Traffic Signals Public Information Document

Prepared for the Georgia Department of Transportation

Prepared by

Institute of Transportation Engineers Georgia Section Technical Committee Group

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1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide local governments, engineers, developers, and citizens a basic understanding of the process behind receiving approval to install a traffic signal and why it is important to include pedestrian facilities at all signalized intersections. The document provides guidance on topics like how citizens can request a new traffic signal, what is the process for approving and installing a new signal, and what are the pedestrian provisions required at signalized locations. This document does not provide new policy; rather it supplements existing policy by providing a laymen's understanding of the signal approval and installation process.

2 HOW DO I REQUEST A NEW SIGNAL?

All requests for a traffic signal installation (new signal) should be made by the local government to the Georgia Department of Transportation (GDOT) District Traffic Operations office for your county. If modifications to an existing traffic signal are being sought, see the Section 3 "How do I request a signal permit revision to an existing signal?" See Figure 1 in Appendix A for a flow-chart process for making a new signal request.

2.1 IS A SIGNAL NEEDED?

A Traffic Engineering study (T.E. study) should be performed by a Professional Traffic Engineer to determine if a traffic signal is needed. This study includes many different aspects of the intersection including; traffic conditions, traffic volumes, pedestrian characteristics, physical characteristics of the roadway, and the Engineer's conclusion & recommendations. In order to obtain approval, the study must include an analysis showing that a traffic signal will improve the safety and operations of the intersection. This is identified by analyzing the traffic volumes in different ways, called Warrants. This is covered in the Manual on Uniform Traffic Control Devices (MUTCD).

2.1.1 What are warrants?

Warrants "*describe a threshold condition based upon average or normal conditions that, if found to be satisfied as part of an engineering study, shall result in analysis of other traffic conditions or factors to determine whether a traffic control device or other improvement is justified*." (Sect. 1A.13 MUTCD)

Satisfaction of one or more warrants does not mean that a traffic control signal is required or that it is the most appropriate traffic control device for a particular location. Engineering judgment must be utilized to determine the best traffic control device for each intersection.

The following is a list of the Warrants from Chapter 4C of the MUTCD :

- 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

2.1.2 What are the types of signals?

The following is a list of the common types of signal devices. More information regarding each device type can be found in different sections of the MUTCD.

1. Traffic Control Signals (Stop and go)
2. Pedestrian Signals
3. Mid block crossings
4. Hybrid Beacons
   - Pedestrian hybrid beacons
   - Emergency Vehicle
5. Signals
6. Flashing Beacons
   - Intersection Control Beacon (overhead at intersection)
   - Warning Beacon (with advance warning signs)
   - Speed Limit Sign Beacon (common with school zone speed limit)
   - Stop Beacon
7. Lane-Use Control Signals
8. In-Roadway Lights

2.1.3 What are other alternatives to traffic signals?

Investigations of a new traffic signal should include evaluation of several improvement scenarios, including improvements that do not include a traffic signal. New traffic signals tend to be permanent and may have adverse impacts to arterial networks even if warranted at a particular location. Other alternative to signalization may include:

Roundabouts: At certain low to moderate volume conditions, a roundabout may improve intersection capacity and safety. Roundabouts are particularly effective for intersections with skewed geometry and intersections with balanced turning movements. They typically provide safety benefits by slowing vehicles and eliminating severe crash types. A roundabout evaluation is now required by GDOT prior to any new traffic signal or intersection improvements.

Multi way stops: Intersections that do not meet warrants for a traffic signal may meet warrants for multi-way stop control, particularly at intersections with balanced approach volumes and/or high crash rates as a two-way stop condition.

Geometric Improvements such as left turn lanes, right turn lanes, medians, islands, or channelization may also improve intersection operations and/or safety without the need for a traffic signal.

2.2 WHO IS INVOLVED IN THE PROCESS?

The Local Government is always involved because they typically pay the monthly utility cost for traffic signals within their jurisdiction. GDOT and/or private developers are sometimes involved depending on the location of the intersection.

2.3 WORKING THROUGH LOCAL GOVERNMENT

SaportaReport - Maria Saporta

The best place to start is the local government's Engineering, Public Works, or Traffic Operations Department. If they do not have any these departments, contact the County Manager or Mayor's Office. Local government support is essential to having your request approved. Traffic engineering studies that indicate the need for a signal are thoroughly evaluated to ensure that all other alternatives have been explored, and that sufficient vehicular demand for a signal installation exists.

2.4 COUNTY AND STATE REVIEWS

If an installation has the proper support from the local government, and the proposed installation is located on a State Route, a signal permit must be obtained from GDOT. To request a signal permit from GDOT, the local government should contact the District Traffic Operations Office.

2.5 COMMON TRIGGERS FOR SIGNAL REVIEWS

Evaluating the need for a traffic signal may be initiated for a variety of reasons.

2.5.1 Citizen Request

Citizens may contact either the local government or GDOT to determine if a traffic signal has been requested at a particular intersection. An appropriate response is given to each citizen request depending on how much data is available: when the intersection was last studied, the results of that study, and if any current or future projects will address the need for a signal.

2.5.2 Local Government Request

Local government transportation agencies frequently conduct their own traffic engineering studies on the roads they own/maintain, including those that intersect state routes. Local governments that do not have the capability to perform a TE study may request one from GDOT.

2.5.3 Crash History

A signal may be appropriate at intersections with a high frequency of correctable crashes, which is defined as any crash that can be prevented by installing a traffic control device. Traffic volumes thresholds must still be met to warrant a traffic signal.

2.5.4 Developers

On occasion, new signals are requested by developers as part of major development projects. A TE study is typically prepared by an engineer representing the developer. The traffic volumes presented in these studies are usually based on the Institute of Transportation Engineers (ITE) Trip Generation models depending on the type of development. Due to the inherent uncertainty in the projected volumes, engineering judgment is important in assessing the need for a signal in these situations.

3 HOW DO I REQUEST A SIGNAL PERMIT REVISION TO AN EXISTING TRAFFIC SIGNAL?

The local government and/or the GDOT district office should be contacted to request any signal modification. GDOT must approve all modifications to signals on the state route system before they are implemented, regardless of who maintains the signal. Figure 2 in Appendix A provides a flow chart of the signal permit revision request process.

Because GDOT permits all signals on the state route system, some changes to the signal require a permit revision. There are two types of modifications to signals: ones that require permit revisions and ones that do not.

3.1 TYPES OF MODIFICATIONS THAT REQUIRE A SIGNAL PERMIT REVISION

Modifications that fall under this category may require a TE study to justify the signal modification.

3.1.1 Change in lane geometry

- Additional lanes
- Modification of lane assignments
- New approach to the intersection

3.1.2 Signal phasing modification

- Adding left turn arrow
- Changing a protected permissive left turn signal to/from a protected only
- Signalizing an additional approach to the intersection
- Changing to/from split phase operation
- Addition of right-turn overlap phase

3.1.3 Addition of pedestrian accommodations

- Push buttons, wheelchair ramps, crosswalks, etc.

3.2 TYPES OF MODIFICATIONS THAT DO NOT REQUIRE A SIGNAL PERMIT REVISION

- Revise signal timing
- Signal maintenance
- Update ramps to American's with Disabilities Act (ADA) standards

4 PEDESTRIAN ACCOMMODATIONS

The GDOT Traffic Signal Policy (6785-1) states: "*Crosswalks and pedestrian signal heads, including ADA considerations, shall be installed on all approaches of new traffic signal installations or revised traffic signal permits unless an approach prohibits pedestrian traffic.*"

4.1 WHY ARE PEDESTRIAN ACCOMMODATIONS REQUIRED AT SIGNALIZED INTERSECTIONS?

FHWA's Flexibility in Highway Design states "*The main objective of intersection design is to: reduce the severity of potential conflicts between motor vehicles, buses, trucks, bicycles, pedestrians, and facilities, while facilitating the convenience, ease, and comfort of people traversing the intersections*." It also states *"the safe and efficient accommodation of pedestrians at intersections is equally important as the provisions made for vehicles. Pedestrian movements should be provided for and their locations controlled to maximize safety and minimize conflicts with other traffic flows."*

Pedestrian accommodations are required by GDOT at all signalized intersections for the following reasons:

1. Traffic safety - According to a study by the National Highway Traffic Safety Administration's (NHTSA) National Center for Statistics and Analysis, "*In 2007, 4,654 pedestrians were killed in traffic crashes in the United States. On average, a pedestrian is killed in a traffic crash every 113 minutes and injured in a traffic crash every 8 minutes.*"
2. Signal Timing Efficiency - An intersection pre-planned with pedestrian-actuated push buttons is likely to be timed to operate in the most efficient way. If no push buttons are installed, every single cycle has to provide a long-enough green time to accommodate a hypothetical pedestrian crossing. If a push button is added to allow activation of a pedestrian phase, the potentially longer pedestrian green phase would only be called up when needed.
3. Changing Land Use - Given that future development is likely to bring pedestrian activity, pedestrian upgrades to the existing intersections would help provide for potential future pedestrian travel demand. New growth and future pedestrian travel demand should be expected at all signalized intersections.
4. Cost-Effectiveness of Current vs. Future Upgrades - Adding pedestrian accommodations in the initial installation can result in future cost savings. Adding pedestrian accommodations when a signal is installed adds a lower cost (less than $10,000) as compared with the cost of a stand-alone project (up to $150,000).
5. ADA Compliance - GDOT is committed to providing accommodations in full compliance with ADA by including pedestrian signal equipment and crosswalks on all signal related projects. If it is determined that full ADA compliance is technically infeasible or determined to be unreasonable, GDOT approval is required for each element that is not in full compliance.
6. Vehicle Breakdowns - Even in remote locations, a motorist whose vehicle has broken down may need to be able to cross the road to access a business or to call for help.
7. Potential Future Transit Routes and Stops - As new transit routes develop, or existing routes change, roadways need to provide for pedestrian crossings so that transit riders can safely access the stop.

4.2 WHAT'S REQUIRED AT A SIGNALIZED INTERSECTION?

1. Marked crosswalks are required for all legs of the intersection, except where it is potentially unsafe.
2. Countdown Pedestrian Signal Heads are now required by GDOT and the MUTCD Chapter 4 section 4E-07 (Chapter 4) because they provide the pedestrian with additional information to better understand the crossing situation and more safely navigate the crosswalk.
3. Pedestrian push buttons are required; they allow the pedestrian timing to run only when actuated.
4. Wheelchair ramps are required in areas of curb and gutter. All ramps shall contain a detectable warning strip and installed in accordance with ADA and GDOT construction details A-3 and A-4.
5. In sections of roadway without curb and gutter, a flush concrete landing pad should be provided. The concrete landing pad shall be at least 7' wide and also include a 2' detectable warning strip.

4.3 POTENTIAL EXCEPTIONS

The following is a list of examples where pedestrian accommodations **may** be omitted:

- The inside leg of a diamond interchange
- Where there is no walkable shoulder
  - Guardrail flush with face of curb
  - Steep front-slope that prohibits a pedestrian's ability to navigate
- Where grades exceed ADA compliance

5 WHAT HAPPENS TO MY REQUEST?

If the TE study is approved, there are still several issues that affect how long it will take before the traffic signal is installed and operational.

5.1 FUNDING

It must be determined how to fund the installation and design costs. Traffic signal installations can be very costly. Even with a variety of funding sources, financial constraints may be a factor in how and when the work is completed.

5.1.1 Government Funded

A local or state government can fund the installation entirely with its own funds. In many cases, state and federal agencies assist with funding resources.

5.1.2 Private Party/Developer Funded

Private funds may also be used to install a traffic signal. Most often these installations are funded by developers who are required to provide traffic control at their driveway or access point. With these installations, the developer must obtain a permit from the jurisdiction responsible for the intersection, and meet the local and/or state design and construction standards.

5.2 DESIGN

5.2.1 Design Process

All state and federally funded projects that will install/revise traffic signals must go through a process called the Plan Development Process (PDP). This process adds time to the design phase, which is needed to ensure that state and/or federal funds are not jeopardized.

5.2.2 Design Guidelines

The GDOT Traffic Signal Design Guidelines give detailed information on how traffic signals are to be designed in the State of Georgia.

5.2.3 Design Factors

There are several design factors that control the timeline for design and installation:

- Staff Availability - Some government agencies have the staff to design traffic signals in-house. If available man power is not available, a consultant can be hired to do the work. Additional time is needed to procure a contract with a consultant. Developer-driven projects typically progress the fastest. The Developer usually has the monetary resources and a design consultant on hand as part of the project. Often times the developer's design of the signal is done before permit approval is given.
- Right-of-Way (ROW) – If additional ROW is required, the project timeline may be slowed to procure the needed ROW.
- Environmental – Improvements that impact streams, endangered or protected species, or historical resources may significantly slow the project timeline in order to obtain the necessary state or federal permits.
- Utilities (UTL) – Poles must be placed to erect a traffic signal. These poles sometimes conflict with existing power, telephone, and/or cable lines. Coordination with the utility owners adds time to the project schedule, especially if the existing utilities have to be relocated.

5.3 CONSTRUCTION DOCUMENTS

The construction standards, details, and specifications provide detailed information on how elements of traffic signals are constructed, which are part of a full set of construction documents. These documents are advertised for interested contractors to bid on. Adequate time must be provided for advertisement, for contractors to prepare their bids, and for the agency to award the project and give the selected contractor a Notice to Proceed with the work.

5.4 CONSTRUCTION TIME

The actual time to construct the signal and for it to become operational can take up to several months; the time can vary widely from one project to the next. Listed are several factors that can increase construction time:

- Constructing turning lanes
- Aligning roads
- Installing drainage structures
- Installing sidewalks and ADA ramps
- Complexity of the design
- Conditions at the intersection
- Equipment & material fabrication
- Limitations on when the contractor is allowed to work
    - restrictions on noise
    - traffic disruption
    - weather conditions

After the installation is complete, the equipment must be put through rigorous testing to ensure proper operation. The traffic signal is then put on flashing mode for a number of days to alert drivers to the impending operation of this new traffic control device.

There are many different components that make up a full traffic signal installation. (See Appendix A Figure 3 for a chart of some of the major components.)

6 REFERENCES AND RESOURCES

Federal Highway Administration (FHWA). *Flexibility in Highway Design*, Chapter 8, http://www.fhwa.dot.gov/environment/flex/ch08.htm

Manual on Uniform Traffic Control Devices (MUTCD).

National Highway Traffic Safety Administration (NHTSA). *Traffic Safety Facts 2007 Data: Pedestrians.* http://www-nrd.nhtsa.dot.gov/pubs/810994.pdf

GDOT Signal Design Guidelines

GDOT Traffic Signal Policies: 6785-1, 6785-2

GDOT Roundabout Policy

GDOT Pedestrian & Streetscape Guide

7 FREQUENT ASKED QUESTIONS

Q1: Who do I contact about getting a traffic signal installed at an intersection?
A1: Since all requests for traffic signals involve the local government, you need to know in which city or county government the intersection resides. Generally, if the intersection in inside the city limits the city has jurisdiction, if it isn't then the county has jurisdiction. Once the jurisdiction of the intersection is determined, you can contact the agency's traffic engineering department, public works department, Mayor's office, or County Manager's office. (See details in Section 2)

Q2: How does GDOT decide whether a traffic signal should be installed on a State Highway?
A2: A thorough investigation of traffic conditions (TE Study) is required to determine if a signal should be installed and to determine the proper design for a signal installation. The MUTCD is a national guideline which outlines criteria that must be met before a new signal is considered. (See details in Section 2)

Q3: Why does it take so long to get a traffic signal installed once it is approved?
A3: After a TE study is approved, it must be determined how the signal will be funded, who will design it, and who will perform the installation. Designing, constructing, and inspecting the signal prior to operation all take time. (See details in Section 5)

Q4: What is a signal permit?
A4: A signal permit is a written agreement between GDOT and the local government agencies that describes the ownership and maintenance responsibilities for the traffic signal. All traffic signal devices erected on the State Route System must have an approved permit issued by GDOT prior to their installation.

Q5: How much does a signal cost?
A5: A typical traffic signal installation costs around $150,000, and has an annual maintenance and power costs of about $5,000.

Q6: What is the purpose of a traffic signal?
A6: Traffic signals are electronically operated traffic control devices which alternately direct traffic. Traffic signals are designed to ensure an orderly flow of traffic, provide an opportunity for pedestrians or vehicles to cross an intersection, and help to reduce the number of conflicts between vehicles entering intersections from different directions.
Q7: Will traffic signals prevent intersection crashes?
A7: Traffic signals do not prevent crashes. Side-angle (T-bone) crashes can be reduced by installing a traffic signal. However, rear-end collisions may increase since traffic is not used to stopping at the intersection.

Q8: Does a traffic signal control speed?
A8: No. In fact, traffic signals sometimes result in greater speeds as drivers accelerate to try to get through the signal before it turns red. Additionally some drivers will speed between signals to make up for lost time at the signals.

Q9: What is the difference between a traffic signal and a ramp meter?
A9: A ramp meter is a traffic control device located at "on ramps" for freeway access. A traffic signal is a traffic control device for two or more intersecting roadways.

Q10: How do traffic signals work?
A10: Traffic signals change the lights according to the amount of traffic in each direction. Most signals use sensors to detect the number of vehicles and automatically adjust the length of the green time to allow as many vehicles as possible through the intersection before responding to the presence of vehicles on another approach.

Q11: How does a traffic signal know when a vehicle is present?
A11: The controller (computer) of the traffic signal receives electric signals from the vehicle detection system, which is typically a loop detector in the roadway. Other types of detection systems are video, sonic and microwave.

Q12: Why do traffic lights take so long to change?
A12: The length of the wait time at a traffic signal depends on the signal cycle length. Frequently on major corridors the cycle lengths are longer to accommodate higher volumes of traffic by providing more green time in order to move more vehicles through an intersection. However, increasing cycle lengths also causes secondary movements to experience longer delays.

Q13: What is traffic signal coordination?
A13: Traffic signal coordination is when two or more traffic signals are working together so that vehicles moving in a group, or platoon, will make the least number of stops possible.

Q14: When traveling on some streets, red lights are hit on a regular basis? Can't they coordinate them?
A14: Yes, all traffic signals along major streets are typically coordinated in peak hours to minimize stops and delays. Traffic engineers examine each corridor and design a "best-fit" timing plan to address the circumstances. However, these streets cannot be perfectly timed due to varying traffic speeds, congestion, the distance between signals, etc.

Q15: Why isn't there enough green time at a signal to get the traffic through at some approaches?
A15: The amount of green time programmed for each movement at a signal varies by traffic demand and increasing green time for one movement requires decreasing the amount of green time for another movement. Therefore, the approach with the highest traffic volume receives the highest green time.

Q16: I know of a traffic signal that has indications out or appears to be malfunctioning. Who do I contact?
A16: If the signal is on a state route, Call 511, and be prepared to give them the following information: The county and/or city that you are in, The name of the two intersecting roads, Is the signal flashing or blank?

Q17: What do I do if all of the signal indications are blank?
A17: When a traffic signal has gone dark due to power failure, it is considered a multi-way stop. Each driver must stop and yield before entering the intersection.

Q18: What do I do if a signal is flashing?
A18: If the signal is flashing yellow in your direction, proceed through the intersection with caution. If the signal is flashing red in your direction, you are required to stop.

Q19: How is the yellow time of a traffic signal determined?
A19: Typical yellow time is approximately 3 to 6 seconds. The largest determining factor in yellow time is the posted speed of the roadway. The slower the posted speed limit, the shorter the yellow time and the faster the posted speed limit, the longer the yellow time.

Q20: How is the all red time of a signal determined?
A20: The purpose of the all red time (the time when all traffic signal lights are red) is to allow vehicles that entered the intersection before the red to clear the intersection before conflicting traffic receives a green. GDOT uses all red times of 1.0 to 3.0 seconds. The largest determining factors in all red timing are the width of the intersection and the posted speed limit of the roadway. The larger the width of the intersection and the slower the speed limit, the longer the all red time.

Q21: When is a left-turn arrow needed at a signalized intersection?
A21: Left-turn arrows, or a left-turn phase, are implemented based on traffic volumes and/or crash history. If the left turning volume and the conflicting through movement volume are not high enough, the traffic signal typically will not need a left turn arrow or phase unless there is an established crash problem. GDOT currently has policy about left-turn phasing (6785-2, Left Turn Phasing).

Appendix A

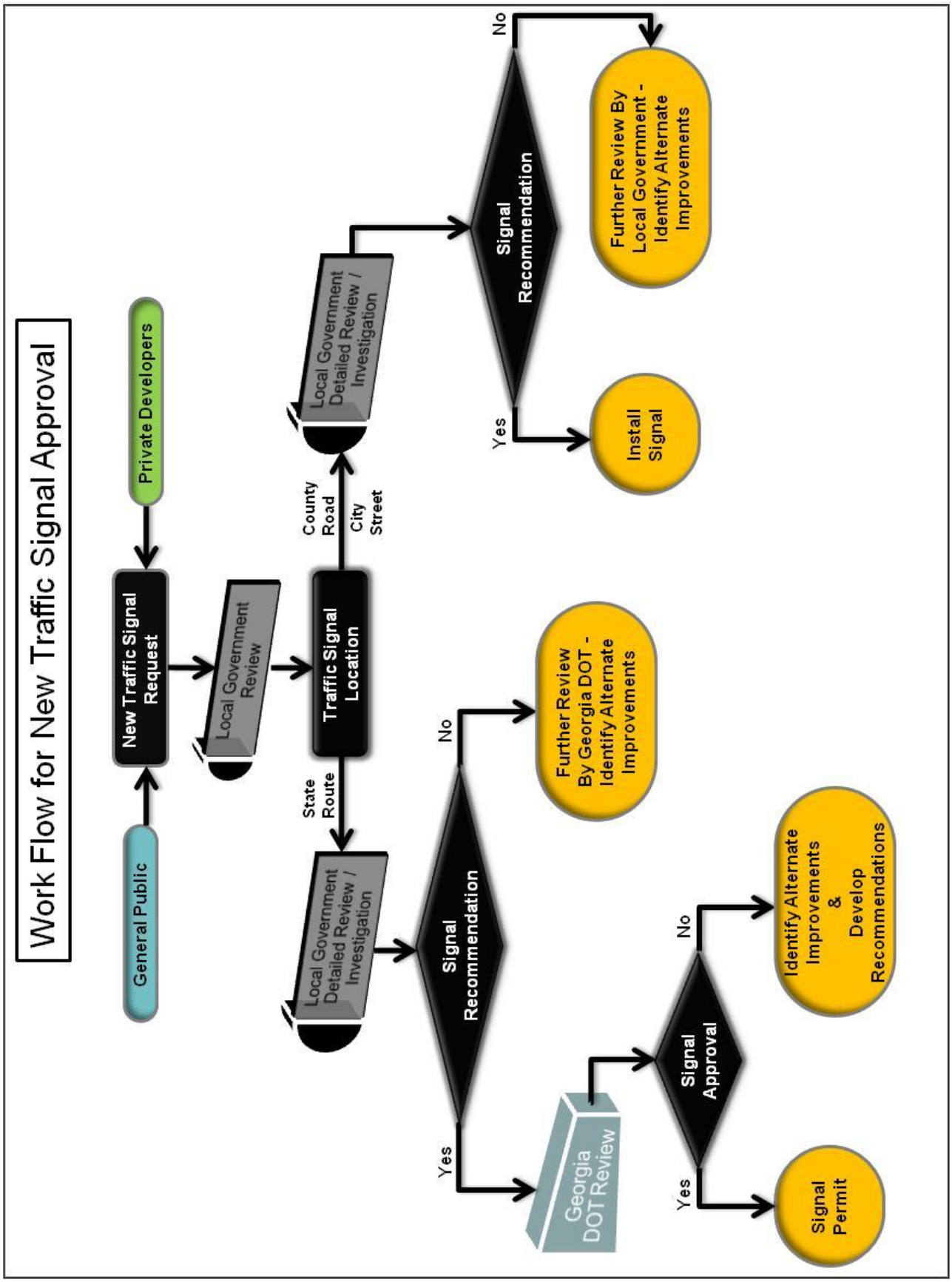
Work Flow for New Traffic Signal Approval
General Public
Private Developers
New Traffic Signal Request
Local Government Review
Traffic Signal Location
State Route
County Road
City Street
Local Government Detailed Review / Investigation
Signal Recommendation
No
Further Review By Georgia DOT - Identify Alternate Improvements
Yes
Georgia DOT Review
Signal Approval
No
Identify Alternate Improvements & Develop Recommendations
Yes
Signal Permit
Local Government Detailed Review / Investigation
Signal Recommendation
No
Further Review By Local Government - Identify Alternate Improvements
Yes
Install Signal

Figure 1

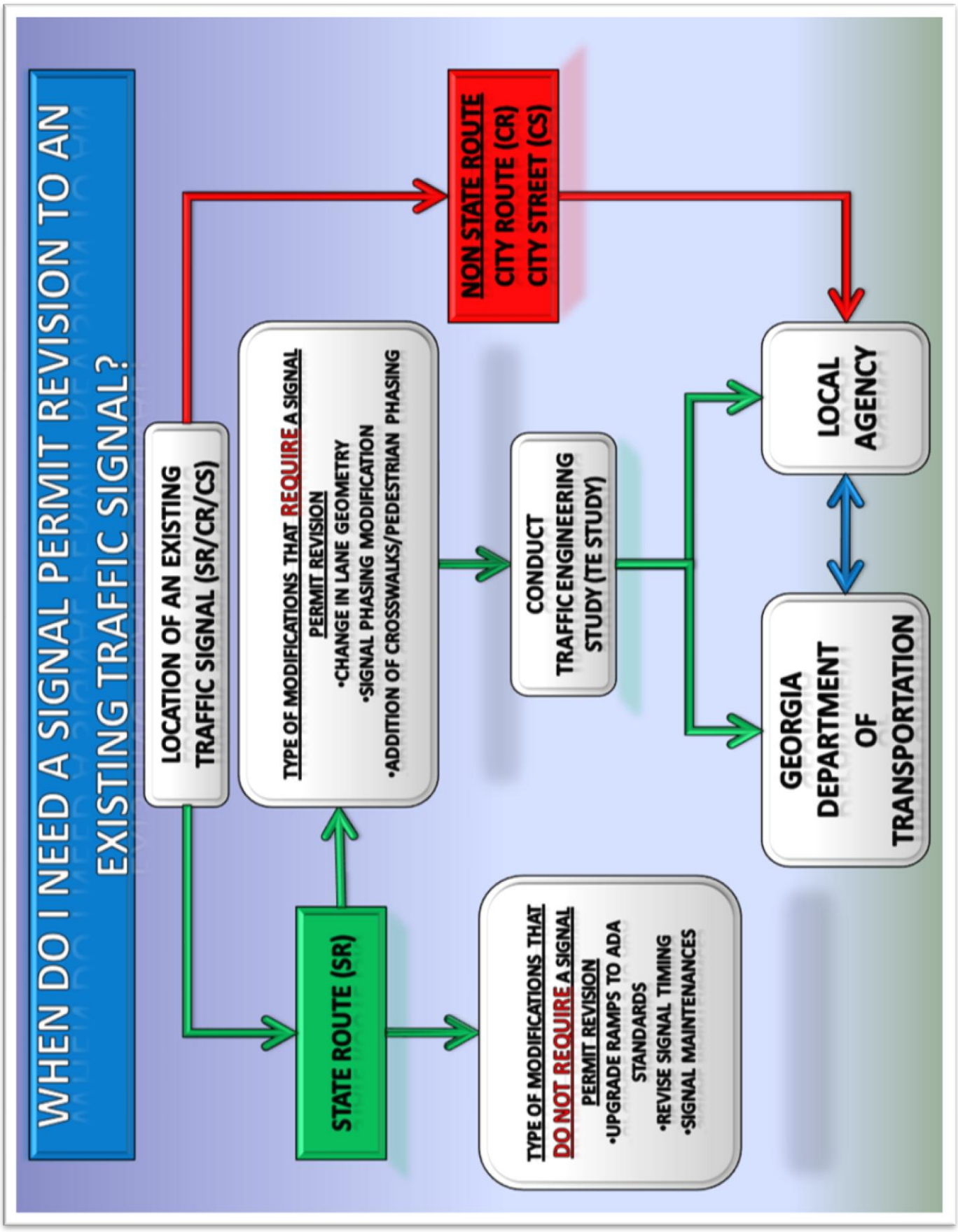
WHEN DO I NEED A SIGNAL PERMIT REVISION TO AN EXISTING TRAFFIC SIGNAL?
LOCATION OF AN EXISTING TRAFFIC SIGNAL (SR/CR/CS)
NON STATE ROUTE CITY ROUTE (CR) CITY STREET (CS)
STATE ROUTE (SR)
TYPE OF MODIFICATIONS THAT REQUIRE A SIGNAL PERMIT REVISION
•CHANGE IN LANE GEOMETRY
•SIGNAL PHASING MODIFICATION
•ADDITION OF CROSSWALKS/PEDESTRIAN PHASING
TYPE OF MODIFICATIONS THAT DO NOT REQUIRE A SIGNAL PERMIT REVISION
•UPGRADE RAMPS TO ADA STANDARDS
•REVISE SIGNAL TIMING
•SIGNAL MAINTENANCES
CONDUCT TRAFFIC ENGINEERING STUDY (TE STUDY)
LOCAL AGENCY
GEORGIA DEPARTMENT OF TRANSPORTATION

Figure 2

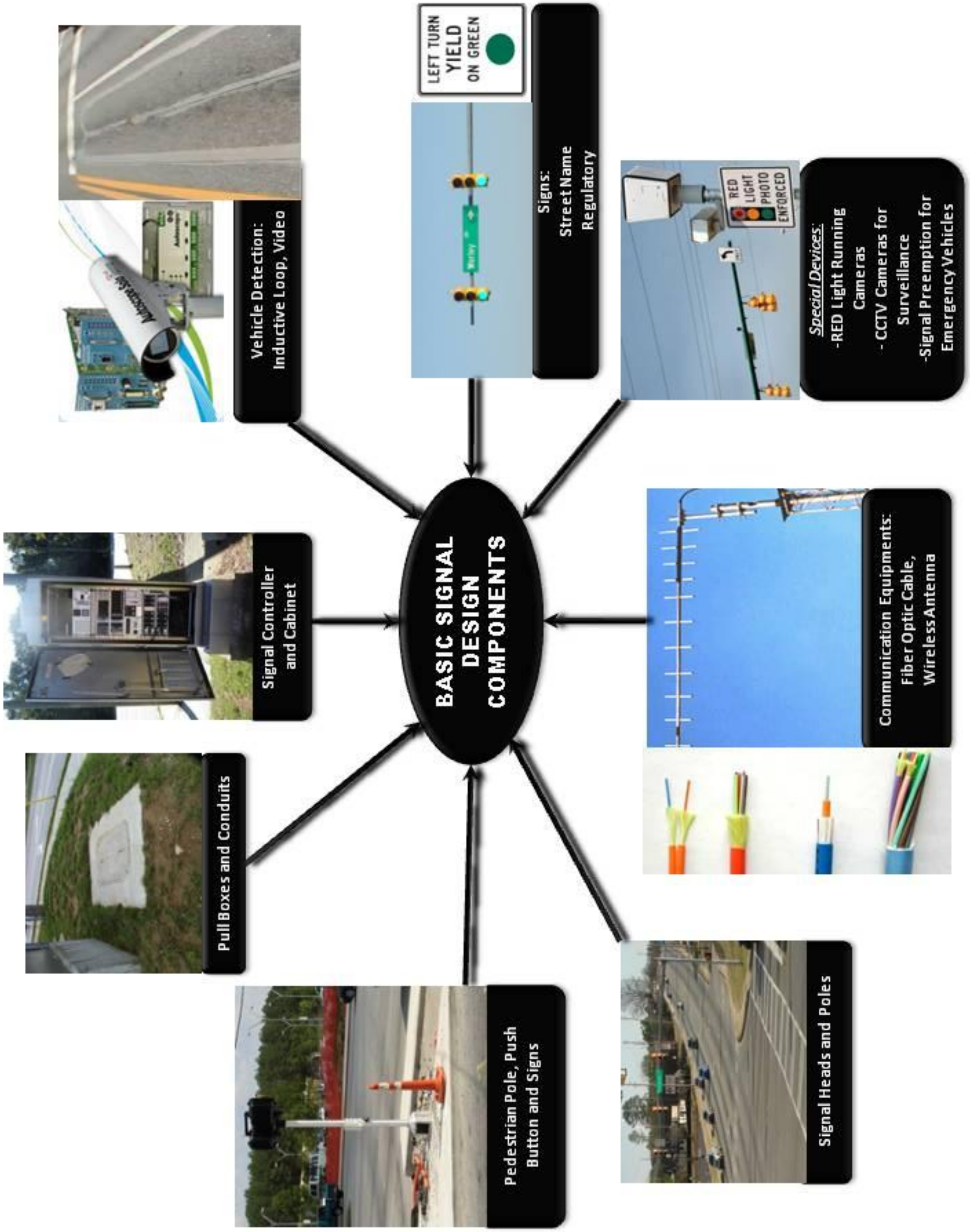
BASIC SIGNAL DESIGN COMPONENTS
Vehicle Detection: Inductive Loop, Video
Signs: Street Name Regulatory
LEFT TURN YIELD ON GREEN
Special Devices: -RED Light Running Cameras - CCTV Cameras for Surveillance -Signal Preemption for Emergency Vehicles
RED LIGHT PHOTO ENFORCED
Communication Equipments: Fiber Optic Cable, Wireless Antenna
Signal Heads and Poles
Pedestrian Pole, Push Button and Signs
Pull Boxes and Conduits
Signal Controller and Cabinet

Figure 3