Length	308*	0	10	224	521	192*	47	-
1.5 Arrivals per Cycle Length	304*	12	4	339	385	414*	22	-
Recommended Length	308	100	160	339	521	414	50	-

*denotes dual turn lane length

Table 21, SR 9 at Woodlake Dr./5 Acre Road, Recommended Turn Lane Lengths

Approach	SR 9 (NB)		SR 9 (SB)		5 Acre Rd. (EB)		Woodlake Dr. (WB)	
	LT	RT	LT	RT	LT	RT/TH	LT	RT/TH
Turning Movement	LT	RT	LT	RT	LT	RT/TH	LT	RT/TH
Number of Turn Lanes	1	1	1	1	1	-	1	-
GDOT Minimum Storage Length	160	100	160	100	-	-	-	-
Synchro Queue Length	2	0	0	0	35	-	7	-
1.5 Arrivals per Cycle Length	7	67	0	7	7	-	60	-
Recommended Length	160	100	160	100	50	-	60	-

Table 22, SR 9 at Creek Club Drive, Recommended Turn Lane Lengths

Approach	SR 9 (EB)		SR 9 (WB)		Creek Club (SB)	
	LT	UT	RT	LT	RT	
Turning Movement	1	1	1	1	1	
Number of Turn Lanes	1	1	1	1	1	
GDOT Minimum Storage Length	160	160	100	-	-	
Synchro Queue Length	565	37	44	47	164	
1.5 Arrivals per Cycle Length	572	23	82	35	350	
Recommended Length	572	160	100	50	350	

Table 23, SR 9 at Sunfish Bend, Recommended Turn Lane Lengths

Approach	SR 9 (EB)		SR 9 (WB)		Sunfish Bend (NB)	
	UT	RT	LT	LT	RT	
Turning Movement	1	1	1	1	1	
Number of Turn Lanes	1	1	1	1	1	
GDOT Minimum Storage Length	160	100	160	-	-	
Synchro Queue Length	27	41	2	133	24	
1.5 Arrivals per Cycle Length	23	140	35	140	35	
Recommended Length	160	140	160	140	50	

Table 24, SR 9 at Kennewick Road, Recommended Turn Lane Lengths

Approach	SR 9 (EB)		SR 9 (WB)		Kennewick Rd. (NB)	
	RT	LT	LT	LT	RT	
Turning Movement	1	1	1	1	1	
Number of Turn Lanes	1	1	1	1	1	
GDOT Minimum Storage Length	100	160	-	-	-	
Synchro Queue Length	6	81	73	32	32	
1.5 Arrivals per Cycle Length	70	70	70	70	70	
Recommended Length	100	160	73	70	70	

RECOMMENDATIONS

In addition to the widening of SR 9 by one lane in each direction, additional design elements should be considered to accommodate turning movements at each intersection. Recommended access points, signalization, turn lane lengths, and lane configurations are shown in Figure 4. Recommendations such as location of access points and signalization needs have been discussed in previous sections of this report.

The following list provides traffic-related recommendations for signalization, access management, and turn lane locations and lengths.

SR 9 from Wal-Mart/Kroger driveways to Wal-Mart/Strathmore Floors driveways

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Wal-Mart/Strathmore Floors driveways

- Install traffic signal at the full access median break.
- Construct exclusive left turn lanes on northbound and southbound approaches to allow for protected left turn option.
- Retain exclusive right turn lane with yield condition on northbound approach.
- Construct exclusive left and right turn lanes on the eastbound and westbound approaches.

SR 9 from Wal-Mart/Strathmore Floors driveways to Webb Road

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Webb Road

- Construct an exclusive channelized right turn lane with yield condition on the westbound approach.
- Construct an exclusive right turn lane with signalization on the eastbound approach.
- Retain existing exclusive left and right turn lanes on all approaches.

SR 9 from Webb Road to Windward Village Parkway/Deerfield Place entrance

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Windward Village Parkway/Deerfield Place entrance

- Partially restrict access through use of a raised median, but allow northbound left turns to be made into Windward Village Parkway to accommodate residents on Commonwealth Circle.
- Relocate existing signal north to Genesis Way/Deerfield Place entrance.
- Retain existing exclusive northbound and southbound right turn lanes.

SR 9 at Genesis Way/Deerfield Place entrance

- Install traffic signal at the full access median break.
- Construct exclusive left turn lanes on eastbound and westbound approaches to allow for protected left turn option.
- Retain exclusive left- and right-turn lanes on all approaches.

SR 9 at Marrywood Drive/Petco driveway

- Partially restrict access through use of a raised median, but allow northbound left turns to be made into Marrywood Drive to accommodate residents.
- Retain exclusive right turn lanes on all approaches.

SR 9 at Deerfield Parkway

- Construct dual westbound right turn lanes due to heavy PM left turns. Signalize Deerfield Parkway to protect westbound PM right turn movement and overlap with southbound left turns. Retain existing exclusive westbound left turn lane.
- Construct dual southbound turn lanes due to heavy AM left turns. The dual left turns should lead into two eastbound receiving lanes on Deerfield Pkwy. This will require extending the outside eastbound receiving lane approximately 75' to the intersection as well as removal of the northbound right turn free flow condition. The northbound right turn should then be controlled by a yield sign. Retain existing exclusive southbound right turn lane.
- Construct exclusive left and right turn lanes on the eastbound approach.
- Retain existing exclusive left- and right-turn lanes on the northbound approach.

SR 9 from Deerfield Parkway to Sonely Court/Keyingham Way

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Sonely Court/Keyingham Way

- Install traffic signal at the full access median break.
- Construct exclusive left turn lanes on eastbound and westbound approaches to allow for protected left turn option.
- Retain exclusive right turn lanes on southbound, eastbound and northbound approaches.
- Retain exclusive left turn lanes on the northbound and southbound approaches.
- Construct exclusive right turn lane on westbound approach. Turn lane should have a yield condition or be signalized to allow for the overlapping right turn option with protected southbound left turns.

SR 9 from Sonely Court/Keyingham Way to Publix driveway/Bethany Bend

- Restrict access through use of raised median. Side street driveways become right-in/right-out.
- Create full access median break at driveway to Cambridge High School. The driveway is expected only to be open before and after school to provide access for students and faculty. At other times of the day, the median break is not expected to be utilized except for minor U-turn movements. A southbound right turn lane of 100' is recommended as well as a northbound left turn lane of 160'.

SR 9 at Publix driveway/Bethany Bend

- Realign Bethany Bend to intersect SR 9 at this location. ***Design concept taken from Traffic Alternatives Analysis Report for GDOT PI #0012635 and is found in Appendix F.***
- Construct exclusive left turn lanes on the northbound and eastbound approaches to allow for signal timing options. Construct a right turn lane on the eastbound approach.
- Construct dual right turn lanes on the westbound approach to accommodate heavy PM right turn movements. The timing for this movement should overlap the southbound protected left turns. A westbound left turn lane should be installed as well.
- Construct dual left turn lanes on the southbound approach to accommodate heavy AM left turn movements. Signal timing for this movement will be protected only. Two eastbound receiving lanes should be incorporated into the intersection design to accommodate these dual left turn lanes.
- Retain existing right turn lanes on the northbound and southbound approaches.

SR 9 from Publix driveway/Bethany Bend to northern Bethany Bend extension

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at northern Bethany Bend extension

- Realign Bethany Bend to intersect SR 9 at this location. ***Design concept taken from Traffic Alternatives Analysis Report for GDOT PI #0012635 and is found in Appendix F.***

- Construct dual left turn lanes on the northbound approach to accommodate heavy PM left turns. Two westbound receiving lanes should be incorporated into the intersection design to accommodate these dual left turn lanes.
- Construct dual right turn lanes on the eastbound approach to accommodate heavy AM right turns. The timing for this movement should overlap the northbound protected left turns.
- Construct exclusive left turn lanes on the southbound, westbound and eastbound approaches to allow for signal timing options.
- Construct exclusive right turn lanes on the northbound and southbound approaches.

SR 9 from northern Bethany Bend extension to Woodlake Drive/5 Acre Road

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Woodlake Drive/5 Acre Road

- Consider realignment of 5 Acre Road to operate as the fourth leg of the intersection of SR 9 and Woodlake Drive.
- Intersection should provide full access for turning movements, but should remain unsignalized at opening year. No signal is warranted in opening year or in design year.
- Exclusive left turn lanes should be constructed on eastbound and westbound approaches to improve operations for left turns and through movements on the side streets.
- Retain exclusive left and right turn lanes on northbound and southbound approaches.

SR 9 from Woodlake Drive/5 Acre Road to Creek Club Drive

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Creek Club Drive

- Install traffic signal at full access median break.
- Retain existing exclusive left and right turn lanes on all approaches.
- Construct a westbound exclusive U-turn lane to accommodate potential U-turns.

SR 9 from Creek Club Drive to Sunfish Bend

- Restrict access through use of raised median. Side street driveways become right-in/right-out.

SR 9 at Sunfish Bend

- Install traffic signal at full access median break.
- Construct northbound exclusive left and right turn lanes to allow for signal timing options.
- Construct an eastbound exclusive U-turn lane to accommodate potential U-turns.
- Retain existing left and right turn lanes on the eastbound and westbound approaches.

SR 9 at Kennewick Road

- Intersection should provide full access for turning movements, but should remain unsignalized at opening year. A signal is warranted in the design year, so a future signal warrant study is recommended if northbound delays become unacceptable.
- Retain exclusive left and right turn lanes on all approaches.

Warrants Summary Matrix Report

INTID	Intersection Name						Warrant Status					
	1	2	3	4	5	6	7	8	9	Bicycle	AWSC	
1	SR 9 @ Wal-Mart/Strathmore											
	Met	Met	Met	Not Met	Not Met	Not Met	N/A	N/A				
2	SR 9 @ Genesis Way/Petco											
	Met	Met	Met	Not Met	Not Met	Not Met	N/A	N/A				
3	SR 9 @ Keyingham Way/Sonely Court											
	Not Met	Met	Met	Not Met	Not Met	Not Met	N/A	N/A				
4	SR 9 @ Woodlake Drive/5 Acre Road											
	Not Met	Not Met	Not Met	Not Met	Not Met	Not Met	N/A	N/A				
5	SR 9 @ Creek Club Drive											
	Met	Met	Met	Not Met	Not Met	Not Met	N/A	N/A				
6	SR 9 @ Sunfish Bend											
	Not Met	Met	Not Met	Not Met	Not Met	Not Met	N/A	N/A				
7	SR 9 @ Kennewick Road											
	Not Met	Not Met	Not Met	Not Met	Not Met	Not Met	N/A	N/A				

Attachment 8
Minutes of Concept meetings



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MEETING MINUTES

Project : PI 0007838 -SR 9 Widening and Operational Improvements from Windward Pkwy to Forsyth Co. line
 Pond Project No. : 1130323
 Meeting : Concept Team Meeting
 Meeting Location : GDOT - District 7 Office, Chamblee Meeting Date : Dec 04, 2013
 Minutes prepared by : Arwin Lopez
 Prepared on : Dec 09, 2013

Copies:

ATTENDEES:

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PURPOSE OF MEETING:

Kevin began the meeting by describing the project and the explained that for the purpose of this meeting would like to use the draft concept report as a supplement to the meeting agenda. Kevin also explained other projects adjacent and in the vicinity of this one, and asked if anybody knew of any others not shown on the draft concept report.

Carter Lucas said that there is a City of Milton project slated to construct a 40,000 sqft mixed use (Fire/Police) building south of Bethany Bend and adjacent to the newly constructed exit of the Cambridge High school.

PI0007526, the proposed interchange at McGinnis Ferry and 400, was discussed and if it would have any effect on the traffic of this project. Graham replied that the traffic report would look into the added traffic coming through Bethany from SR 400.

Nobody had anything else to add.

Kevin explained that this project is part of a larger cluster of projects along the SR 9 corridor which all have a single environmental document in common.

Jeremy Busby added that the environmental document is being prepared by Kimley-Horn and Associates (KHA).

Kevin also stated that the surveying is being performed by Southeast Engineering Inc. (SEI), and mapping by Woolpert; he also added that GDOT will provide SUE level D and later on in the process will be upgraded to level B.

Kevin proceeded by directing attention to the draft concept report's project justification statement. Jeremy emphasized that the purpose of the project is to add capacity to SR 9.

Graham pointed out that the existing volumes have been approved and build volumes are in review by GDOT. Graham described some of the methodology for the preparation of the traffic analysis, such as the use of the approved growth rate of 1.3%. He elaborated that the current traffic analysis predicts the byproduct of this project would be an estimated 5,000 additional vehicles to the corridor.

Kevin briefly described the impact on right-of-way the project will have, and highlighted that the existing corridor's right-of-way is generous and that at the moment no displacements have been identified. He pointed out that the concept display shows a typical section that meets standards but has no bike lanes; he added that the City of Milton has a preferred border configuration that consists of a 10 foot landscaped strip with an 8 foot trail. Kevin explained that GDOT has identified this corridor as bike route.

Mike Lobdell suggested to use an 8 foot landscaped buffer with a 10 foot trail instead; and stated that this border area would satisfy the Pedestrian and Bike component of the Complete Streets standards.

There was discussion of the Marta route and how far north the line extends. Sara noted that currently the buses turn on Webb Road but don't run along SR 9. Carter added that the City plans on requesting the bus route to go farther north up to Bethany Bend.

Kevin proceeded to ask Jeremy about the pavement evaluation. Jeremy replied that it is yet to be prepared.

Kevin stated that the existing posted speed limit on the corridor is 45 mph and the City would like to lower the speed to 35 mph where possible. Carter added that the City would at least like posted speed of 35 from Windward Pkwy to Deerfield Pkwy to be consistent with the City of Alpharetta. Mike Lobdell asked if there has been a speed study on this corridor to justify the change in posted speed. Carter replied that there has not been one performed recently. Mike said that a speed study should be performed and stated that the proposed design elements should be in line with the speed of the 85 percentile of the travelling cars.

Ron stated that the current concept does not propose lighting, and asked Carter if the City would like lighting. Carter responded that the City would like pedestrian lighting and asked Jeremy if it could be included in the project. Jeremy responded yes and that a lighting application should be submitted to get the process started.

Matthew Thompson from AGL stated that they would be impacted at the intersection of SR 9 and Windward Pkwy. Clyde stated that Public Interest Determination Policy and Procedure was not recommended for this project. Earl from Fulton County utilities informed that they have a water line throughout the length of the project.

Ron described the general topographic features of the corridor and stated that the southern section up to Deerfield Pkwy is predominantly urban; the northern section is mostly rural and would require more right of way or easements.

Ron asked Saurabh what the median configuration is for the northern project which ties to this project and that Parson's is working on. Saurabh explained that at the moment they are proposing a raised 16 foot median. Scott Lee stated that 16 foot raised median would require a variance and that in some of the unsignalized intersections the opposing left turning vehicles might have a problem. Kevin noted that there are only 3 unsignalized median openings currently, but mentioned possibly widening the median at locations where unsignalized median breaks are considered to provide an increase in the line of sight for the left turning vehicles. Jeremy added that the other project within this corridor have requested a design variance for the use of the 16 foot median and recommended keeping a standard median width throughout.

Kevin stated that the project is proposed to be built under traffic.



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Jeremy said that the project's schedule is yet to be approved, and added that this project has approved ROW funds for 2019.

Kevin adjourned the meeting and thanked everyone for their attendance.

END OF MEETING MINUTES

ADDITIONAL COMMENTS:

Attachment 9

Minutes of any meetings that shows support or objection to the
concept)

GDOT Office of Environmental Services | PIOH Summary of Comments

PI#(s): 0007838, County: Forsyth

GDOT NEPA Planner: Cindy Treadway

Date Submitted: 6/19/2014

Consultant Preparer (if applicable): N/A

GDOT Project Manager: Jeremy Busby

Once the comment period has ended, the GDOT NEPA Analyst should route this as a pdf to the GDOT Project Manager (and others as necessary) along with a pdf of the comments and a Word document of your draft response letter. OES and OPD must work together to complete the response letter. Once the draft response letter is complete, email it to your team leader and the OES Office Head for final review. Aim to respond to all comments within **45 days** of the open house.

Basic Meeting and Response Letter Info	
Meeting Date: 5/21/2014	Number of Attendees: 101
End of Comment Period: 6/1/2014	

Forms at the Meeting	Forms or Letters Mailed to OES	Court Reporter Statements	Comments from OES's Website
20	3	10	4

Click to access the website comments (GDOT only). Remember to close the comments at the end of the comment period.

No. Opposed	No. In Support	No. Uncommitted	Conditional
22	9	0	6

If additional info is relevant, such as No. Preferred Alternative 1, etc..., just add the needed rows or columns.

Major Concerns:

Concerns that constructing a raised median on SR 9 would negatively impact businesses and cause delays to local residents. Access to local businesses would be limited.

The raised median prevents a left turn when exiting Milton Preserve, forcing the public to make a right turn heading north and make a U-turn heading south on SR 9. Concerns GDOT didn't make provisions for the forced U-turn.

Public Officials:

None

Media:

None

Disposition of Comments:

Nature of Comment <i>(Use complete sentences with enough context and information that the statements below can be listed in the response letter.)</i>	Comment #
Reducing speed from 45 to 35 mph would impede traffic flow.	1, 19, 27, 30, 34
Request for GDOT to consider changing timing of the traffic signal located at SR 9 and Francis Road due to heavy traffic backup in the morning and afternoon.	1
Concerns that constructing a raised median on SR 9 would negatively impact businesses. Access to local businesses would be limited.	3, 4, 7, 9, 10, 15, 16, 17, 19
A local business owner has concerns that planting trees in the median will block the view of his business. The city of Milton's sign ordinance requires low to ground level signage.	4, 9
Crosswalks need to be installed across from Starbucks, Cambridge, and Publix to improve pedestrian safety.	5
Request for GDOT to widen Bethany Bend to 4 lanes.	6
Did GDOT contemplate a turn lane considering the raised median would negatively affect local businesses?	9, 19

GDOT Office of Environmental Services | PIOH Summary of Comments

PI#(s): 0007838, County: Forsyth

The proposed traffic signals would result in traffic delays for residents in local subdivisions.	11, 26, 34
Concerns the proposed project would result in noise pollution for local residents.	11, 16, 17, 26, 32, 35
Did GDOT consider a roundabout?	14, 31
Concerns that Wood Lake Drive egress would be an issue without a traffic signal.	14, 20
The proposed median will make accessing local communities difficult.	17, 19
The proposed 4 lane roadway will increase local traffic.	17, 31, 32
Installation of new traffic signals will delay access to local businesses.	19
Eliminating the median and using the center turn lane concept would be less costly.	19
The raised median prevents a left turn when exiting Milton Preserve, forcing the public to make a right turn heading north and make a U-turn heading south on SR 9. Concerns GDOT didn't make provisions for the forced U-turn.	21, 26, 35, 36, 37
Concerns eliminating the northbound turning lane into Milton Preserve will create a safety hazard.	21, 35, 36, 37
The absence of a turning lane into Milton Preserve necessitates the school buses stop on SR 9. This also impacts the egress and entrance of emergency vehicles.	21
Concerns installing a traffic signal at Sunfish Bend will hinder vehicles from exiting Milton Preserve.	21
Request for GDOT to maintain access for both northbound and southbound routes on SR 9 at Five Acre Road without installing a median.	23, 24
Request for GDOT to purchase the total lot that is being intersected near Five Acre Road and used as green space.	23, 24
Concerns the construction will cause drainage problems for local residents.	28
Will the city of Milton reimburse local residents for required land/property?	28, 32
Did GDOT consider widening SR 400 which would alleviate some traffic congestion in the city of Milton? SR 9 is used as an alternate route.	29
The owner of the Shell Gas Station located at 3105 Bethany Bend has concerns access to his business will be negatively impacted and result in lost revenue.	33
Concerns the proposed project will force school buses to make a U-turn which is a safety issue.	35
Did the traffic study conducted include the Milton Preserve residents?	35, 36, 37
A local resident is requesting that GDOT bury the utilities?	30
The local resident at 1190 Krobot Way opposes a portion of his property being used for construction but would like to discuss that all of this property be purchased. Mr. Nagarajan is opposed to sub-dividing his property for a project that is not warranted.	16
Did GDOT consider eliminating the multiuse trail and installing a turn lane for the Milton Preserve residents?	37

Please find attached a PDF of all comments (or a link to the PDF) and a Word document of the draft response letter.

Please review the comments and provide responses in the draft response letter by 7/4/2014.

cc. Provide a PDF (or link) to the Project Manager, other relevant offices (confer with PM to determine), and Project Documents; Hardcopy to General Files

Attachment 10
Hydrology Study for MS4 Permit –N/A

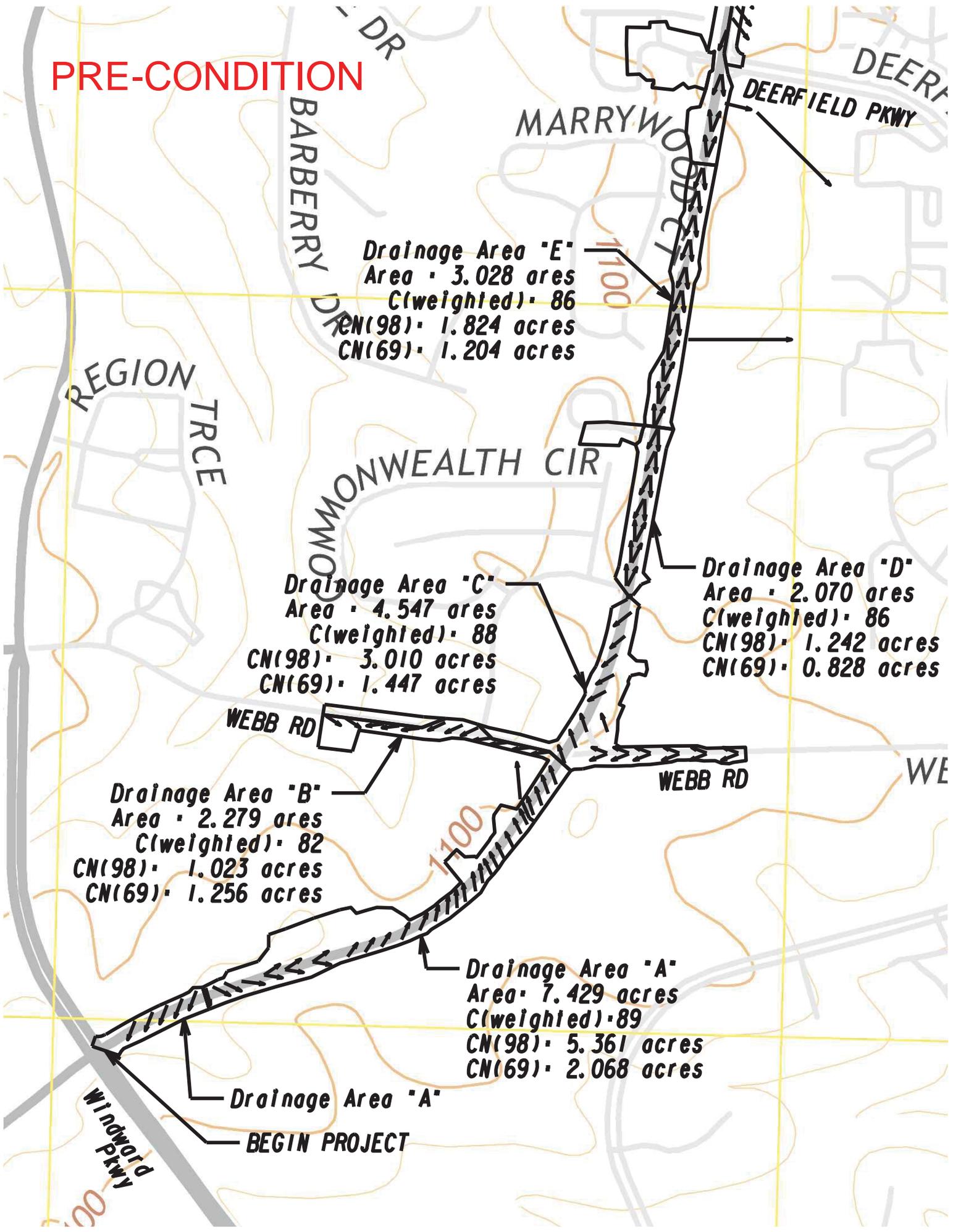
Attachment 10 Concept Level Hydrology Study Summary

This analysis comprises of the SR 9 corridor from Windward Pkwy to the Forsyth County line for the purpose of determining the extent to meet the MS4 permit requirements.

The SR9 corridor can be described as a ridge line to the adjacent properties. The runoff from the project ultimately outfall to either of the following creeks: Camp Creek, Cooper Sandy Creek, and Chicken Creek. Many of the existing drainage areas have conveyances that concentrate the runoff to a single outfall; therefore, the increase of post construction flow can be attributed to the increase in impervious area and the net increase of drainage area due to increase of road footprint. The southern section of the project from Windward Pkwy up to Deerfield Parkway can be described as commercial. The mid section of the project from Deerfield Pkwy to Woodlake drive is a mixture of small commercial lots and residential subdivisions. Lastly the northern section of the project is mostly residential subdivisions. Many of the more recent and larger developments, as well as the residential subdivisions, have existing stormwater management facilities. These facilities could potentially be analyzed and used to attenuate the increase in peak flows.

The subsequent sections of this analysis show the existing drainage delineation with CN classification, proposed drainage delineation with CN classification, and the analysis worksheets. The worksheets show the existing vs post peak flows and the volume required to meet the water quality, channel protection, and over bank flood protection criteria of the MS4 permit.

PRE-CONDITION



Drainage Area "E"
Area : 3.028 acres
C(weighted) : 86
CN(98) : 1.824 acres
CN(69) : 1.204 acres

Drainage Area "C"
Area : 4.547 acres
C(weighted) : 88
CN(98) : 3.010 acres
CN(69) : 1.447 acres

Drainage Area "D"
Area : 2.070 acres
C(weighted) : 86
CN(98) : 1.242 acres
CN(69) : 0.828 acres

Drainage Area "B"
Area : 2.279 acres
C(weighted) : 82
CN(98) : 1.023 acres
CN(69) : 1.256 acres

Drainage Area "A"
Area : 7.429 acres
C(weighted) : 89
CN(98) : 5.361 acres
CN(69) : 2.068 acres

Drainage Area "A"
BEGIN PROJECT

PRE-CONDITON

BETHANY BND

Drainage Area "L"
Area · 1.764 ares
C(weighted) · 81
CN(98) · 0.742 acres
CN(69) · 1.022 acres

Drainage Area "J"
Area · 1.848 ares
C(weighted) · 93
CN(98) · 1.504 acres
CN(69) · 0.344 acres

Drainage Area "H"
Area · 2.725 ares
C(weighted) · 90
CN(98) · 1.965 acres
CN(69) · 0.760 acres

Drainage Area "F"
Area · 3.370 ares
C(weighted) · 85
CN(98) · 1.913 acres
CN(69) · 1.457 acres

Drainage Area "M"
Area · 0.725 ares
C(weighted) · 85
CN(98) · 0.415 acres
CN(69) · 0.310 acres

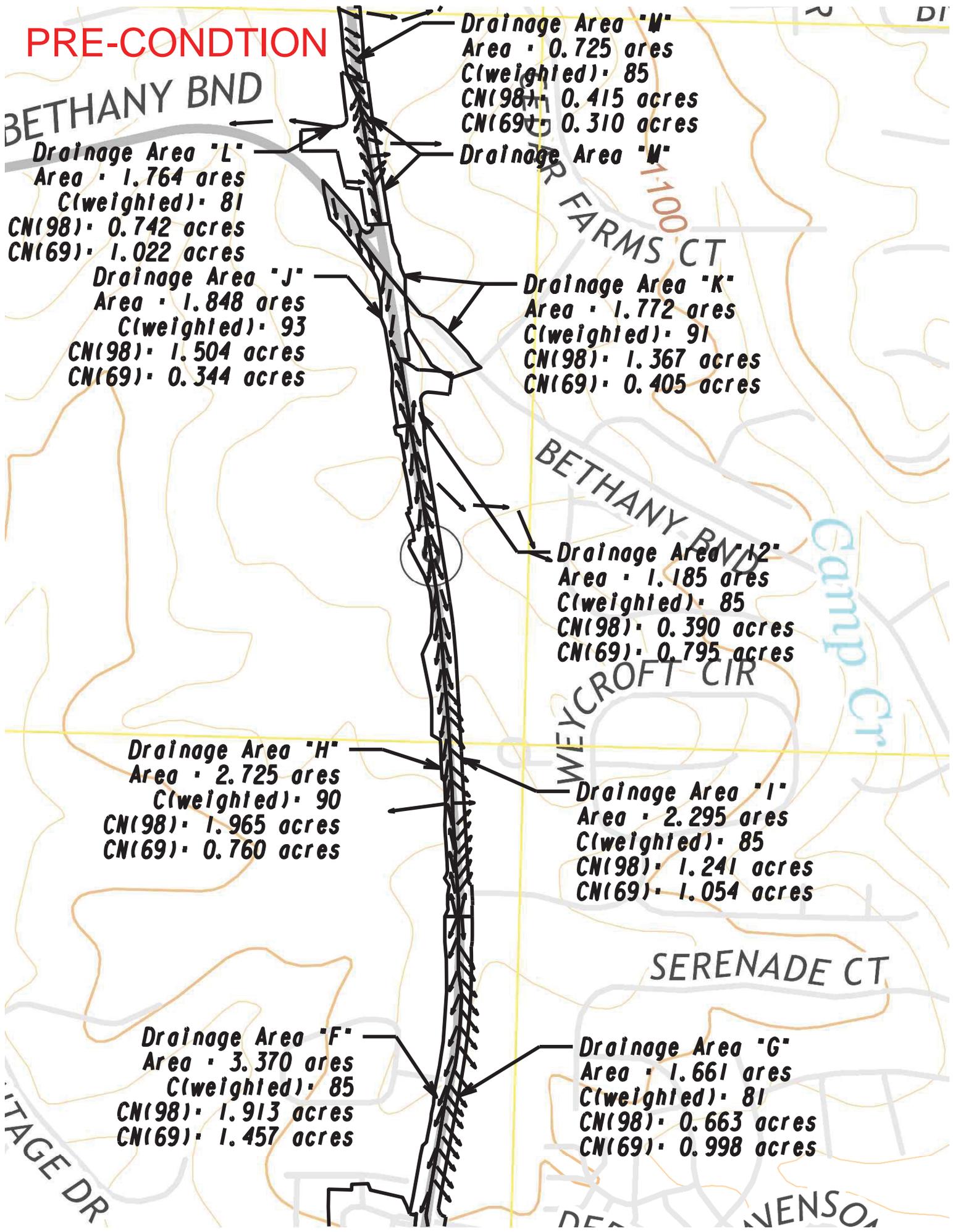
Drainage Area "W"

Drainage Area "K"
Area · 1.772 ares
C(weighted) · 91
CN(98) · 1.367 acres
CN(69) · 0.405 acres

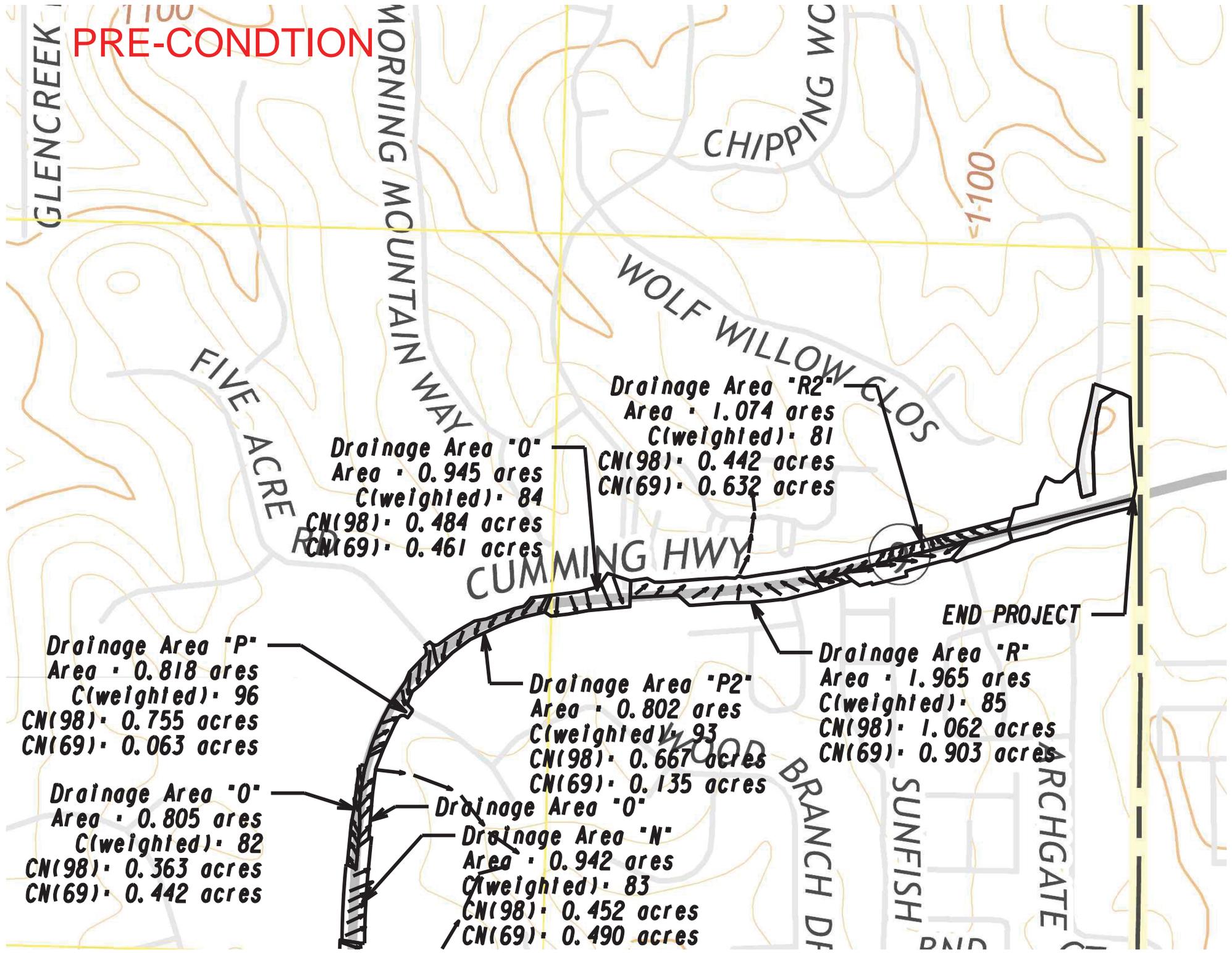
Drainage Area "12"
Area · 1.185 ares
C(weighted) · 85
CN(98) · 0.390 acres
CN(69) · 0.795 acres

Drainage Area "I"
Area · 2.295 ares
C(weighted) · 85
CN(98) · 1.241 acres
CN(69) · 1.054 acres

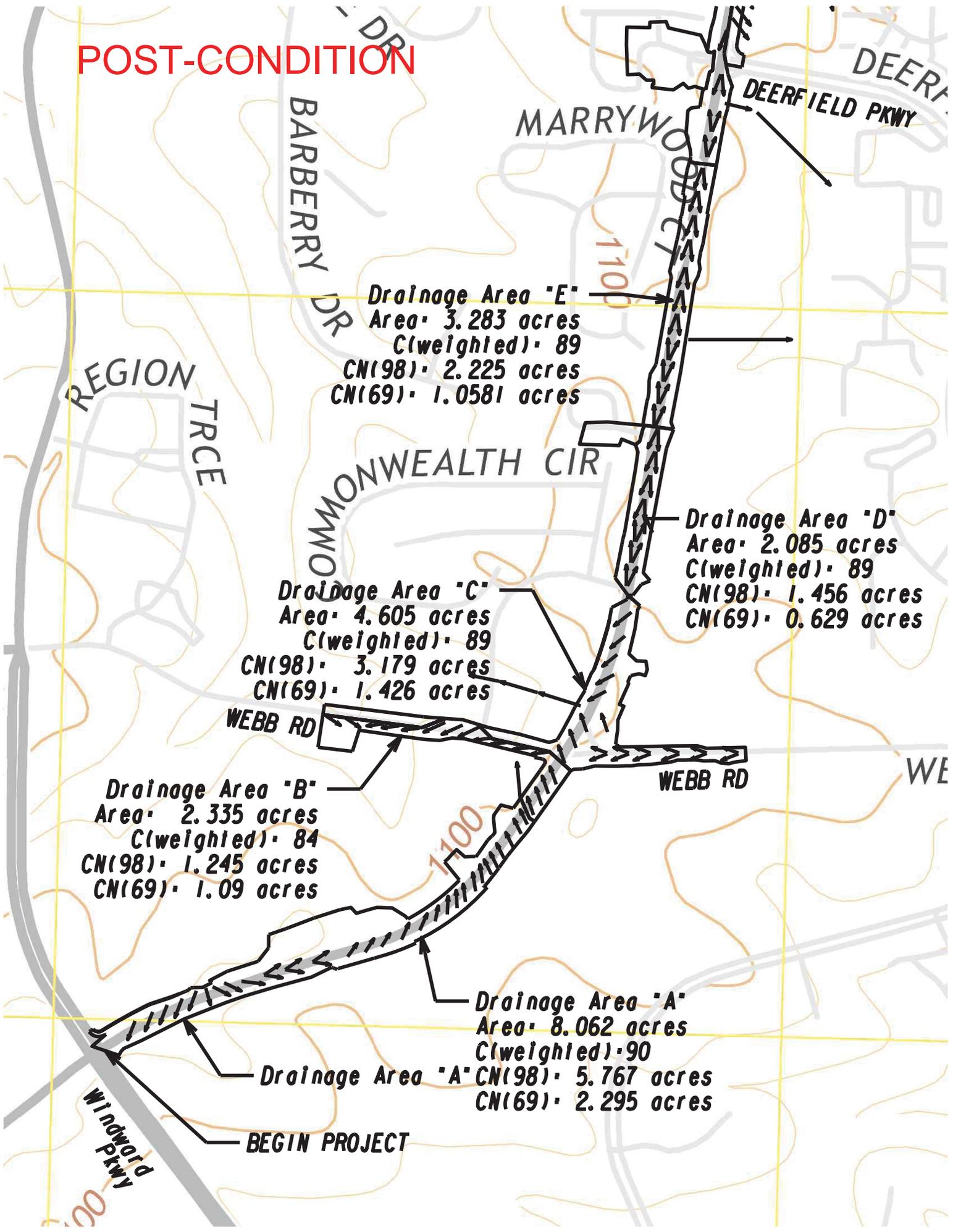
Drainage Area "G"
Area · 1.661 ares
C(weighted) · 81
CN(98) · 0.663 acres
CN(69) · 0.998 acres



PRE-CONDITON



POST-CONDITION



Drainage Area "E"
Area: 3.283 acres
C(weighted): 89
CN(98): 2.225 acres
CN(69): 1.0581 acres

Drainage Area "D"
Area: 2.085 acres
C(weighted): 89
CN(98): 1.456 acres
CN(69): 0.629 acres

Drainage Area "C"
Area: 4.605 acres
C(weighted): 89
CN(98): 3.179 acres
CN(69): 1.426 acres

Drainage Area "B"
Area: 2.335 acres
C(weighted): 84
CN(98): 1.245 acres
CN(69): 1.09 acres

Drainage Area "A"
Area: 8.062 acres
C(weighted): 90
CN(98): 5.767 acres
CN(69): 2.295 acres

BEGIN PROJECT

POST-CONDITION

BETHANY BND

Drainage Area "L"
Area: 1.765 acres
C(weighted): 94
CN(98): 1.517 acres
CN(69): 0.248 acres

Drainage Area "J"
Area: 2.011 acres
C(weighted): 86
CN(98): 1.147 acres
CN(69): 0.864 acres

Drainage Area "H"
Area: 3.053 acres
C(weighted): 88
CN(98): 2.007 acres
CN(69): 1.046 acres

Drainage Area "F"
Area: 3.526 acres
C(weighted): 88
CN(98): 2.283 acres
CN(69): 1.243 acres

Drainage Area "M"

Drainage Area "M"
Area: 0.705 acres
C(weighted): 94
CN(98): 0.597 acres
CN(69): 0.108 acres

Drainage Area "K"
Area: 1.7826 acres
C(weighted): 80
CN(98): 0.669 acres
CN(69): 1.113 acres

Drainage Area "B12"
Area: 1.185 acres
C(weighted): 94
CN(98): 1.035 acres
CN(69): 0.150 acres

Drainage Area "I"
Area: 2.295 acres
C(weighted): 90
CN(98): 1.641 acres
CN(69): 0.654 acres

Drainage Area "G"
Area: 1.661 acres
C(weighted): 88
CN(98): 1.084 acres
CN(69): 0.577 acres

BETHANY BND

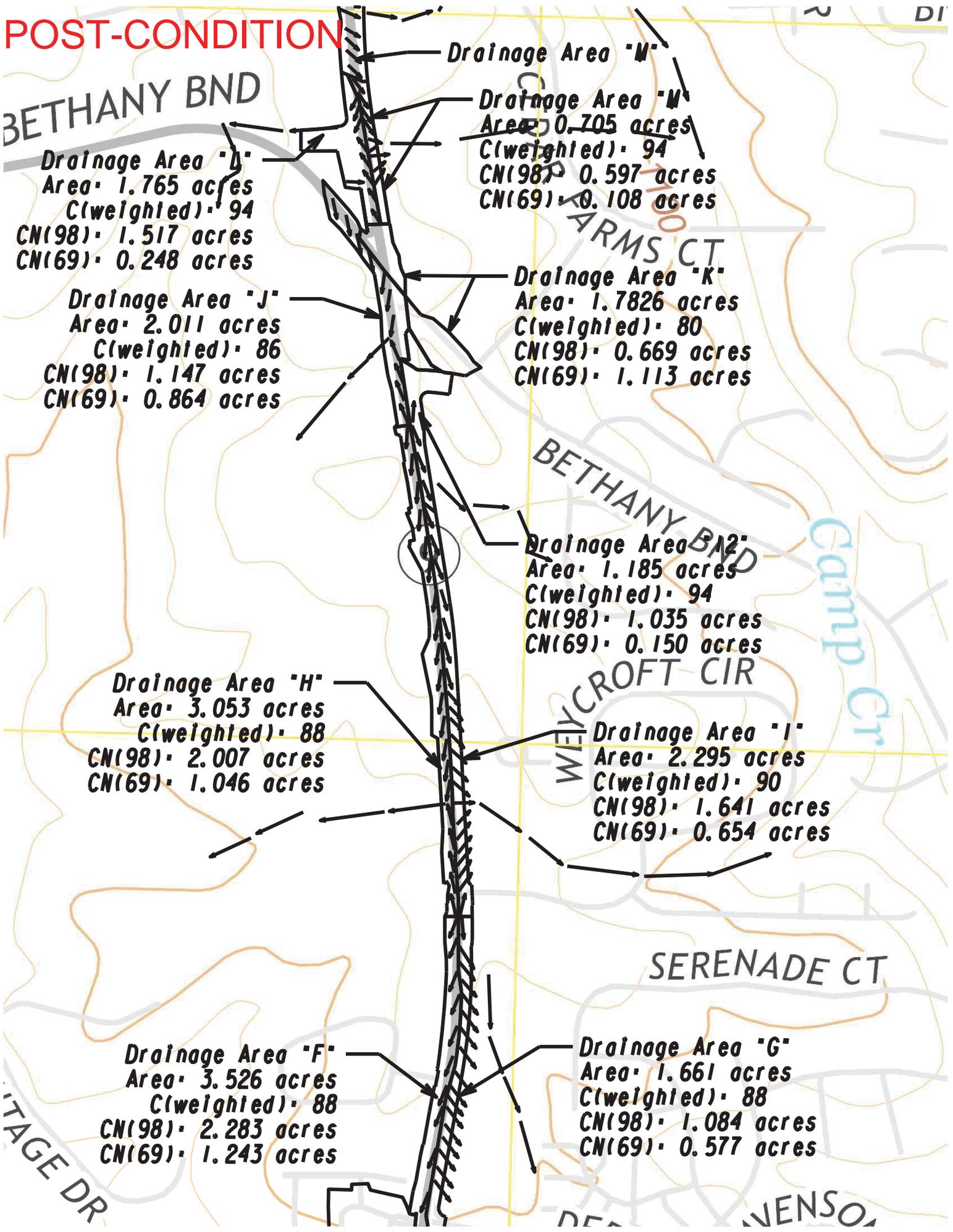
WEYCROFT CIR

SERENADE CT

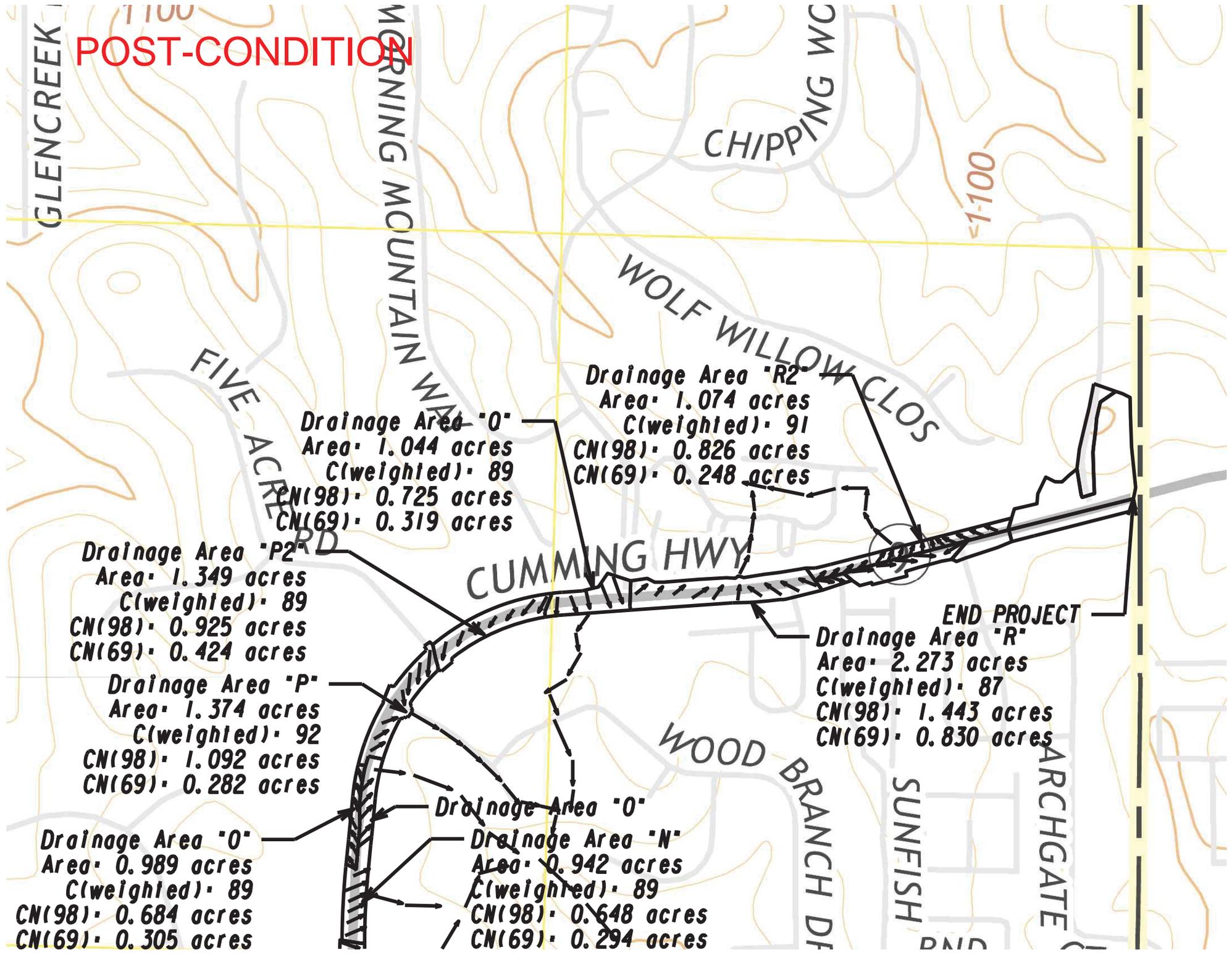
VITAGE DR

WENSOR

Camp Cr



POST-CONDITION



Drainage Basin A

What city is closest
 Rainfall Distribution Type

Roswell			
II			
PRE	POST		
Tc=	0.25	0.25	hours
CN=	89	90	
A=	7.429	8.062	acres
i=		72%	% impervious

Water Quality

Rv=	0.69
WQv=	0.56 acre-feet
WQv=	24,363.86 cuft
Release Rate	0.28 cfs

Channel Protection

qo/qi=	0.02	Peak Outflow To Peak Inflow
Vs/Vr=	0.65	
Cpv=	1.02	ac-ft
Cpv=	44,353.62	cuft
Release Rate	0.51	cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	44.16 cfs
qi=	48.96 cfs
qo/qi=	0.90
Vs/Vr=	0.14
Vs=	0.49 acre-ft
Vs=	21,221.24 cu-ft

Storm year	1	2	5	10	25	50	100
S=	1.24						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	18.91	22.69	30.40	36.26	44.16	50.11	54.10
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	731	731	731	731	731	731	731
Volume (cuft)	60,086	72,089	96,563	115,192	140,267	159,199	171,864

Storm year	1	2	5	10	25	50	100
S=	1.11						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.222						
Q (in)=	2.32	2.77	3.68	4.38	5.31	6.02	6.49
Qp (cfs)=	21.35	25.50	33.94	40.34	48.96	55.45	59.80
Ia/P (in)=	0.07	0.06	0.05	0.04	0.03	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	731	731	731	731	731	731	731
Volume (cuft)	67,814	80,998	107,803	128,160	155,521	176,155	189,952

Drainage Basin B

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.116 0.116 hours

CN= 82 84

A= 2.279 2.335 acres

i= _____ 53% % impervious

Water Quality

Rv= 0.53
 WQv= 0.12 acre-feet
 WQv= 5,389.55 cuft
 Release Rate 0.06 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.23 ac-ft
 Cpv= 10,073.96 cuft
 Release Rate 0.12 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 15.25 cfs
 qi= 16.39 cfs
 qo/qi= 0.93
 Vs/Vr= 0.12
 Vs= 0.11 acre-ft
 Vs= 4,868.74 cu-ft

Storm year	1	2	5	10	25	50	100
S=	2.20						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.439						
Q (in)=	1.67	2.07	2.90	3.55	4.43	5.10	5.56
Qp (cfs)=	5.66	7.08	9.98	12.21	15.25	17.56	19.12
Ia/P (in)=	0.13	0.11	0.09	0.08	0.07	0.06	0.06
is Ia/P less than 0.1?	0.13	0.11	0.10	0.10	0.10	0.10	0.10
C0	2.54004	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61624	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15691	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	953	962	966	966	966	966	966
Volume (cuft)	13,796	17,099	23,998	29,353	36,656	42,223	45,968

Storm year	1	2	5	10	25	50	100
S=	1.90						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.381						
Q (in)=	1.82	2.23	3.09	3.75	4.65	5.33	5.79
Qp (cfs)=	6.38	7.86	10.89	13.22	16.39	18.79	20.41
Ia/P (in)=	0.11	0.10	0.08	0.07	0.06	0.05	0.05
is Ia/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	962	966	966	966	966	966	966
Volume (cuft)	15,402	18,907	26,174	31,780	39,393	45,179	49,063

Drainage Basin C

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.16 0.16 hours

CN= 88 89

A= 4.547 4.605 acres

i= _____ 69% % impervious

Water Quality

Rv= 0.67
 WQv= 0.31 acre-feet
 WQv= 13,465.26 cuft
 Release Rate 0.16 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.56 ac-ft
 Cpv= 24,360.49 cuft
 Release Rate 0.28 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 31.41 cfs
 qi= 32.51 cfs
 qo/qi= 0.97
 Vs/Vr= 0.11
 Vs= 0.21 acre-ft
 Vs= 9,232.64 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	1.36					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.273						
Q (in)=	2.14	2.58	3.48	4.16	5.09	5.79	6.26
Qp (cfs)=	13.22	15.93	21.47	25.71	31.41	35.72	38.61
Ia/P (in)=	0.08	0.07	0.06	0.05	0.04	0.04	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	869	869	869	869	869	869	869
Volume (cuft)	35,345	42,597	57,428	68,744	84,001	95,533	103,253

Storm year	1	2	5	10	25	50	100
	S=	1.24					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	13.93	16.71	22.38	26.70	32.51	36.90	39.84
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	869	869	869	869	869	869	869
Volume (cuft)	37,246	44,686	59,856	71,404	86,947	98,682	106,533

Drainage Basin D

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.0833 0.08333 hours

CN= 86 89

A= 2.07 2.085 acres

i= _____ 70% % impervious

Water Quality

Rv= 0.68
 WQv= 0.14 acre-feet
 WQv= 6,162.04 cuft
 Release Rate 0.07 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.25 ac-ft
 Cpv= 11,029.67 cuft
 Release Rate 0.13 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 16.72 cfs
 qi= 17.99 cfs
 qo/qi= 0.93
 Vs/Vr= 0.12
 Vs= 0.11 acre-ft
 Vs= 4,891.86 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	1.63					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.326						
Q (in)=	1.97	2.40	3.28	3.95	4.87	5.56	6.02
Qp (cfs)=	6.78	8.25	11.27	13.58	16.72	19.09	20.68
Ia/P (in)=	0.10	0.08	0.07	0.06	0.05	0.05	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	14,840	18,048	24,652	29,718	36,571	41,765	45,246

Storm year	1	2	5	10	25	50	100
	S=	1.24					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	7.71	9.25	12.39	14.78	17.99	20.42	22.04
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	16,864	20,232	27,101	32,329	39,367	44,680	48,235

Drainage Basin E

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.0833 0.0833 hours

CN= 86 89

A= 3.028 3.2831 acres

i= _____ 68% % impervious

Water Quality

Rv= 0.66
 WQv= 0.22 acre-feet
 WQv= 9,437.78 cuft
 Release Rate 0.11 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.40 ac-ft
 Cpv= 17,367.63 cuft
 Release Rate 0.20 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 24.45 cfs
 qi= 28.33 cfs
 qo/qi= 0.86
 Vs/Vr= 0.15
 Vs= 0.22 acre-ft
 Vs= 9,457.33 cu-ft

Storm year	1	2	5	10	25	50	100
S=	1.63						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.326						
Q (in)=	1.97	2.40	3.28	3.95	4.87	5.56	6.02
Qp (cfs)=	9.92	12.07	16.48	19.87	24.45	27.92	30.25
Ia/P (in)=	0.10	0.08	0.07	0.06	0.05	0.05	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	21,708	26,400	36,061	43,471	53,497	61,094	66,187

Storm year	1	2	5	10	25	50	100
S=	1.24						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	12.14	14.56	19.50	23.27	28.33	32.16	34.72
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	26,554	31,858	42,674	50,907	61,988	70,355	75,952

Drainage Basin F

What city is closest
 Rainfall Distribution Type

	Roswell	
	II	
	PRE	POST
Tc=	0.166	0.166
	85	88
CN=		
A=	3.37	3.5264
		acres
i=		65%
		% impervious

Water Quality

Rv=	0.63
WQv=	0.22 acre-feet
WQv=	9,719.67 cuft
Release Rate	0.11 cfs

Channel Protection

qo/qi=	0.02	Peak Outflow To Peak Inflow
Vs/Vr=	0.65	
Cpv=	0.41	ac-ft
Cpv=	17,928.75	cuft
Release Rate	0.21	cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	21.48 cfs
qi=	24.04 cfs
qo/qi=	0.89
Vs/Vr=	0.14
Vs=	0.21 acre-ft
Vs=	9,131.78 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	1.76					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.353						
Q (in)=	1.89	2.32	3.18	3.85	4.76	5.44	5.90
Qp (cfs)=	8.50	10.45	14.37	17.39	21.48	24.58	26.66
Ia/P (in)=	0.11	0.09	0.07	0.06	0.05	0.05	0.05
is Ia/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	852	857	857	857	857	857	857
Volume (cuft)	23,181	28,324	38,946	47,117	58,192	66,597	72,235

Storm year	1	2	5	10	25	50	100
	S=	1.36					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.273						
Q (in)=	2.14	2.58	3.48	4.16	5.09	5.79	6.26
Qp (cfs)=	10.12	12.19	16.44	19.68	24.04	27.34	29.55
Ia/P (in)=	0.08	0.07	0.06	0.05	0.04	0.04	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	857	857	857	857	857	857	857
Volume (cuft)	27,412	33,036	44,538	53,314	65,147	74,090	80,077

Drainage Basin G

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.166 0.166 hours

CN= 81 88

A= 1.661 1.6608 acres

i= _____ 65% % impervious

Water Quality

Rv= 0.64
 WQv= 0.11 acre-feet
 WQv= 4,610.15 cuft
 Release Rate 0.05 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.19 ac-ft
 Cpv= 8,443.76 cuft
 Release Rate 0.10 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 9.62 cfs
 qi= 11.32 cfs
 qo/qi= 0.85
 Vs/Vr= 0.16
 Vs= 0.11 acre-ft
 Vs= 4,840.75 cu-ft

Storm year	1	2	5	10	25	50	100
S=	2.35						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.469						
Q (in)=	1.60	1.99	2.81	3.45	4.32	4.99	5.44
Qp (cfs)=	3.47	4.37	6.25	7.68	9.62	11.11	12.11
Ia/P (in)=	0.14	0.12	0.10	0.08	0.07	0.07	0.06
is Ia/P less than 0.1?	0.14	0.12	0.10	0.10	0.10	0.10	0.10
C0	2.53565	2.54444	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61661	-0.61587	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15454	-0.15928	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	837	847	857	857	857	857	857
Volume (cuft)	9,622	11,985	16,938	20,796	26,069	30,095	32,806

Storm year	1	2	5	10	25	50	100
S=	1.36						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.273						
Q (in)=	2.14	2.58	3.48	4.16	5.09	5.79	6.26
Qp (cfs)=	4.76	5.74	7.74	9.27	11.32	12.88	13.92
Ia/P (in)=	0.08	0.07	0.06	0.05	0.04	0.04	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	857	857	857	857	857	857	857
Volume (cuft)	12,910	15,559	20,976	25,109	30,682	34,894	37,713

Drainage Basin H

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.2 0.2 hours

CN= 90 88

A= 2.725 3.0528 acres

i= _____ 66% % impervious

Water Quality

Rv= 0.64
 WQv= 0.20 acre-feet
 WQv= 8,531.60 cuft
 Release Rate 0.10 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.36 ac-ft
 Cpv= 15,520.90 cuft
 Release Rate 0.18 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 18.10 cfs
 qi= 19.42 cfs
 qo/qi= 0.93
 Vs/Vr= 0.12
 Vs= 0.16 acre-ft
 Vs= 6,929.09 cu-ft

Storm year	1	2	5	10	25	50	100
S=	1.11						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
la (in)=	0.222						
Q (in)=	2.32	2.77	3.68	4.38	5.31	6.02	6.49
Qp (cfs)=	7.89	9.43	12.55	14.92	18.10	20.50	22.11
la/P (in)=	0.07	0.06	0.05	0.04	0.03	0.03	0.03
is la/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	800	800	800	800	800	800	800
Volume (cuft)	22,921	27,378	36,438	43,319	52,567	59,541	64,205

Storm year	1	2	5	10	25	50	100
S=	1.36						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
la (in)=	0.273						
Q (in)=	2.14	2.58	3.48	4.16	5.09	5.79	6.26
Qp (cfs)=	8.17	9.85	13.28	15.89	19.42	22.08	23.87
la/P (in)=	0.08	0.07	0.06	0.05	0.04	0.04	0.04
is la/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	800	800	800	800	800	800	800
Volume (cuft)	23,730	28,599	38,556	46,154	56,397	64,140	69,323

Drainage Basin I

What city is closest
 Rainfall Distribution Type

Roswell	
II	
PRE	POST
Tc= 0.166	0.166 hours
CN= 85	90
A= 2.295	2.2955 acres
i=	71% % impervious

Water Quality

Rv=	0.69
WQv=	0.16 acre-feet
WQv=	6,932.64 cuft
Release Rate	0.08 cfs

Channel Protection

qo/qi=	0.02 Peak Outflow To Peak Inflow
Vs/Vr=	0.65
Cpv=	0.29 ac-ft
Cpv=	12,628.84 cuft
Release Rate	0.15 cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	14.63 cfs
qi=	16.34 cfs
qo/qi=	0.89
Vs/Vr=	0.14
Vs=	0.14 acre-ft
Vs=	6,175.15 cu-ft

Storm year	1	2	5	10	25	50	100
S=	1.76						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
la (in)=	0.353						
Q (in)=	1.89	2.32	3.18	3.85	4.76	5.44	5.90
Qp (cfs)=	5.79	7.12	9.79	11.84	14.63	16.74	18.16
la/P (in)=	0.11	0.09	0.07	0.06	0.05	0.05	0.05
is la/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	852	857	857	857	857	857	857
Volume (cuft)	15,787	19,289	26,523	32,087	39,630	45,353	49,193

Storm year	1	2	5	10	25	50	100
S=	1.11						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
la (in)=	0.222						
Q (in)=	2.32	2.77	3.68	4.38	5.31	6.02	6.49
Qp (cfs)=	7.13	8.51	11.33	13.47	16.34	18.51	19.96
la/P (in)=	0.07	0.06	0.05	0.04	0.03	0.03	0.03
is la/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	857	857	857	857	857	857	857
Volume (cuft)	19,309	23,063	30,695	36,491	44,281	50,157	54,085

Drainage Basin I2

What city is closest

Roswell

Rainfall Distribution Type

II

PRE POST

Tc= 0.0833 0.0833 hours

CN= 79 94

A= 1.185 1.1854 acres

i= 87% % impervious

Water Quality

Rv= 0.84
 WQv= 0.10 acre-feet
 WQv= 4,314.29 cuft
 Release Rate 0.05 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.17 ac-ft
 Cpv= 7,596.85 cuft
 Release Rate 0.09 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 8.08 cfs
 qi= 11.35 cfs
 qo/qi= 0.71
 Vs/Vr= 0.21
 Vs= 0.12 acre-ft
 Vs= 5,092.76 cu-ft

PRE

Storm year	1	2	5	10	25	50	100
S=	2.66						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.532						
Q (in)=	1.46	1.83	2.63	3.25	4.11	4.77	5.21
Qp (cfs)=	2.82	3.57	5.16	6.40	8.08	9.37	10.24
Ia/P (in)=	0.16	0.14	0.11	0.10	0.08	0.07	0.07
is Ia/P less than 0.1?	0.16	0.14	0.11	0.10	0.10	0.10	0.10
C0	2.52686	2.53565	2.54883	2.55323	2.55323	2.55323	2.55323
C1	-0.61736	-0.61661	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.14979	-0.15454	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1044	1050	1059	1062	1062	1062	1062
Volume (cuft)	6,272	7,891	11,314	13,998	17,684	20,509	22,414

POST

Storm year	1	2	5	10	25	50	100
S=	0.64						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.128						
Q (in)=	2.70	3.17	4.11	4.82	5.77	6.49	6.96
Qp (cfs)=	5.31	6.23	8.08	9.48	11.35	12.76	13.70
Ia/P (in)=	0.04	0.03	0.03	0.02	0.02	0.02	0.02
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	11,615	13,631	17,689	20,747	24,838	27,913	29,965

Drainage Basin J

What city is closest
 Rainfall Distribution Type

	Roswell	
	II	
	PRE	POST
Tc=	0.0833	0.0833
CN=	91	86
A=	1.848	2.011
i=		57%

hours
 acres
 % impervious

Water Quality

Rv=	0.56
WQv=	0.11 acre-feet
WQv=	4,934.20 cuft
Release Rate	0.06 cfs

Channel Protection

qo/qi=	0.02	Peak Outflow To Peak Inflow
Vs/Vr=	0.65	
Cpv=	0.22	ac-ft
Cpv=	9,429.26	cuft
Release Rate	0.11	cfs

Overbank Flood Protection

Qp25 required?	No
qo=	N/A cfs
qi=	N/A cfs
qo/qi=	#VALUE!
Vs/Vr=	#VALUE!
Vs=	#VALUE! acre-ft
Vs=	#VALUE! cu-ft

Storm year	1	2	5	10	25	50	100
	S=	0.99					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.198						
Q (in)=	2.41	2.86	3.79	4.49	5.43	6.14	6.61
Qp (cfs)=	7.39	8.78	11.61	13.76	16.64	18.81	20.26
Ia/P (in)=	0.06	0.05	0.04	0.04	0.03	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	16,159	19,215	25,412	30,108	36,410	41,159	44,332

Storm year	1	2	5	10	25	50	100
	S=	1.63					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.326						
Q (in)=	1.97	2.40	3.28	3.95	4.87	5.56	6.02
Qp (cfs)=	6.59	8.01	10.95	13.20	16.24	18.55	20.09
Ia/P (in)=	0.10	0.08	0.07	0.06	0.05	0.05	0.04
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	14,417	17,533	23,950	28,871	35,529	40,574	43,957

Drainage Basin K

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.0833 0.0833 hours

CN= 91 80

A= 1.772 1.78263 acres

i= _____ 38% % impervious

Water Quality

Rv= 0.39
 WQv= 0.07 acre-feet
 WQv= 3,012.48 cuft
 Release Rate 0.03 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.15 ac-ft
 Cpv= 6,458.71 cuft
 Release Rate 0.07 cfs

Overbank Flood Protection

Qp25 required? No
 qo= N/A cfs
 qi= N/A cfs
 qo/qi= #VALUE!
 Vs/Vr= #VALUE!
 Vs= #VALUE! acre-ft
 Vs= #VALUE! cu-ft

Storm year	1	2	5	10	25	50	100
S=	0.99						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.198						
Q (in)=	2.41	2.86	3.79	4.49	5.43	6.14	6.61
Qp (cfs)=	7.08	8.42	11.14	13.20	15.96	18.04	19.43
Ia/P (in)=	0.06	0.05	0.04	0.04	0.03	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	15,494	18,425	24,367	28,870	34,913	39,466	42,509

Storm year	1	2	5	10	25	50	100
S=	2.50						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.500						
Q (in)=	1.53	1.91	2.72	3.35	4.22	4.88	5.33
Qp (cfs)=	4.45	5.60	8.04	9.91	12.47	14.43	15.75
Ia/P (in)=	0.15	0.13	0.10	0.09	0.08	0.07	0.07
is Ia/P less than 0.1?	0.15	0.13	0.10	0.10	0.10	0.10	0.10
C0	2.53125	2.54004	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61698	-0.61624	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15217	-0.15691	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1047	1053	1062	1062	1062	1062	1062
Volume (cuft)	9,875	12,361	17,595	21,685	27,288	31,574	34,462

Drainage Basin L

What city is closest
 Rainfall Distribution Type

Roswell	
II	
PRE	POST
Tc= 0.0833	0.0833
CN= 81	94
A= 1.764	1.7647
i=	86%

hours
acres
% impervious

Water Quality

Rv=	0.82
WQv=	0.15 acre-feet
WQv=	6,329.96 cuft
Release Rate	0.07 cfs

Channel Protection

qo/qi=	0.02 Peak Outflow To Peak Inflow
Vs/Vr=	0.65
Cpv=	0.26 ac-ft
Cpv=	11,309.41 cuft
Release Rate	0.13 cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	12.65 cfs
qi=	16.90 cfs
qo/qi=	0.75
Vs/Vr=	0.19
Vs=	0.16 acre-ft
Vs=	7,144.93 cu-ft

Storm year	1	2	5	10	25	50	100
S=	2.35						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.469						
Q (in)=	1.60	1.99	2.81	3.45	4.32	4.99	5.44
Qp (cfs)=	4.62	5.78	8.22	10.09	12.65	14.61	15.92
Ia/P (in)=	0.14	0.12	0.10	0.08	0.07	0.07	0.06
is Ia/P less than 0.1?	0.14	0.12	0.10	0.10	0.10	0.10	0.10
C0	2.53565	2.54444	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61661	-0.61587	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15454	-0.15928	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1050	1056	1062	1062	1062	1062	1062
Volume (cuft)	10,219	12,728	17,989	22,086	27,686	31,961	34,840

Storm year	1	2	5	10	25	50	100
S=	0.64						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.128						
Q (in)=	2.70	3.17	4.11	4.82	5.77	6.49	6.96
Qp (cfs)=	7.90	9.27	12.04	14.12	16.90	18.99	20.39
Ia/P (in)=	0.04	0.03	0.03	0.02	0.02	0.02	0.02
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	17,291	20,292	26,333	30,887	36,977	41,554	44,609

Drainage Basin M

What city is closest

Roswell

Rainfall Distribution Type

II

PRE POST

Tc= 0.08333 0.0833 hours

CN= 85 94

A= 0.725 0.7051 acres

i= _____ 85% % impervious

Water Quality

Rv= 0.81
 WQv= 0.06 acre-feet
 WQv= 2,492.98 cuft
 Release Rate 0.03 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.10 ac-ft
 Cpv= 4,518.76 cuft
 Release Rate 0.05 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 5.72 cfs
 qi= 6.75 cfs
 qo/qi= 0.85
 Vs/Vr= 0.16
 Vs= 0.05 acre-ft
 Vs= 2,344.51 cu-ft

Storm year	1	2	5	10	25	50	100
S=	1.76						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.353						
Q (in)=	1.89	2.32	3.18	3.85	4.76	5.44	5.90
Qp (cfs)=	2.27	2.78	3.83	4.63	5.72	6.55	7.10
Ia/P (in)=	0.11	0.09	0.07	0.06	0.05	0.05	0.05
is Ia/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1059	1062	1062	1062	1062	1062	1062
Volume (cuft)	4,987	6,093	8,379	10,136	12,519	14,327	15,540

Storm year	1	2	5	10	25	50	100
S=	0.64						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.128						
Q (in)=	2.70	3.17	4.11	4.82	5.77	6.49	6.96
Qp (cfs)=	3.16	3.71	4.81	5.64	6.75	7.59	8.15
Ia/P (in)=	0.04	0.03	0.03	0.02	0.02	0.02	0.02
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	6,909	8,108	10,522	12,341	14,774	16,603	17,824

Drainage Basin N

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.0833 0.0833 hours

CN= 83 89

A= 0.9419 0.9419 acres

i= _____ 69% % impervious

Water Quality

Rv= 0.67
 WQv= 0.06 acre-feet
 WQv= 2,744.56 cuft
 Release Rate 0.03 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.11 ac-ft
 Cpv= 4,982.66 cuft
 Release Rate 0.06 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 7.09 cfs
 qi= 8.13 cfs
 qo/qi= 0.87
 Vs/Vr= 0.15
 Vs= 0.06 acre-ft
 Vs= 2,644.80 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	2.05					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.410						
Q (in)=	1.74	2.15	2.99	3.65	4.54	5.22	5.67
Qp (cfs)=	2.71	3.35	4.68	5.70	7.09	8.15	8.86
Ia/P (in)=	0.12	0.11	0.09	0.07	0.06	0.06	0.05
is Ia/P less than 0.1?	0.12	0.11	0.10	0.10	0.10	0.10	0.10
C0	2.54444	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61587	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15928	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1056	1059	1062	1062	1062	1062	1062
Volume (cuft)	5,954	7,344	10,236	12,474	15,519	17,837	19,394

Storm year	1	2	5	10	25	50	100
	S=	1.24					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	3.48	4.18	5.60	6.68	8.13	9.23	9.96
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	7,618	9,140	12,243	14,605	17,784	20,184	21,790

Drainage Basin O

What city is closest

Roswell

Rainfall Distribution Type

II

PRE POST

Tc= 0.0833 0.0833 hours

CN= 82 89

A= 0.805 0.9893 acres

i= _____ 69% % impervious

Water Quality

Rv= 0.67
 WQv= 0.07 acre-feet
 WQv= 2,895.09 cuft
 Release Rate 0.03 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.12 ac-ft
 Cpv= 5,233.41 cuft
 Release Rate 0.06 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 5.92 cfs
 qi= 8.54 cfs
 qo/qi= 0.69
 Vs/Vr= 0.21
 Vs= 0.09 acre-ft
 Vs= 3,940.94 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	2.20					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.439						
Q (in)=	1.67	2.07	2.90	3.55	4.43	5.10	5.56
Qp (cfs)=	2.21	2.75	3.87	4.74	5.92	6.82	7.42
Ia/P (in)=	0.13	0.11	0.09	0.08	0.07	0.06	0.06
is Ia/P less than 0.1?	0.13	0.11	0.10	0.10	0.10	0.10	0.10
C0	2.54004	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61624	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15691	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1053	1059	1062	1062	1062	1062	1062
Volume (cuft)	4,873	6,040	8,477	10,368	12,948	14,914	16,237

Storm year	1	2	5	10	25	50	100
	S=	1.24					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	3.66	4.39	5.88	7.01	8.54	9.69	10.46
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	8,002	9,600	12,859	15,340	18,679	21,200	22,887

Drainage Basin P

What city is closest
 Rainfall Distribution Type

Roswell	
II	
PRE	POST
Tc= 0.0833	0.0833 hours
CN= 96	92
A= 0.818	1.3739 acres
i=	80% % impervious

Water Quality

Rv=	0.77
WQv=	0.11 acre-feet
WQv=	4,581.29 cuft
Release Rate	0.05 cfs

Channel Protection

qo/qi=	0.02 Peak Outflow To Peak Inflow
Vs/Vr=	0.65
Cpv=	0.19 ac-ft
Cpv=	8,164.45 cuft
Release Rate	0.09 cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	8.15 cfs
qi=	12.63 cfs
qo/qi=	0.65
Vs/Vr=	0.23
Vs=	0.14 acre-ft
Vs=	6,249.93 cu-ft

Storm year	1	2	5	10	25	50	100
S=	0.42						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.083						
Q (in)=	2.91	3.38	4.33	5.05	6.01	6.72	7.20
Qp (cfs)=	3.95	4.59	5.88	6.85	8.15	9.12	9.77
Ia/P (in)=	0.02	0.02	0.02	0.02	0.01	0.01	0.01
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	8,632	10,041	12,869	14,994	17,832	19,963	21,384

Storm year	1	2	5	10	25	50	100
S=	0.87						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.174						
Q (in)=	2.50	2.96	3.89	4.60	5.54	6.25	6.73
Qp (cfs)=	5.71	6.75	8.88	10.48	12.63	14.25	15.33
Ia/P (in)=	0.05	0.05	0.04	0.03	0.03	0.02	0.02
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	12,483	14,778	19,421	22,932	27,639	31,182	33,548

Drainage Basin P2

What city is closest

Roswell

Rainfall Distribution Type

II

PRE

POST

Tc= 0.0833 0.0833 hours

CN= 93 89

A= 0.802 1.3489 acres

i= _____ 69% % impervious

Water Quality

Rv= 0.67
 WQv= 0.09 acre-feet
 WQv= 3,919.40 cuft
 Release Rate 0.05 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.16 ac-ft
 Cpv= 7,135.69 cuft
 Release Rate 0.08 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 7.53 cfs
 qi= 11.64 cfs
 qo/qi= 0.65
 Vs/Vr= 0.23
 Vs= 0.13 acre-ft
 Vs= 5,747.66 cu-ft

PRE

Storm year	1	2	5	10	25	50	100
S=	0.75						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.151						
Q (in)=	2.60	3.06	4.00	4.71	5.66	6.37	6.85
Qp (cfs)=	3.46	4.08	5.32	6.27	7.53	8.48	9.11
Ia/P (in)=	0.04	0.04	0.03	0.03	0.02	0.02	0.02
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	7,569	8,921	11,650	13,710	16,468	18,543	19,928

POST

Storm year	1	2	5	10	25	50	100
S=	1.24						
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	4.99	5.98	8.01	9.56	11.64	13.21	14.26
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	10,910	13,089	17,533	20,916	25,469	28,906	31,206

Drainage Basin Q

What city is closest

Roswell
 II

Rainfall Distribution Type

PRE POST

Tc= 0.0833 0.0833 hours

CN= 84 89

A= 0.945 1.0442 acres

i= _____ 69% % impervious

Water Quality

Rv= 0.67
 WQv= 0.07 acre-feet
 WQv= 3,069.26 cuft
 Release Rate 0.04 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.13 ac-ft
 Cpv= 5,523.83 cuft
 Release Rate 0.06 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 7.29 cfs
 qi= 9.01 cfs
 qo/qi= 0.81
 Vs/Vr= 0.17
 Vs= 0.08 acre-ft
 Vs= 3,408.97 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	1.90					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.381						
Q (in)=	1.82	2.23	3.09	3.75	4.65	5.33	5.79
Qp (cfs)=	2.84	3.50	4.84	5.88	7.29	8.36	9.08
Ia/P (in)=	0.11	0.10	0.08	0.07	0.06	0.05	0.05
is Ia/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1059	1062	1062	1062	1062	1062	1062
Volume (cuft)	6,234	7,652	10,593	12,862	15,943	18,284	19,857

Storm year	1	2	5	10	25	50	100
	S=	1.24					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.247						
Q (in)=	2.23	2.67	3.58	4.27	5.20	5.90	6.37
Qp (cfs)=	3.86	4.63	6.20	7.40	9.01	10.23	11.04
Ia/P (in)=	0.07	0.06	0.05	0.04	0.04	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	8,446	10,133	13,573	16,191	19,716	22,377	24,157

Drainage Basin R

What city is closest
 Rainfall Distribution Type

	Roswell	
	II	
	PRE	POST
Tc=	0.0833	0.0833
CN=	85	87
A=	1.965	2.273
i=		63%

hours
 acres
 % impervious

Water Quality

Rv=	0.62
WQv=	0.14 acre-feet
WQv=	6,151.81 cuft
Release Rate	0.07 cfs

Channel Protection

qo/qi=	0.02	Peak Outflow To Peak Inflow
Vs/Vr=	0.65	
Cpv=	0.25	ac-ft
Cpv=	11,100.92	cuft
Release Rate	0.13	cfs

Overbank Flood Protection

Qp25 required? Yes	
qo=	15.51 cfs
qi=	18.77 cfs
qo/qi=	0.83
Vs/Vr=	0.17
Vs=	0.16 acre-ft
Vs=	6,842.46 cu-ft

PRE	Storm year	1	2	5	10	25	50	100	
	S=	1.76							
	P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68	
	Ia (in)=	0.353							
	Q (in)=	1.89	2.32	3.18	3.85	4.76	5.44	5.90	
	Qp (cfs)=	6.16	7.55	10.38	12.56	15.51	17.75	19.25	
	Ia/P (in)=	0.11	0.09	0.07	0.06	0.05	0.05	0.05	
	is Ia/P less than 0.1?	0.11	0.10	0.10	0.10	0.10	0.10	0.10	
	C0	2.54883	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	
	C1	-0.61549	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	
	C2	-0.16166	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	
	qu (csm/in)=	1059	1062	1062	1062	1062	1062	1062	
	Volume (cuft)	13,517	16,515	22,709	27,473	33,931	38,832	42,119	

POST	Storm year	1	2	5	10	25	50	100	
	S=	1.49							
	P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68	
	Ia (in)=	0.299							
	Q (in)=	2.06	2.49	3.38	4.06	4.98	5.67	6.14	
	Qp (cfs)=	7.76	9.39	12.74	15.31	18.77	21.39	23.15	
	Ia/P (in)=	0.09	0.08	0.06	0.05	0.05	0.04	0.04	
	is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
	C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	
	C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	
	C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	
	qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062	
	Volume (cuft)	16,973	20,548	27,883	33,494	41,072	46,807	50,648	

Drainage Basin R2

What city is closest

Roswell

Rainfall Distribution Type

II

PRE POST

Tc= 0.0833 0.0833 hours

CN= 81 91

A= 1.074 1.0744 acres

i= _____ 77% % impervious

Water Quality

Rv= 0.74
 WQv= 0.08 acre-feet
 WQv= 3,472.25 cuft
 Release Rate 0.04 cfs

Channel Protection

qo/qi= 0.02 Peak Outflow To Peak Inflow
 Vs/Vr= 0.65
 Cpv= 0.14 ac-ft
 Cpv= 6,144.50 cuft
 Release Rate 0.07 cfs

Overbank Flood Protection

Qp25 required? Yes
 qo= 7.70 cfs
 qi= 9.68 cfs
 qo/qi= 0.80
 Vs/Vr= 0.18
 Vs= 0.09 acre-ft
 Vs= 3,752.04 cu-ft

Storm year	1	2	5	10	25	50	100
	S=	2.35					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.469						
Q (in)=	1.60	1.99	2.81	3.45	4.32	4.99	5.44
Qp (cfs)=	2.81	3.52	5.01	6.15	7.70	8.89	9.70
Ia/P (in)=	0.14	0.12	0.10	0.08	0.07	0.07	0.06
is Ia/P less than 0.1?	0.14	0.12	0.10	0.10	0.10	0.10	0.10
C0	2.53565	2.54444	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61661	-0.61587	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.15454	-0.15928	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1050	1056	1062	1062	1062	1062	1062
Volume (cuft)	6,222	7,749	10,952	13,447	16,856	19,460	21,212

Storm year	1	2	5	10	25	50	100
	S=	0.99					
P(inches)=	3.36	3.84	4.8	5.52	6.48	7.2	7.68
Ia (in)=	0.198						
Q (in)=	2.41	2.86	3.79	4.49	5.43	6.14	6.61
Qp (cfs)=	4.29	5.11	6.75	8.00	9.68	10.94	11.78
Ia/P (in)=	0.06	0.05	0.04	0.04	0.03	0.03	0.03
is Ia/P less than 0.1?	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C0	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323	2.55323
C1	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512	-0.61512
C2	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403	-0.16403
qu (csm/in)=	1062	1062	1062	1062	1062	1062	1062
Volume (cuft)	9,395	11,171	14,774	17,504	21,168	23,929	25,774