Georgia Department of Transportation

Roundabout and Alternative Intersection Design in the GDOT Plan Development Process

Colin Abbey, E.I.T., GDOT Office of Traffic Operations
Project Review Concept Supervisor

Georgia Department of Transportation

GDOT's Mission:

Deliver a transportation system focused on innovation, safety, sustainability and mobility.

Takeaways for Today:

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- **Discover similarities between GDOT's PDP and TDOT's PDN**

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- **Learn the benefits of a holistic approach to incorporating roundabouts into conventional project delivery**

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- **Discover similarities between GDOT's PDP and TDOT's PDN**

- **Learn the benefits of a holistic approach to incorporating roundabouts into conventional project delivery**

- **Appreciate the need and purpose of specialty groups within an organization**

Abbreviated Organizational Chart

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The People

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State Transportation Board

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GDOT Commissioner

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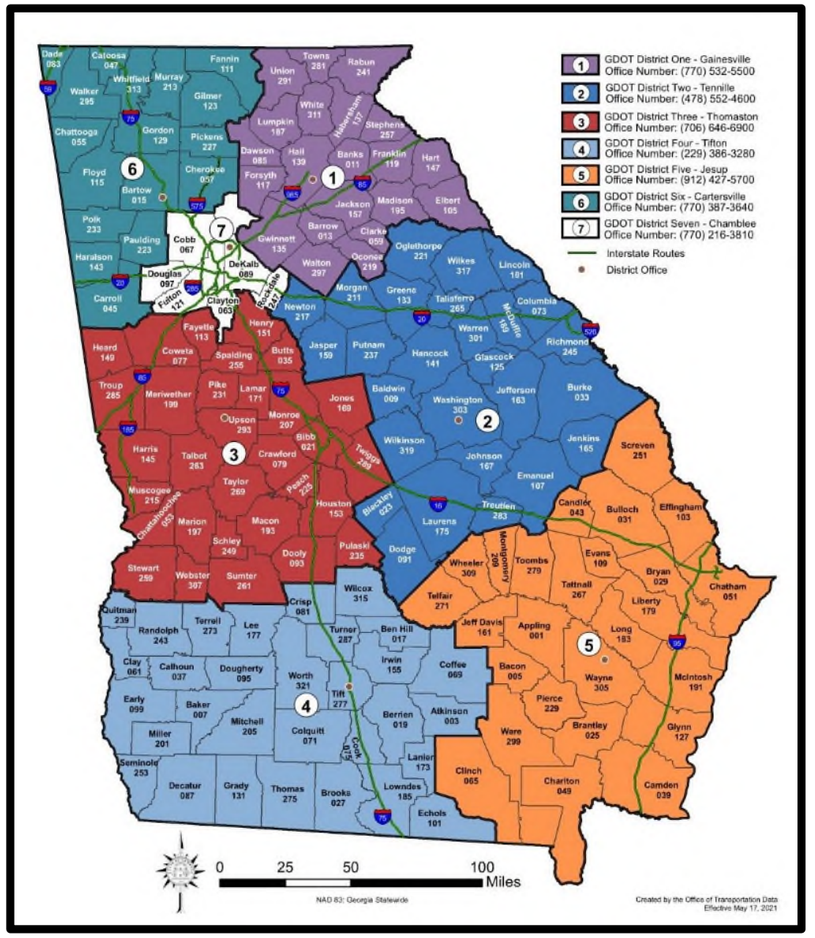

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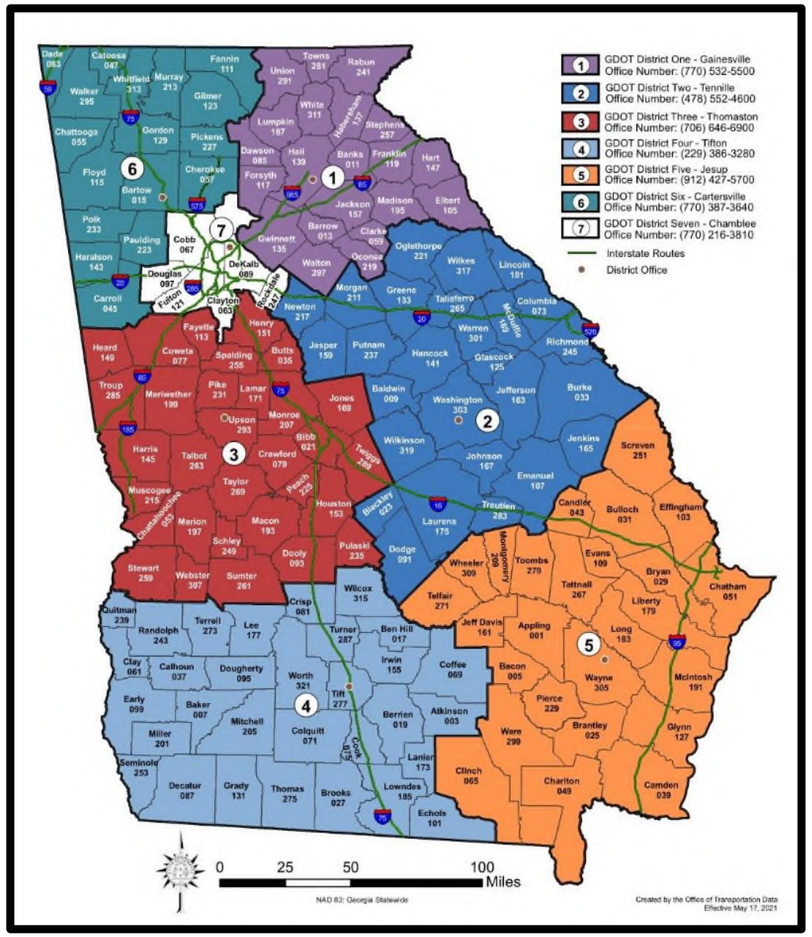

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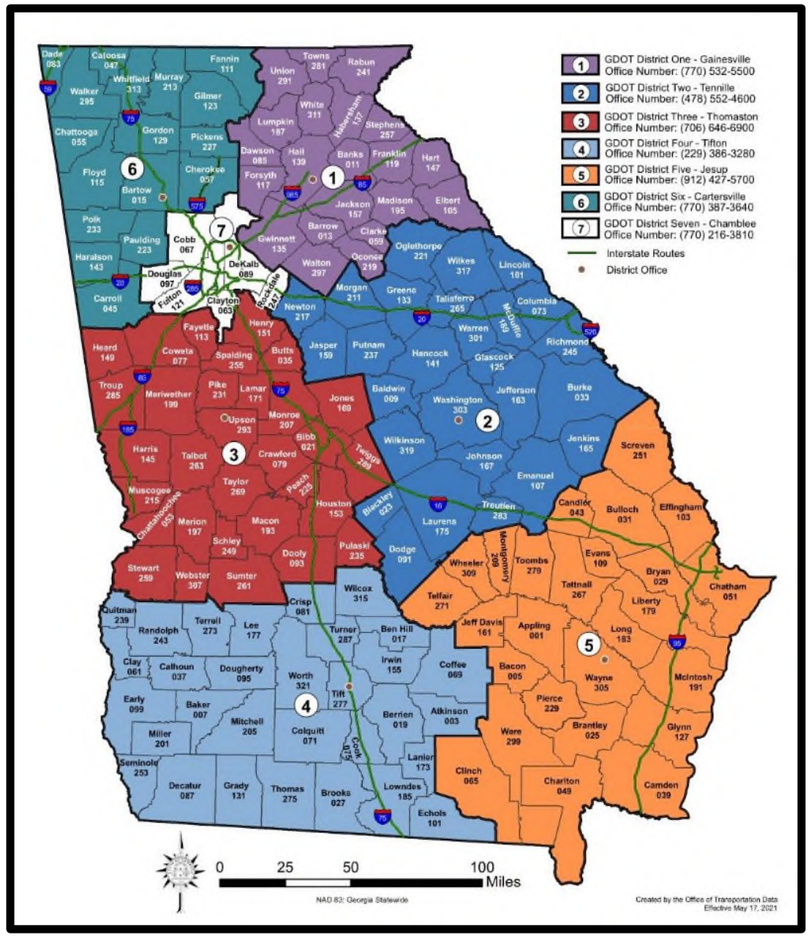

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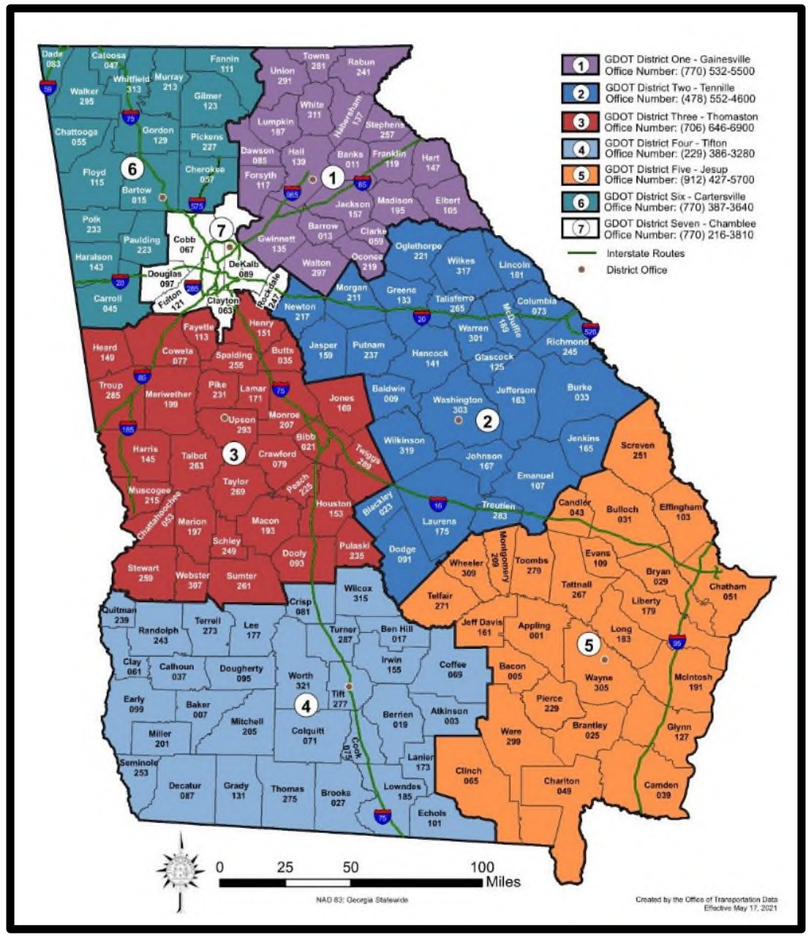

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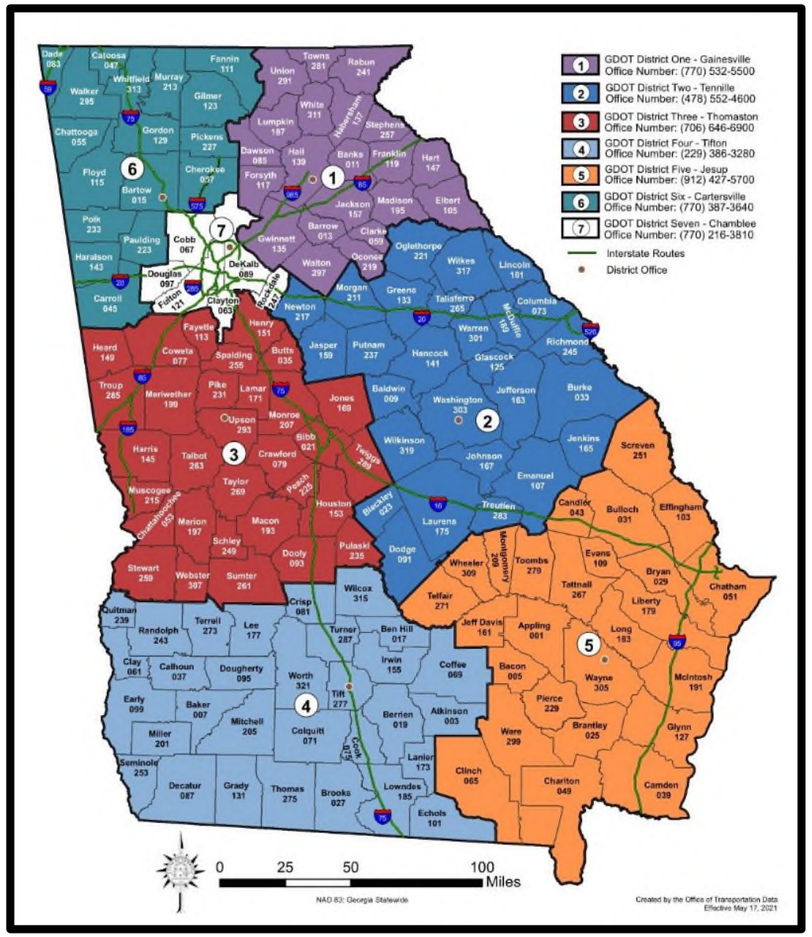

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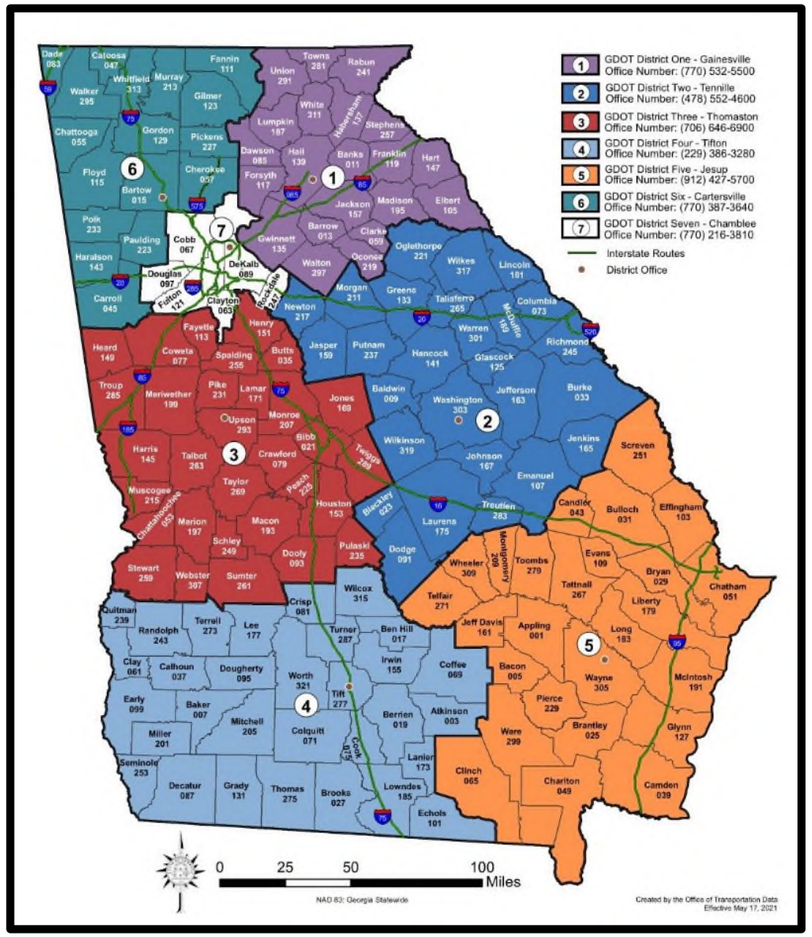

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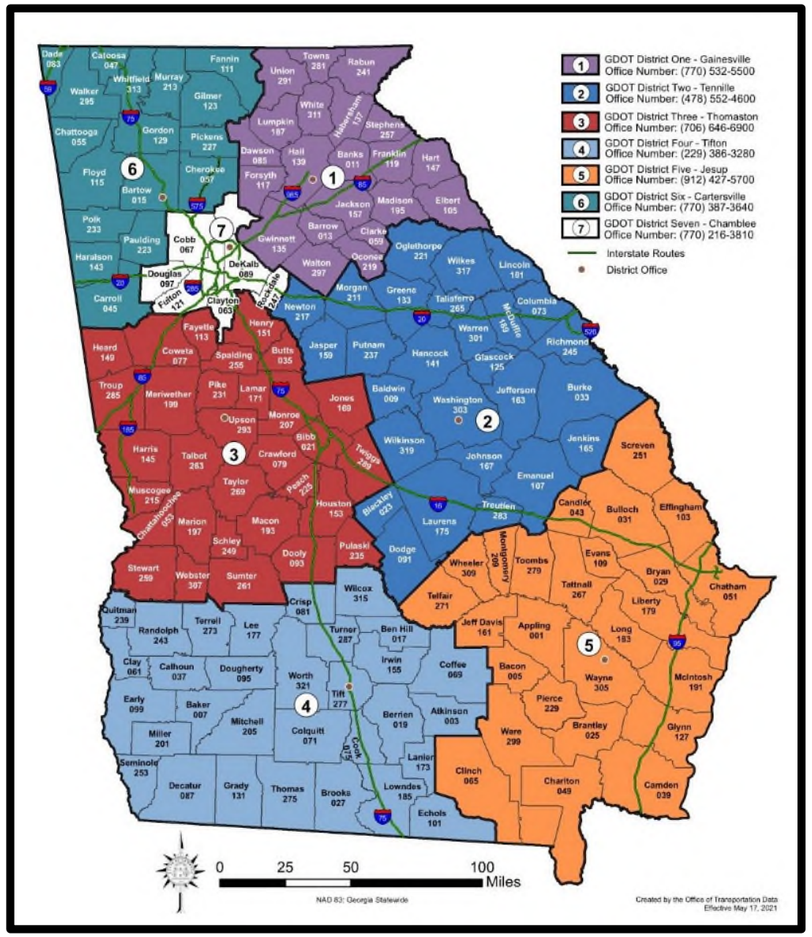

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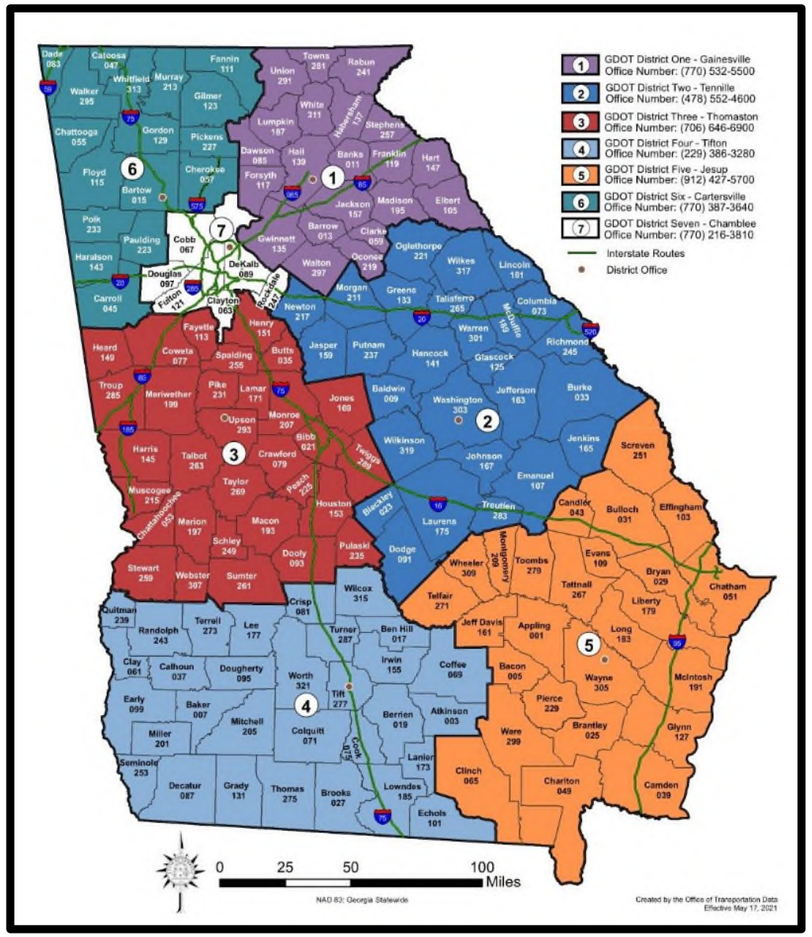
ITS
Signal Operations
Freeway / Incident Management



Project Review Concept Supervisor

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- Signing and Marking Subject Matter Expert (SME)

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- Consultant Contracts / Task Orders – Traffic Tasks

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Roundabout and Alternative Intersection Design (RAID)
Team Responsibilities and Functions

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Team Responsibilities and Functions

Design Foundations

Roundabout and Alternative Intersection Design (RAID)
Team Responsibilities and Functions

Design Foundations

Support Services

Roundabout and Alternative Intersection Design (RAID)
Team Responsibilities and Functions

Design Foundations

- Roundabout Design Guide
- Design Training (in-person & hybrid)
- Intersection Control Evaluation (ICE) Training

Support Services

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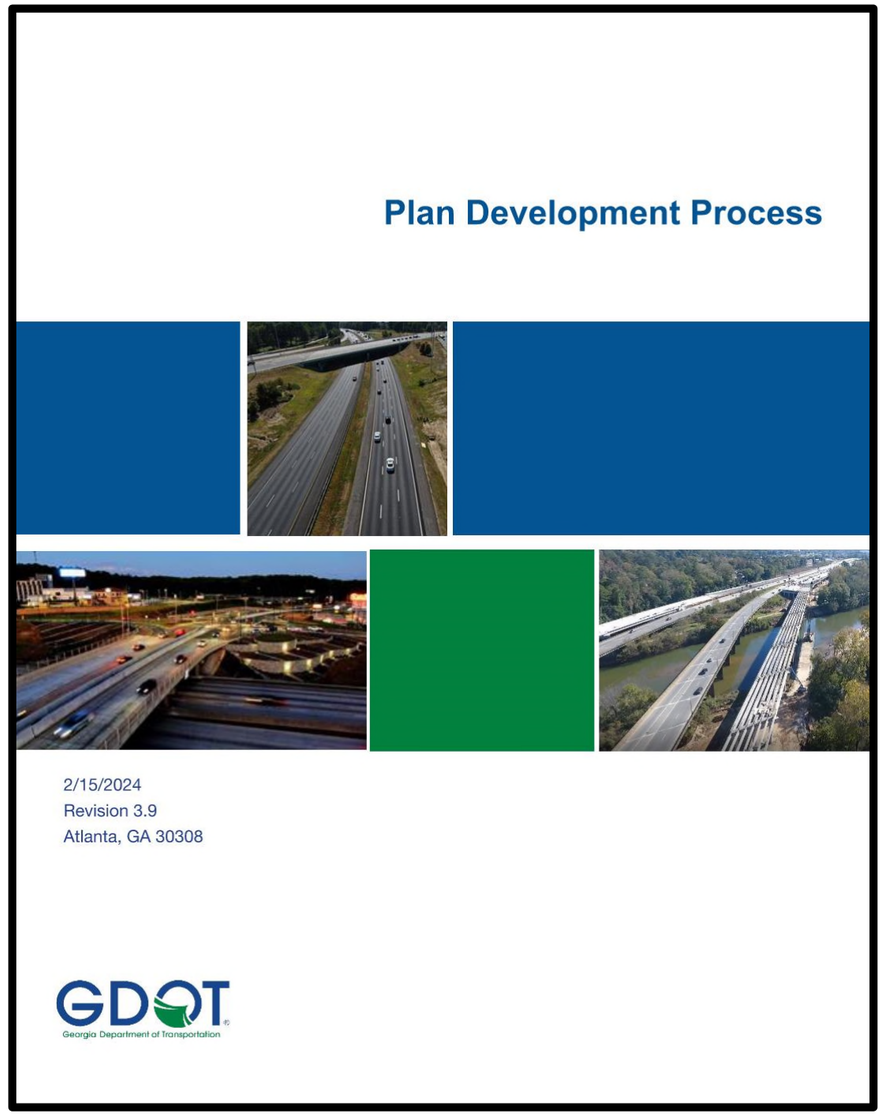
Support Services

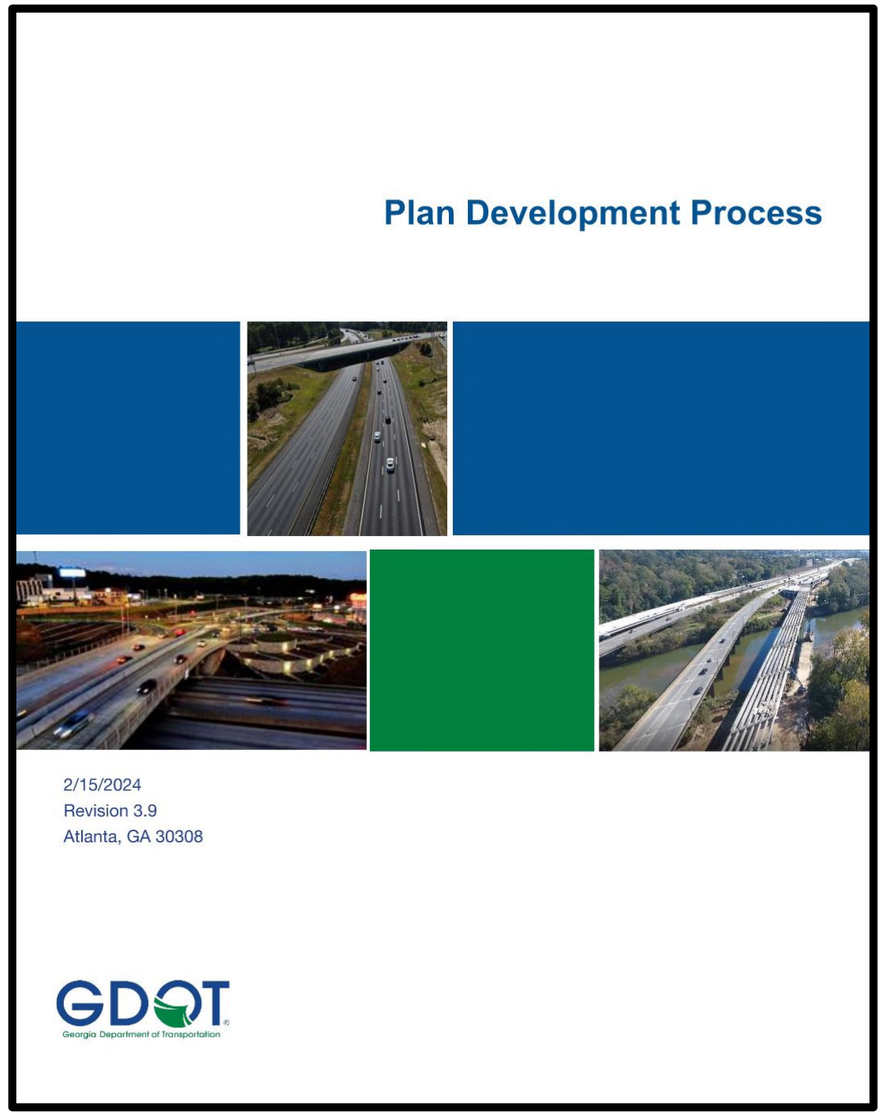
- ICE Review
- Concept Validation / Peer Review: Performance Checks and Operational Analysis
- Avoidance and Minimization Measures Meeting (A3M), Practical Design / 30%, Public Involvement
- Preliminary and Final Field Plan Reviews (PFPR & FFPR)
- On-Call Contract Services
- UOC Reviews & “In-Service” Reviews

GDOT Plan Development Process (PDP)



GDOT Plan Development Process (PDP)

- Program Delivery and Office of Program Control



GDOT Plan Development Process (PDP)

- Program Delivery and Office of Program Control
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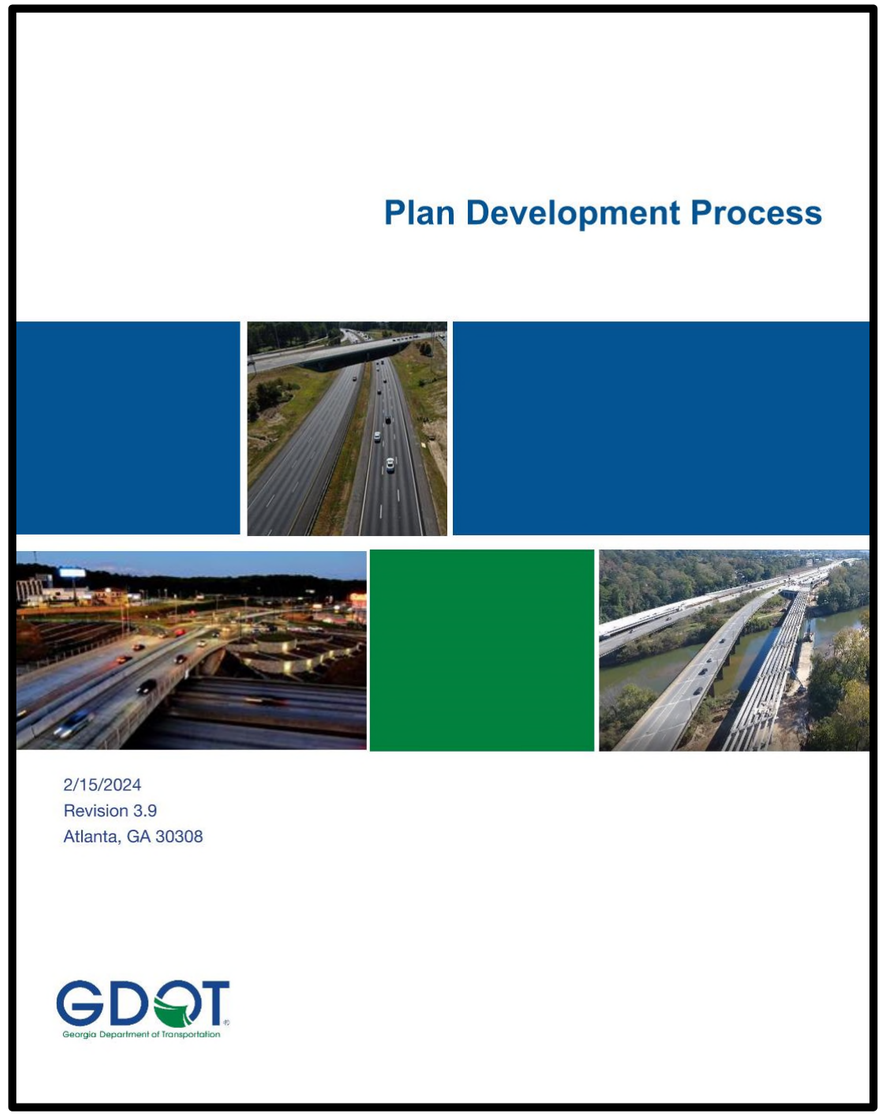
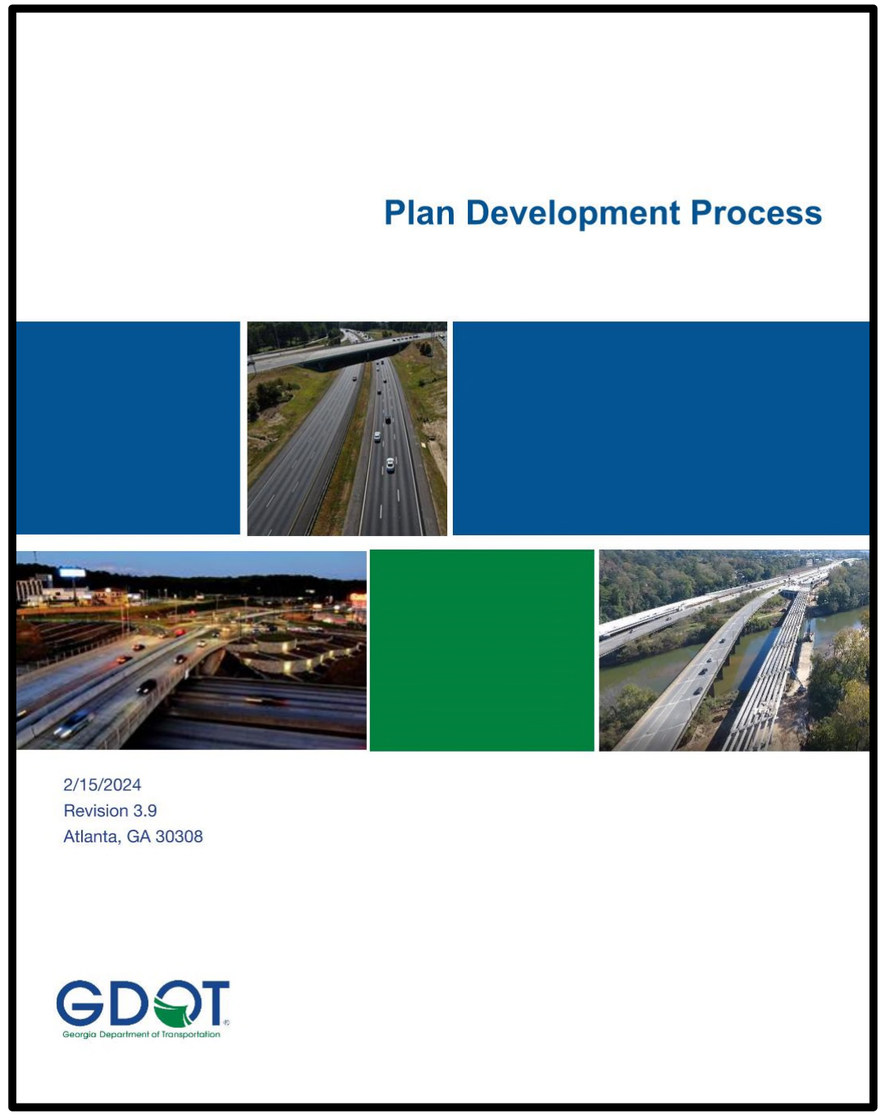


GDOT Plan Development Process (PDP)

- Program Delivery and Office of Program Control
- Conventional Design-Bid-Build Delivery
- Collaborative & Detail-oriented process



GDOT Plan Development Process (PDP)

- Program Delivery and Office of Program Control
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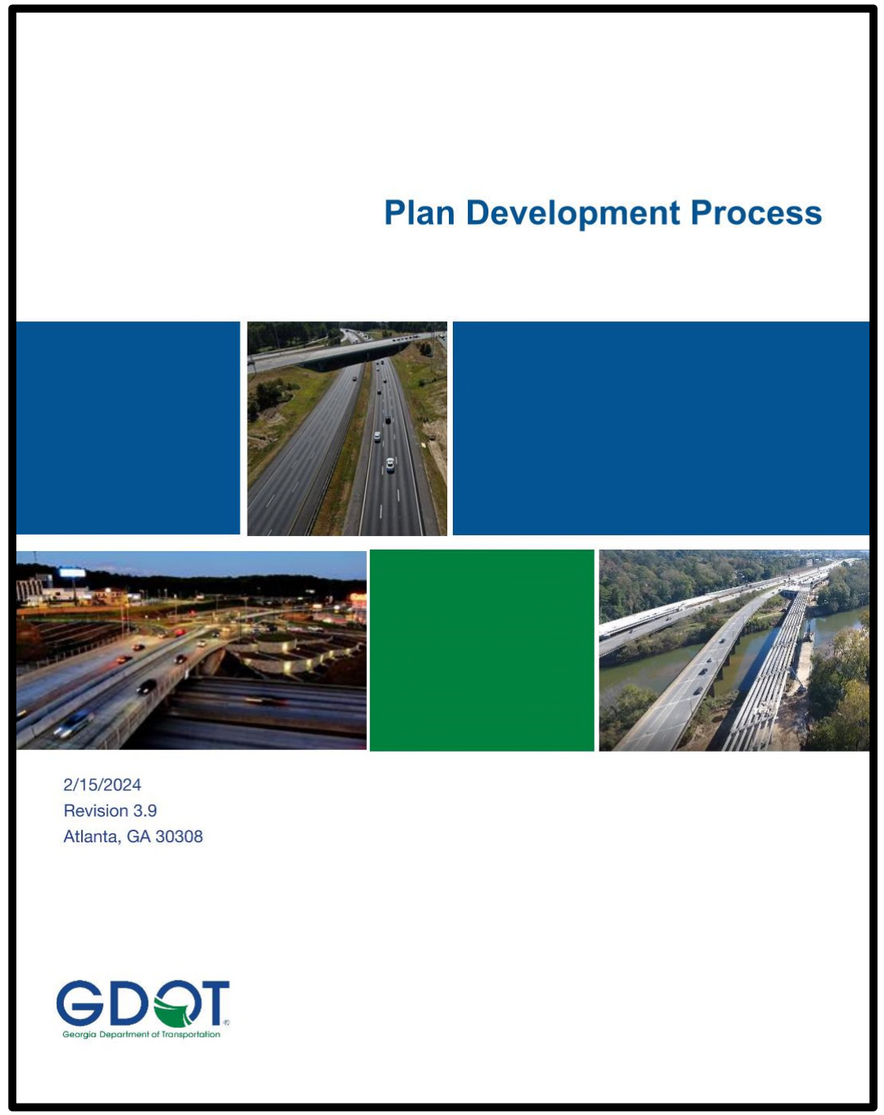
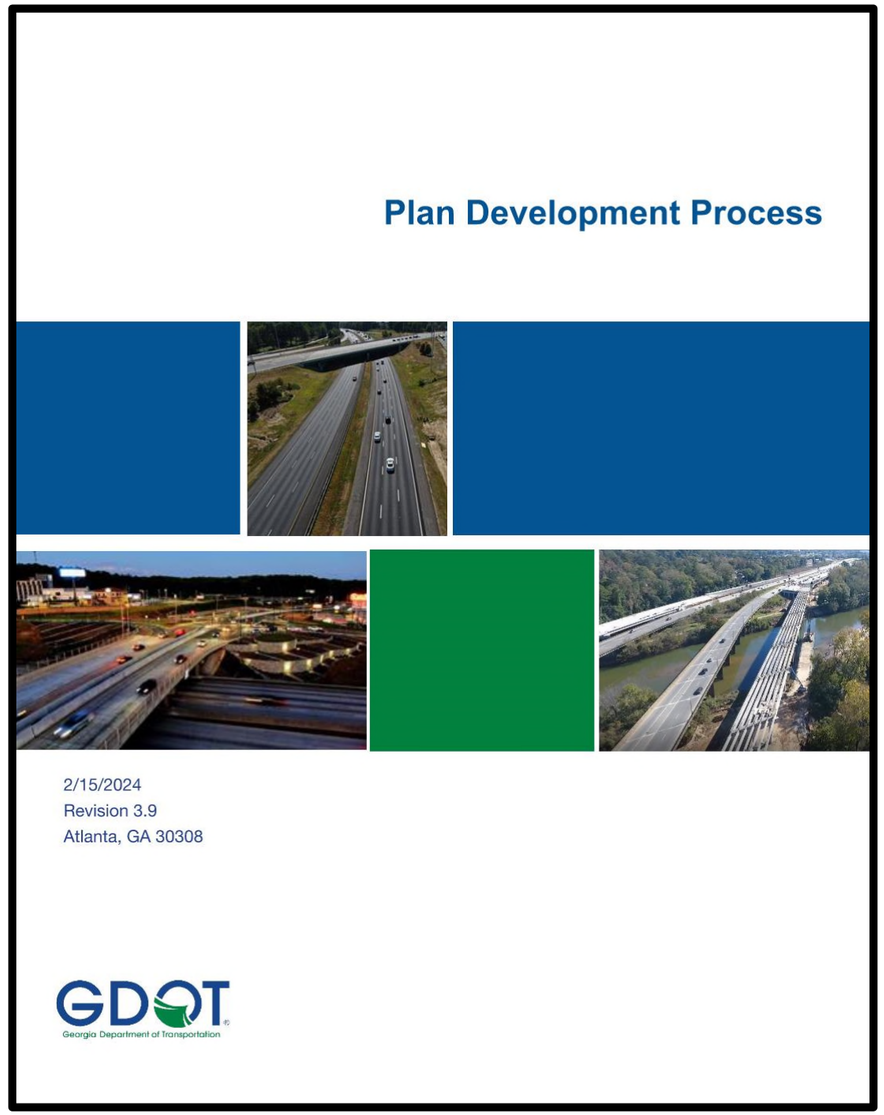
- Collaborative & Detail-oriented process
- “…Minimize production costs while reducing technical problems, utility delays, construction supplemental agreements, and the occurrence of liability claims.”

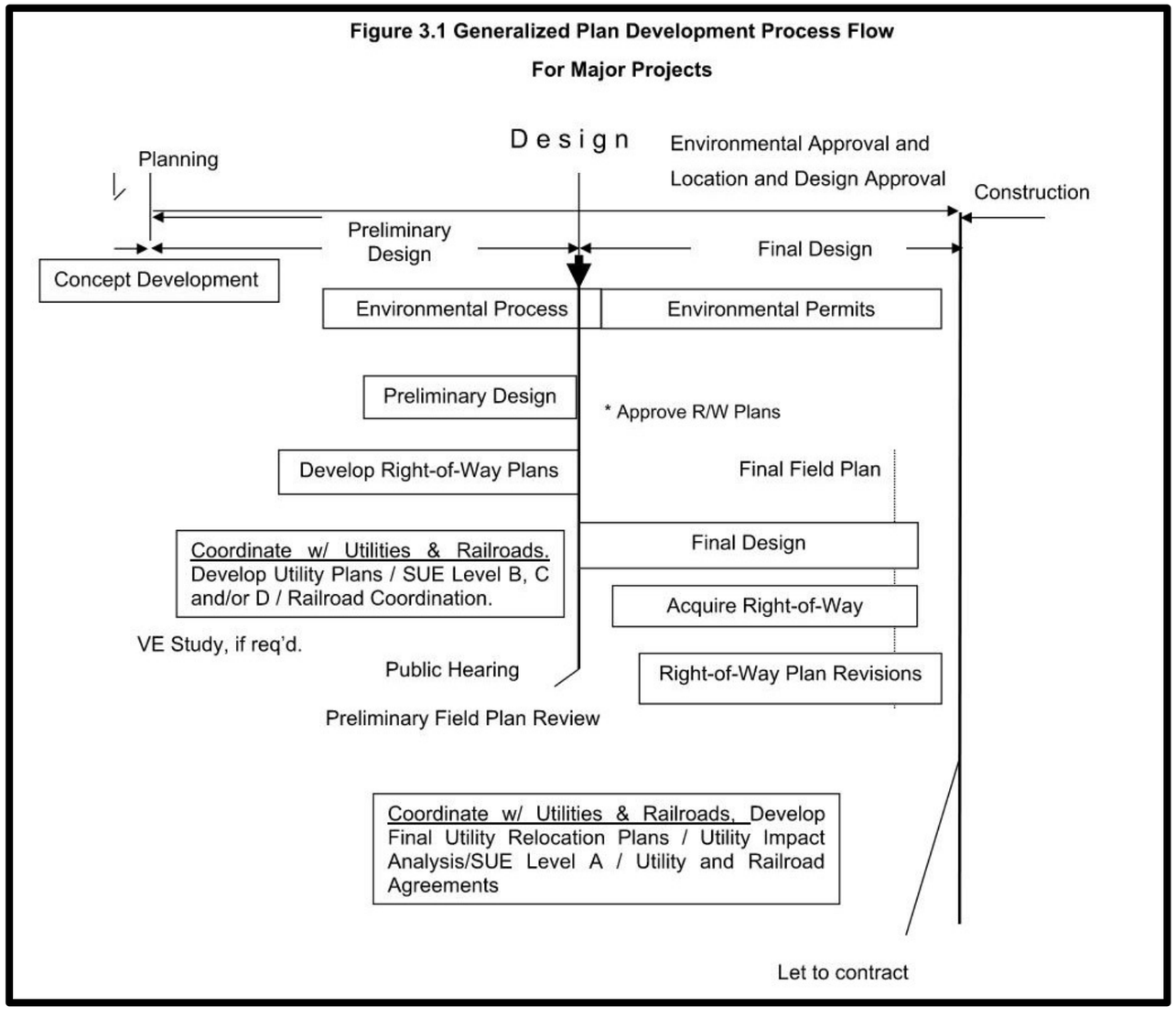


GDOT Plan Development Process (PDP)

- Program Delivery and Office of Program Control
- Conventional Design-Bid-Build Delivery
- Collaborative & Detail-oriented process
- “…Minimize production costs while reducing technical problems, utility delays, construction supplemental agreements, and the occurrence of liability claims.”
- Similar to TDOT’s Project Delivery Network (PDN)



PDP Highlights



PDP Highlights

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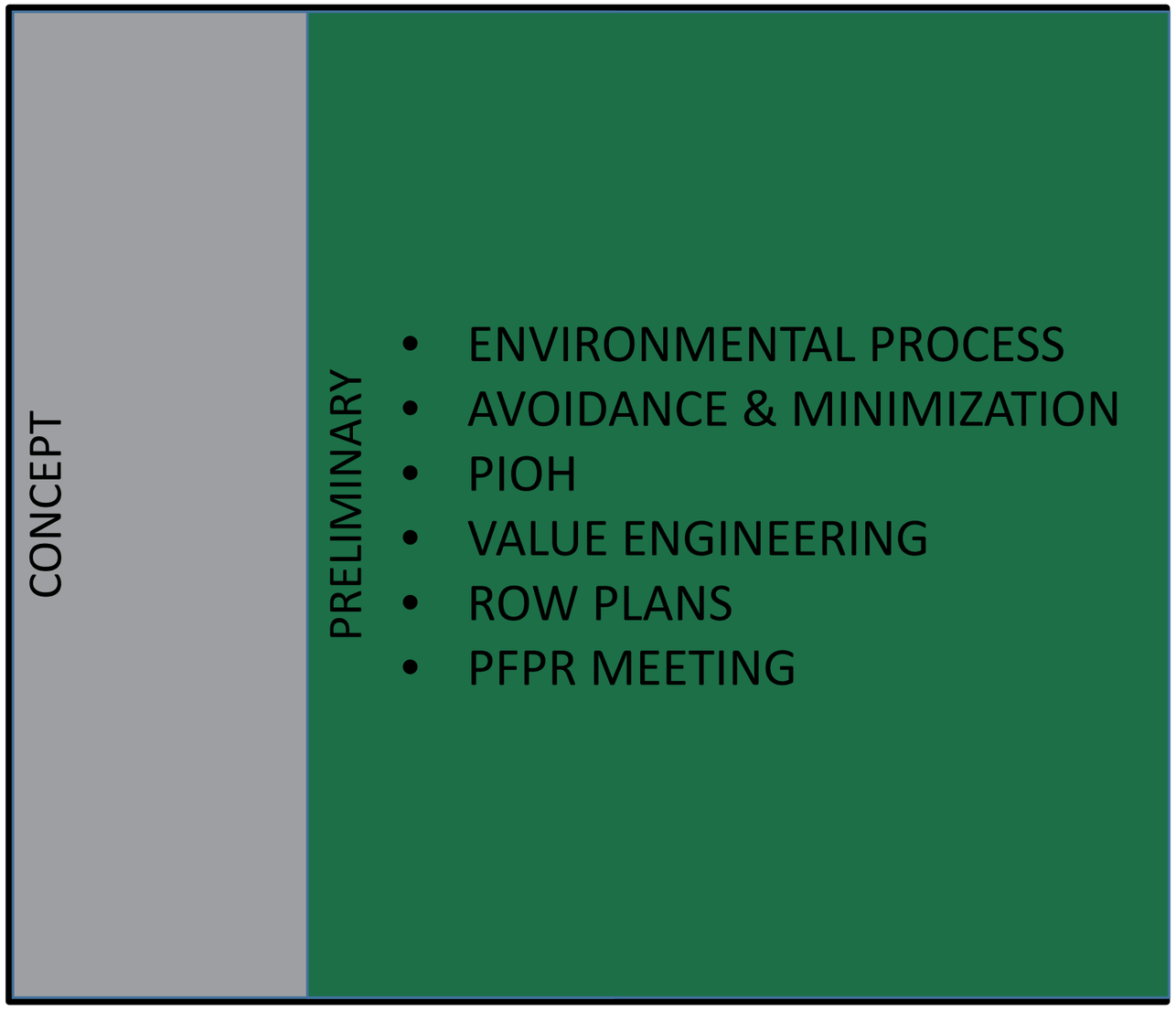
- Concept Development
  (Concept Team Meeting & Concept Report – compare to TDOT Stage 1)

CONCEPT

- IDENTIFY PROJECT'S NEED/PURPOSE
- PTIP/ICTM
- CTM
- IDENTIFY STAKEHOLDERS
- CONSIDER RISKS
- SELECT PREFERRED ALTERNATIVE
- CONCEPT REPORT APPROVAL

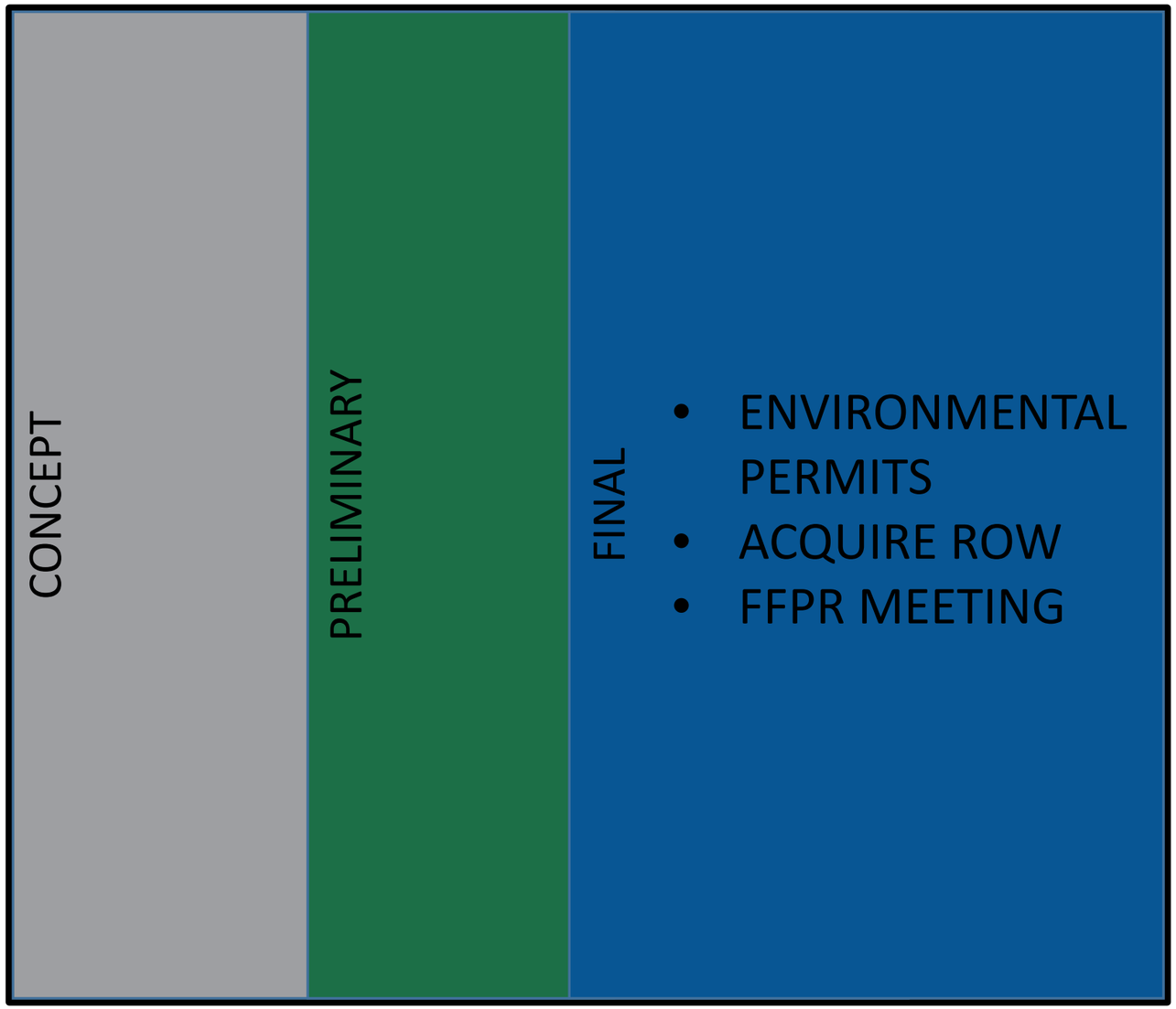
PDP Highlights

- Concept Development
  (Concept Team Meeting & Concept Report – compare to TDOT Stage 1)
- Preliminary Design
  (Preliminary Field Plan Review -- compare to TDOT Functional Design Plans Field Review)



PDP Highlights

- Concept Development
  (Concept Team Meeting & Concept Report – compare to TDOT Stage 1)
- Preliminary Design
  (Preliminary Field Plan Review -- compare to TDOT Functional Design Plans Field Review)
- Final Design
  (Final Field Plan Review -- compare to TDOT Plan-In-Hand Field Review)



Why Roundabouts?

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To support GDOT's mission providing an innovative, safe, and sustainable transportation system

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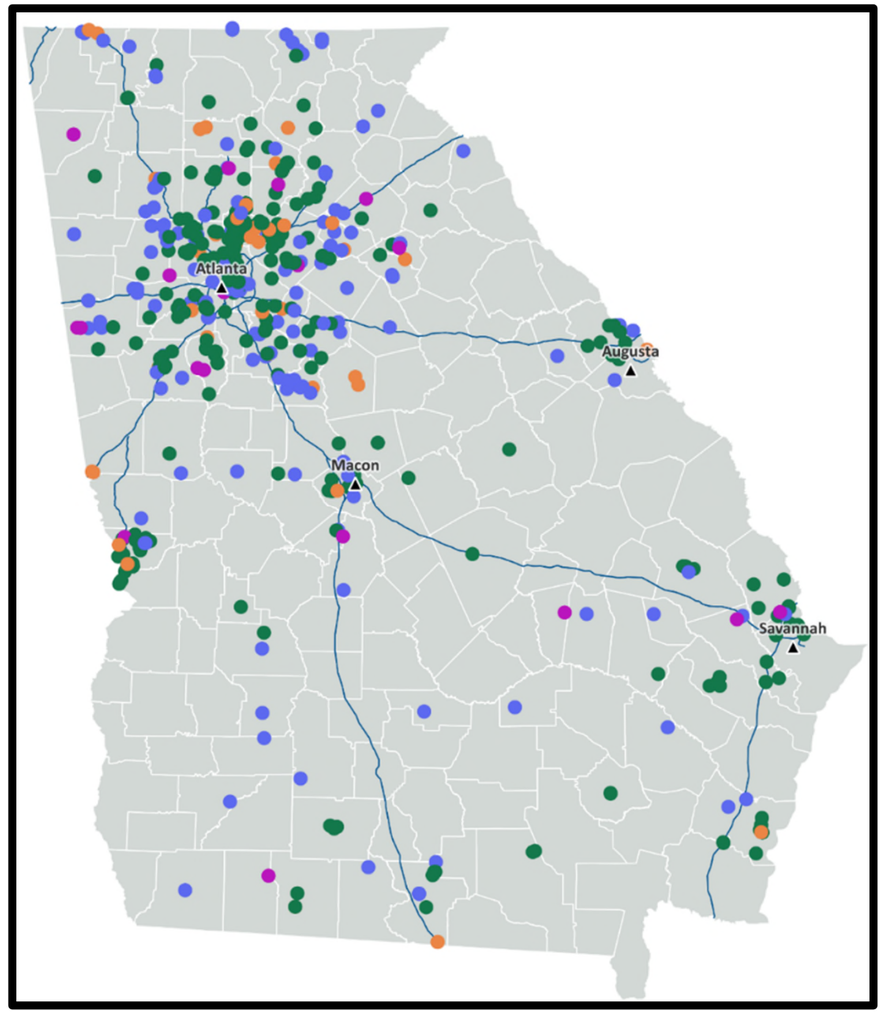
- Reduce crash frequency, severity, and intersection conflict points
- Align with "Towards Zero Deaths" GOHS initiative
- Align with Federal initiatives such as the Safe System Approach (SSA)
- Improve road user experience for Vulnerable Road Users (VRUs)

Why Roundabouts?

To support GDOT's mission providing an innovative, safe, and sustainable transportation system

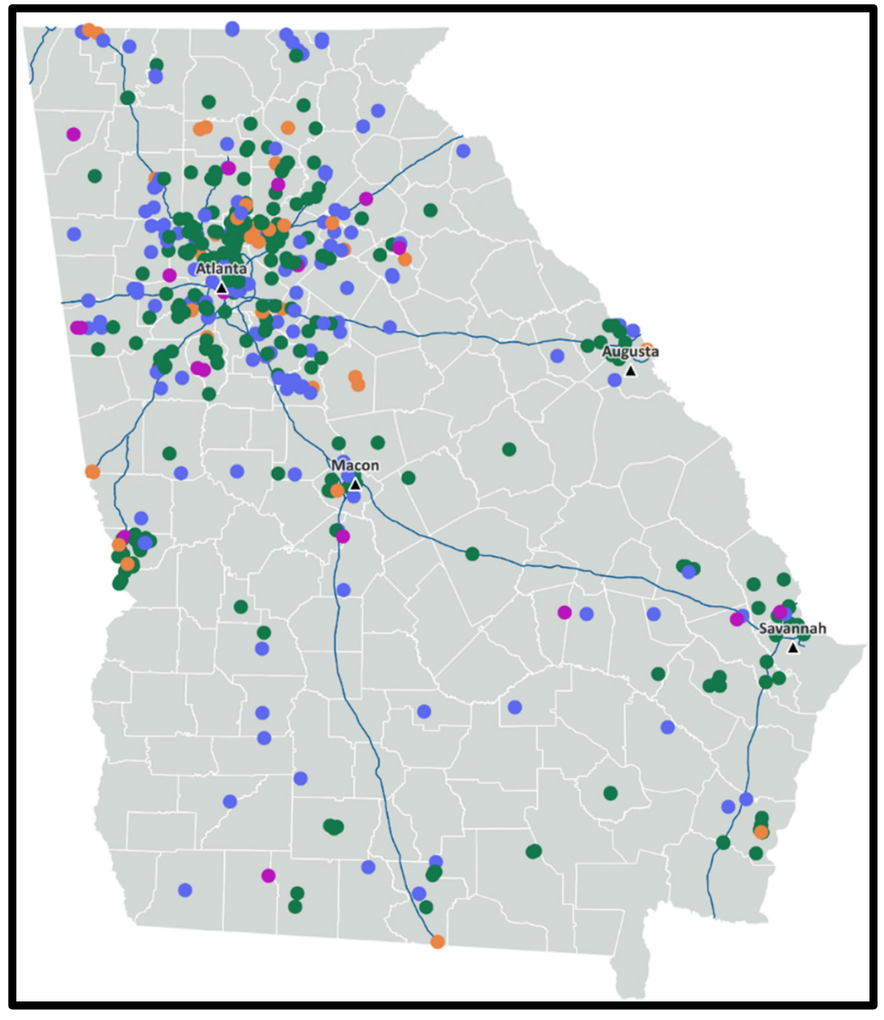
- Provide traffic calming while improving operations for reduced delay and emissions
- Improve mobility for both the traveling public and freight operations
- Improve sustainability and resilience

Roundabouts in Georgia



Roundabouts in Georgia

- Standalone intersection projects and in corridor/longitudinal projects



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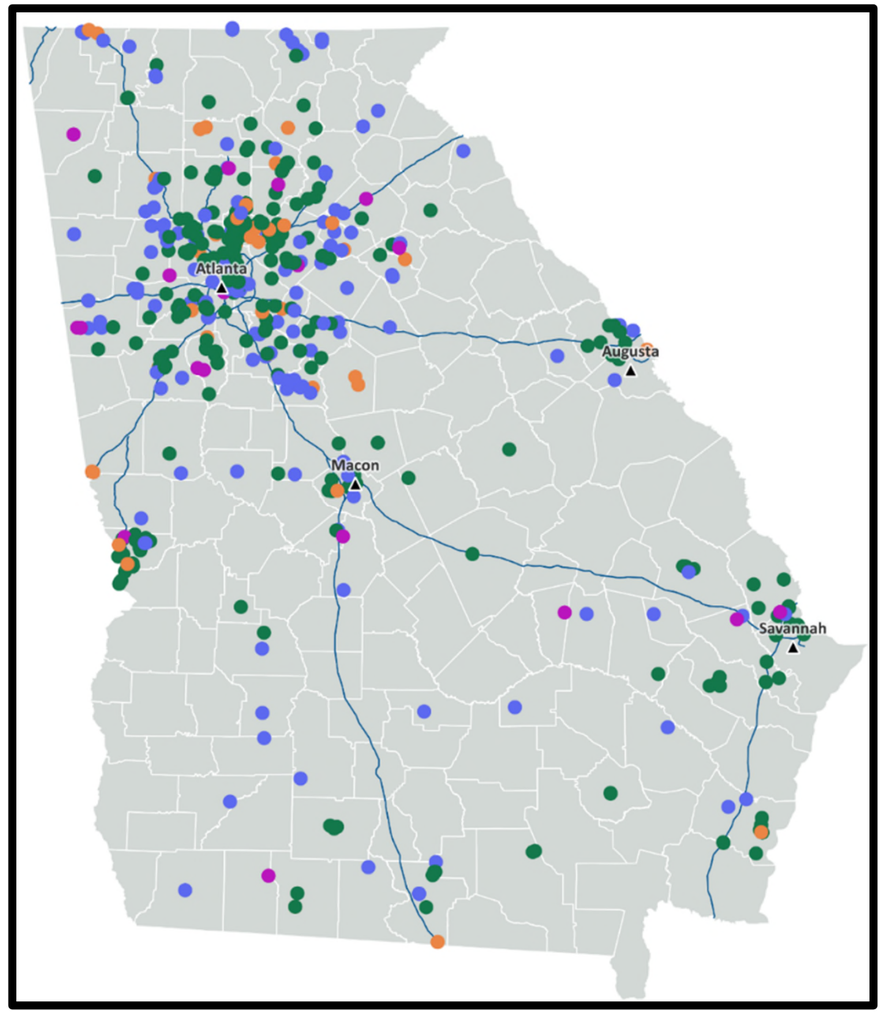
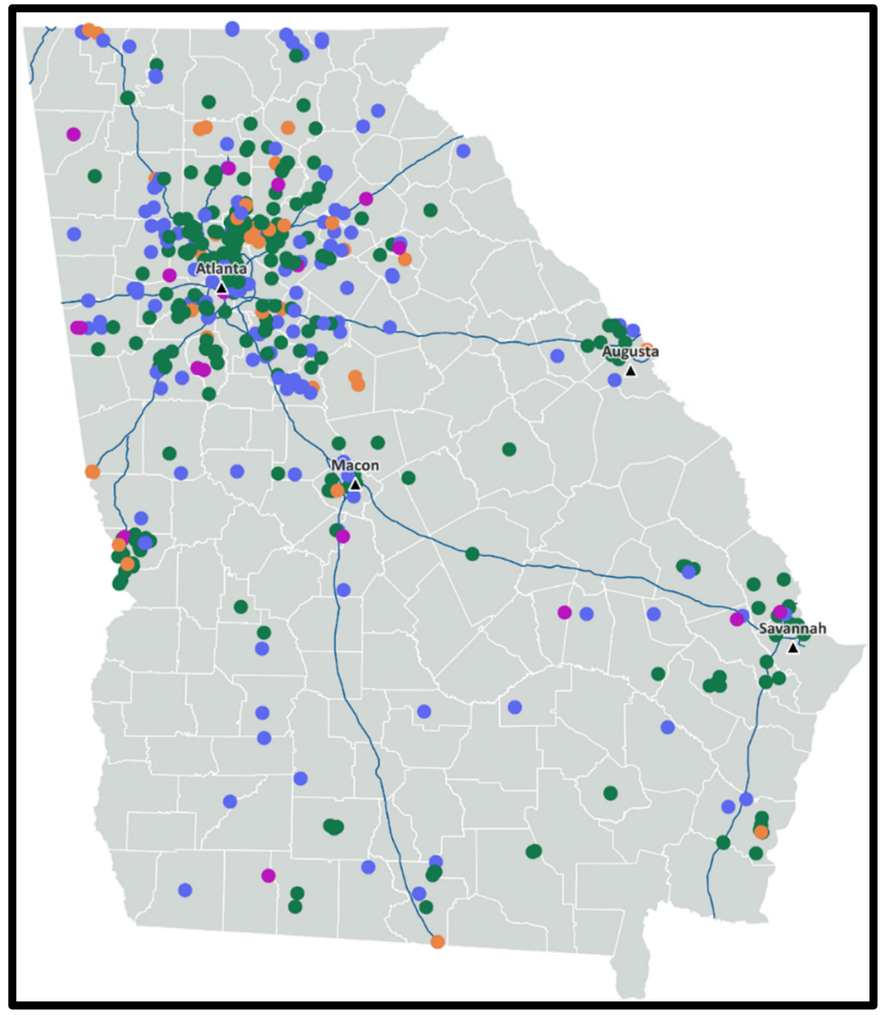
- 98 in operation on the State Route System



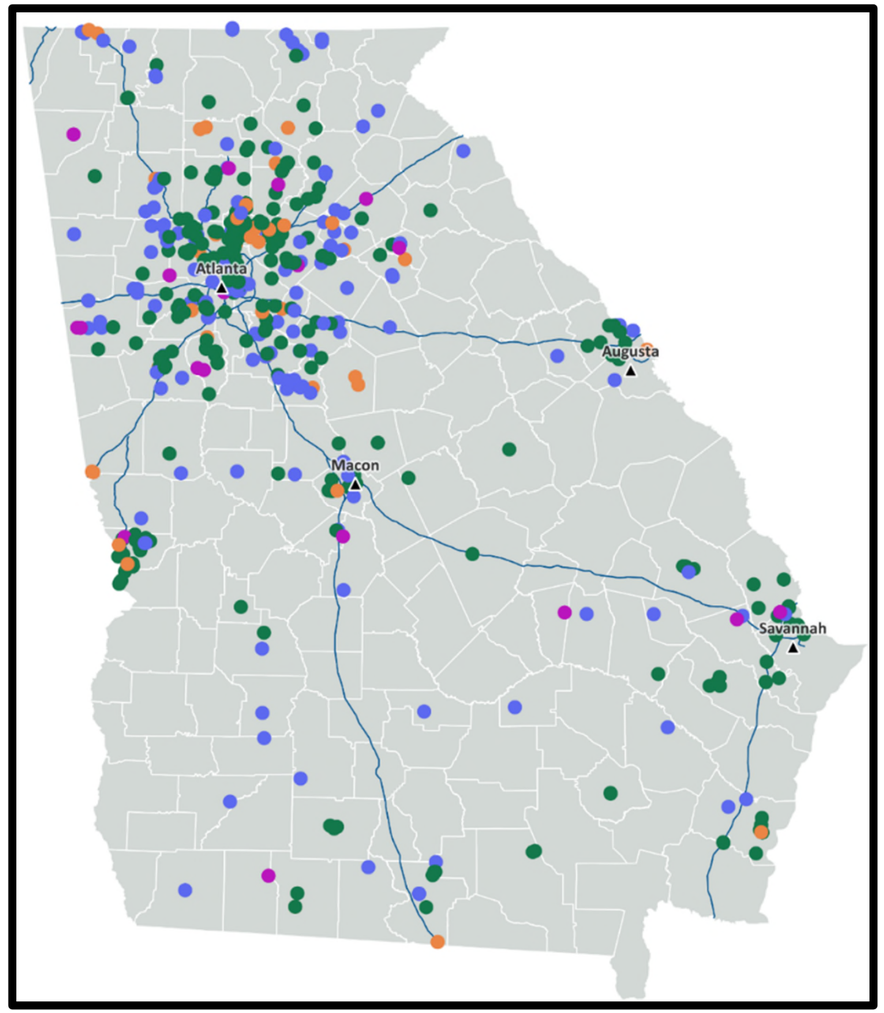
Roundabouts in Georgia

- Standalone intersection projects and in corridor/longitudinal projects
- 98 in operation on the State Route System
- 50 under construction on the State Route System



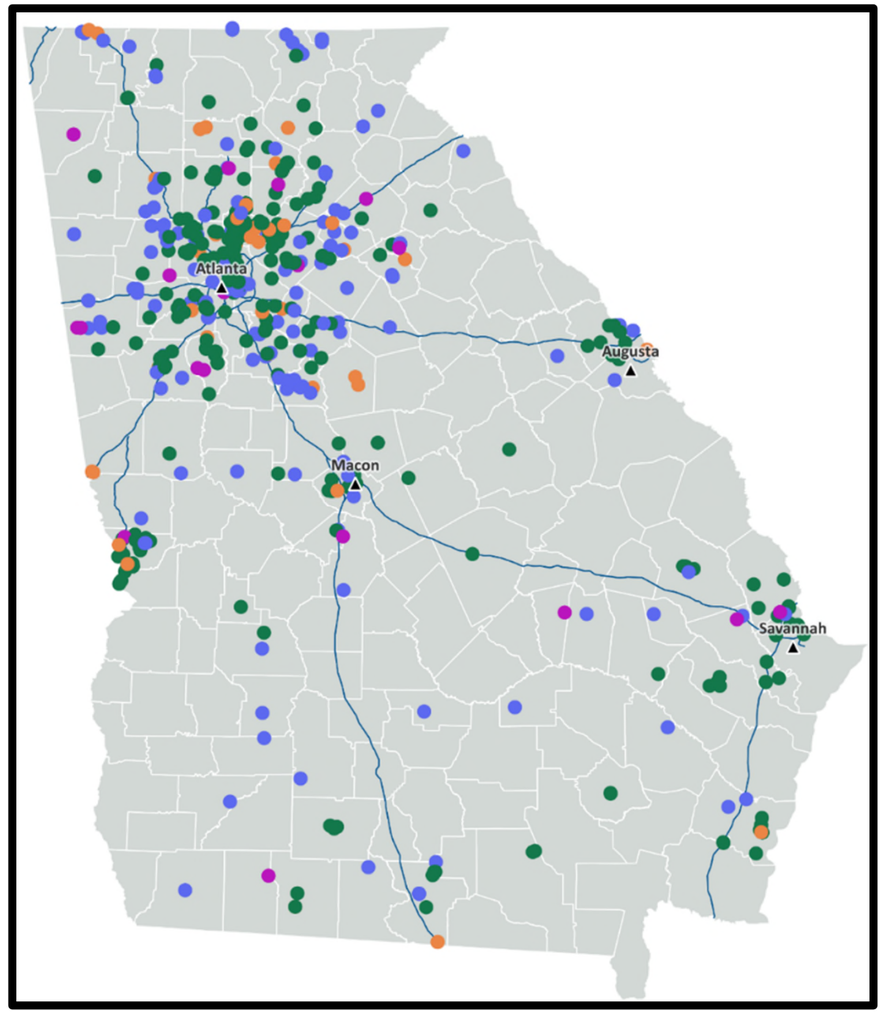
Roundabouts in Georgia

- Standalone intersection projects and in corridor/longitudinal projects
- 98 in operation on the State Route System
- 50 under construction on the State Route System
- 240 “under development” on the State Route System



Roundabouts in Georgia

- Standalone intersection projects and in corridor/longitudinal projects
- 98 in operation on the State Route System
- 50 under construction on the State Route System
- 240 “under development” on the State Route System
- ~400 total in Georgia operational and open to traffic



Incorporating Roundabouts into PDP Projects

Collaborating with Internal Stakeholders and Respective Responsibilities

Division / Office	Respective Responsibilities

Division / Office

Respective Responsibilities

- Program Delivery

Division / Office	Respective Responsibilities
• Program Delivery	• Funding/Programming, project management, and *The PDP Manual*

Division / Office

- Program Delivery
- Office of Design Policy and Support

Respective Responsibilities

- Funding/Programming, project management, and *The PDP Manual*

Division / Office

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Respective Responsibilities

- Funding/Programming, project management, and *The PDP Manual*
- Design criteria, exceptions/variances, policies, and *The Design Policy Manual*

Division / Office

- Program Delivery
- Office of Design Policy and Support
- Division of Field Services (District Offices)

Respective Responsibilities

- Funding/Programming, project management, and *The PDP Manual*
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• Program Delivery	• Funding/Programming, project management, and *The PDP Manual*
• Office of Design Policy and Support	• Design criteria, exceptions/variances, policies, and *The Design Policy Manual*
• Division of Field Services (District Offices)	• Construction supervision, local outreach/coordination, and lifecycle maintenance

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• Office of Engineering Services	

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• Office of Traffic Operations	• RAID SMEs, funding and program management for benefit/cost –driven projects/programs, ICE review

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• State Construction, State Maintenance, State & District Utilities, Office of Environmental Services, etc..	

Office of Traffic Operations Responsibilities

Chapter 3. Geometric Design

3.1 Design Process and Workflow

Achieving an optimal roundabout geometry requires a thorough exploration of the 'design space': location context, geometric requirements, and potential trade-offs of safety with capacity and/or cost. Concept sketching allows initial exploration of feasibility and potential impacts before investing significant effort in detail design elements. When sketching conceptual layouts, it is important to produce the most cost-effective layout, with minimal tradeoffs, for a given set of constraints and location context.

To limit the number of iterations of design, the operational analysis should be completed before the general footprint of a roundabout is designed. Figure 3-1 summarizes this process to align with the stages of project development for GDOT PDP Projects including roundabouts. Roundabouts constructed using non-PDP delivery mechanisms such as: Quick Response projects, special encroachment & driveway permits, a non-GDOT roadway, etc. may use an abbreviated project development process.

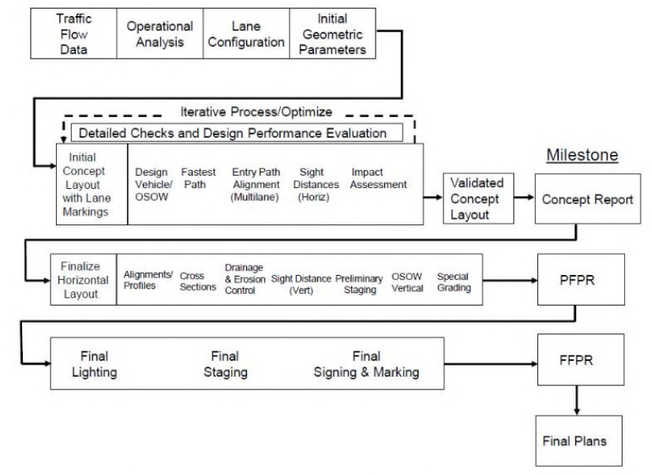
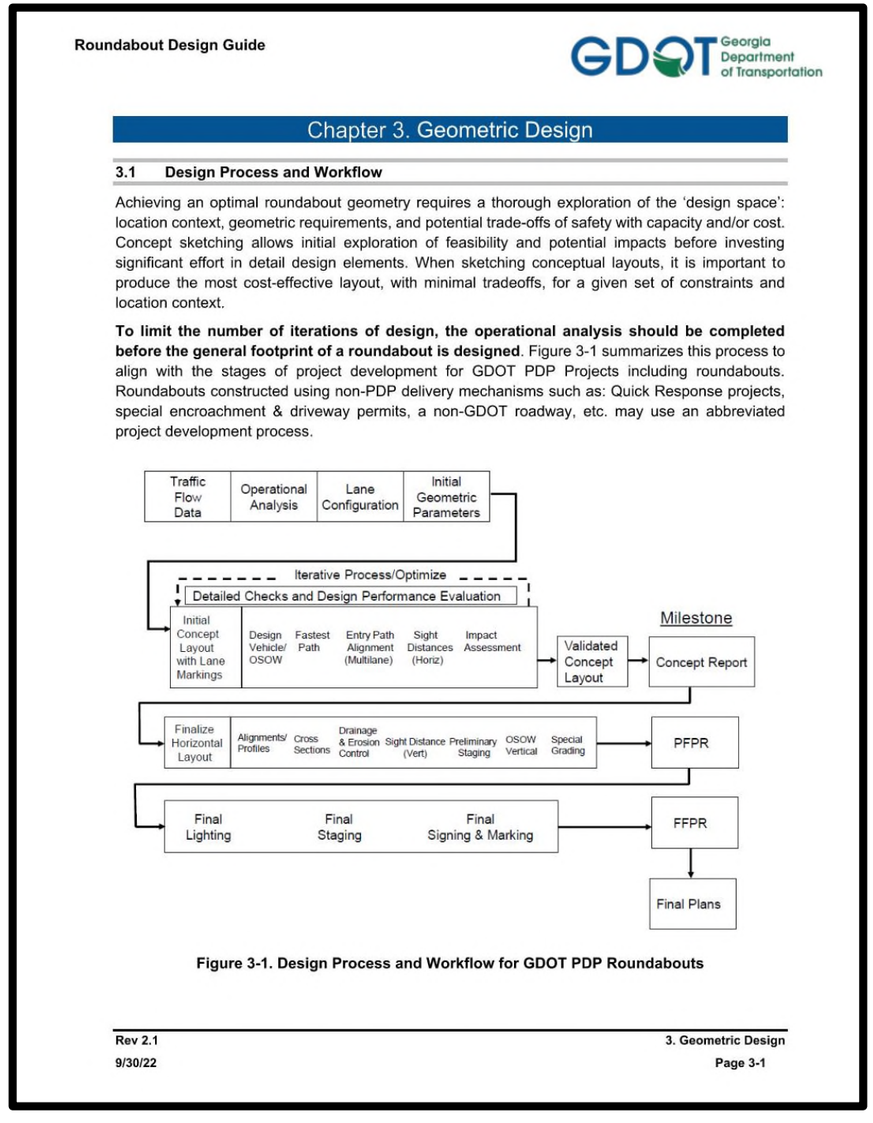


Figure 3-1. Design Process and Workflow for GDOT PDP Roundabouts

Office of Traffic Operations Responsibilities

- Funding & Program Management for Operational Improvement and Safety Improvement projects



Roundabout Design Guide

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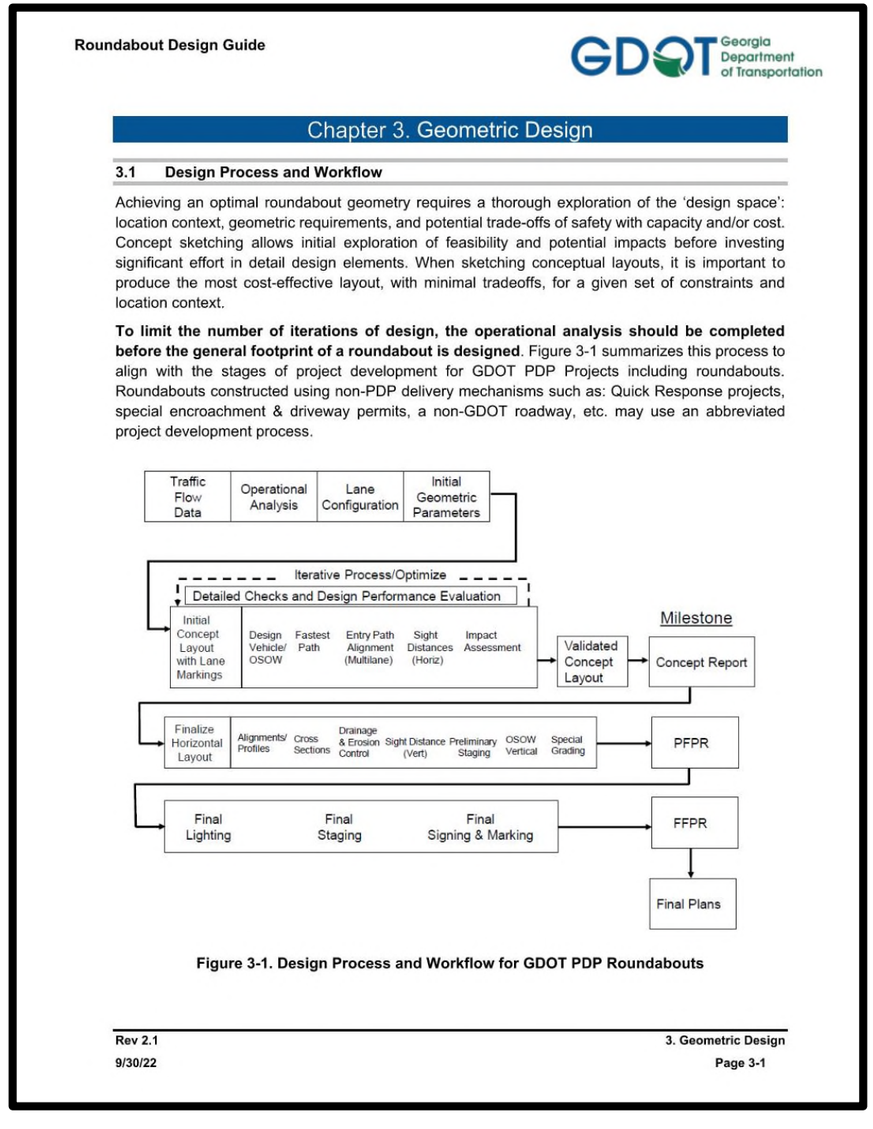

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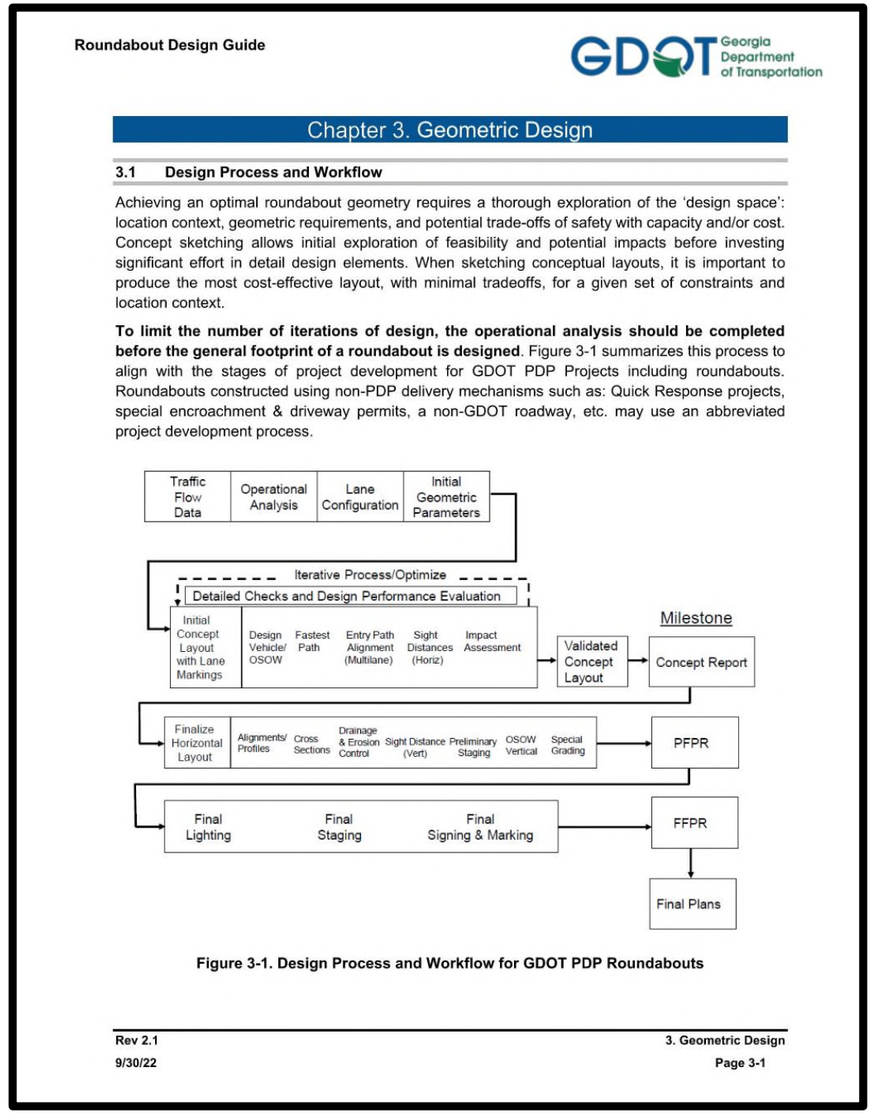

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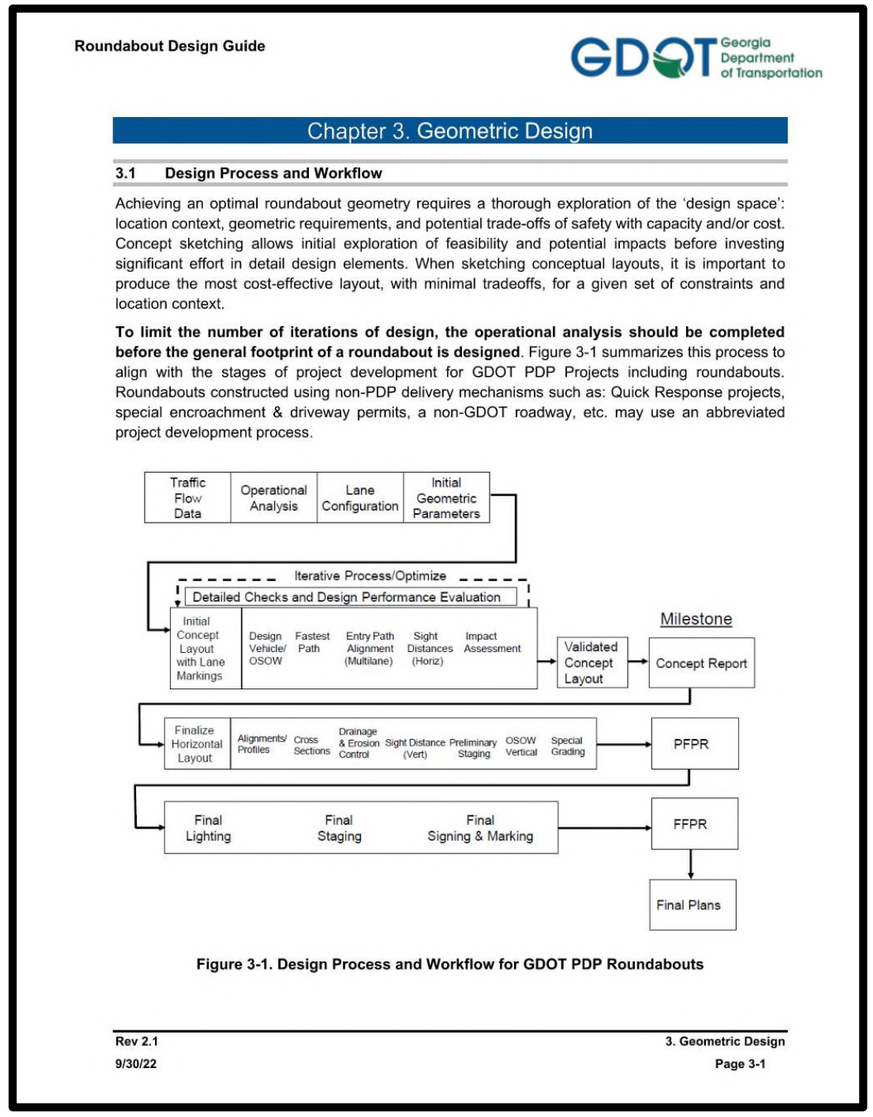
- Intersection Control Evaluation (ICE) review
- Facilitate public/stakeholder involvement



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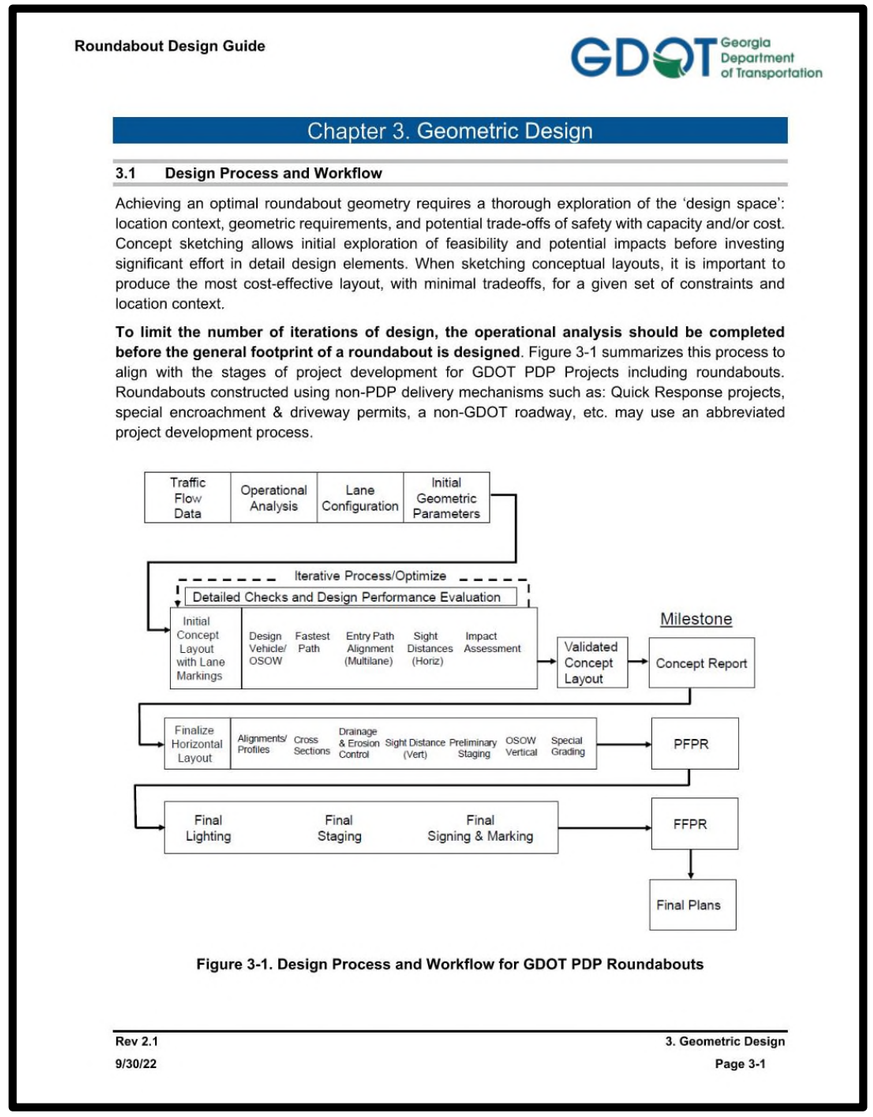
Office of Traffic Operations Responsibilities

- Funding & Program Management for Operational Improvement and Safety Improvement projects
- RAID Team – Department subject matter experts (SMEs)
- Intersection Control Evaluation (ICE) review
- Facilitate public/stakeholder involvement
- Support practical designs to fit projects' need & purpose without detrimental affects to schedule or budget



Roundabout Design Guide

GDOT Georgia Department of Transportation

Chapter 3. Geometric Design

3.1 Design Process and Workflow

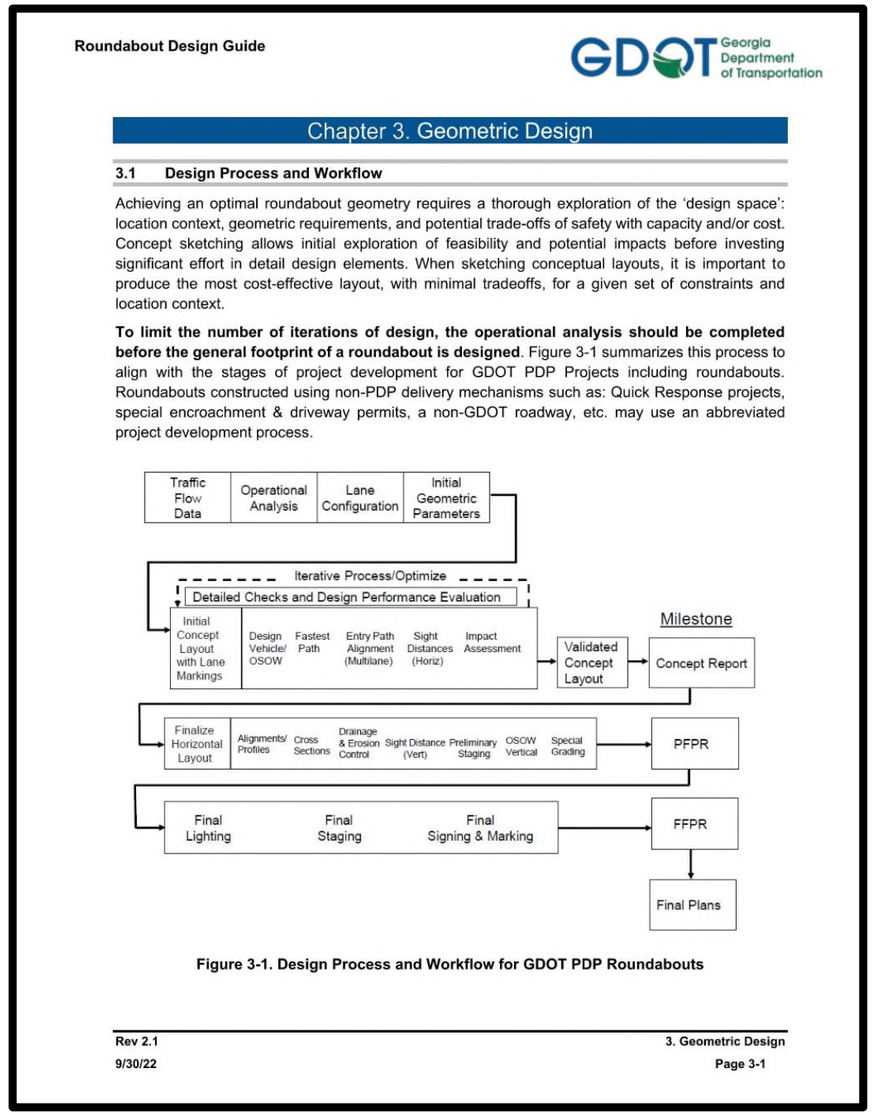
Achieving an optimal roundabout geometry requires a thorough exploration of the 'design space': location context, geometric requirements, and potential trade-offs of safety with capacity and/or cost. Concept sketching allows initial exploration of feasibility and potential impacts before investing significant effort in detail design elements. When sketching conceptual layouts, it is important to produce the most cost-effective layout, with minimal tradeoffs, for a given set of constraints and location context.

To limit the number of iterations of design, the operational analysis should be completed before the general footprint of a roundabout is designed. Figure 3-1 summarizes this process to align with the stages of project development for GDOT PDP Projects including roundabouts. Roundabouts constructed using non-PDP delivery mechanisms such as: Quick Response projects, special encroachment & driveway permits, a non-GDOT roadway, etc. may use an abbreviated project development process.

Figure 3-1. Design Process and Workflow for GDOT PDP Roundabouts

Office of Traffic Operations Responsibilities

- Funding & Program Management for Operational Improvement and Safety Improvement projects
- RAID Team – Department subject matter experts (SMEs)
- Intersection Control Evaluation (ICE) review
- Facilitate public/stakeholder involvement
- Support practical designs to fit projects' need & purpose without detrimental affects to schedule or budget
- Ensure consistent, safe, effective statewide implementation



Roundabout Design Guide

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Roundabout and Alternative Intersection Design (RAID)
Team Responsibilities and Functions

Design Foundations

- Roundabout Design Guide
- Design Training (in-person & hybrid)
- Intersection Control Evaluation (ICE) Training

Support Services

- ICE Review
- Concept Validation / Peer Review: Performance Checks and Operational Analysis
- Avoidance and Minimization Measures Meeting (A3M), Practical Design / 30%, Public Involvement
- Preliminary and Final Field Plan Reviews (PFPR & FFPR)
- On-Call Contract Services
- UOC Reviews & “In-Service” Reviews

Roundabout and Alternative Intersection Design (RAID)
Team Responsibilities and Functions

Pre-Concept & Concept

- Roundabout Design Guide
- Design Training (in-person & hybrid)
- ICE Review & Training
- Concept Validation, Performance Checks, Operational Analysis

Preliminary Design

- A3M / Practical Design
- Public Involvement
- Preliminary Field Plan Review
- On-Call Contract Services

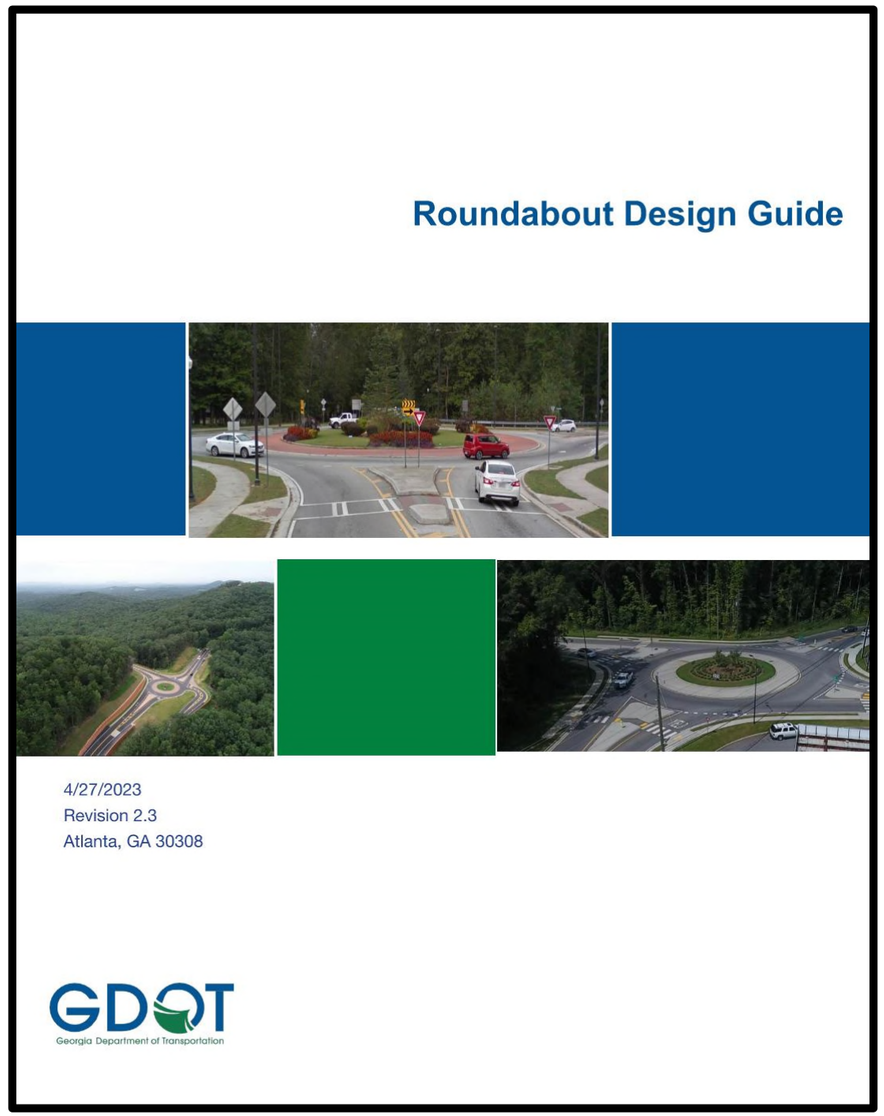
Final Design +

- Final Field Plan Review
- On-Call Contract Services
- UOC Reviews
- Post-Construction “In-Service” Reviews

Georgia Department of Transportation

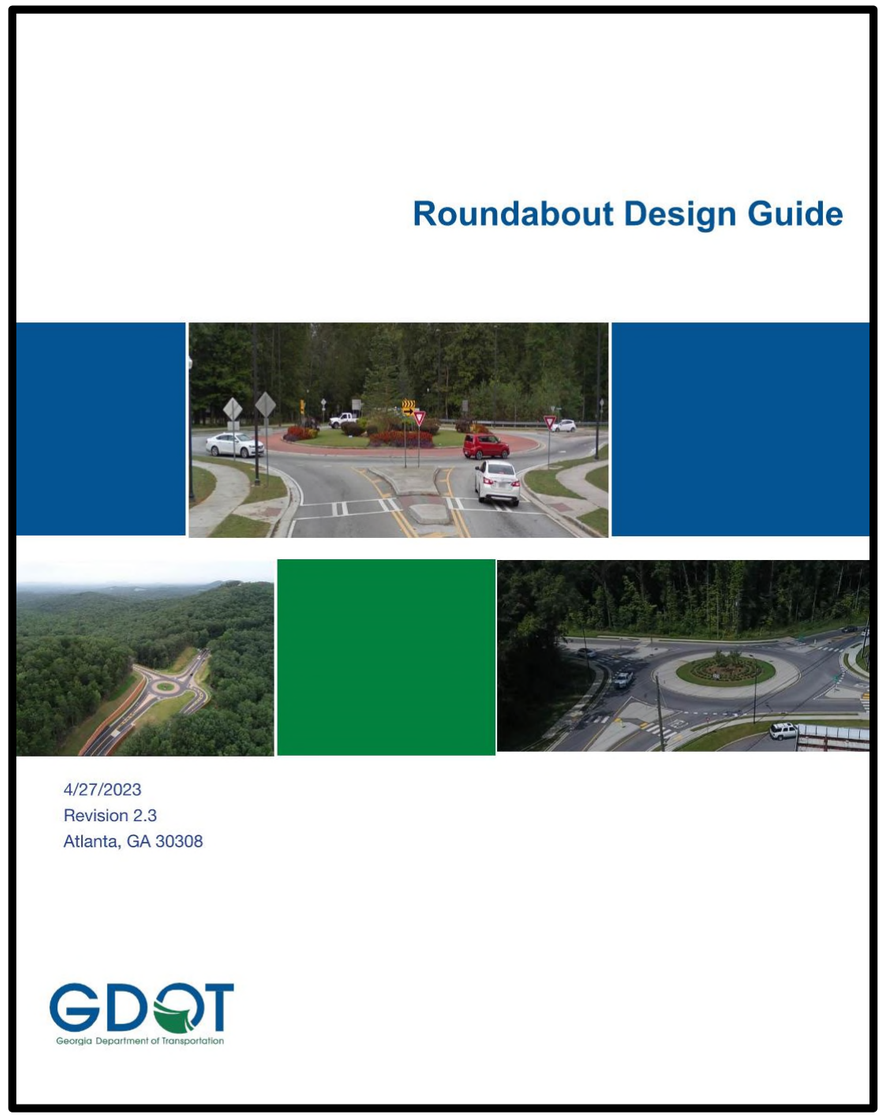
Roundabout Design Guide

Roundabout Design Guide



Roundabout Design Guide

- Compare to TDOT’s Roundabout Design Reference Guide



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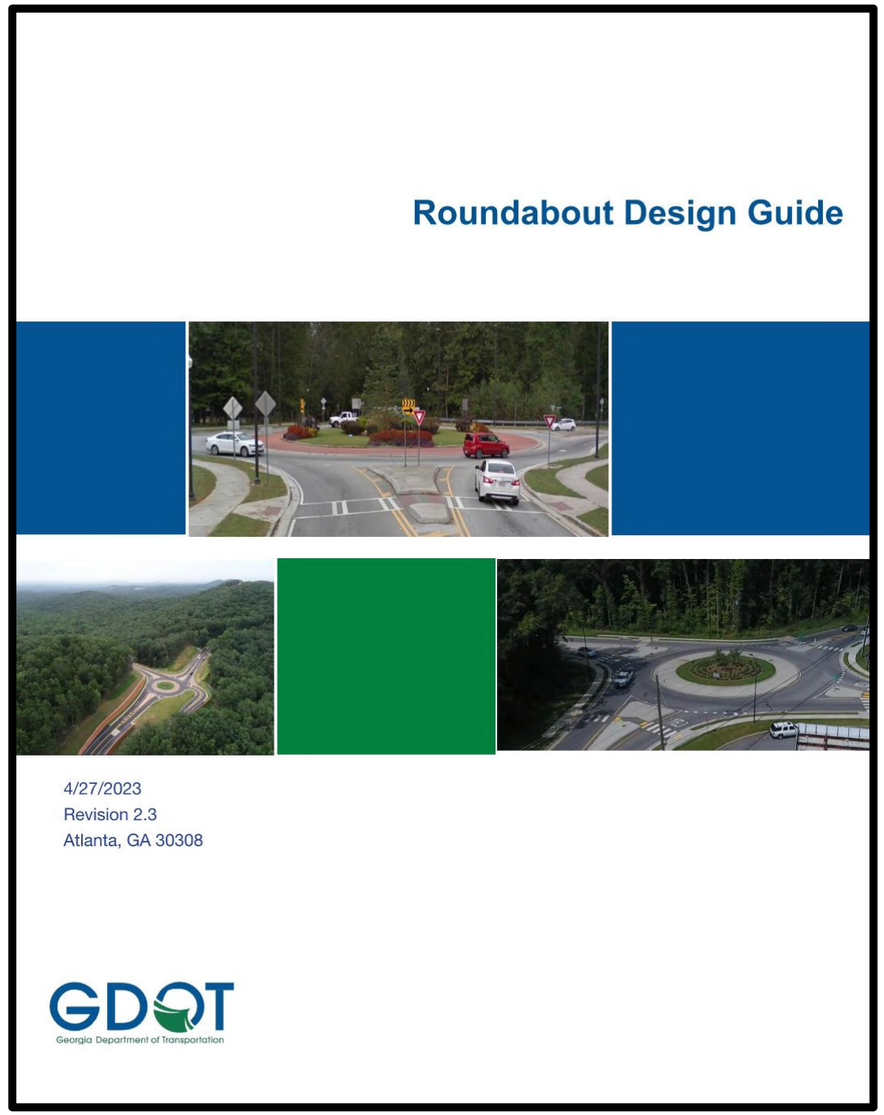
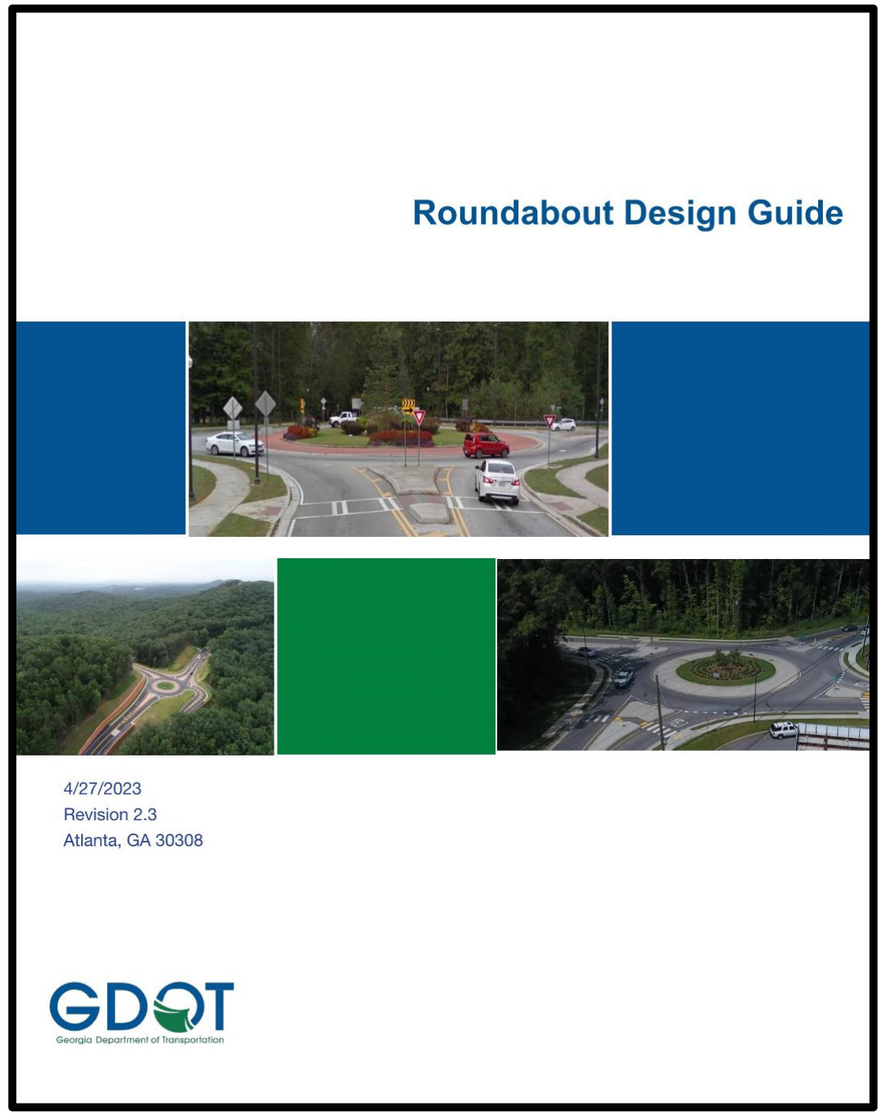
- Compare to TDOT's Roundabout Design Reference Guide
- "…Principles-based, performance-driven design…"



Roundabout Design Guide

- Compare to TDOT's Roundabout Design Reference Guide
- "…Principles-based, performance-driven design…"
- Compliments GDOT's Design Policy Manual and Synthesizes Department preference from NCHRP 672/1043



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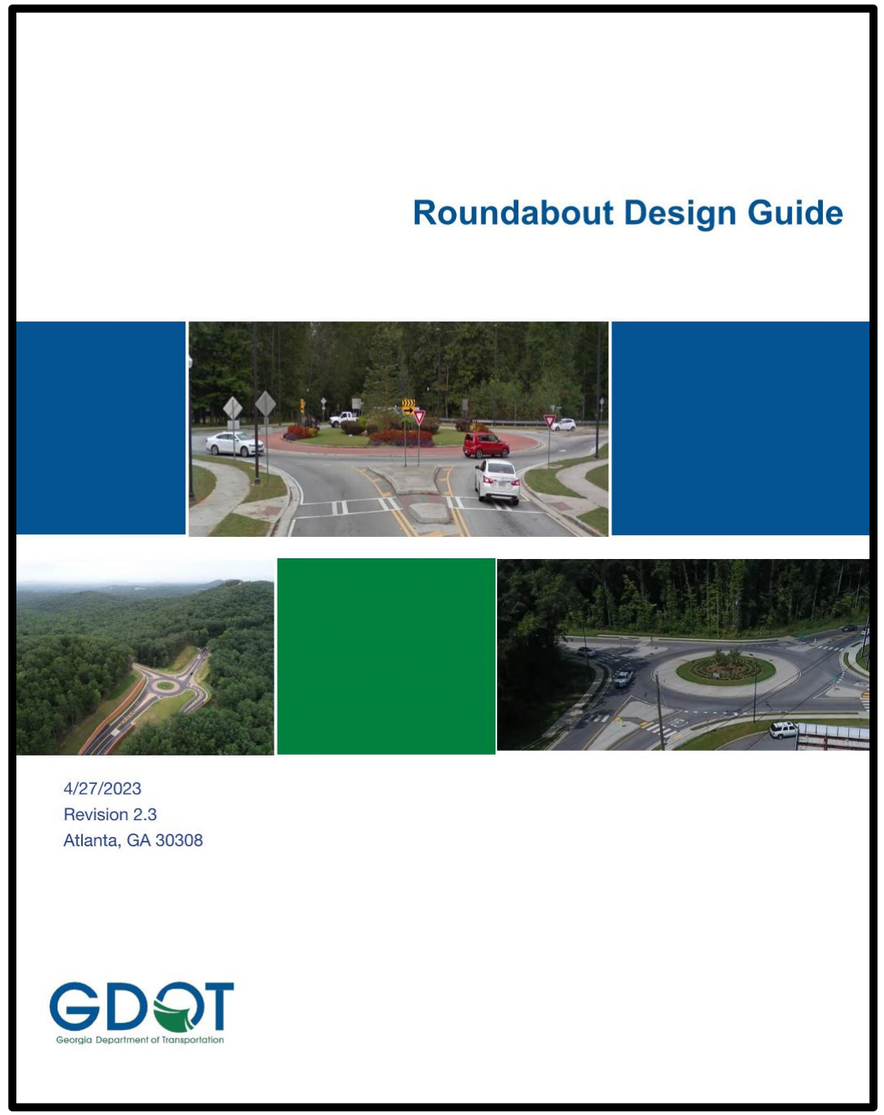

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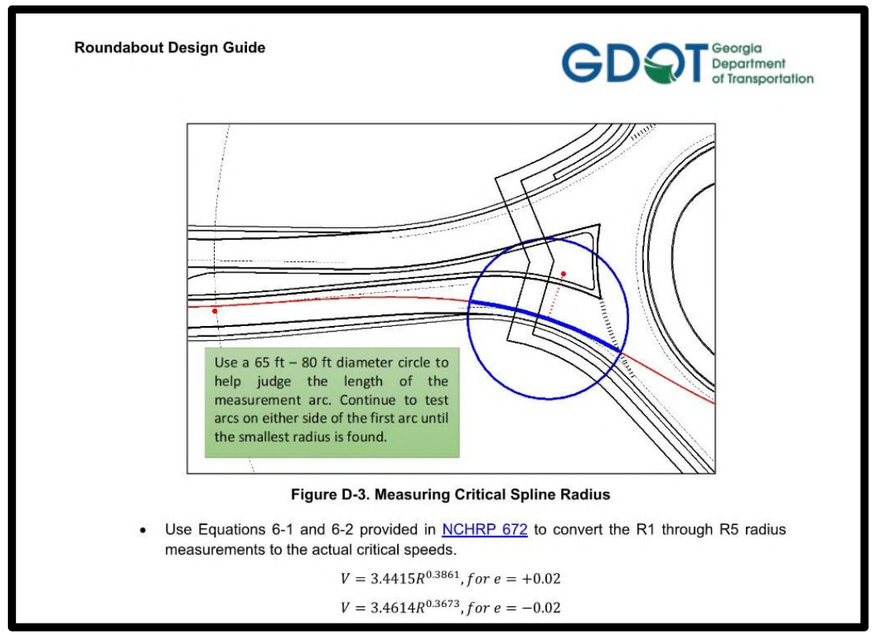


Roundabout Design Guide

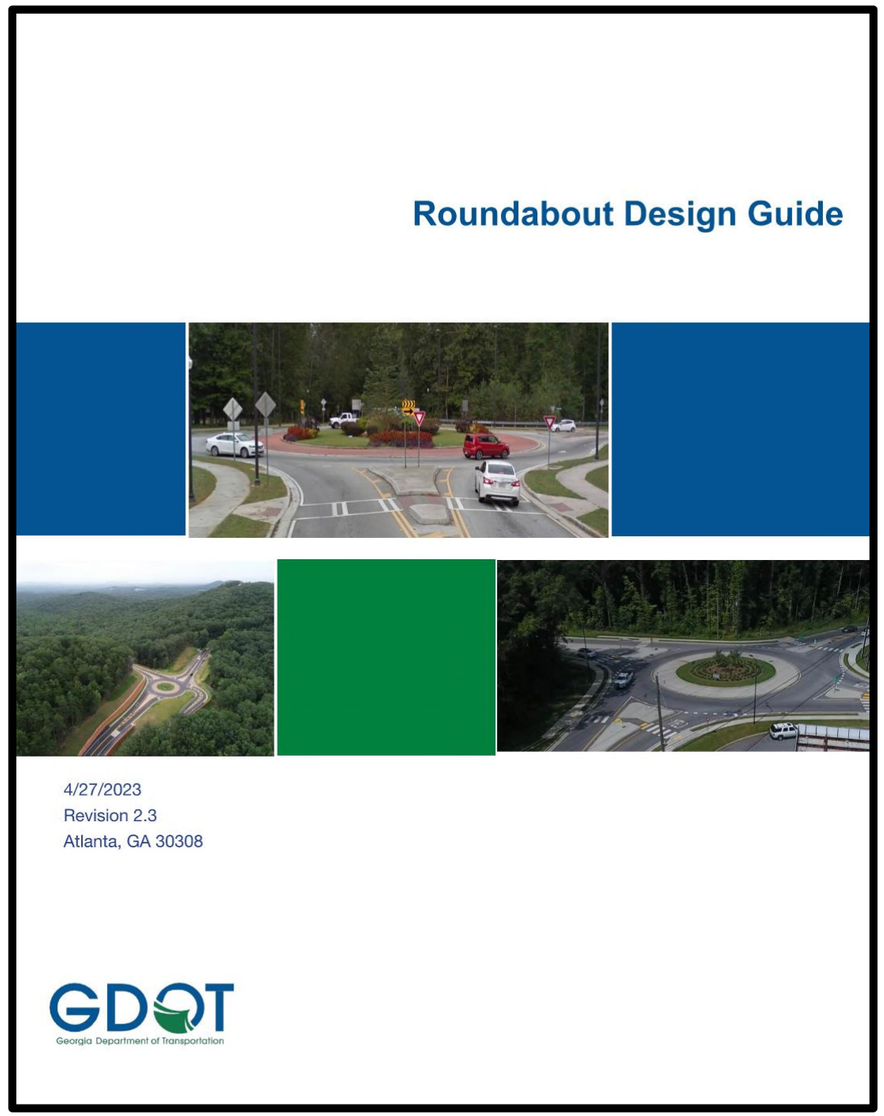
GDOT Georgia Department of Transportation

Figure D-3. Measuring Critical Spline Radius

- Use Equations 6-1 and 6-2 provided in NCHRP 672 to convert the R1 through R5 radius measurements to the actual critical speeds.

$$V = 3.4415R^{0.3861}, for\ e = +0.02$$

$$V = 3.4614R^{0.3673}, for\ e = -0.02$$



Roundabout Design Guide

4/27/2023
Revision 2.3
Atlanta, GA 30308

GDOT Georgia Department of Transportation

Internal Roundabout Design Training

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- “Hands-on” compliment to the Roundabout Design Guide

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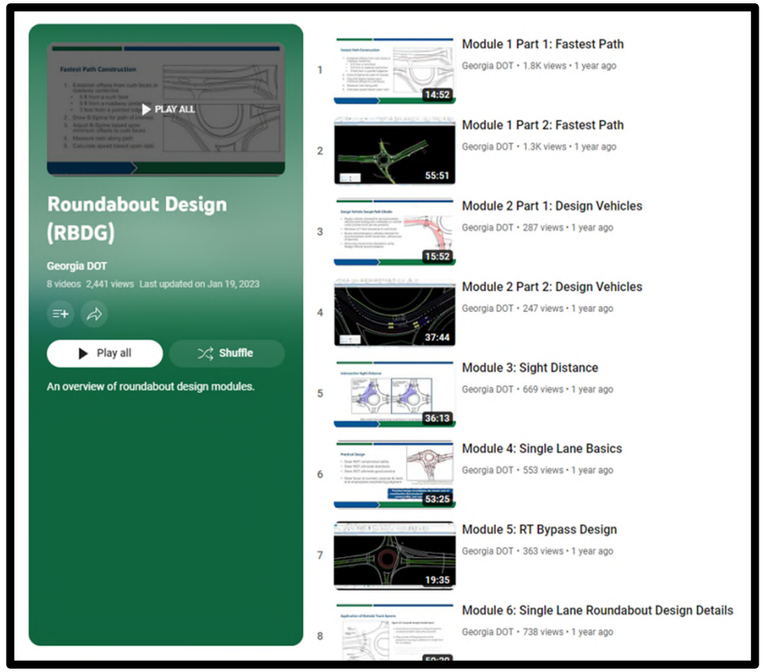

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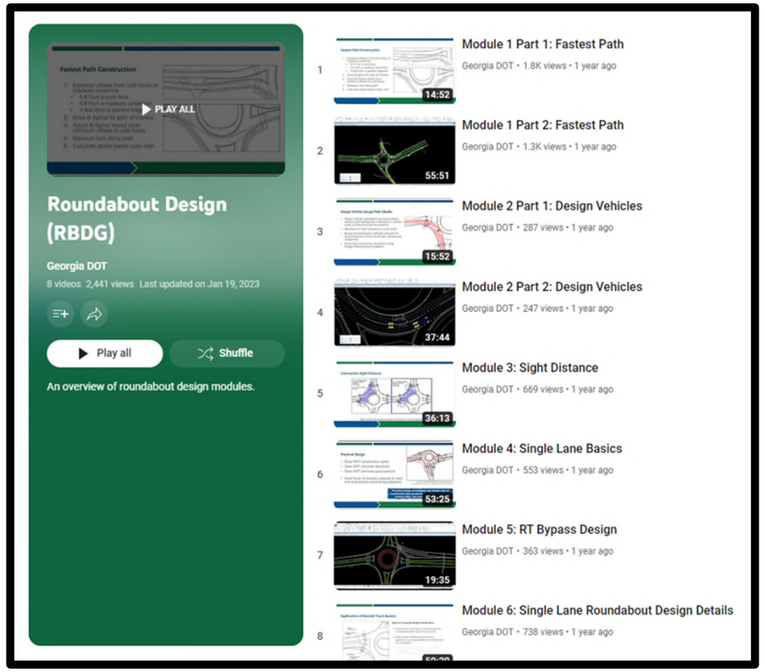

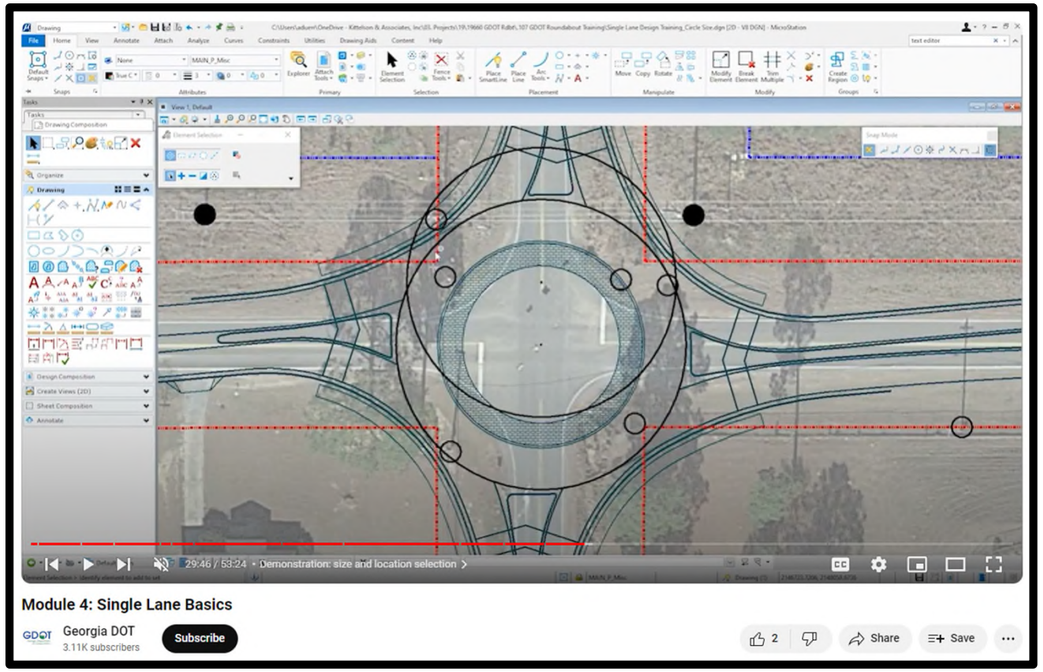

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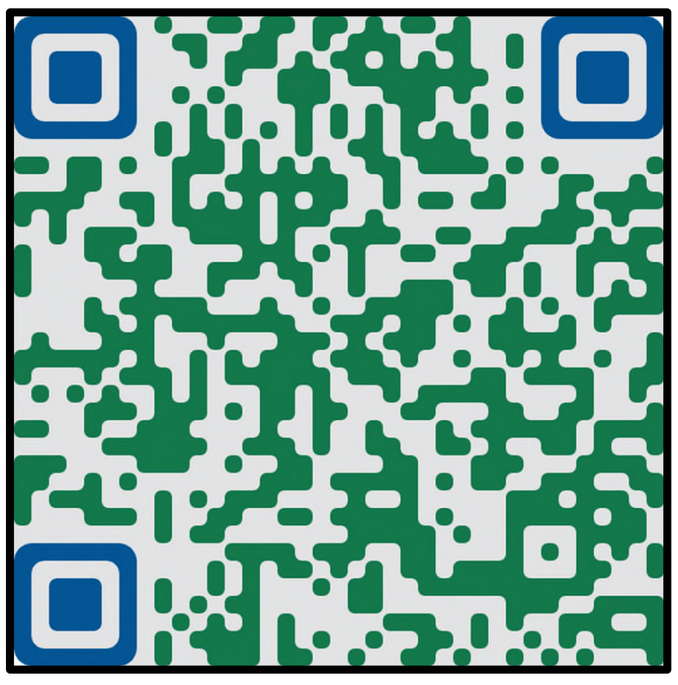

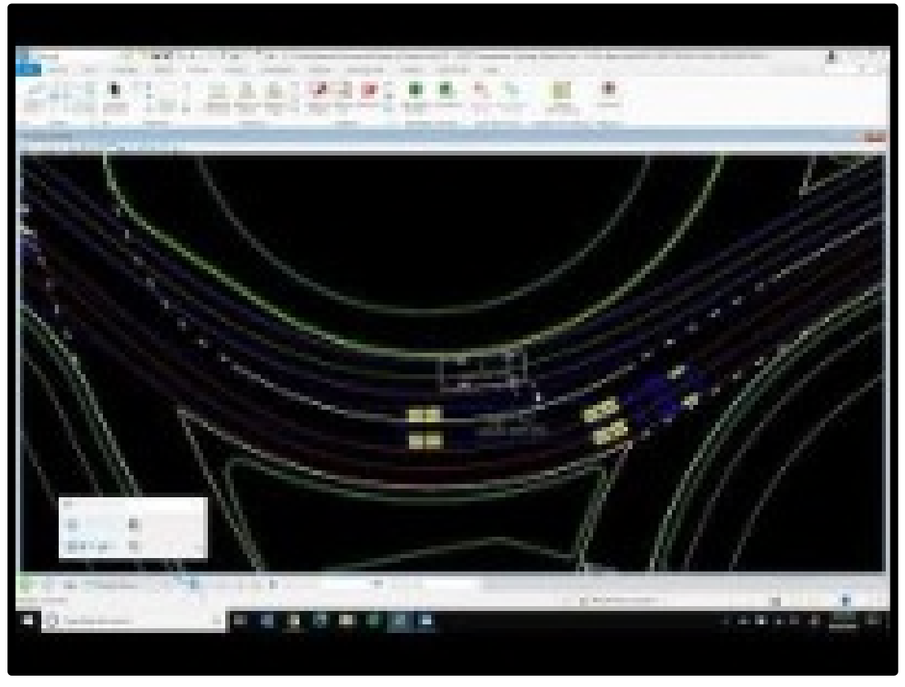

Intersection Control Evaluation (ICE)

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- Traceable, Transparent, and Objective analysis

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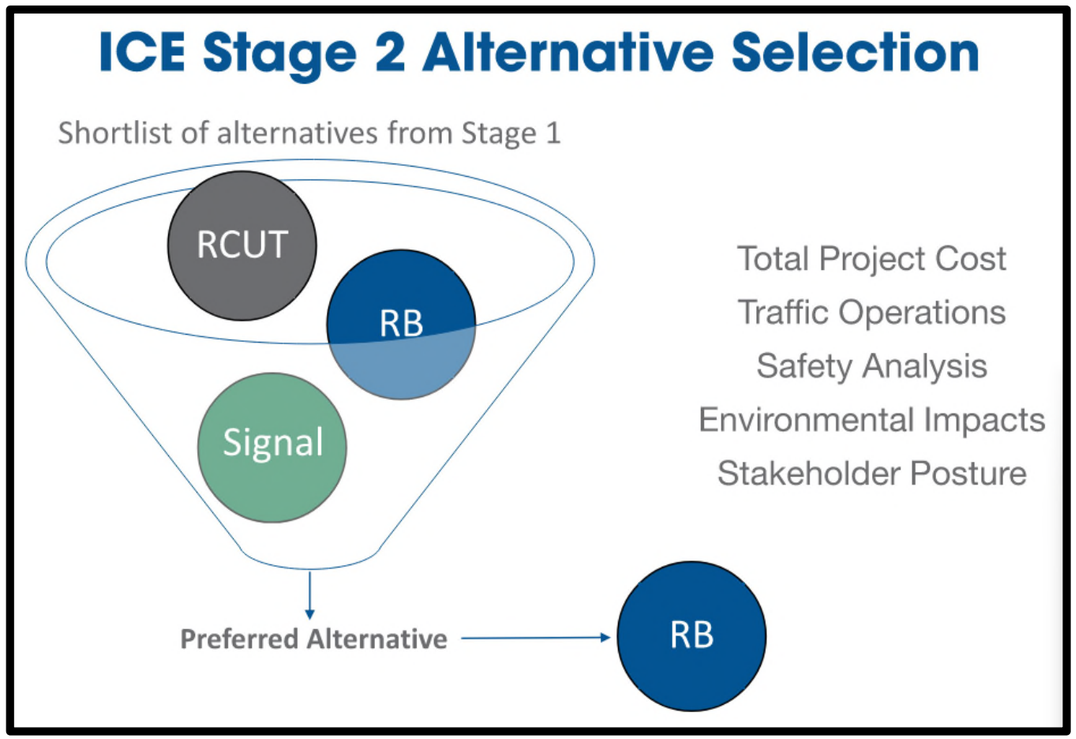

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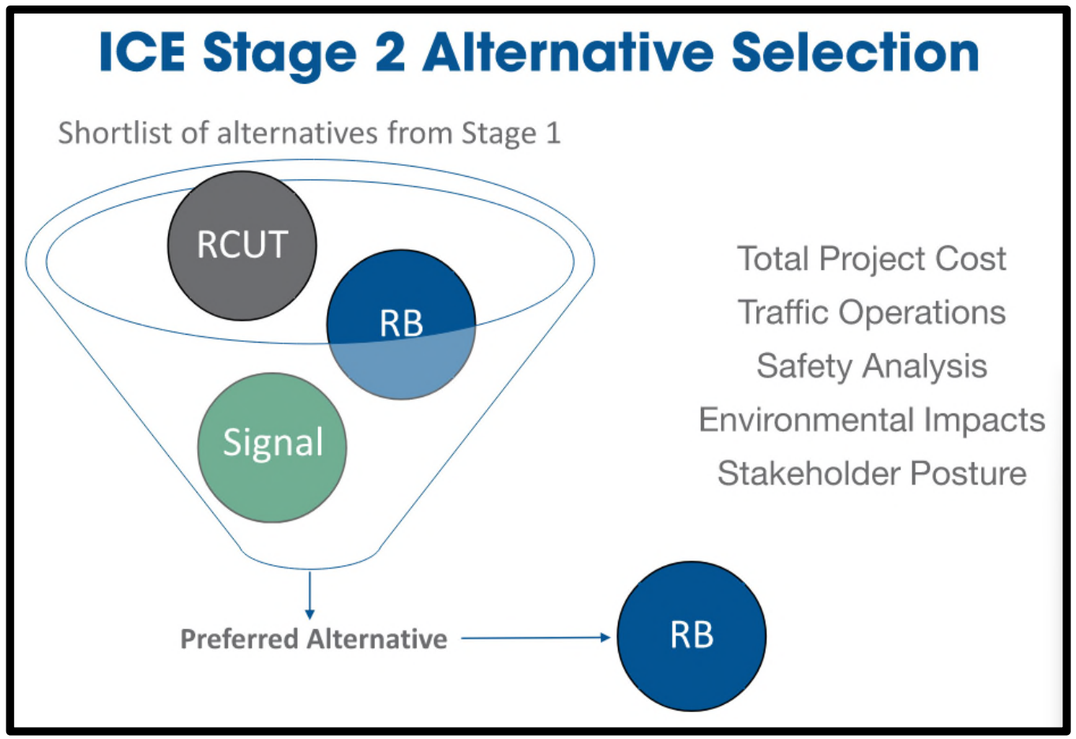
- Traceable, Transparent, and Objective analysis
- Required by GDOT Policy, spreadsheet-based tool



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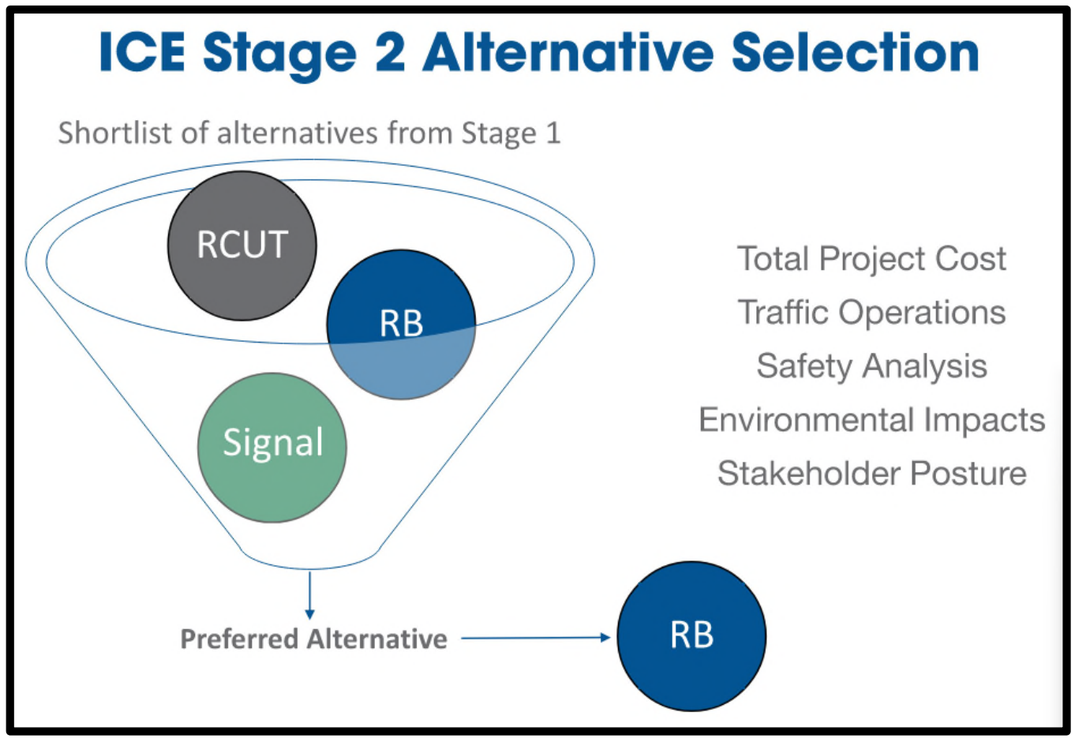
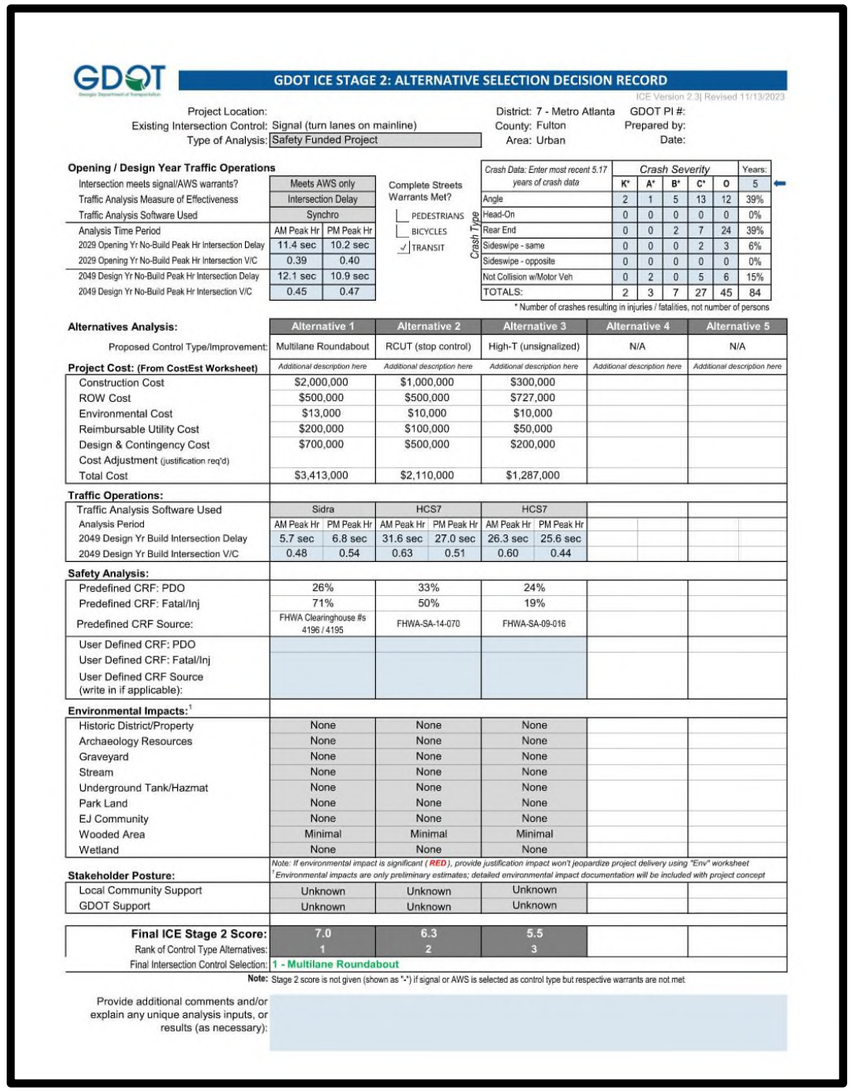




GDOT ICE STAGE 2: ALTERNATIVE SELECTION DECISION RECORD

ICE Version 2.3| Revised 11/13/2023

Project Location:
Existing Intersection Control: Signal (turn lanes on mainline)
Type of Analysis: Safety Funded Project

District: 7 - Metro Atlanta
County: Fulton
Area: Urban

GDOT PI #:
Prepared by:
Date:

Opening / Design Year Traffic Operations

Intersection meets signal/AWS warrants?	Meets AWS only	
Traffic Analysis Measure of Effectiveness	Intersection Delay	
Traffic Analysis Software Used	Synchro	
Analysis Time Period	AM Peak Hr	PM Peak Hr
2029 Opening Yr No-Build Peak Hr Intersection Delay	11.4 sec	10.2 sec
2029 Opening Yr No-Build Peak Hr Intersection V/C	0.39	0.40
2049 Design Yr No-Build Peak Hr Intersection Delay	12.1 sec	10.9 sec
2049 Design Yr No-Build Peak Hr Intersection V/C	0.45	0.47

Complete Streets Warrants Met?
- PEDESTRIANS
- BICYCLES
- ✓ TRANSIT

Crash Type

Crash Data: Enter most recent 5.17 years of crash data	Crash Severity K*	A*	B*	C*	O	Years: 5
Angle	2	1	5	13	12	39%
Head-On	0	0	0	0	0	0%
Rear End	0	0	2	7	24	39%
Sideswipe - same	0	0	0	2	3	6%
Sideswipe - opposite	0	0	0	0	0	0%
Not Collision w/Motor Veh	0	2	0	5	6	15%
TOTALS:	2	3	7	27	45	84

* Number of crashes resulting in injuries / fatalities, not number of persons

Alternatives Analysis:	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Proposed Control Type/Improvement:	Multilane Roundabout	RCUT (stop control)	High-T (unsignalized)	N/A	N/A
Project Cost: (From CostEst Worksheet)	*Additional description here*	*Additional description here*	*Additional description here*	*Additional description here*	*Additional description here*
Construction Cost	$2,000,000	$1,000,000	$300,000		
ROW Cost	$500,000	$500,000	$727,000		
Environmental Cost	$13,000	$10,000	$10,000		
Reimbursable Utility Cost	$200,000	$100,000	$50,000		
Design & Contingency Cost	$700,000	$500,000	$200,000		
Cost Adjustment (justification req'd)					
Total Cost	$3,413,000	$2,110,000	$1,287,000		
Traffic Operations:					
Traffic Analysis Software Used	Sidra		HCS7		HCS7			
Analysis Period	AM Peak Hr	PM Peak Hr	AM Peak Hr	PM Peak Hr	AM Peak Hr	PM Peak Hr		
2049 Design Yr Build Intersection Delay	5.7 sec	6.8 sec	31.6 sec	27.0 sec	26.3 sec	25.6 sec		
2049 Design Yr Build Intersection V/C	0.48	0.54	0.63	0.51	0.60	0.44		
Safety Analysis:					
Predefined CRF: PDO	26%	33%	24%		
Predefined CRF: Fatal/Inj	71%	50%	19%		
Predefined CRF Source:	FHWA Clearinghouse #s 4196 / 4195	FHWA-SA-14-070	FHWA-SA-09-016		
User Defined CRF: PDO					
User Defined CRF: Fatal/Inj					
User Defined CRF Source (write in if applicable):					
Environmental Impacts:[1]					
Historic District/Property	None	None	None		
Archaeology Resources	None	None	None		
Graveyard	None	None	None		
Stream	None	None	None		
Underground Tank/Hazmat	None	None	None		
Park Land	None	None	None		
EJ Community	None	None	None		
Wooded Area	Minimal	Minimal	Minimal		
Wetland	None	None	None		
Stakeholder Posture:	*Note: If environmental impact is significant (RED), provide justification impact won't jeopardize project delivery using "Env" worksheet* [1]*Environmental impacts are only preliminary estimates; detailed environmental impact documentation will be included with project concept*				
Local Community Support	Unknown	Unknown	Unknown		
GDOT Support	Unknown	Unknown	Unknown		
Final ICE Stage 2 Score:	7.0	6.3	5.5		
Rank of Control Type Alternatives:	1	2	3		
Final Intersection Control Selection:	1 - Multilane Roundabout				

Note: Stage 2 score is not given (shown as "-") if signal or AWS is selected as control type but respective warrants are not met

Provide additional comments and/or explain any unique analysis inputs, or results (as necessary):

Concept Validation

Concept Validation

Operational Analysis

- Validate design life operations
- Capacity, Configuration, and Footprint
- Avoid “over-building”

Concept Validation

Operational Analysis

- Validate design life operations
- Capacity, Configuration, and Footprint
- Avoid “over-building”

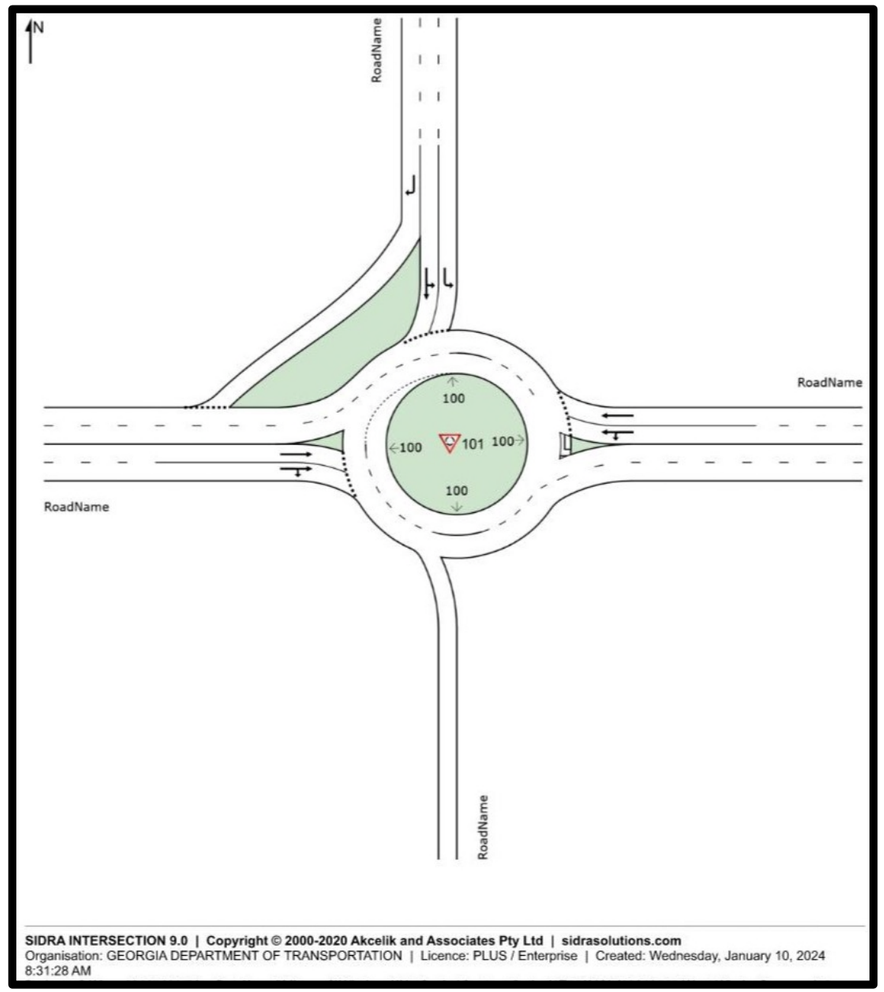
Performance Checks / Peer Review

- Verify standard/controlling criteria for driver and other road user safety
- Determine proper accommodations for design vehicle swept paths
- Practical design concerns

Concept Validation – Operational Analysis

Concept Validation – Operational Analysis

- Validate functionality of intersection for 20-year life cycle



Concept Validation – Operational Analysis

- Determine size/footprint, number of lanes, lane assignments, etc.

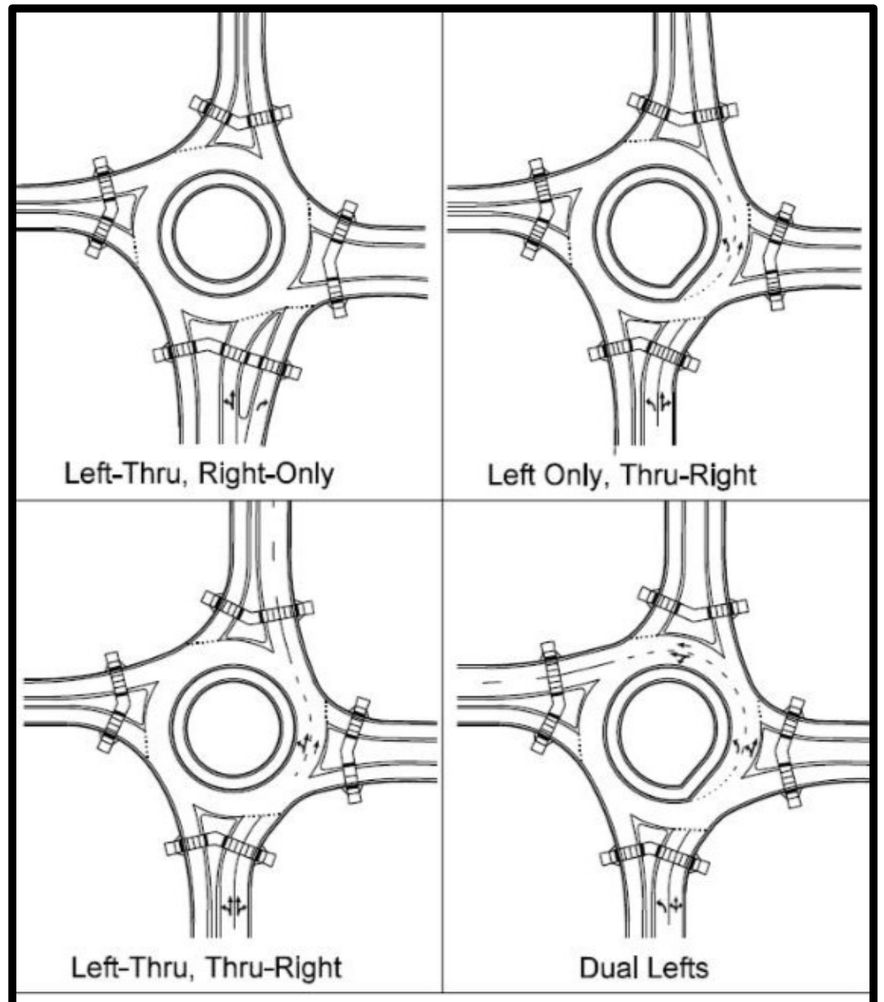
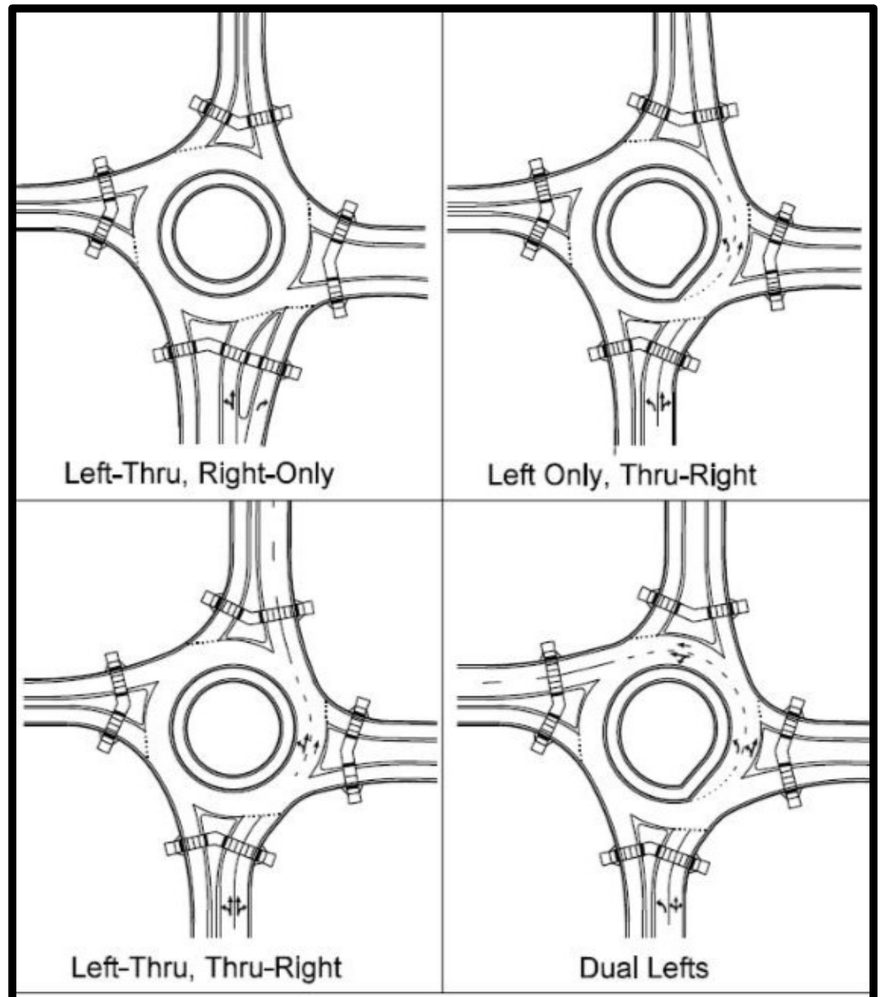


Figure 2-1. Lane Configuration Options for Two-lane Entry

Concept Validation – Operational Analysis

- Determine size/footprint, number of lanes, lane assignments, etc.
- Validate need for bypasses, expandable designs, metering



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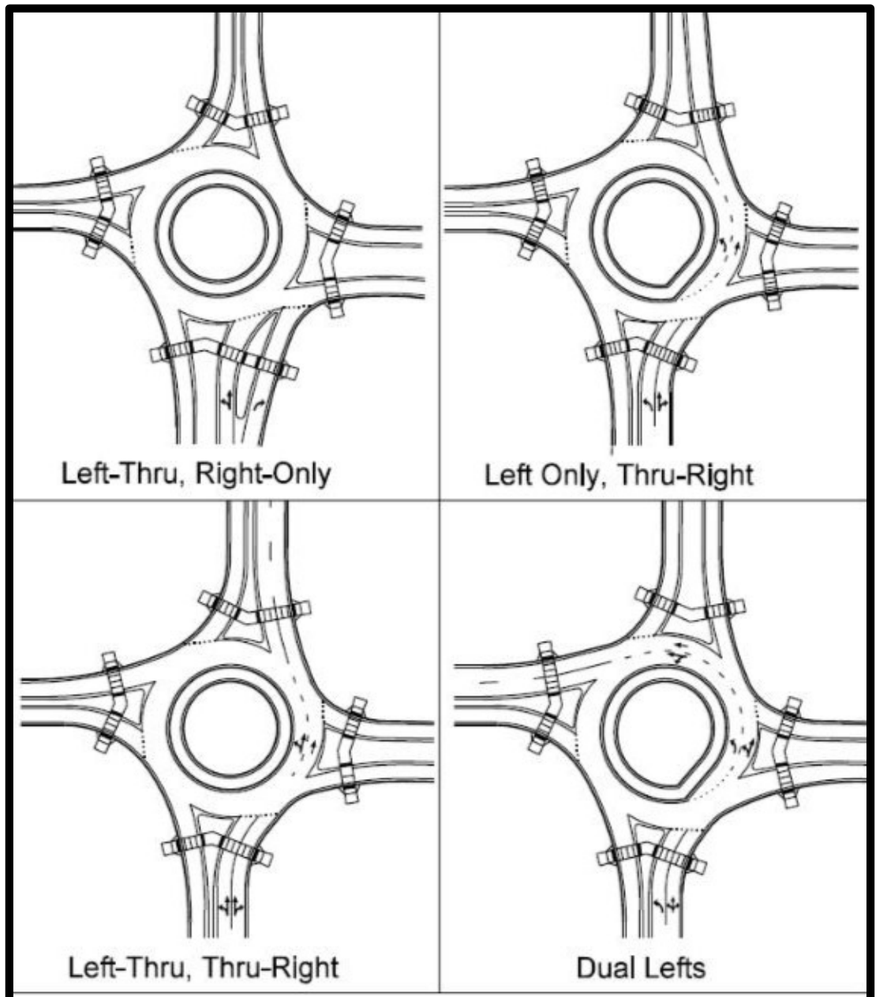

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Concept Validation – Performance Checks

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- In-house “peer review” equivalent

Concept Validation – Performance Checks

- In-house “peer review” equivalent
- Intersection & Stopping Sight Distance

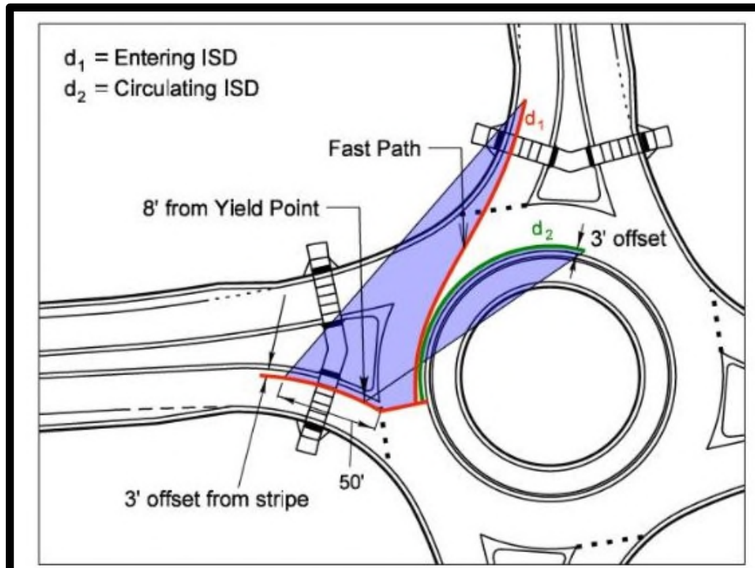
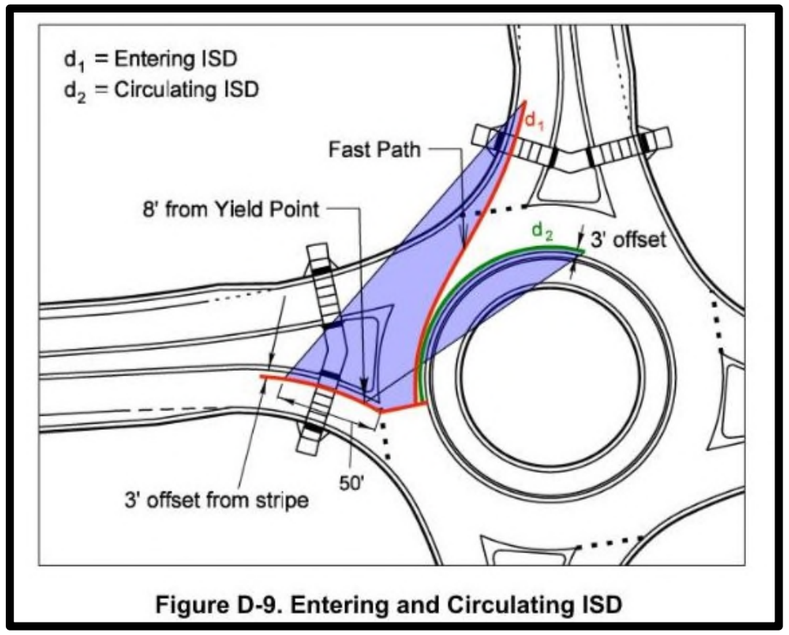


Figure D-9. Entering and Circulating ISD

Concept Validation – Performance Checks

- In-house “peer review” equivalent
- Intersection & Stopping Sight Distance
- Design/check vehicle swept paths



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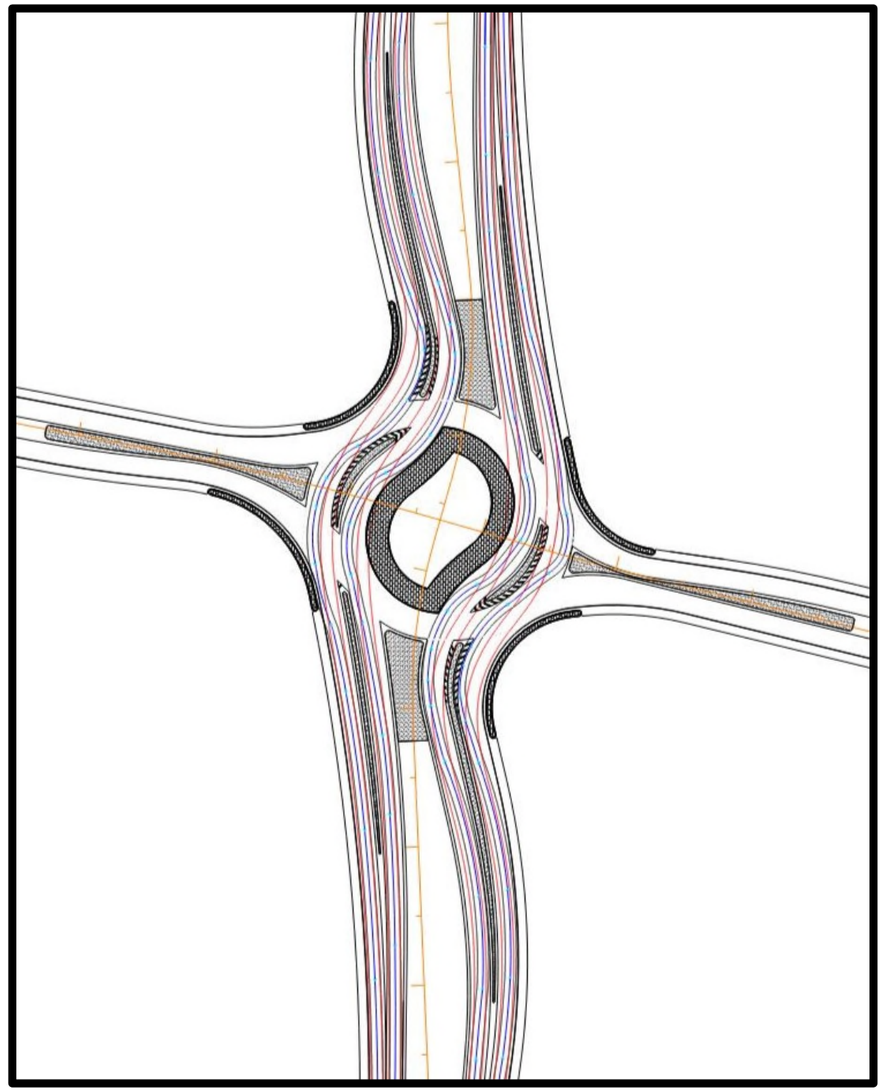
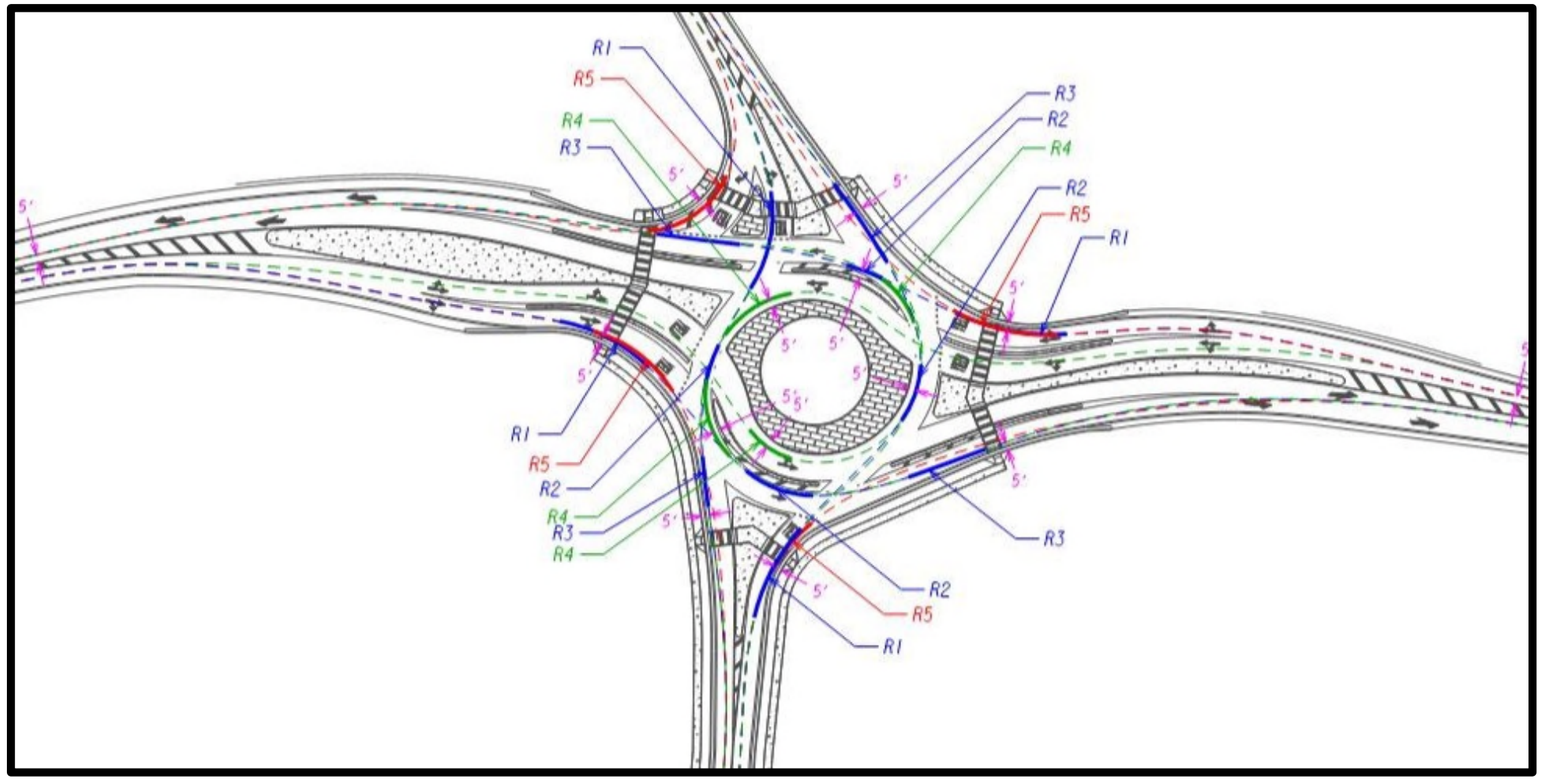


Concept Validation – Performance Checks

- In-house “peer review” equivalent
- Intersection & Stopping Sight Distance
- Design/check vehicle swept paths
- Fastest Paths



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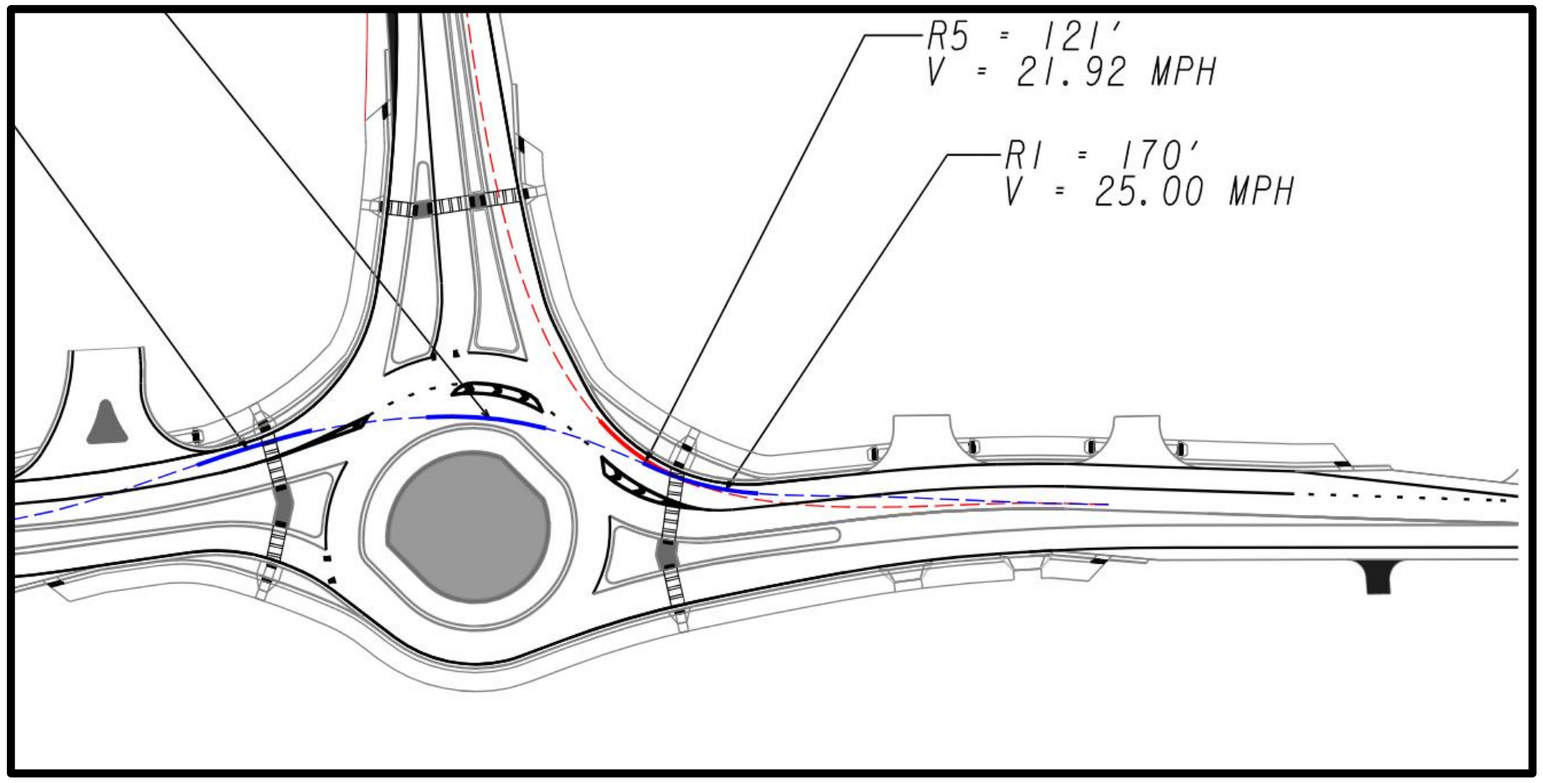

Practical Design

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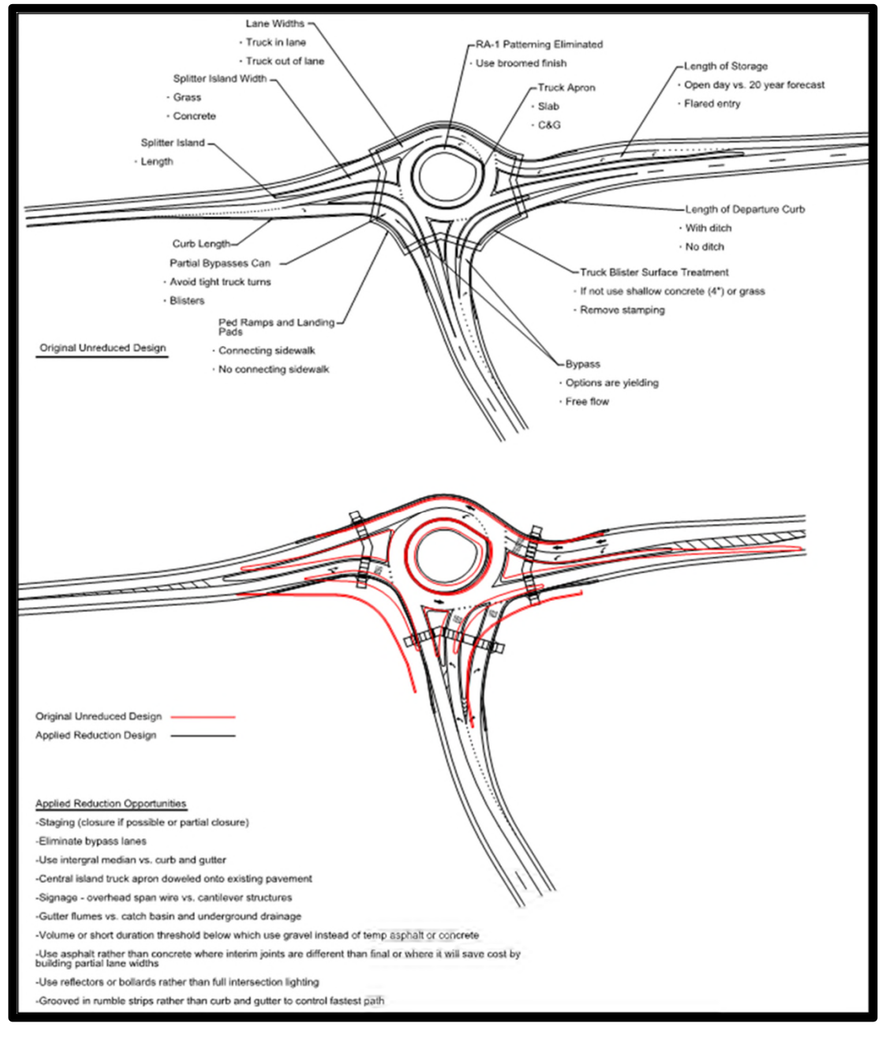

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- Develop/review practical, cost- and context-sensitive designs
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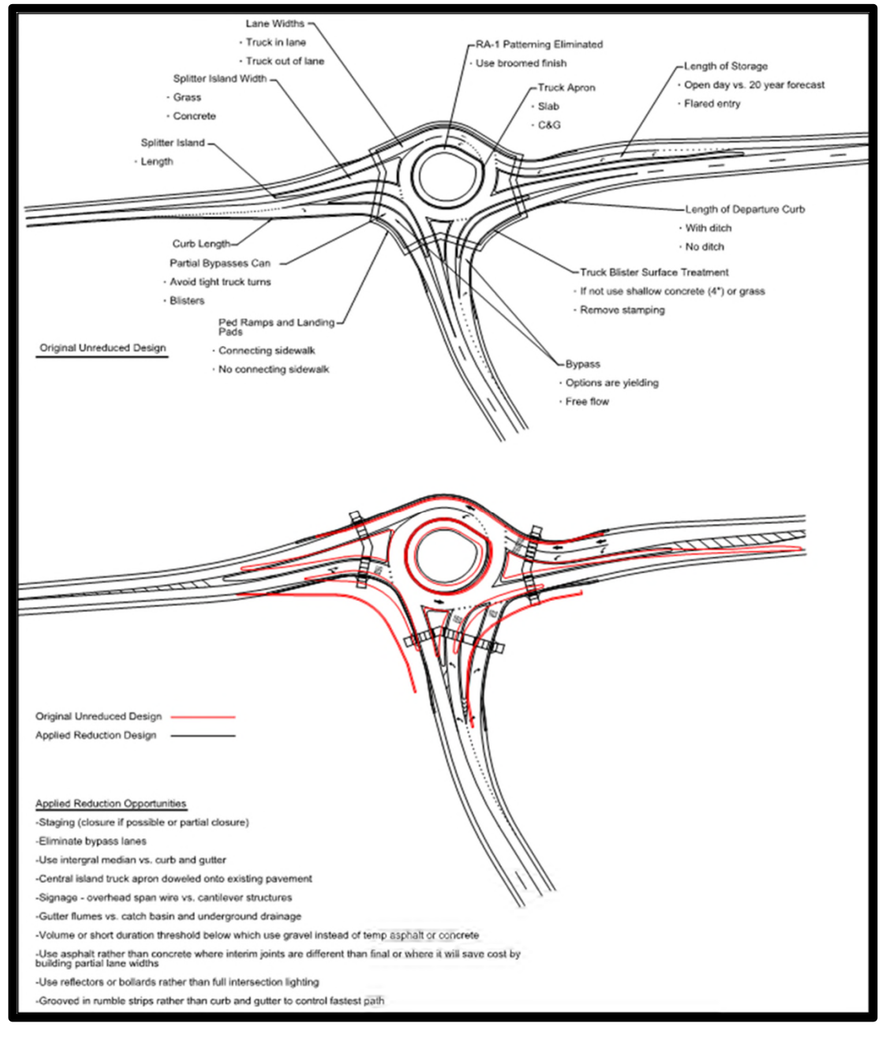

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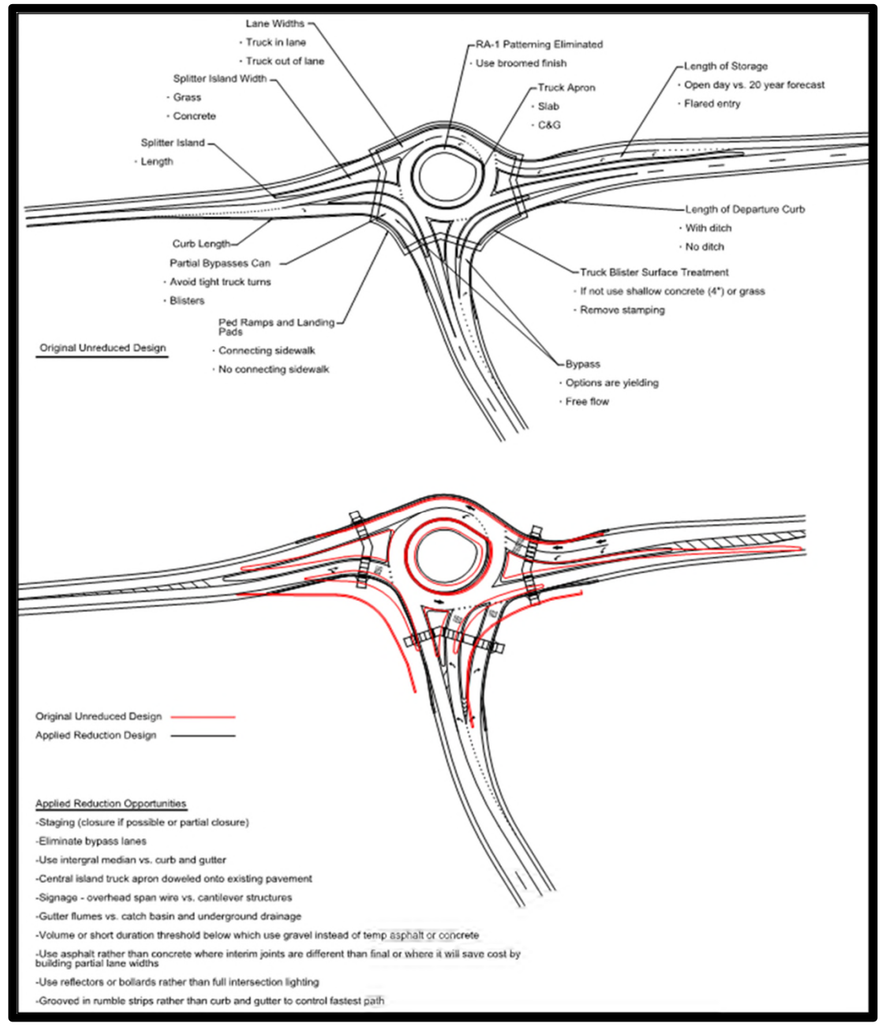

Practical Design

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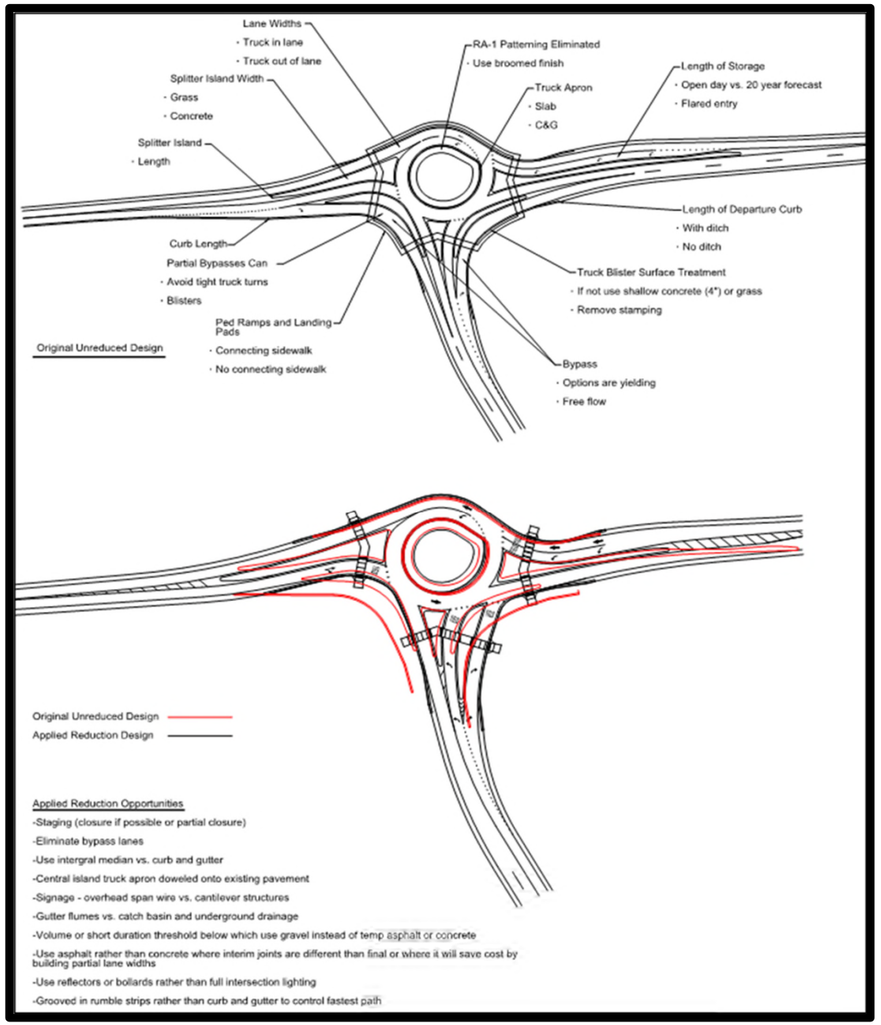
- Multimodal accommodations



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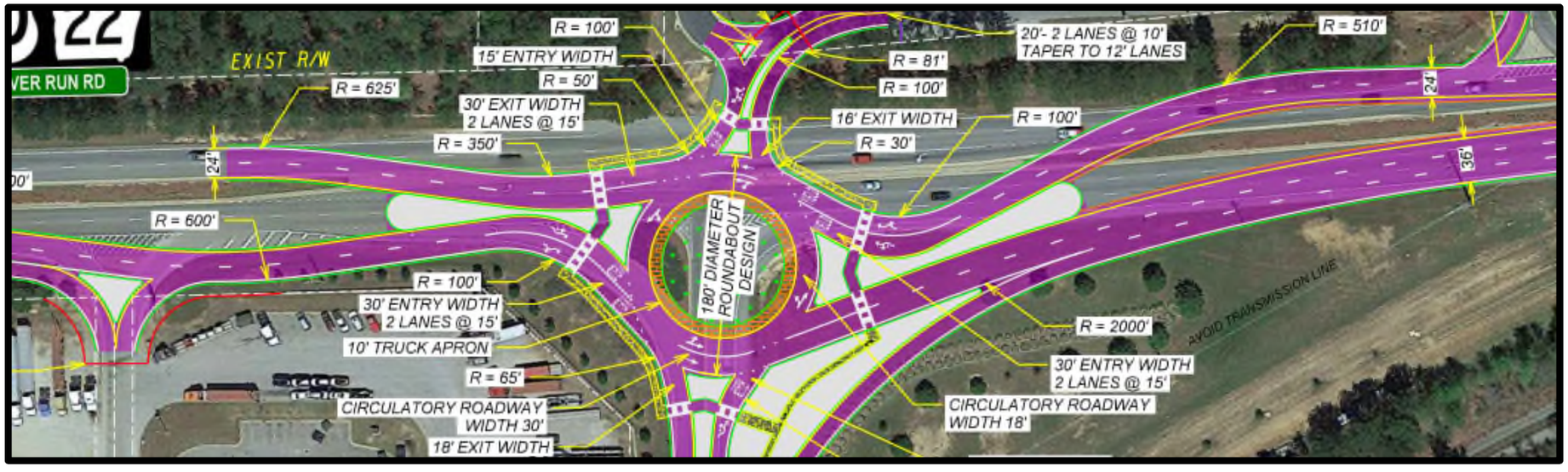

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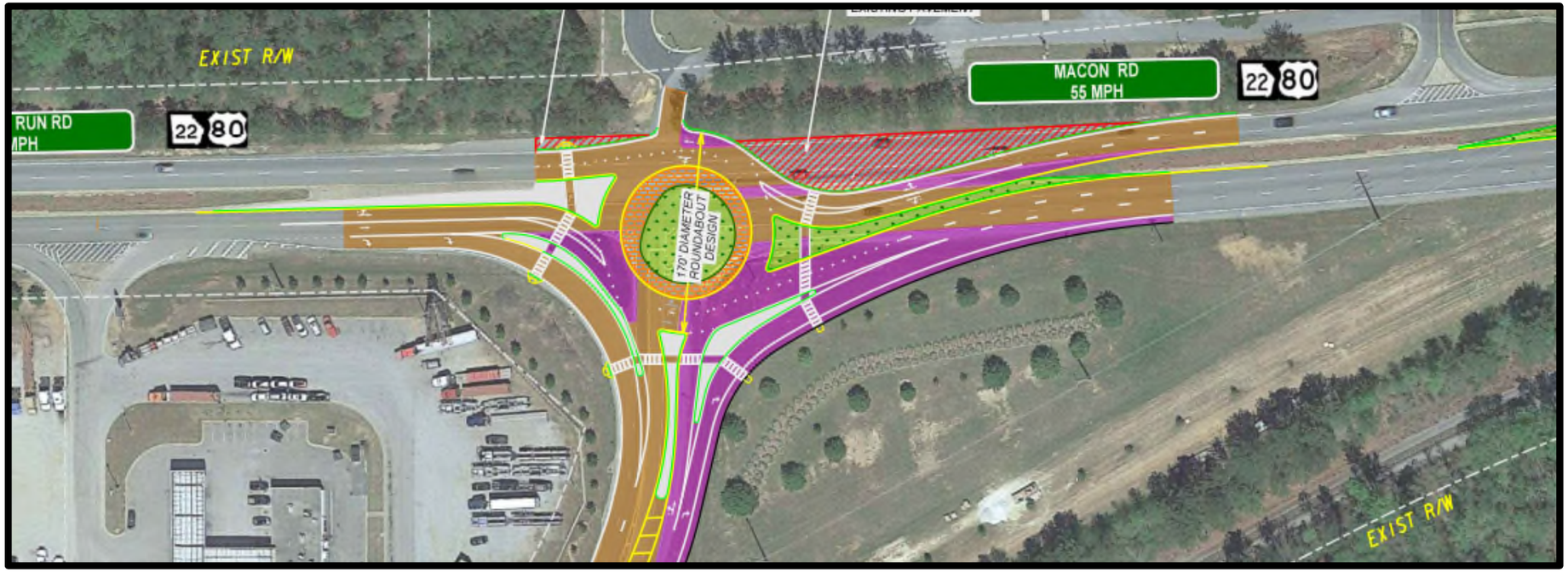

Field Plan Reviews

Field Plan Reviews

- Preliminary (PFPR) and Final (FFPR) (347 to-date FY24)

Field Plan Reviews

- Preliminary (PFPR) and Final (FFPR) (At least 30 ind. RABs)

Field Plan Reviews

- Preliminary (PFPR) and Final (FFPR) (347 to-date FY24)
- VS TDOT’s Functional Design Plans and Plan-In-Hand reviews

Field Plan Reviews

- Preliminary (PFPR) and Final (FFPR) (347 to-date FY24)
- VS TDOT’s Functional Design Plans and Plan-In-Hand reviews
- Improve product quality through quality assurance and control

Field Plan Reviews

- Preliminary (PFPR) and Final (FFPR) (347 to-date FY24)
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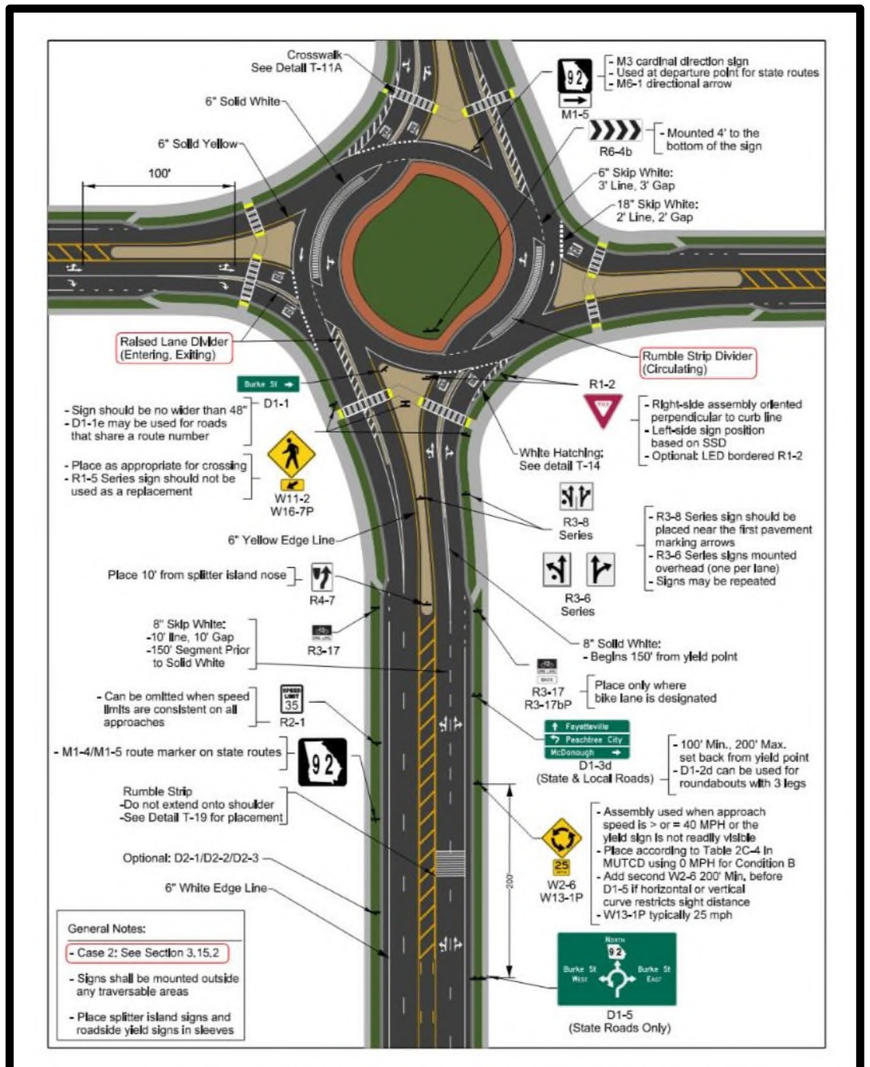

Figure 5-4. Case 2 Multilane Roundabout Signing and Marking

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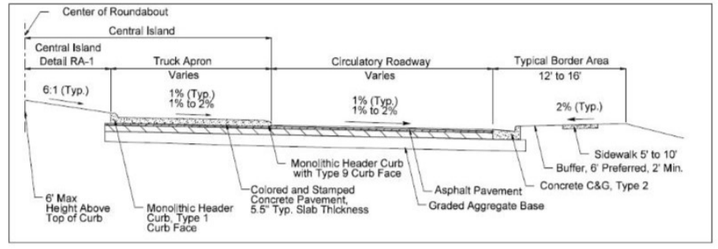


Figure 3-38A. Roundabout Detailed Section with Monolithic Truck Apron

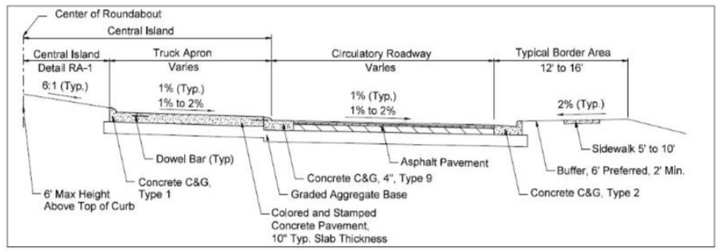


Figure 3-38B. Roundabout Detailed Section

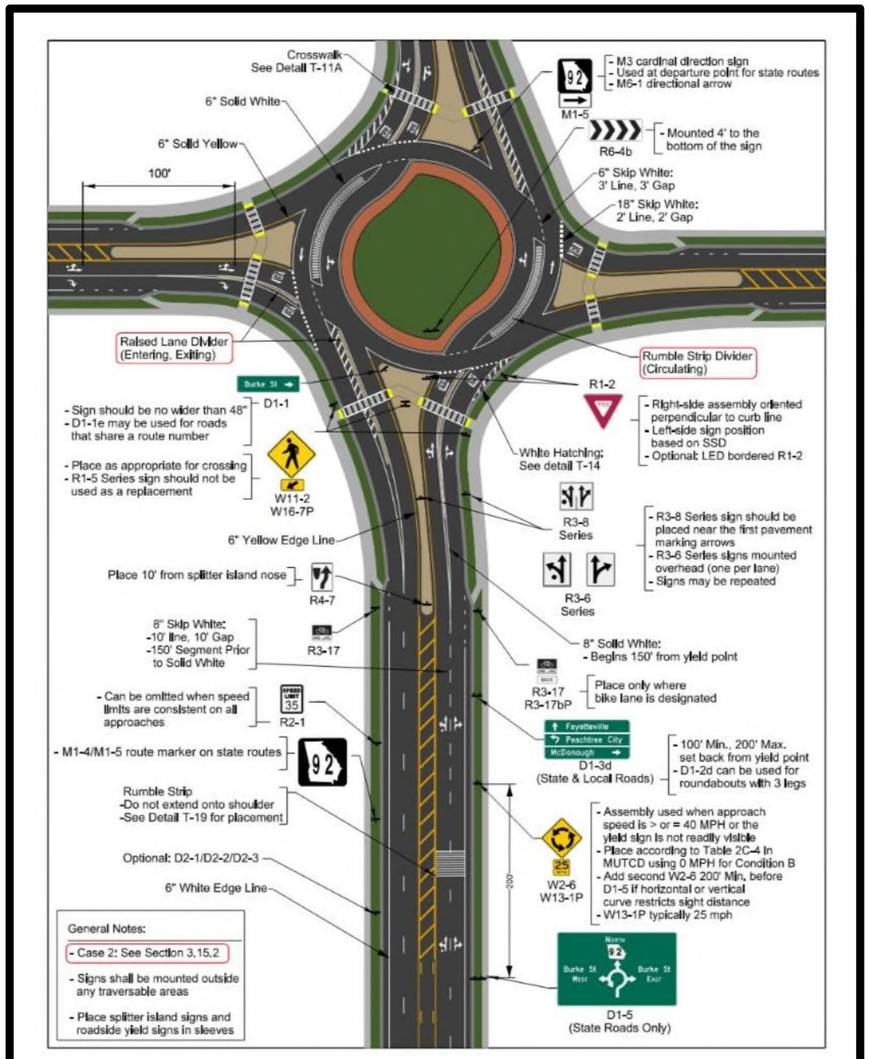
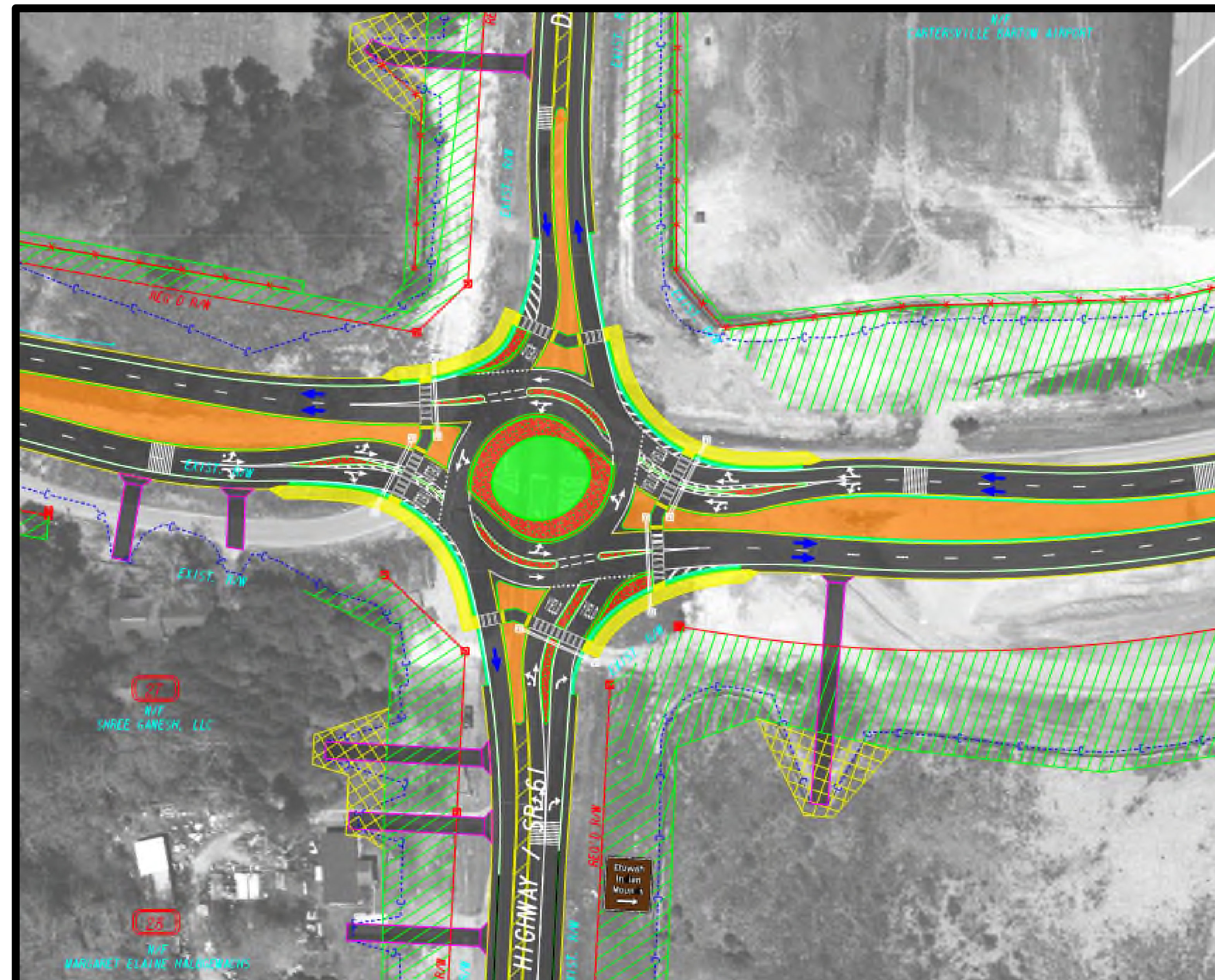


Figure 5-4. Case 2 Multilane Roundabout Signing and Marking

On-Call Contract Services



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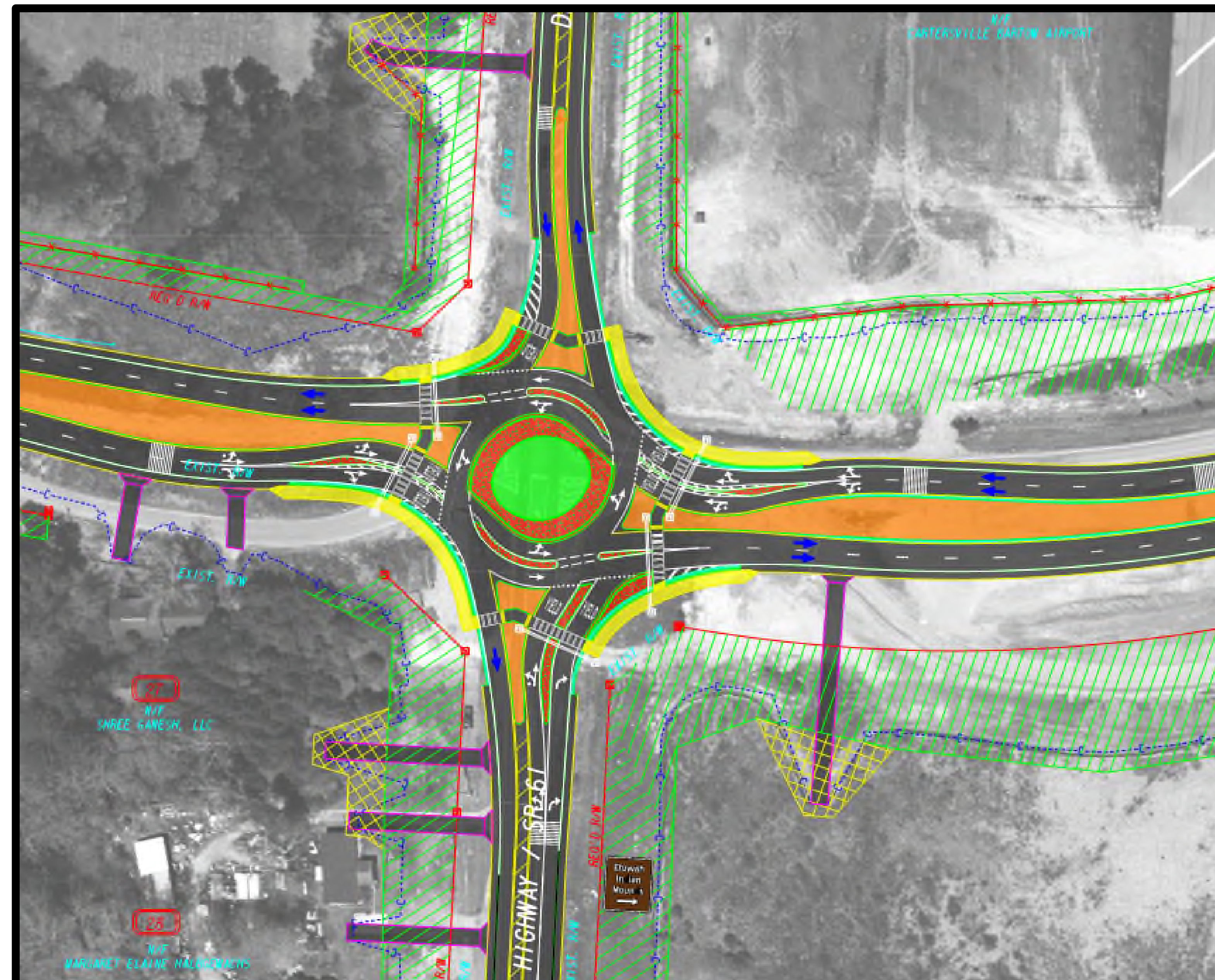

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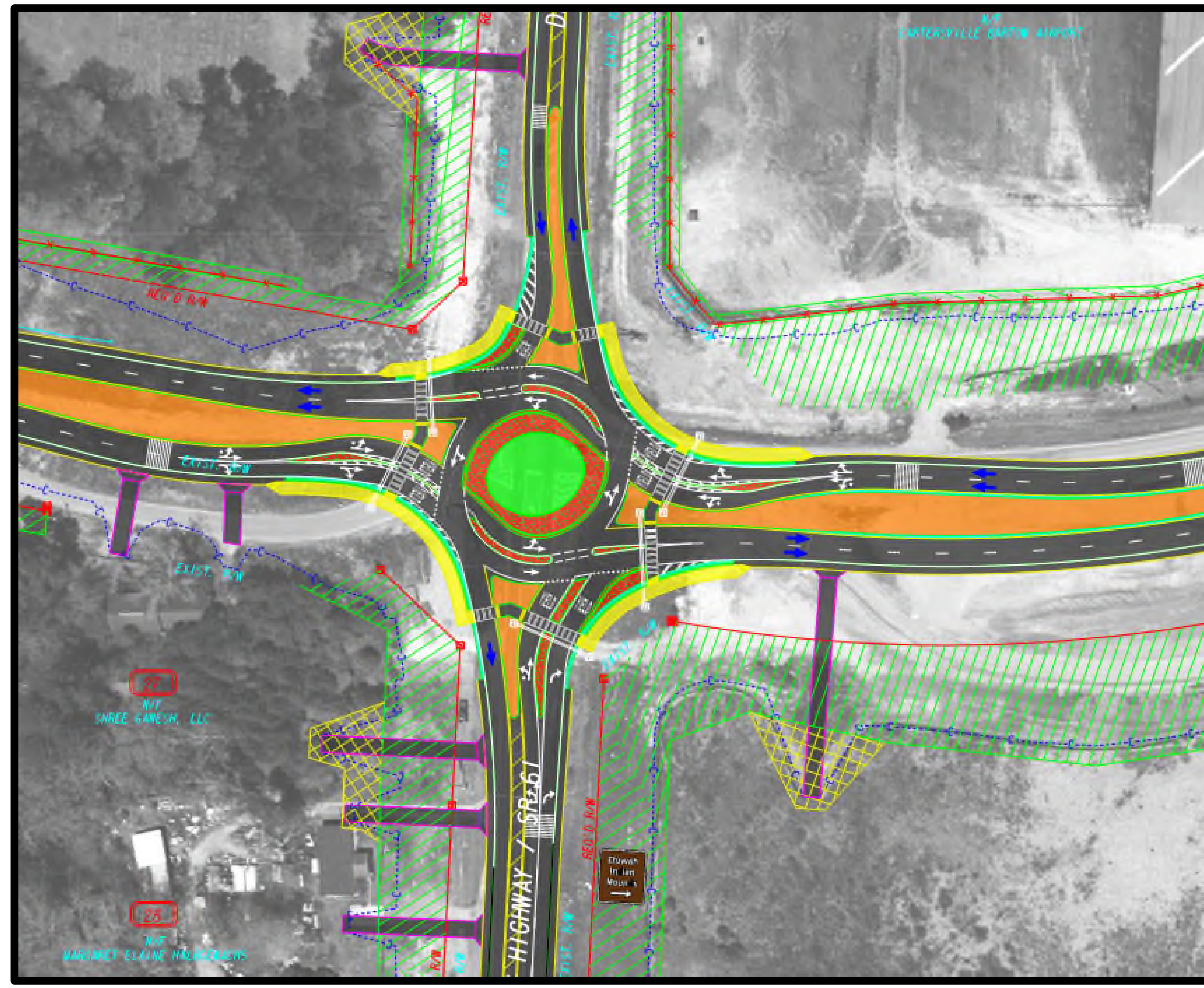

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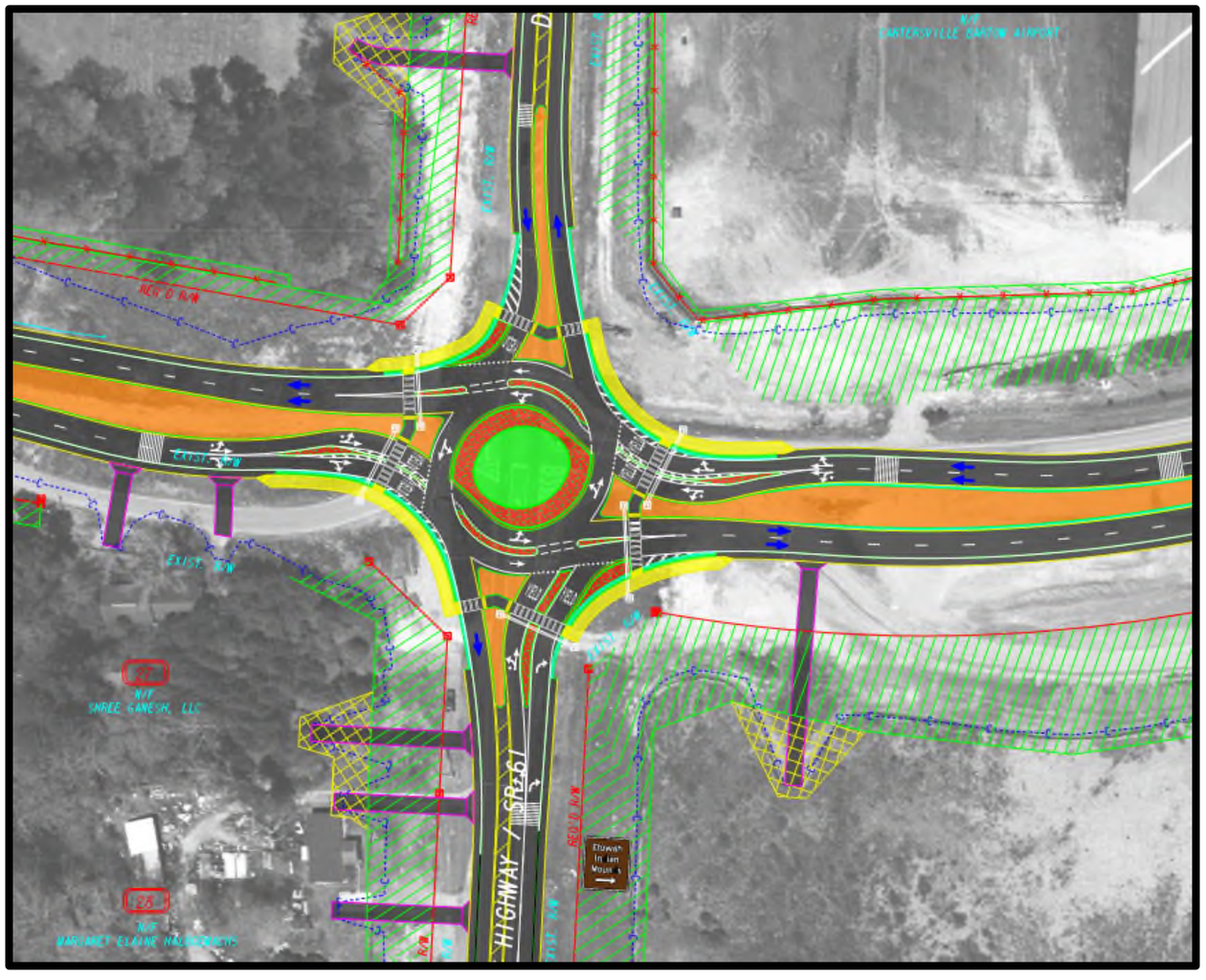

On-Call Contract Services

- Barge Design Solutions
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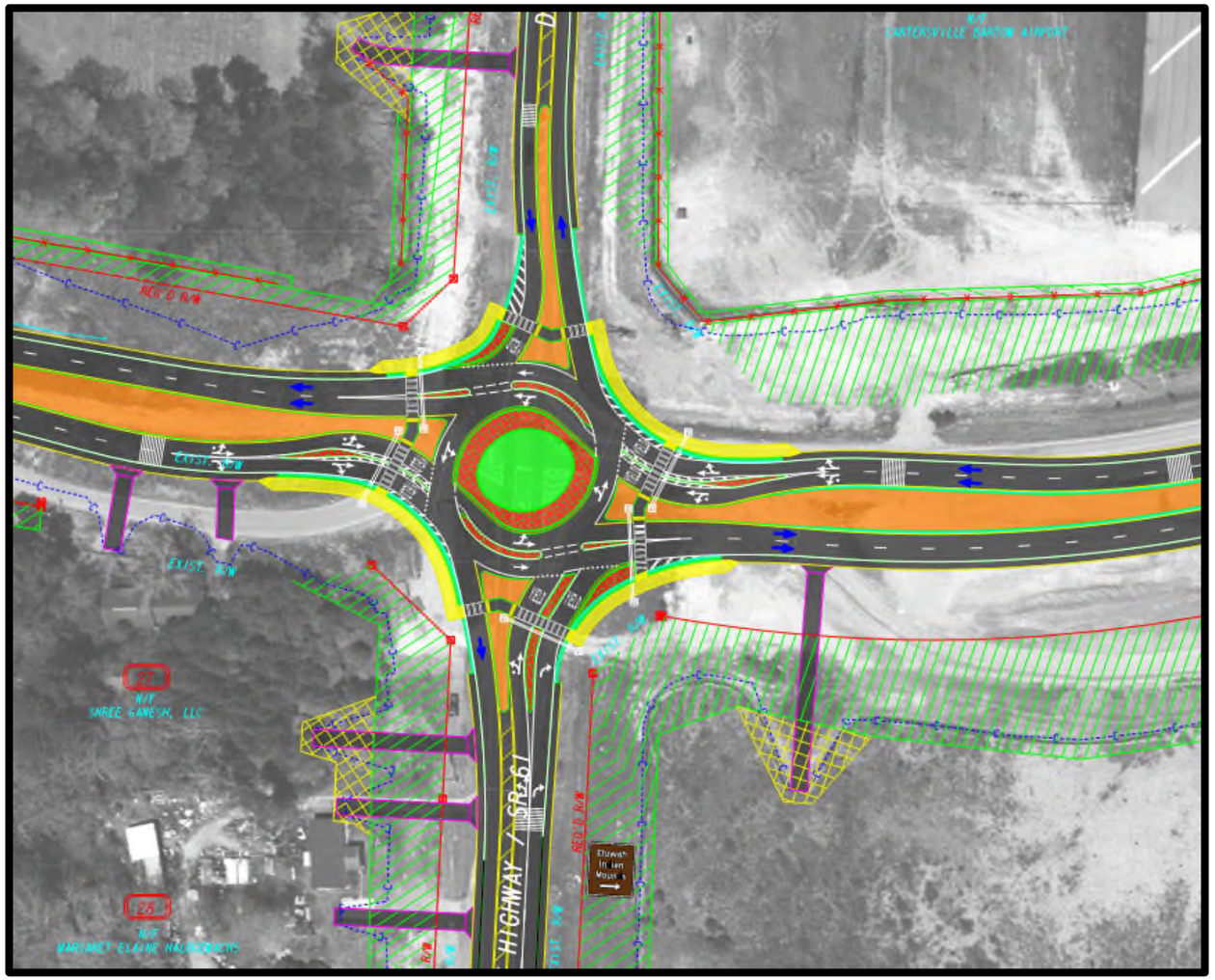
- Supplement GDOT staff throughout project life-cycle, from concept, through design and into the future post-construction



Implementing Other Alternative Intersection Designs

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Unsignalized

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Signalized

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- High-T
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- Signalized RCUT
- Median U-Turn
- Green-T
- Displaced Left Turn (DLT) / Continuous Flow Intersection (CFI)
- Quadrant Roadway
- Diverging Diamond Interchange (DDI)
- Other unique/hybrid configurations

Benefits, Challenges, and Work Flow

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- Improve safety and/or operations

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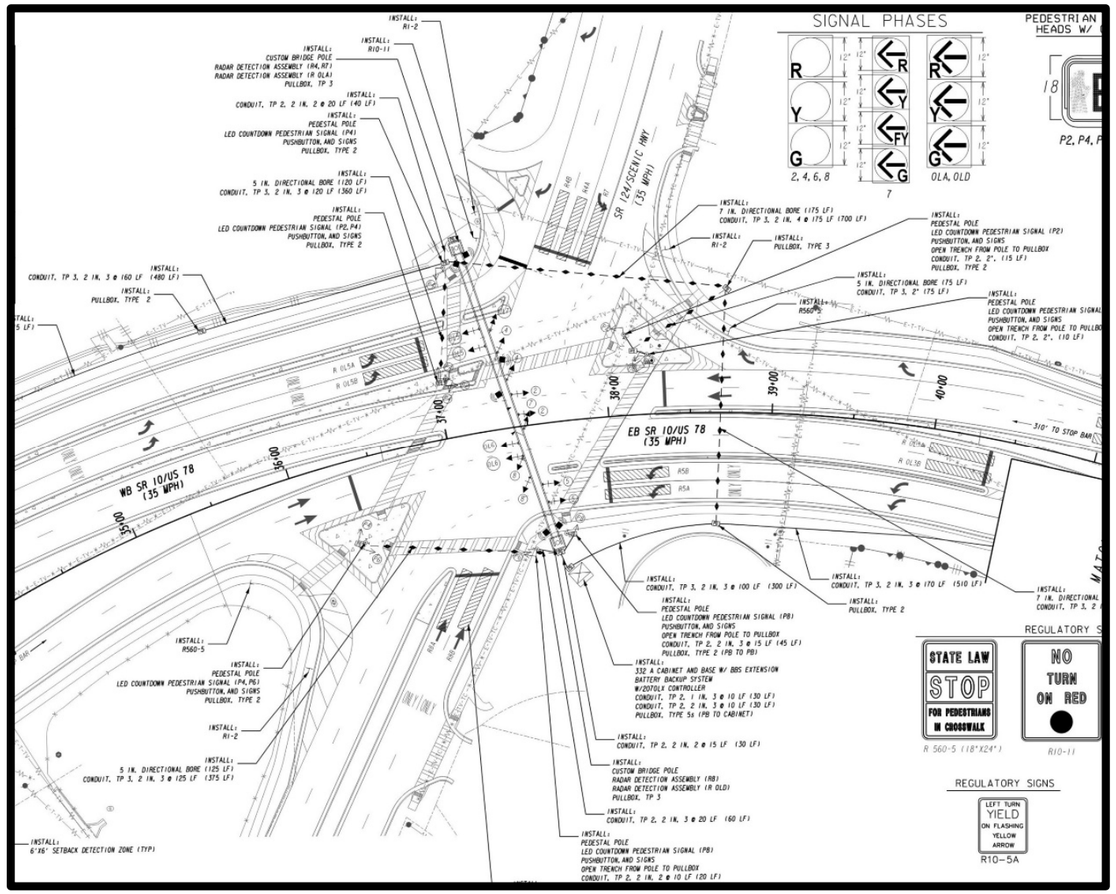
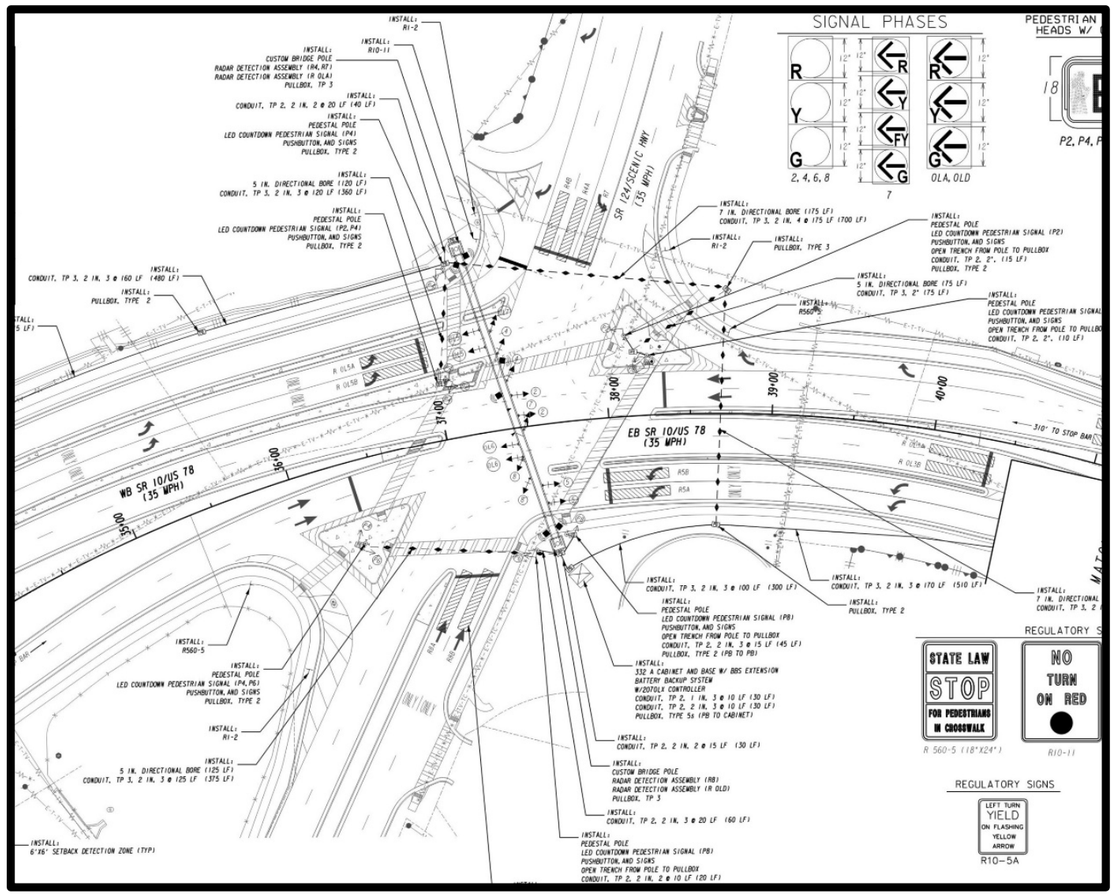
- Concept -> Preliminary -> Final Design

Office of Traffic Operations Responsibilities



Office of Traffic Operations Responsibilities

- Support alternative designs during planning/scoping



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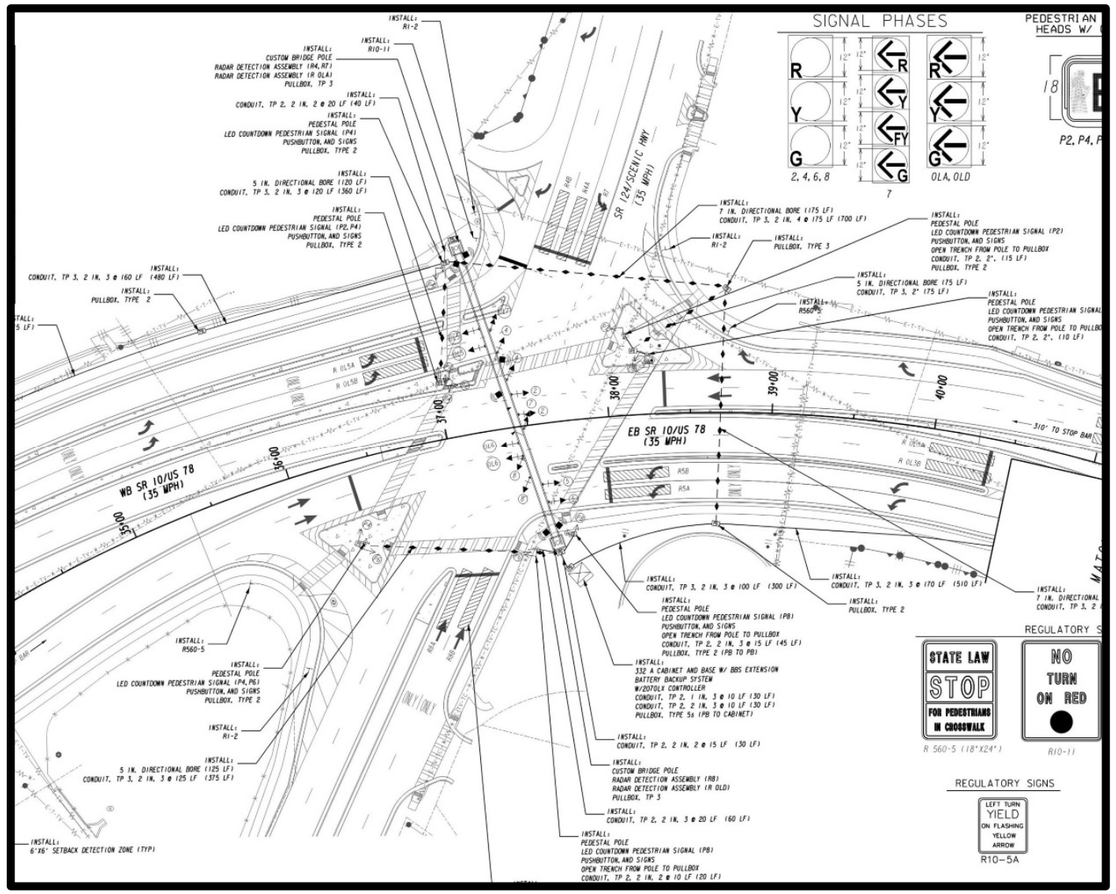

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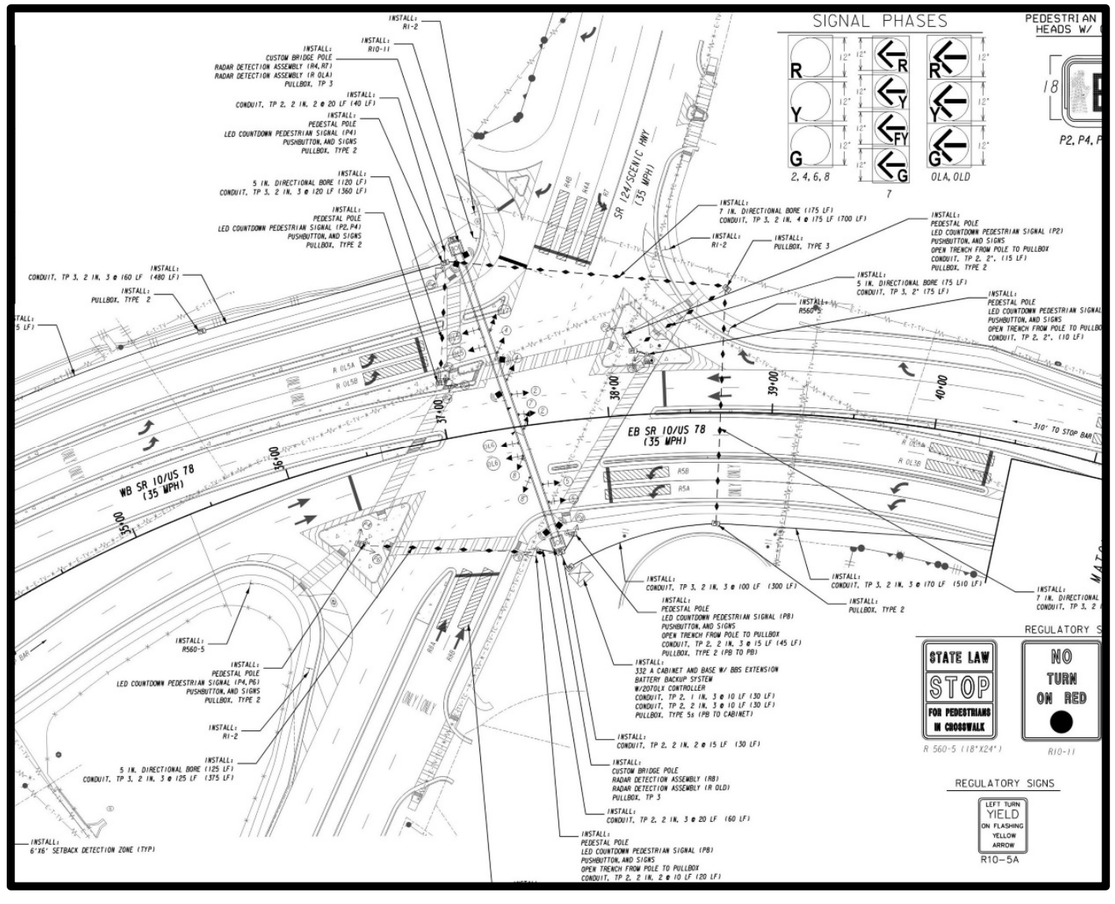
- Preform practical design reviews to set footprints, identify critical flaws



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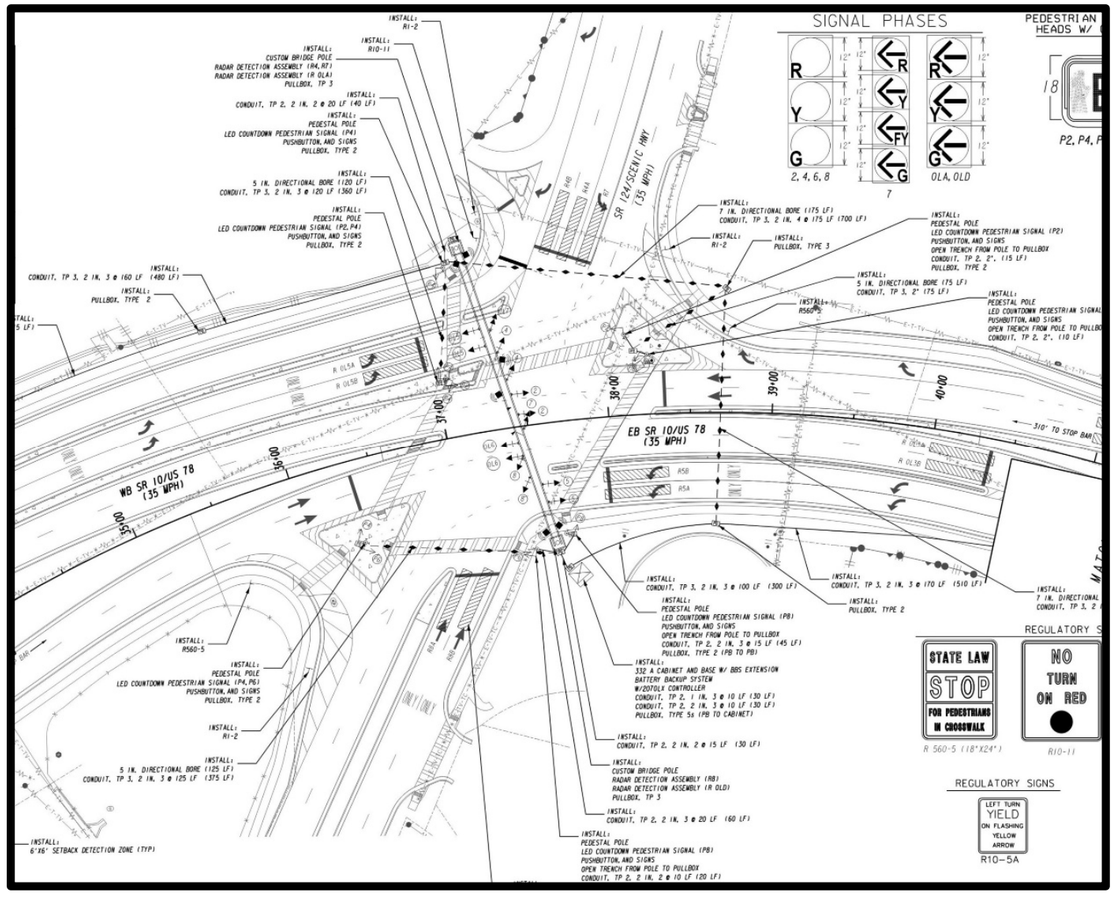

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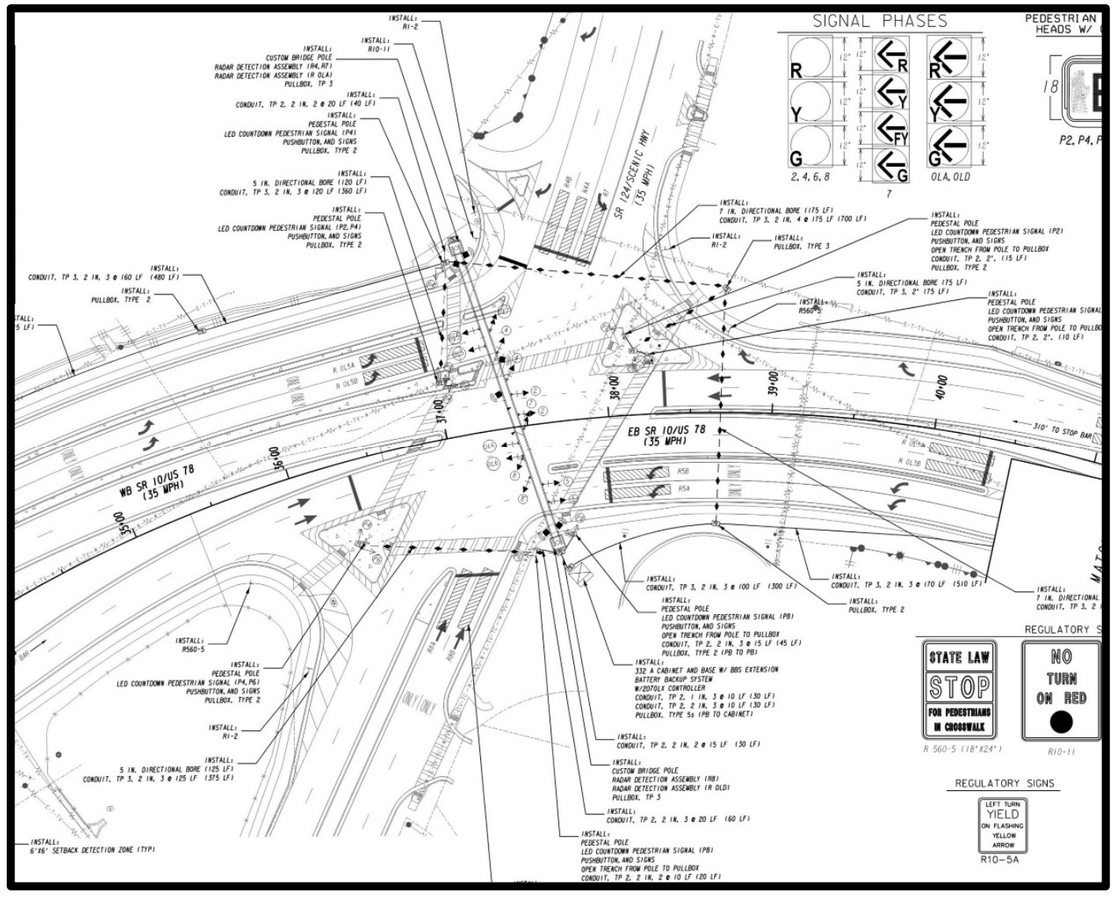
- Assist with complex operational analysis
- Preform practical design reviews to set footprints, identify critical flaws
- Support public involvement and stakeholder outreach
- Provide oversight to ensure statewide continuity to best align with the traveling public's expectations



Justifying Specialty Groups

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- SMEs for other specialties
  like signals, bridges, pavement, etc.

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Final Thoughts:

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Final Thoughts:

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- **Dedicated subject matter expert groups form the basis for consistent agency-wide implementation of niche design disciplines.**

Questions, Comments, Concerns

Colin Abbey, E.I.T., rabbey@dot.ga.gov & RAIDTeam@dot.ga.gov