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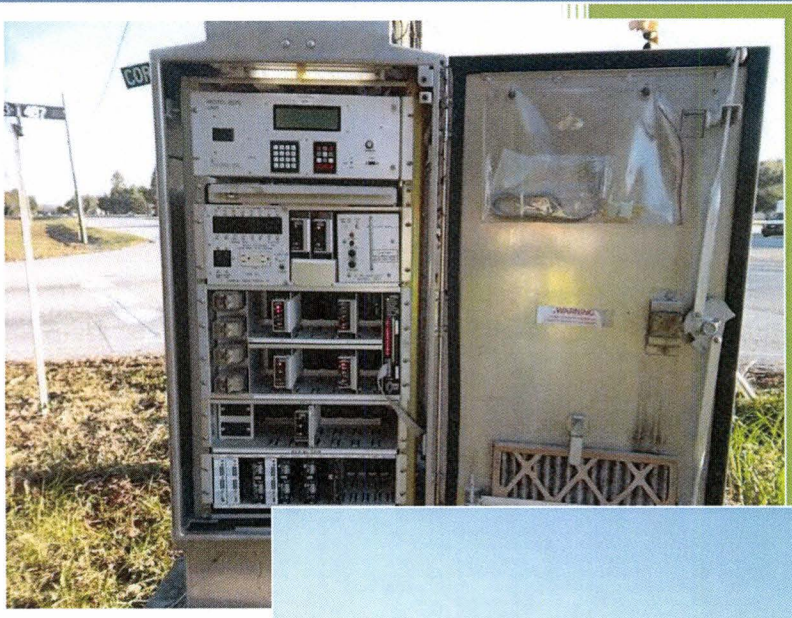
# Traffic Signals: Managing our Assets



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# Traffic Signals

Managing our Assets

Langland, Patricia E.

## Introduction

MOVING AHEAD FOR PROGRESS IN THE 21ST CENTURY ACT (MAP-21) was signed into law by President Obama on July 6, 2012. MAP-21 sets the course for investing in transportation by strengthening America's highways, establishing a performance-based program, creating jobs and supporting economic growth, supporting the Department of Transportation's (DOT) aggressive safety agenda, streamlining Federal highway transportations, accelerating project delivery and promoting innovation.

Performance Management is the cornerstone of MAP-21. States achieve individual targets through a performance and outcome-based program with better use of limited federal funding; and collectively move toward meeting national goals. The relevant areas are safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. This report will focus on the infrastructure condition aspect of Performance Management, in the area of traffic signals.

In order to determine the infrastructure condition of assets, MAP-21 requires the development of a risk-based asset management plan for the National Highway System (NHS). The purpose is to improve or preserve the condition of the assets and the performance of the

system. (23 U.S.C. 101(a)(2), MAP-21 § 1103) A risk-based asset management plan includes strategies that lead to a program of projects which would make progress toward achievement of the State targets for asset condition and performance. States must address pavements and bridges but are encouraged to include all infrastructure assets within the highway right-of-way in their risk-based asset management plan, which includes, among other things, traffic signals.

## Problem Statement

Asset management is a process of operating, maintaining, and improving physical assets strategically and systematically. It is the goal of South Carolina Department of Transportation (SCDOT) to meet the requirements set forth by MAP-21 for asset management. (See Appendix A for a summary of MAP-21.) The Gap Analysis will analyze SCDOT's state of compliance with the goals of MAP-21 and identify methods to address areas where SCDOT is not yet in compliance.

## Gap Analysis

The requirement for asset management is to have a plan to maintain the highway infrastructure asset system in a state of good repair. The plan should include:

1. A summary listing of the physical assets on the NHS in the State, including a description of the condition of those assets;
2. Asset management objectives and measures;
3. Performance gap identification;
4. Lifecycle cost and risk management analysis;

5. A financial plan; and
6. Investment strategies.

The plan for pavement and bridge assets should be in place by October 2016. While there is not a date specified for traffic signals, SCDOT wants to be in compliance before any target date is determined.

## Discovering Gaps

SCDOT is ahead of the required MAP-21 asset management implementation schedule for developing a summary listing of the traffic signal assets including their condition and developing asset management objectives and measures for traffic signals.

An assessment of the traffic signals and how they match up with the requirements of the MAP-21 risk-based asset management plan is below:

| | Goal – Set forth by MAP-21 | Current Status for SCDOT Traffic Signals |
|---|---|---|
| 1 | A summary listing of the traffic signal assets on the NHS in the State, including a description of the condition of those assets; | SCDOT has an inventory in place that lists the traffic signal assets on the NHS in the State. It includes the date of installation of equipment, providing an age for each major piece of equipment upon which average condition can be estimated. |
| 2 | Asset management objectives and measures | SCDOT has an annual inspection program in place that identifies the objectives and measures of properly functioning equipment. |
| 3 | Performance gap identification | SCDOT does not currently have this in place. |
| 4 | Lifecycle cost and risk management analysis | SCDOT does not currently have this in place. |
| 5 | A financial plan | SCDOT does not currently have this in place. |
| 6 | Investment strategies | SCDOT does not currently have this in place. |

SCDOT has exceeded MAP-21 requirements by having already addressed asset management from traffic signals with summary listing of the traffic signal assets on the NHS in the State in TEAMS (Transportation Engineering Asset Management System). TEAMS is a software application that has been used since October 2010 to house the traffic signal assets that are deployed in the field. The software has the ability to house very detailed information about various pieces of equipment. It is also able to house images of the intersections, design plans, timing plans, and turning movement counts. (See Appendix B for screenshots of TEAMS.)

Currently, SCDOT considers the age of the equipment an acceptable means to describe the condition of those assets. A task module and work history within TEAMS can also assist with identifying the condition of the equipment. SCDOT also utilizes the electronic inspection form that can be used on a laptop or tablet in the field and entered via wifi or cellular connection directly into the system. These annual inspections satisfy the requirement of managing the objectives and measures of the traffic signal equipment through MAP-21.

SCDOT has taken strides with the first two goals of MAP-21 and is being proactive toward meeting the requirements. There are, however, still areas where improvement is desired. SCDOT has not yet addressed performance gap identification, lifecycle costs and risk-management, financial planning, and investment strategies for traffic signals.

## Addressing Gaps

Through the analysis comparing the current state of SCDOT traffic signal asset management with MAP-21 goals, it was determined that SCDOT needs to continue striving to

meet the MAP-21 requirements for asset management in the area of traffic signals. Recommended actions for each unmet goal are identified:

**Performance Gap Identification** – SCDOT has identified a performance gap in the area of tracking particular equipment from cradle to grave. Unlike many other roadway assets, traffic signal assets are not all installed in the field. Many assets are stored in signal shop inventories for use in repairing assets when needed. By not accurately accounting for these assets and tracking assets at all times, SCDOT is not providing a complete picture of the traffic signal assets in the State.

**Lifecycle Cost and Risk-Management** – SCDOT will need to identify lifecycle costs and risk-management associated with traffic signals. Life cycle costs will include not only equipment costs, but also construction costs for installation, costs of annual preventative maintenance inspections and periodic maintenance costs.

**Financial Planning** – SCDOT will need to use lifecycle costs to identify a preservation plan, rehabilitation plan, and replacement plan. These plans will need to show not only the funding required to achieve the traffic signal performance goals, but plans will also need to show the level of performance that can be expected with varying levels of available funding. In this way, decision makers can see the degree to which assets will degrade over time if adequate funding is not provided.

**Investment Strategies** – SCDOT will need to use the preservation plan, the rehabilitation plan, and the replacement plan to identify investment strategies to get the most out of our assets.

## Focus

The focus of this project was the performance gap identified above, the tracking of equipment from purchase to disposal. The analysis steps through identifying the parameters necessary for the system and the methodology that was used to determine the best practice for traffic signal asset management. While the tracking process was determined for particular types of equipment, the intent of the process is to be expandable and be able to manage and track any traffic signal asset in the future.

Security of traffic signal assets has become a priority of SCDOT. There is a desire to be able to track equipment to ensure the security of the equipment in the district signal shops and yards. Another driving force behind tracking the traffic signal assets is to ensure SCDOT is getting not only new equipment directly from the contractor or vendor, but also equipment that is not outdated and is still under warranty from the manufacturers.

In order to begin the process of tracking the assets, SCDOT considered several parameters for asset tracking. These parameters included determining when the tracking begins and ends, which assets should be tracked, the system that should be used, and the process for entering the data. Once the parameters were determined, they were updated in the Traffic Signal Business Rules under Equipment Tracking. (See Appendix C for draft Traffic Signal Business Rules.)

## Begin and End Tracking

A key consideration was when the tracking of assets should begin. SCDOT had to determine when the equipment enters the tracking system and when it is considered expired from the tracking system, if ever. There were several options as to the point at which equipment should enter the inventory:

- **When assets are ordered** – SCDOT was quickly able to eliminate the option tracking assets from the time of the order because many times items are on back order or orders get cancelled. Therefore, tracking at this point was an additional step that was deemed unnecessary.
- **When assets are purchased by the SCDOT Supply Depot** – Supply Depot orders and inventory are already tracked by the staff at the Supply Depot and therefore meet the desired goal of tracking on-hand signal equipment. Additionally, traffic signal staff does not control these orders and are often unaware of orders for traffic signal equipment being placed. Therefore, signal staff does not have the ability to begin tracking these assets upon delivery to the Supply Depot.
- **When assets are delivered to District Signal Shops from either the SCDOT Supply Depot, a vendor or a traffic signal contractor** – Often signal equipment is delivered to the District Signal Shop prior to being installed in the field. Because the drive behind the tracking was the security in shop and on the yard, beginning the tracking was necessary upon delivery to the shop.
- **When assets are installed in the field** – Not all equipment passes through the signal shop prior to being installed in the field if a contractor has purchased and installed the equipment as part of a project. Since that equipment is not the responsibility of SCDOT until the project is complete and the traffic signal equipment is accepted, it was determined that equipment

installed by a contractor as part of a project would be entered into the inventory from the field at the time of acceptance.

All of this considered, tracking was determined to begin upon SCDOT Signal Shops assuming responsibility for an asset, whether that occurs at the time of delivery to the District Signal Shop or when the equipment is accepted as installed in the field. The end of the tracking is when the equipment leaves SCDOT property for salvage. This equipment will not be back in the field and will be identified if it is entered into the system again.

## Equipment to Track

The next parameter determined was which equipment should be tracked. Signal shops have equipment ranging from values less than one dollar to greater than $10,000 flowing in and out to either be stocked or used for projects. The size of items vary as well, from parts and supplies as small as a bolt to a traffic signal cabinet measuring 72" X 24" X 30" and 40' concrete poles. Another thing to consider was individual identifications. Items such as cabinets and controllers, and a few others, have specific serial numbers from the manufacturer for each item. Traffic signal heads, pedestrian equipment, and junction boxes, among others, do not have serial numbers and are only identified by model numbers.

By analyzing the chart below and taking into consideration the time added to the district signal shops to add this process to their workload, it was determined to begin by tracking a select variety of equipment. The original list came from a district that was tracking the most equipment internally. In a quarterly standards meeting held in February 2015 for district traffic

signal maintainers, that list of inventoried equipment was presented and discussed. Consideration was jointly given to the value, size, realistic goals for maintaining the inventory, and likelihood of the loss of particular pieces of equipment. For instance, SCDOT obtains eight detector cards worth $70 each with each cabinet purchased and occasionally does not need all eight of them at a signalized location. The district signal shops then add the spares to their stockpile. District shops typically have over 50 spare detector cards without ever having to purchase any individually. If one of these were stolen, there would be no resale value because the districts have plenty and no need to purchase any individually. Items such as these, are not going to be inventoried. However, items with serial numbers are going to be tracked. Those items have historically been found to be fraudulently reused once they were taken out of the field. With all of their intricate electronics, they are vital to the function of the traffic signal and should not be re-commissioned. As noted previously, is the intent of SCDOT to be able to customize the types of equipment being tracked and expand the list in the future. While some districts are tracking additional equipment, until a more automated asset management system is in place, these are the only requirements. (See Appendix D for table of equipment to be included in the inventory.)

## Tracking System

The final decisions for tracking equipment were the system that will be used and how will it be entered. There are seven different districts, and nearly that many ways of currently tracking various, non-standard equipment throughout the state. SCDOT needs a universal

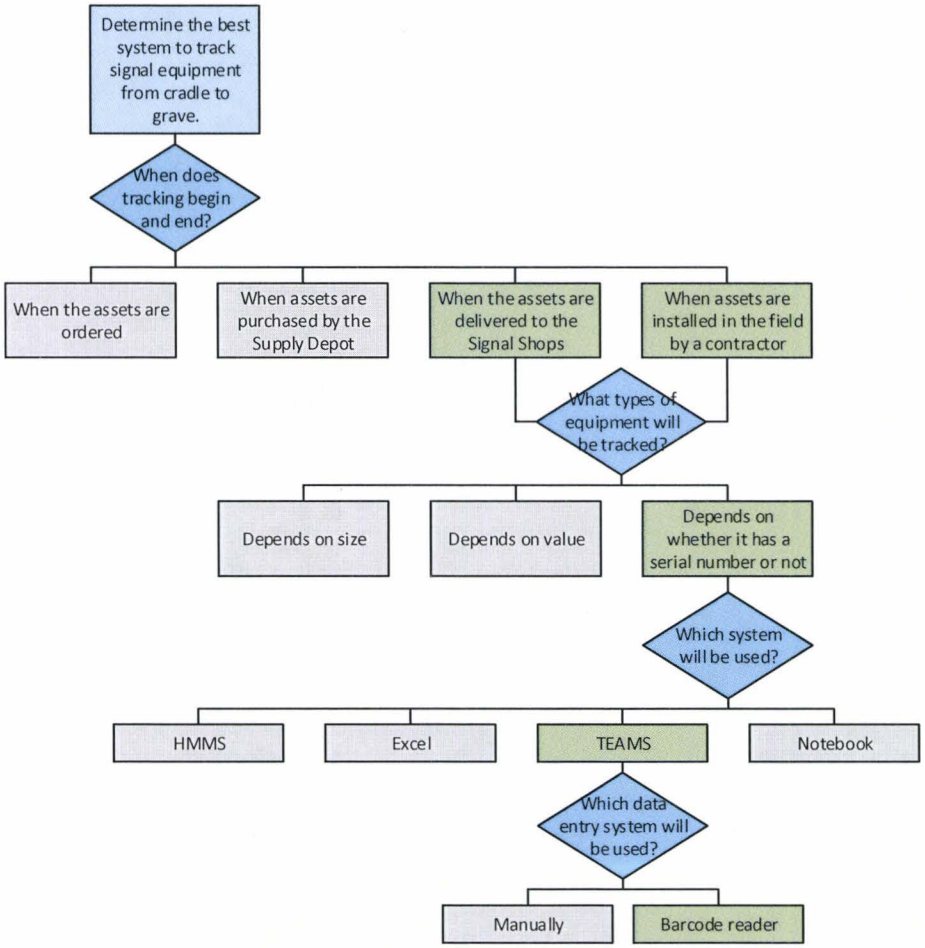
system to house the tracking information. Current systems being used are Highway Maintenance Management System (HMMS), Microsoft Excel, and notebooks. Even with all of the data these systems contain, none are currently tracking the equipment from cradle to grave. When considering HMMS, the flow of equipment and supplies is tracked in and out of the general stockpiles, but there is not a way to indicate where it goes once it is in the field. HMMS also does not have the ability to list individual equipment items with serial numbers, which is a key piece to having a successful system in place. The districts who are using an Excel spreadsheet are only tracking the equipment with serial numbers; however, Excel does not make it easy for them to be input because all data is manually entered. Not only is this time consuming, but it also allows for more user error and leaves the security of the equipment questionable, as the spreadsheet can be manipulated at any time. Keeping the data in a handwritten notebook is not an option, as everything SCDOT is doing is going toward automated and electronic processes.

The final option was TEAMS. While TEAMS does not currently have a module to track the equipment from cradle to grave, since this project began, it has added a module to inventory stockpiles at Signal Shops. This module can be modified to allow SCDOT to track any items we wish to track from cradle to grave. The electronic version of a system will limit the user errors as well as secure the equipment transfers and restrict the possibilities of losing equipment. It was decided that TEAMS would be the best system to move forward with because of the ability for SCDOT to have input toward the development and the customization it allows.

## Data Input

In this analysis, it was determined that it would save the signal technicians time and limit user errors even more to automate the entry of the equipment. A barcode system to streamline the data entry for the entire system of tracking equipment from cradle to grave was decided upon. This aspect of the system will be incorporated in an upcoming Request for Proposal (RFP) for various traffic signal equipment and services.

The methodology used to determine the final result for the asset tracking system was:



## Project Concept

After all of the analysis was complete and parameters identified, a final system was conceptualized. Tracking will begin when SCDOT takes ownership of the equipment. Equipment with serial numbers will be the first to be tracked. The data will all be held in TEAMS once a module for the entire system is developed; and a barcode system will be used to scan in the item, identify who scanned it in, where it came from, and where it is going. There will be options to indicate the equipment's status; it could be put in the stock inventory, it could be allocated to a project and set aside in the holding stock until it is ready to be deployed, or it could go directly in to the field to be installed. Any time equipment is moved from the stock inventory, holding stock, or the field, it is again scanned and its destination identified. Once equipment is brought in from the field, it will be determined whether it can be repaired or it must be salvaged. Either way, it is identified in the TEAMS system. Items that are salvaged are not considered suitable for redeployment. Serial items of salvaged equipment will be saved in the system and if ever entered again, users will be notified that the equipment is used and not to be accepted from the vendor or a contractor. The developer of TEAMS will be working on the tracking system in the software; and then will be working with a vendor for implementation of the barcode system once the contract with that requirement has been awarded. (See Appendix E for the for the completion schedule of TEAMS for each of the phases included in this project.) The success of the project will ultimately be measured by how closely we are able to manage our assets, how well we move the inventory we have on hand, and our ability to anticipate equipment needs, thereby reducing instances of equipment shortages.

## Summary

SCDOT desires to meet federal requirements set forth in MAP-21 for not only the pavement markings and bridge assets, but also for traffic signal assets. Through this analysis, SCDOT compared the current state of traffic signal asset management against the requirements of MAP-21. It was determined that SCDOT is already meeting two of the goals of the performance management program. While there is not a date set for traffic signals to have a plan in place according to MAP-21, it is the desire of the FHWA to include all aspects of the highway system, which includes traffic signals. SCDOT hopes to have met all of the goals by 2017, before this becomes a required area for asset management. This analysis stepped through the process of determining the best practice in tracking traffic signal equipment from cradle to grave. When considering all of the parameters, the best solution for tracking traffic signal assets is to track the identified equipment beginning once SCDOT takes possession of it. The data will be entered via barcode into the current TEAMS inventory. Anticipated roll-out date for the asset management tracking system in all districts is June 30, 2015.

# Appendix A

## Summary of MAP-21

http://www.fhwa.dot.gov/MAP21/summaryinfo.cfm

# Moving Ahead for Progress in the 21st Century Act (MAP-21)

A Summary of Highway Provisions

Federal Highway Administration
Office of Policy and Governmental Affairs
July 17, 2012

## Moving Ahead for Progress in the 21st Century Act

### Overview

On July 6, 2012, President Obama signed into law P.L. 112-141, the Moving Ahead for Progress in the 21st Century Act (MAP-21). Funding surface transportation programs at over $105 billion for fiscal years (FY) 2013 and 2014, MAP-21 is the first long-term highway authorization enacted since 2005. MAP-21 represents a milestone for the U.S. economy – it provides needed funds and, more importantly, it transforms the policy and programmatic framework for investments to guide the growth and development of the country's vital transportation infrastructure.

MAP-21 creates a streamlined, performance-based, and multimodal program to address the many challenges facing the U.S. transportation system. These challenges include improving safety, maintaining infrastructure condition, reducing traffic congestion, improving efficiency of the system and freight movement, protecting the environment, and reducing delays in project delivery.

MAP-21 builds on and refines many of the highway, transit, bike, and pedestrian programs and policies established in 1991. This summary reviews the policies and programs administered by the Federal Highway Administration. The Department will continue to make progress on transportation options, which it has focused on in the past three years, working closely with stakeholders to ensure that local communities are able to build multimodal, sustainable projects ranging from passenger rail and transit to bicycle and pedestrian paths.

Setting the course for transportation investment in highways, MAP-21 –

- *Strengthens America's highways*
  MAP-21 expands the National Highway System (NHS) to incorporate principal arterials not previously included. Investment targets the enhanced NHS, with more than half of highway funding going to the new program devoted to preserving and improving the most important highways -- the National Highway Performance Program.

- *Establishes a performance-based program.*
  Under MAP-21, performance management will transform Federal highway programs and provide a means to more efficient investment of Federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decisionmaking through performance-based planning and programming.

- *Creates jobs and supports economic growth*
  MAP-21 authorizes $82 billion in Federal funding for FYs 2013 and 2014 for road, bridge, bicycling, and walking improvements. In addition, MAP-21enhances innovative financing and encourages private sector investment through a substantial increase in funding for the TIFIA program. It also includes a number of provisions designed to improve freight movement in support of national goals.

- *Supports the Department of Transportation's (DOT) aggressive safety agenda*
  MAP-21 continues the successful Highway Safety Improvement Program, doubling funding for infrastructure safety, strengthening the linkage among modal safety programs, and creating a positive agenda to make significant progress in reducing highway fatalities. It also continues to build on other aggressive safety efforts, including the Department's fight against distracted driving and its push to improve transit and motor carrier safety.

- *Streamlines Federal highway transportation programs.*
  The complex array of existing programs is simplified, substantially consolidating the program structure into a smaller number of broader core programs. Many smaller programs are eliminated, including most discretionary programs, with the eligibilities generally continuing under core programs.

- *Accelerates project delivery and promotes innovation.*
  MAP-21 incorporates a host of changes aimed at ensuring the timely delivery of transportation projects. Changes will improve innovation and efficiency in the development of projects, through the planning and environmental review process, to project delivery.

Following are brief descriptions of many of the MAP-21 highway provisions. The appropriate section of the Act is noted in brackets.

**Program Restructuring**

MAP-21 restructures core highway formula programs. Activities carried out under some existing formula programs – the National Highway System Program, the Interstate Maintenance Program, the Highway Bridge Program, and the Appalachian Development Highway System Program – are incorporated into the following new core formula program structure:

- National Highway Performance Program (NHPP)
- Surface Transportation Program (STP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program (HSIP)
- Railway-Highway Crossings (set-aside from HSIP)
- Metropolitan Planning

It creates two new formula programs:

- Construction of Ferry Boats and Ferry Terminal Facilities – replaces a similarly purposed discretionary program.
- Transportation Alternatives (TA) – a new program, with funding derived from the NHPP, STP, HSIP, CMAQ and Metropolitan Planning programs, encompassing most activities funded under the Transportation Enhancements, Recreational Trails, and Safe Routes to School programs under SAFETEA-LU.

MAP-21 creates a new discretionary program – Tribal High Priority Projects (THPP) – and continues the following current discretionary programs:

- Projects of National and Regional Significance (PNRS)
- On-the-Job Training Supportive Services
- Disadvantaged Business Enterprise (DBE) Supportive Services
- Highway Use Tax Evasion (Intergovernmental enforcement projects)
- Work Zone Safety Grants

It also eliminates most current discretionary programs, but many of the eligibilities are covered in other programs:

- Delta Region Transportation Development
- Ferry Boats Discretionary
- Highways for LIFE Demonstration Program
- Innovative Bridge Research and Deployment

- Interstate Maintenance Discretionary
- National Historic Covered Bridge Preservation
- National Scenic Byways
- Public Lands Highway Discretionary
- Railway-Highway Crossing Hazard Elimination in High Speed Rail Corridors
- Transportation, Community, and System Preservation
- Truck Parking Pilot Program
- Value Pricing Pilot Program (no additional funding, but authority remains)

## Investment

**Authorizations** [1101]
MAP-21 extends current law (SAFETEA-LU) for the remainder of FY 2012, with new provisions for FY 2013 and beyond taking effect on October 1, 2012. Funding levels are maintained at FY 2012 levels, plus minor adjustments for inflation – $40.4 billion from the Highway Trust Fund (HTF) for FY 2013, and $41.0 billion for FY 2014.

**Administrative expenses** [1105]
FHWA administrative expenses associated with the Federal-aid highway program, Appalachian Regional Commission administration of the Appalachian Development Highway System (ADHS), and Office of the Inspector General audit costs are provided as a separate authorization of $454 million for FY 2013 and $440 million for FY 2014. However, more than $30 million of the administrative funds are designated for other purposes each year, as follows:

- On-the-job training supportive services ($10 million annually) [1109]
- DBE supportive services ($10 million annually) [1109]
- Highway use tax evasion projects ($10 million annually) [1110]
- Combined amount for Work Zone Safety Grants, safety clearinghouses, and Operation Lifesaver ($3 million annually) [1519]
- Air quality and congestion mitigation measures outcomes assessment study (up to $1 million in FY 2013 only) [1113]

**Obligation limitation** [1102]
MAP-21 establishes an annual obligation limitation of $39.699 billion for FY 2013 and $40.256 billion for FY 2014 for the purpose of limiting highway spending each year. Distribution of the limitation is similar to current law. The current requirement to annually recover unused obligation limitation and distribute it as formula limitation to States that can use it before the end of the fiscal year is also continued. Funding for the following programs is exempt from the limitation:

- Emergency Relief
- Demonstration projects from ISTEA and earlier authorization acts (specified)
- Minimum Allocation (pre TEA-21)
- $639 million per year of TEA-21 Minimum Guarantee
- $639 million per year of SAFETEA-LU (and extensions) Equity Bonus
- $639 million per year of National Highway Performance Program funds (MAP-21)

**New approach to formulas** [1105]
Prior to MAP-21, each apportioned program had its own formula for distribution, and each State's total was the sum of the amount it received for each program.

MAP-21's new approach to distribution of formula funds is now based on the amount of formula funds each State received under SAFETEA-LU.

- *Step one – authorize lump sum*

A single amount (approximately $38 billion/year) is authorized to fund the core programs— National Highway Performance Program (NHPP), Surface Transportation Program (STP), Highway Safety Improvement Program, including Rail-Highway Crossings, (HSIP), Congestion Mitigation and Air Quality Improvement Program (CMAQ), and Metropolitan Planning. Note: These new core programs are outlined below.

- *Step two – calculate each State's share of the total*

For FY 2013, each State receives virtually the same total apportionment as in FY 2012. In FY 2014, the total amount available for distribution will be divided proportionally among the States based on the share of apportionments each State received for FY 2012, adjusted, if necessary, to ensure that no State receives less than 95 cents of every dollar it contributed to the Highway Account of the HTF.

- *Step three – for each State, divide the total amount up among programs*

Once each State's total Federal-aid apportionment is calculated, amounts are set aside for Metropolitan Planning and CMAQ via a calculation based on the relative size of the State's FY 2009 apportionment of those programs. The remainder is then divided among the rest of the formula programs as follows: NHPP (63.7%), STP (29.3%), and HSIP (7%). An amount is set aside from HSIP to fund the Rail-Highway Crossings program, and amounts are set aside proportionally from each State's NHPP, STP, HSIP, CMAQ, and Metropolitan Planning apportionments to fund the State's Transportation Alternatives program.

To enhance flexibility, a State may transfer up to 50% of any apportionment to another formula program, except no transfers are permitted of Metropolitan Planning funds or funds suballocated to areas based on population (STP and TA). [1509]

**TIFIA** [2002]

The Transportation Infrastructure Financing and Innovation Act (TIFIA) program provides Federal credit assistance to eligible surface transportation projects. MAP-21 dramatically increases funding available for TIFIA, authorizing $750 million in FY 2013 and $1 billion in FY 2014 to pay the subsidy cost (similar to a commercial bank's loan reserve requirement) of supporting Federal credit. A $1 billion TIFIA authorization will support about $10 billion in actual lending capacity. MAP-21 also calls for a number of significant program reforms, to include: a 10 percent set-aside for rural projects; an increase in the share of eligible project costs that TIFIA may support; and a rolling application process.

**Tolling** [1512]

MAP-21 makes changes to the statutory provisions governing tolling on highways that are constructed or improved with Federal funds (23 USC 129). One significant change is the removal of the requirement for an agreement to be executed with the U.S. DOT prior to tolling under the mainstream tolling programs (though such agreements will continue to be required under the toll pilot programs). Other changes include the mainstreaming of tolling new Interstates and added lanes on existing Interstates, which was previously allowed only under the *Interstate System Construction Toll Pilot Program* and the *Express Lanes Demonstration Program*. The *Value Pricing Pilot Program*, which allows congestion pricing, is continued (but without discretionary grants), as is the *Interstate System Reconstruction and Rehabilitation Pilot Program*, which allows tolling of all lanes on an existing Interstate highway when required for reconstruction or rehabilitation. MAP-21 also requires that all Federal-aid highway toll facilities implement technologies or business practices that provide for the interoperability of electronic toll collection by October 1, 2016 (four years after the enactment of MAP-21's new tolling requirements).

## Highway Trust Fund

### Operation of the Highway Trust Fund

The Highway Trust Fund (HTF) is the source of funding for most of the programs in the Act. The HTF is comprised of the Highway Account, which funds highway and intermodal programs, and the Mass Transit Account. Federal motor fuel taxes are the major source of income into the HTF. Although MAP-21 achieves dramatic policy and programmatic changes, reform of the way highway programs are funded remains a challenge for the future. Additional funds are provided to maintain solvency of the HTF – transfers from the General Fund and from the Leaking Underground Storage Tank Trust Fund (a separate trust fund set up for certain environmental cleanup purposes, which is financed with a small portion of motor fuel taxes). Revenue raisers are included that will offset the transfers made to the HTF.

MAP-21 extends the imposition of the highway-user taxes, generally at the rates that were in place when the legislation was enacted, through September 30, 2016. It also extended provisions for full or partial exemption from highway-user taxes. In addition, it extends provision for deposit of almost all of the highway-user taxes into the HTF through September 30, 2016.

Federal law regulates not only the imposition of the taxes, but also their deposit into and expenditure from the HTF. For the Highway Account, authority to expend from the HTF for programs under the Act and previous authorization acts is provided through September 30, 2014. For the Mass Transit Account, expenditures are authorized through September 30, 2014. Beginning on October 1, 2014, expenditures may be made only to liquidate obligations made prior to the September 30, 2014 deadline.

### Highway tax compliance [1110]

Traditionally, the highway programs of the Federal government and most States depend on highway-user tax receipts as the principal source of funding. MAP-21 continues the Highway Use Tax Evasion program to reduce motor fuel tax evasion, funded at up to $10 million per year from FHWA administrative funds. Funds may be allocated to the Internal Revenue Service (for efforts including the development, operation, and maintenance of databases to support tax compliance) and the States at the discretion of the Secretary, except that $2 million per year must be used for inter-governmental enforcement efforts, including research and training. States may also elect to use 0.25 percent of their STP funding for fuel tax evasion activities.

## Transportation Planning

[1201 and 1202]

In MAP-21, the metropolitan and statewide transportation planning processes are continued and enhanced to incorporate performance goals, measures, and targets into the process of identifying needed transportation improvements and project selection. Public involvement remains a hallmark of the planning process.

Requirements for a long-range plan and a short-term transportation improvement plan (TIP) continue, with the long-range plan to incorporate performance plans required by the Act for specific programs. The long-range plan must describe the performance measures and targets used in assessing system performance and progress in achieving the performance targets. The TIP must also be developed to make progress toward established performance targets and include a description of the anticipated achievements. In the statewide and nonmetropolitan planning process, selection of projects in nonmetropolitan areas, except projects on the NHS or funded with funds remaining from the discontinued Highway Bridge Program, must be made in cooperation with affected nonmetropolitan officials or any regional transportation planning organization.

The Secretary is required to establish criteria for the evaluation of the new performance-based planning processes. The process will consider whether States developed appropriate performance targets and made progress toward achieving the targets. Five years after enactment of MAP-21, the Secretary is to provide to the Congress reports evaluating the overall effectiveness of performance-based planning and the effectiveness of the process in each State and for each MPO.

**Performance Management**
[1203]

The cornerstone of MAP-21's highway program transformation is the transition to a performance and outcome-based program. States will invest resources in projects to achieve individual targets that collectively will make progress toward national goals.

MAP-21 establishes national performance goals for Federal highway programs:

- **Safety**—To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- **Infrastructure condition**—To maintain the highway infrastructure asset system in a state of good repair.
- **Congestion reduction**—To achieve a significant reduction in congestion on the NHS.
- **System reliability**—To improve the efficiency of the surface transportation system.
- **Freight movement and economic vitality**—To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
- **Environmental sustainability**—To enhance the performance of the transportation system while protecting and enhancing the natural environment.
- **Reduced project delivery delays**—To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

The Secretary, in consultation with States, MPOs, and other stakeholders, will establish performance measures for pavement conditions and performance for the Interstate and NHS, bridge conditions, injuries and fatalities, traffic congestion, on-road mobile source emissions, and freight movement on the Interstate System. States (and MPOs, where applicable) will set performance targets in support of those measures, and State and metropolitan plans will describe how program and project selection will help achieve the targets.

States and MPOs will report to DOT on progress in achieving targets. If a State's report shows inadequate progress in some areas – most notably the condition of the NHS or key safety measures – the State must undertake corrective actions, such as the following:

- NHPP: If no significant progress is made toward targets for NHS pavement and bridge condition, the State must document in its next report the actions it will take to achieve the targets.
- HSIP: If no significant progress is made toward targets for fatalities or serious injuries, the State must dedicate a specified amount of obligation limitation to safety projects and prepare an annual implementation plan.

In addition, due to the critical focus on infrastructure condition, MAP-21 requires that each State maintain minimum standards for Interstate pavement and NHS bridge conditions. If a State falls below either standard, that State must spend a specified portion of its funds for that purpose until the minimum standard is exceeded.

## Accelerating Project Delivery
[1301-1323]

MAP-21 provides an array of provisions designed to increase innovation and improve efficiency, effectiveness, and accountability in the planning, design, engineering, construction and financing of transportation projects. Building on FHWA's "Every Day Counts" initiative, MAP-21 changes will speed up the project delivery process, saving time and money for individuals and businesses, and yielding broad benefits nationwide.

Some MAP-21 provisions are designed to improve efficiency in project delivery, broadening the ability for States to acquire or preserve right-of-way for a transportation facility prior to completion of the review process required under the National Environmental Policy Act of 1969 (NEPA), providing for a demonstration program to streamline the relocation process by permitting a lump sum payment for the acquisition and relocation if elected by the displaced person, enhancing contracting efficiencies, and encouraging the use of innovative technologies and practices. Other changes target the environmental review process, providing for earlier coordination, greater linkage between the planning and environmental review processes, using a programmatic approach where possible, and consolidating environmental documents. MAP-21 establishes a framework for setting deadlines for decisionmaking in the environmental review process, with a process for issue resolution and referral, and penalties for agencies that fail to make a decision. Projects stalled in the environmental review process can get technical assistance to speed completion within four years.

One area in particular that MAP-21 focuses on to speed up project delivery is expanded authority for use of categorical exclusions (CEs). "Categorical exclusion" describes a category of actions that do not typically result in individual or cumulative significant environmental impacts. CEs, when appropriate, allow Federal agencies to expedite the environmental review process for proposals that typically do not require more resource-intensive Environmental Assessments (EAs) or Environmental Impact Statements (EISs). In addition to those currently allowed, MAP-21 expands the usage of CEs to a variety of other types of projects, including multi-modal projects, projects to repair roads damaged in a declared disaster, projects within existing operational right-of-way, and projects receiving limited Federal assistance. To assess the impact of the above changes, the Secretary will compare completion times of CEs, EAs and EISs before and after implementation.

## Programs

**National Highway Performance Program (NHPP)** [1106]
Under MAP-21, the enhanced National Highway System (NHS) is composed of approximately 220,000 miles of rural and urban roads serving major population centers, international border crossings, intermodal transportation facilities, and major travel destinations. It includes the Interstate System, all principal arterials (including some not previously designated as part of the NHS) and border crossings on those routes, highways that provide motor vehicle access between the NHS and major intermodal transportation facilities, and the network of highways important to U.S. strategic defense (STRAHNET) and its connectors to major military installations.

The NHPP is authorized at an average of $21.8 billion per year to support the condition and performance of the NHS, for the construction of new facilities on the NHS, and to ensure that investments of Federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in an asset management plan of a State for the NHS.

MAP-21 establishes a performance basis for maintaining and improving the NHS.

- States are required to develop a risk- and performance-based asset management plan for the NHS to improve or preserve asset condition and system performance; plan development process must be reviewed and recertified at least every four years. The penalty for failure to implement this requirement is a reduced Federal share for NHPP projects in that year (65 percent instead of the usual 80 percent).
- The Secretary will establish performance measures for Interstate and NHS pavements, NHS bridge conditions, and Interstate and NHS system performance. States will establish targets for these measures, to be periodically updated.
- MAP-21 also requires minimum standards for conditions of Interstate pavements and NHS bridges by requiring a State to devote resources to improve the conditions until the established minimum is exceeded. The Secretary will establish the minimum standard for Interstate pavement conditions, which may vary by geographic region. If Interstate conditions in a State fall below the minimum set by the Secretary, the State must devote resources (a specified portion of NHPP and STP funds) to improve conditions. MAP-21 establishes the minimum standard for NHS bridge conditions – if more than 10 percent of the total deck area of NHS bridges in a State is on structurally deficient bridges, the State must devote a portion of NHPP funds to improve conditions.

**Surface Transportation Program (STP)** [1108]
MAP-21 continues the STP, providing an annual average of $10 billion in flexible funding that may be used by States and localities for projects to preserve or improve conditions and performance on any Federal-aid highway, bridge projects on any public road, facilities for nonmotorized transportation, transit capital projects and public bus terminals and facilities.

Most current STP eligibilities are continued, with some additions and clarifications. Activities of some programs that are no longer separately funded are incorporated, including transportation enhancements (replaced by "transportation alternatives" which encompasses many transportation enhancement activities and some new activities), recreational trails, ferry boats, truck parking facilities, and Appalachian Development Highway System projects (including local access roads). Explicit eligibilities are added for electric vehicle charging infrastructure added to existing or included in new fringe and corridor parking facilities, and projects and strategies that support congestion pricing, including electronic toll collection and travel demand management strategies and programs.

Fifty percent of a State's STP funds are to be distributed to areas based on population (suballocated), with the remainder to be used in any area of the State. Consultation with rural planning organizations, if any, is required. Also, a portion of its STP funds (equal to 15 percent of the State's FY 2009 Highway Bridge Program apportionment) is to be set aside for bridges not on Federal-aid highways (off-system bridges), unless the Secretary determines the State has insufficient needs to justify this amount. A special rule is provided to allow a portion of funds reserved for rural areas to be spent on rural minor collectors, unless the Secretary determines this authority is being used excessively.

**Highway Safety Improvement Program (HSIP)** [1112]
Safety throughout all transportation programs remains DOT's number one priority. MAP-21 continues the successful HSIP, with average annual funding of $2.4 billion, including $220 million per year for the Rail-Highway Crossings program.

The HSIP emphasizes a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. The foundation for this approach is a safety data system, which each State is required to have to identify key safety problems, establish their relative severity, and then adopt strategic and performance-based goals to maximize safety. Every State is required to develop a Strategic

Highway Safety Plan (SHSP) that lays out strategies to address these key safety problems. Every State now has an SHSP in place, and MAP-21 ensures ongoing progress toward achieving safety targets by requiring regular plan updates and defining a clear linkage between behavioral (NHTSA funded) State safety programs and the SHSP. A State that fails to have an approved updated plan will not be eligible to receive additional obligation limitation during the overall redistribution of unused obligation limitation that takes place during the last part of the fiscal year. The SHSP remains a statewide coordinated plan developed in cooperation with a broad range of multidisciplinary stakeholders.

Safety Performance

- States will set targets for the number of serious injuries and fatalities and the number per vehicle mile of travel. If a State fails to make progress toward its safety targets, it will have to devote a certain portion of its formula obligation limitation to the safety program and submit an annual implementation plan on how the State will make progress to meet performance targets.
- Although MAP-21 eliminates the requirement for every State to set aside funds for High Risk Rural Roads, a State is required to obligate funds for this purpose if the fatality rate on such roads increases.
- The Secretary is required to carry out a study of High Risk Rural Road "best practices."
- States are required to incorporate strategies focused on older drivers and pedestrians if fatalities and injuries per capita for those groups increase.

**Congestion Mitigation and Air Quality Improvement Program (CMAQ)** [1113]
The CMAQ program, continued in MAP-21 at an average annual funding level of $3.3 billion, provides a flexible funding source to State and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) as well as former nonattainment areas that are now in compliance (maintenance areas). States with no nonattainment or maintenance areas may use their CMAQ funds for any CMAQ- or STP-eligible project.

Under MAP-21, a State with PM 2.5 (fine particulate matter) areas must use a portion of its funds to address PM 2.5 emissions in such areas; eligible projects to mitigate PM 2.5 include diesel retrofits. Highlighted CMAQ eligibilities include transit operating assistance and facilities serving electric or natural gas-fueled vehicles (except where this conflicts with prohibition on rest area commercialization).

The CMAQ program also has new performance-based features. The Secretary will establish measures for States to use to assess traffic congestion and on-road mobile source emissions. Each Metropolitan Planning Organization (MPO) with a transportation management area of more than one million in population representing a nonattainment or maintenance area is required to develop and update biennially a performance plan to achieve air quality and congestion reduction targets. A CMAQ outcomes assessment study for the program is also required.

**Transportation Alternatives (TA)** [1122]
MAP-21 establishes a new program to provide for a variety of alternative transportation projects that were previously eligible activities under separately funded programs. This program is funded at a level equal to two percent of the total of all MAP-21 authorized Federal-aid highway and highway research funds, with the amount for each State set aside from the State's formula apportionments). Unless a State opts out, it must use a specified portion of its TA funds for recreational trails projects. Eligible activities include:

- Transportation alternatives (new definition incorporates many transportation enhancement activities and several new activities)

- Recreational trails program (program remains unchanged)
- Safe routes to schools program
- Planning, designing, or constructing roadways within the right-of way of former Interstate routes or other divided highways.

Fifty percent of TA funds are distributed to areas based on population (suballocated), similar to the STP. States and MPOs for urbanized areas with more than 200,000 people will conduct a competitive application process for use of the suballocated funds; eligible applicants include tribal governments, local governments, transit agencies, and school districts. Options are included to allow States flexibility in use of these funds.

**Federal Lands and Tribal Transportation Programs** [1119]
MAP-21 continues to acknowledge the importance of access to federal and tribal lands. Recognizing the need for all public Federal and tribal transportation facilities to be treated under uniform policies similar to the policies that apply to Federal-aid highways and other public transportation facilities, MAP-21 creates a unified program for Federal lands transportation facilities, Federal lands access transportation facilities, and tribal transportation facilities.

- The *Federal Lands Transportation Program* provides $300 million annually for projects that improve access within the Federal estate, such as national forests and national recreation areas, on infrastructure owned by the Federal government. This program combines the former Park Roads and Refuge Roads programs, and adds three new Federal land management agency (FLMA) partners. A portion of the funds will support traditional partner agencies at current funding levels, with new partners competing for a modest portion. All FLMA partners will administer the program using a new performance management model.

- The *Federal Lands Access Program* provides $250 million annually for projects that improve access to the Federal estate on infrastructure owned by States and local governments. Replacing and expanding the Forest Highways program, projects providing access to any Federal lands are eligible for this new comprehensive program. Funds are distributed by formula based on recreational visitation, Federal land area, Federal public road mileage, and the number of Federal public bridges. Eighty percent of funds go to States with large areas of public land. States are required to provide a non-Federal match for program funds (which has not been the case historically for Federal lands highway funding). Programming decisions will be made locally using a tri-party model in each State comprised of representatives from FHWA, State DOT, and local government, in consultation with applicable FLMAs.

- The *Tribal Transportation Program* provides $450 million annually for projects that improve access to and within Tribal lands. This program generally continues the existing Indian Reservation Roads program, while adding new setasides for tribal bridge projects (in lieu of the existing Indian Reservation Road Bridge program) and tribal safety projects. It continues to provide setasides for program management and oversight and tribal transportation planning. A new statutory formula for distributing funds among tribes, based on tribal population, road mileage, and average funding under SAFETEA-LU, plus an equity provision, is to be phased in over a 4 year period.

MAP-21 also authorizes the *Tribal High Priority Projects Program*, a discretionary program modeled on an earlier program that was funded by setaside from the Indian Reservation Roads Program. MAP-21 provides $30 million per year from the General fund (subject to appropriation) for this new program. [1123]

**Emergency Relief** [1107]
The Emergency Relief (ER) program assists Federal, State, tribal and local governments with the expense of repairing serious damage to Federal-aid, tribal, and Federal Lands highways resulting from natural disasters or catastrophic failures. Unlike other highway programs, ER is funded by a permanent authorization of $100 million per year.

MAP-21 continues the ER program, with some changes in requirements:

- State must apply and provide a complete list of project sites and costs within two years of the event; cost may not exceed the cost to repair or reconstruct a comparable facility.
- For emergency repairs, a 100 percent Federal share is allowed during the first 180 days following a disaster. MAP-21 allows the Secretary to extend the time period if access to damaged areas is limited.
- Debris removal for major disasters declared under the Stafford Act will be funded by FEMA.
- Maintenance and operation of additional ferryboats or transit is eligible as a temporary substitute service.

**Workforce Development and DBE** [1109]
MAP-21 continues current law goals for use of small business concerns owned and controlled by socially and economically disadvantaged individuals. On-the-Job Training and DBE Supportive Services programs are continued without change. States may continue to use apportioned funds (except Metropolitan Planning or Ferry Program) for surface transportation workforce development, training, education, and small business capacity building.

**Bridge and Tunnel Inspection** [1111]
To provide for continued improvement to bridge and tunnel conditions essential to protect the safety of the traveling public and allow for the efficient movement of people and goods on which the U.S. economy relies, MAP-21 requires inspection and inventory of highway bridges and tunnels on public roads. No dedicated funds are provided for inspections, but it is an eligible use of NHPP, STP, HSIP, FHWA administrative, Tribal Transportation, and Research funds.

**Territorial and Puerto Rico Highway Program** [1114]
MAP-21 continues funding for the Puerto Rico Highway program ($150 million annually) and the Territorial Highway program ($40 million annually).

**Projects of National and Regional Significance** [1120]
MAP-21 authorizes $500 million from the General Fund (subject to appropriation) in FY 2013 only, to fund critical high-cost surface transportation capital projects that will accomplish national goals, such as generating national/regional economic benefits and improving safety, and that are difficult to complete with existing Federal, State, local, and private funds. States, tribes, transit agencies, and multi-State or multi-jurisdictional groups of these entities are eligible to apply for competitive grant funding.

**Construction of Ferry Boats and Ferry Terminal Facilities** [1121]
It provides $67 million annually to construct ferry boats and ferry terminal facilities, to be distributed by formula. Unlike the former ferry boat discretionary program, there are no set-asides for specific States.

**Appalachian Development Highway System (ADHS)** [1528]
The ADHS program is continued, but without separate funding. Portions that are on the NHS are eligible for NHPP funding, and ADHS routes, including local access roads, are eligible for STP funding. To encourage the completion of the ADHS, States are required to submit plans for completion of the system and an increased Federal share is provided.

## Research, Technology Deployment, Training and Education

MAP-21 establishes the principles and practices for a flexible, nationally-coordinated research and technology program that addresses fundamental, long-term highway research needs, significant research gaps, emerging issues with national implications, and research related to policy and planning. The Secretary provides leadership for the national coordination of research and technology transfer activities, conducting and coordinating research projects, and partnering with State highway agencies and other stakeholders. All research activities are to include a component of performance measurement and evaluation, should be outcome-based, and must be consistent with the research and technology development strategic plan. MAP-21 provides new authority for the Secretary to use up to one percent of funds authorized for research and education for a program to competitively award cash prizes to stimulate innovation that has the potential for application to the national transportation system.

MAP-21 authorizes $400 million per year for the following six programs: Highway Research and Development, Technology and Innovation Deployment, Training and Education, Intelligent Transportation Systems, University Transportation Research, and the Bureau of Transportation Statistics.

Following is a description of the programs that are administered by FHWA.

Research and Technology Development and Deployment

- MAP-21 provides $115 million per year for the Highway Research and Development program. Research areas include highway safety, infrastructure integrity, planning and environment, highway operations, exploratory advanced research, and the Turner-Fairbank Highway Research Center. [52003]

- Separate funding is provided for the Technology Innovation and Deployment Program ($62.5 million per year) to accelerate implementation and delivery of new innovations and technologies that result from highway research and development to benefit all aspects of highway transportation. At least $12 million per year of these funds must be used to accelerate the deployment and implementation of pavement technology. [52003]

- The technology deployment program would also fund implementation of Future Strategic Highway Research Program (F-SHRP) results, but with an opportunity to supplement from State Planning and Research funds, if 75 percent of States agree to a percentage for this use. [52005]

Three specific programs are repealed: the International Outreach Program [52006], the Surface Transportation Environment Cooperative Research Program [52007], and the National Cooperative Freight Research Program [52008]. However, the authority for international collaboration remains, and environmental and freight research and development activities are incorporated into Highway Research and Development.

Training and Education [52004]

MAP-21 authorizes $24 million per year for continuation of training and education programs, including the National Highway Institute, the Local Technical Assistance Program (LTAP), the Tribal Technical Assistance Program (TTAP), the Dwight D. Eisenhower Transportation Fellowships, the Garrett A. Morgan Technology and Transportation Education Program, the Transportation Education Development Program, and the Freight Capacity Building Program. Also funded from the Training and Education funds are the competitively-selected centers for transportation excellence in the areas of the environment, surface transportation safety, rural safety, and project finance. The Federal share for LTAP and TTAP centers remains at 50 percent and 100 percent respectively.

MAP-21 continues the authority for States to use apportioned funds for training and other educational activities; this applies to the NHPP, STP, HSIP, and CMAQ. The Federal share for funds used in this manner is 100 percent, except that when funds are used for the LTAP centers, the Federal share is 50 percent.

State Planning and Research (SP&R) [52005]
MAP-21 continues the SP&R, as a two percent takedown of four core programs: National Highway Performance Program, Surface Transportation Program, Congestion Mitigation Air Quality program, and Highway Safety Improvement Program. At least 25 percent of these funds have to be used for research purposes. States are required to agree on what portion of their share of their SP&R funds they make available to the Secretary to implement the results of the F-SHRP program.

Transportation Research and Development (R&D) Strategic Planning [52012]
The Secretary is directed to develop a 5-year research and development strategic plan within 1 year of enactment, to be reviewed by the National Research Council, and report to Congress annually on R&D spending. The plan must address the following purposes: promoting safety, reducing congestion and improving mobility, preserving the environment, preserving the existing transportation system, improving the durability and extending the life of transportation infrastructure, and improving goods movement. MAP-21 offers the opportunity to conduct a nationally-coordinated, flexible, and strategically-targeted Research, Technology, and Education program.

## Other Provisions of Interest

Freight [1115-1118]
MAP-21includes a number of provisions designed to enhance freight movement in support of national goals. MAP-21 firmly establishes national leadership in improving the condition and performance of a National Freight Network by identifying the components of the network, which will be designated by the Secretary. It includes incentives to prioritize projects that advance freight performance targets. DOT, in consultation with partners and stakeholders, will develop a national freight strategic plan. States are encouraged to develop individual freight plans and establish freight advisory committees.

Truck Size and Weight Study [32801]
No changes to current truck size and weight provisions are included in MAP-21, but a new study and inventory of current State laws is required.

## For More Information

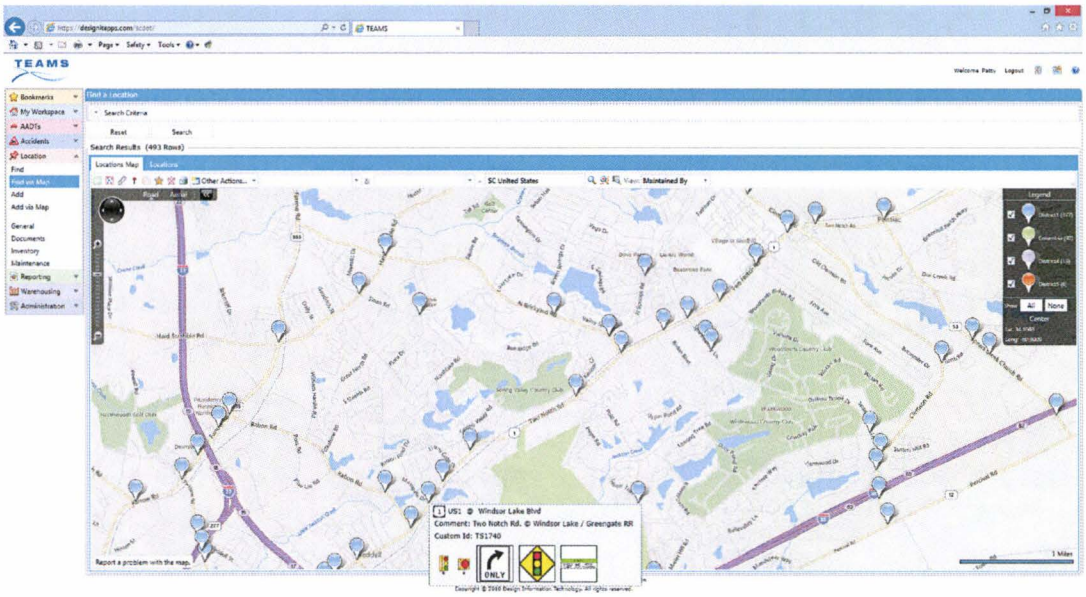
Additional information related to MAP-21 is available on the Federal Highway Administration website at http://www.fhwa.dot.gov/map21.

As implementation of the new law progresses, more material will be added.

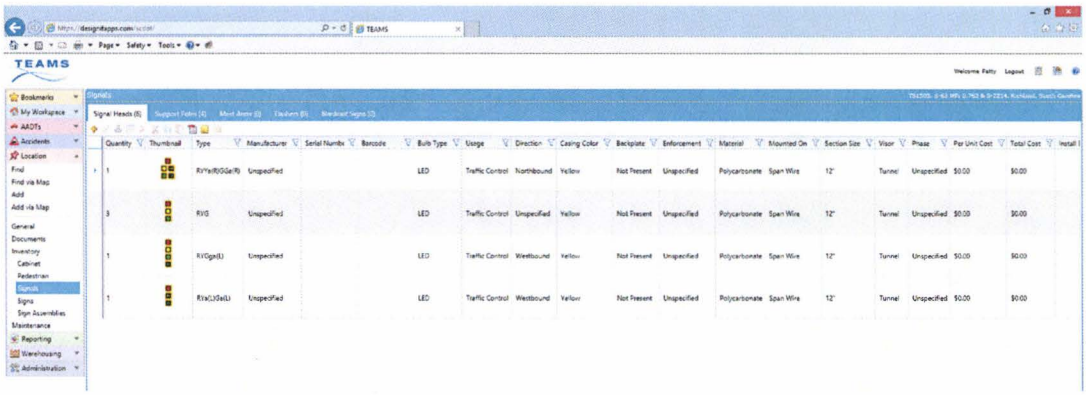
# Appendix B

## TEAMS Screenshots

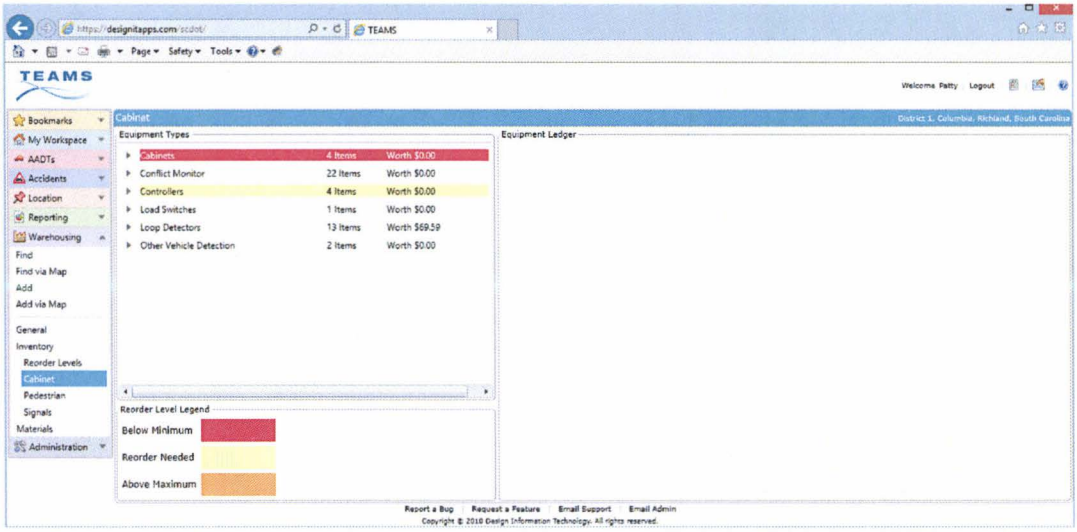
## TEAMS Inventory Module – Mapped locations




## TEAMS Inventory Module - Equipment Inventory




## Warehousing Module – Warehouse inventory



# Appendix C

## SCDOT Traffic Signal Business Rules – DRAFT

These business rules detail the South Carolina Department of Transportation's practice concerning signal shops.

Other documents addressing signal related issues include:

- EDM 2 - Fiscal and Maintenance Responsibilities for Traffic Signal Installations on the State Highway System
- EDM 33 - Mast Arm Guidelines
- Traffic Signal Design Guidelines
- Maintenance Manual
- MUTCD

The following main topics will be addressed in this document:

***I. General Responsibilities***
***II. Staff and Training***
***III. Procurement***
***IV. Fixed Price, Multi-vendor On-Call Traffic Signal Contract Management & Inspection***
***V. Maintenance and Work Order Items***
***VI. Projects with Signals***
***VII. Signal Shop Inventory Control***

## *I. General Responsibilities*

- District signal shops are responsible for the maintenance of SCDOT owned traffic signals and flashers within their jurisdictional area.
- District signal shops will perform signal inspection for any signal revisions or installations performed by others. (See Section VI)
- District signal shops will maintain signal system communications. This communication system termini is from the traffic signal cabinets in the field to the point of presence on the ITS fiber or IT Services network switch. Any outages located on the ITS fiber should be reported to the ITS Coordinator. Any outage at the ITS Services switch should be reported to IT Services.
- District signal shops will maintain and verify signal timing parameters are operating as designed by the District Traffic Engineer (DTE) / DTE Office.
- District signal shops shall procure and store signal and other equipment needed for maintenance and repair of traffic signals and flashers.
- District signal shops shall manage any Fixed Price, Multi-vendor Procurement Contract for signal work, including paying invoices and signal inspection.
- District signal shops shall be maintained and operated in accordance with all Federal and State safety regulations and the SCDOT Employee Safety Handbook.

## *II. Staff and Training*

1. The district signal shop supervisor will be responsible for the safety and production of signal shop employees and accountable for all signal shop equipment, tools and inventory, including all computers and other IT devices.

2. Each signal shop employee will be responsible and accountable for all assigned equipment, tools and inventory, including computers and other IT devices.
3. The district signal shop supervisor will reconcile the shop budget/expenditure reports each month.
4. All signal employees responsible for signal repair should be IMSA Level 2 Traffic Signal certified within 3 years of employment. All signal technicians should be encouraged to complete all IMSA certifications.
5. Each signal shop should have personnel with expertise in the following areas:
   - Signal construction
   - Signal construction inspection
   - Signal software programming
   - Signal operations
   - Signal troubleshooting/maintenance
   - Communications installation/maintenance
   - Signal equipment procurement methods
   - Basic knowledge of signal timing/design
   - Most current approved Work Zone Traffic Control schemes for shoulder closure/lane closure

   In addition to this training, signal shops should provide the minimum following training for all personnel that work on traffic signals:
   - Cabinet training
   - Ethernet training
   - Fiber Optics training
   - National Electric Code training
   - Safety training in accordance with SCDOT policy
   - Work Zone Traffic Control

   The signal shop supervisor is responsible for evaluating each shop employee and jointly preparing an annual training program for each employee to achieve and maintain the levels of knowledge, skills and ability noted above.

## *III. Procurement*

1. All procurements shall be in accordance with SCDOT Procurement Policies and Procedures as defined by the Procurement Policy Manual. All procurements shall be completed through the SCEIS.

2. Supply Depot Purchases

   - All signal items stocked at the Supply Depot must be procured through the Supply Depot rather than district personnel procuring them directly from the vendor. The DEA must approve exceptions when there is a situation in which the Supply Depot does not have adequate stock on hand.

     a. For Federally funded purchases, all district initiated requests for equipment must be submitted to the State Traffic Signal and Systems Engineer for approval via email. The request must include equipment type, quantity, and charge code. The State Traffic Signal and Systems Engineer or designee will order equipment for delivery to the district signal shop.

b. For Federally funded purchases, all HQ initiated requests for equipment must be approved by the State Traffic Signal and Systems Engineer. The request must include equipment type, quantity, and charge code. The State Traffic Signal and Systems Engineer or designee will order equipment for delivery to the district signal shop.
c. For State funded purchases, the district signal shop supervisor will order equipment directly by creating a shopping cart under SRM in SCEIS.

3. Non-Depot Stock Contract Purchases

- For Federally funded purchases of equipment and items on contract but not stocked at the depot, all district initiated requests for equipment must be submitted to the State Traffic Signal and Systems Engineer for approval via email. The request must include equipment type, quantity, and charge code. The State Traffic Signal and Systems Engineer or designee will order the equipment.

- For State funded purchases of equipment and items on contract but not stocked at the depot, the district signal shop supervisor is responsible for making purchases directly from the vendor. Signal shops will be responsible for paying invoices.

4. Non-contract Purchases

d. For equipment and items that are not on contract, the district signal shop supervisor will initiate procurement using SCDOT Procurement Policies and procedures.

## *IV. Fixed Price, Multi-vendor On-Call Traffic Signal Contract Management & Inspection*

1. The district signal shop supervisor may recommend and the district supervisor approve the use of fixed price, multi-vendor on-call contractors to perform new signal installation, signal rebuild or maintenance as needed for State funded projects only.

2. On-call Contractor Use

- All actions related to the procurement, work and project completion will be documented by the district signal shop supervisor in a shared Excel workbook maintained by the State Traffic Signal and Systems Engineer's office.
- The district signal shop supervisor should initially review the Contractors Tab to check Date of Last Call and Number of Requests for each contractor to give fair opportunities for those contractors who have not had work recently. Only those contractors who have expressed interest in working in the specific District will be considered for rotation in that District.
- Once a contractor is selected, the signal shop supervisor will record each contact attempt on the Contractor's tab and record the District number, Date of Request, Location of Work, Work Performed, Approximate Value, and whether the contractor accepted the work or not.
- Once the project is complete, the signal shop supervisor must record Date Work Completed, Actual Value of work, and Vendor Performance.
- If the Vendor Performance is anything less than "Good", a comment must be included explaining any deficiencies or discrepancies during the project.

3. Project Management

- The signal shop supervisor will be responsible for ensuring that all work performed on the Fixed Price On-Call Signal Contract meets all Traffic Signal Specifications according to the latest version of specifications found on the SCDOT website: http://www.scdot.org/doing/publications_Traffic.aspx#trafficSpec.
- Upon notice of completion of work by the contractor, the signal shop supervisor will provide a punch list of items to be addressed prior to final acceptance of signal work or initiate a final inspection.
- The signal shop supervisor shall provide a signal plan and work order with proposed project quantities to the contractor for concurrence prior to acceptance of the work.

4. Payment for On-Call Contracts

- The signal shop supervisor will initiate payment upon final acceptance of work and receipt of an invoice from the contractor.
- The signal shop supervisor is responsible for processing payments for work performed under the Fixed Price On-Call Contract.

## *V. Maintenance and Work Order Items:*

1. TEAMS (Traffic Engineering Asset Management Software) Inventory of Traffic Signal Installations on the State Highway System

   In accordance with EDM 2, the district signal shops are responsible for maintaining electronic inventories of SCDOT maintained signal locations and equipment. All equipment in the field shall be entered into the TEAMS inventory database. The TEAMS inventory database shall be updated upon completion of signal work at an intersection.

2. Preventative Maintenance

   - Signal shops shall perform annual Preventative Maintenance reviews for all stop and go signals they maintain.
   - Signal shops shall perform annual Preventative Maintenance reviews on all flashing beacons associated with school zones.
   - All other flashing beacons shall have a Preventative Maintenance review every two years.
   - These reviews shall be documented in TEAMS.

3. New Installs/Repairs

   - New signals shall be installed as soon as possible upon approval by the District Engineering Administrator (DEA), based on budget availability. The DTE/signal shop supervisor shall maintain a listing of pending approved installations and current status toward completion of work.
   - Defective loops shall be repaired as soon as possible upon notification, based on budget availability, and prioritization determined by signal shop supervisor and/or the DTE.

- For stop and go signals, upon notification of a signal in flash or not operating, signal technicians will respond as soon as possible to repair signal to operating condition. For emergency repairs of damage to signal span, cabinet, or poles, the signal shop supervisor or technician shall respond as soon as possible and begin making repairs. The responding employee shall coordinate with other shop employees or inform the signal shop supervisor if contractor assistance is needed to place the signal back into operation as quickly as possible. The signal shop supervisor or responding technician will coordinate with the appropriate SCDOT maintenance unit for other traffic control devices that may be needed to provide direction until repairs are completed.

4. Signal LED/lamp maintenance

- A single burned out red signal indication on a given approach movement should be replaced as soon as possible after notification within 24 hours. A single burned out yellow and green elements for a given approach movement should be replaced as soon as possible after notification within 72 hours.
- If all red, yellow or green signal indications for a given approach movement are burned out, they shall be replaced as soon as possible after notification is received.

5. Coordination w/ Local Government Signal Maintenance

   As Intergovernmental Agreements for Traffic Signal Maintenance are developed or updated, the district signal shop supervisor shall be responsible for adding, removing or reassigning signals to and from local governments within the TEAMS database.

   The signal shop supervisor will verify that annual Preventative Maintenance has been performed by the responsible local government for signals in their jurisdictions under the IGA for signal maintenance agreement, will ensure the completed reports in TEAMS are updated and notify HQ Traffic Engineering accordingly.

6. Work Requests - All work requests received for signals maintained by SCDOT should be logged into HMMS. The responsible supervisor will ensure the Daily Work Reports are completed in accordance with HMMS business rules. Work requests received for signals maintained by a local jurisdiction as part of a maintenance agreement should be forwarded to the appropriate jurisdiction.

## *VI.* ***Projects with Traffic Signals***

1. Responsibility of construction management of traffic signal projects will be assigned at the discretion of the DEA.

2. Inspection for all signal related work in a non-signal construction contract shall be performed by the district signal shop in conjunction with the assigned Resident Construction Engineer (RCE). The signal shop will provide expertise and direction to the RCE concerning any deficient items. At the end of the work, the signal shop will provide a Punch List for items that must be corrected prior to final acceptance of the work. The signal shop supervisor must approve all signal work.

3. Signals added by Encroachment Permit to be coordinated through the District Signal Shop.

## *VII. Signal Shop Inventory Control*

The district signal shop supervisor shall be responsible for maintaining an electronic inventory of all signal equipment assigned to that district, including equipment in operation and spare equipment stored in the district signal shop warehouse area as described below.

1. Statewide inventory systems will be maintained by each Signal Shop as described below.

2. Equipment and supplies stocked must be kept at levels that are reasonable based on historical usage. The signal shop supervisor shall use historical data to establish minimum and maximum inventory levels and reorder points.

3. Inventory items shall be identified as follows:
   - Accountable Equipment is defined as any equipment item with a value of $1000 or more. This shall include cabinets, controllers, poles and video detection cameras regardless of cost.
   - Non-Accountable (Stockpile) equipment is defined as any durable item with a value of less than $1000 and shall include conflict monitors, signal heads/modules, pedestrian heads/modules, and pedestrian poles regardless of cost.
   - Expendable items shall not require an inventory. Examples are signal cable, signal wire, nuts and bolts, non-specialty brackets, etc. Procurement, storage, use and replacement shall be the responsibility of the signal shop supervisor and shall be monitored on a regular basis.

4. Inventory Data

   The inventory shall include the following information as a minimum:
   - Accountable Equipment: Quantities shall be maintained in HMMS Stockpile Module and updated daily by standard HMMS reporting procedures. The shop supervisor shall review and sign off on stockpile records monthly. Stockpile values shall be updated on a quarterly basis. TEAMS shall be used to track materials referencing the following: serial number, date of delivery, status as defined as In Operation, In Repair, Salvage, Acquisition Value.
   - Non-Accountable (Stockpile) Equipment: Quantities shall be maintained in HMMS Stockpile module and updated daily by standard HMMS reporting procedures. The shop supervisor shall review and sign off on stockpile records monthly. Stockpile values shall be updated on a quarterly basis.

   The signal shop supervisor shall perform cycle counts of inventory. Accountable items shall be counted quarterly and non-accountable items shall be visually verified annually. Discrepancies shall be noted and the cause identified (i.e. physical count error, recording error, item identification error or physical control problem.) Corrections shall be made to inventory storage or security and record keeping procedures to address any discrepancies found.

5. Storage Security

Inventory shall be controlled and secured to insure maintenance of accurate inventory records and controlled physical movement and distribution of accountable and non-accountable items.

- Expendable inventory shall be stored in a controlled area with monitored access.
- Accountable and Non-Accountable inventory items shall be stored in such a way as to provide optimum security and controlled access by designated employees.

  a. Each signal shop must provide a security plan to their DEA for approval, including a diagram indicating where items are stored, how they are fenced/gated or locked up separately from maintenance yard/facility, who is authorized access to each location and how the storage area is secured and monitored by authorized signal shop personnel. This plan must also indicate how facility is secured during non-business hours or when signal shop employees are not accessing the storage area.
  b. The signal shop supervisor shall authorize employees that are allowed access this storage area and will assign keys.
  c. All inventory items shall be maintained neatly and like items shall be stored in a manner to facilitate ease of tracking. All inventory items must be stored in a designated storage location, i.e., all signal heads together, all conflict monitors together, unless separated for projects, salvage piles or repairs. Each area shall be marked with name of item as well as minimum and maximum level.
  d. Inventory items must be updated regularly to ensure that the quantity is equal to that which is stored electronically.

Power and hydraulic tools and equipment used in signal shops that are valued at less than $1000 each shall be recorded in an electronic tool and equipment record listing the quantity, unit value and location stored or assigned employee. The signal shop supervisor shall, at least annually, verify the location and condition of the shop's tools and equipment.

6. Inventory Storage and Release

The signal shop supervisor shall authorize employees that are allowed access to the accountable and non-accountable inventory storage area. Any authorized employee entering the storage area shall sign an entrance log kept at the locked gate or door prior to entry. The employee shall sign out when leaving. These employees must insure that the appropriate transfer record is completed before removing or adding items from or to this area. The shop supervisor shall designate one employee to be responsible for updating the electronic inventory record of daily transfers from the inventory storage area. A complete audit trail shall be maintained through the electronic inventory system of items moved from and to the storage area, when moved, by whom and who received the item.

7. Traffic Signal Equipment Transfer to Non-District Entities

Procedures for accepting or delivering accountable and non-accountable equipment from the signal shop inventory shall be the same whether user is a contractor or local government.

Users may be allowed on signal shop grounds to pick up equipment (Accountable and Non-Accountable Equipment) designated for a particular project. A location on the grounds separate and secured from inventory storage or warehouse and employee work area shall be designated for equipment transfer. The signal shop supervisor or designee must be present to ensure the correct equipment is picked up or delivered.

A standard transfer form will be used to record the following information for all deliveries or pick-ups:

For the person and entity represented, it shall include signature, legible printed name of individual, company/local government name and company/local government contact information, date of pick up or delivery, project file number or name, if applicable, and the field location where the equipment will be installed.

The user representative must sign the transfer form verifying the transmittal of the listed traffic signal equipment. A copy of the form will be maintained in the signal shop files, either in hard copy format or electronically and a receipt shall be given the user representative.

8. Borrowing Signal Equipment

Contractors and local governments may only be allowed to borrow signal equipment for an SCDOT initiated project or existing signal installed on the SCDOT system, if approved by the DE A. Borrowed equipment must be replaced in kind within 2 months of transfer. The signal shop supervisor will be responsible for tracking all borrowed equipment and its return. If the equipment is not replaced within 2 months, the signal shop supervisor shall generate an invoice to be submitted to the borrowing entity for immediate payment including late fees. Documentation for this process is the same as item 8 above using a loan form.

At the DEA's discretion, if a user borrows equipment and does not return it in kind within the 2 month period, that user shall not be allowed to borrow equipment again.

9. Surplus Equipment

The signal shop supervisor shall review all accountable and non-accountable inventories annually and determine whether the items should be retained or declared surplus. If the supervisor determines an item is surplus, a recommendation shall be sent to the next level supervisor for concurrence. If declared surplus by the district supervisor:

a. A list of items that are considered for surplus will be developed and will include the quantity, unit value and condition of each item. This list should be submitted to the State Traffic Signal and Systems Engineer to determine if other signal maintenance shops could use these items. The State Traffic Signal and Systems Engineer will advise the signal shop supervisor if other users are identified.
b. If no other users are found in the state, the item shall be determined as surplus property and will be disposed of in accordance with South Carolina Regulation 19-445.2150.
c. Contact South Carolina's Surplus Property Office to dispose of surplus property and equipment http://surplus.sc.gov/surplus/SP-index.phtm .

# Appendix D

## Equipment Inventory List

| Equipment Type | Value | Size | Serial Numbers |
|---|---|---|---|
| Backplates | $110 | Medium | No |
| Battery Backup | $5,175 | Medium | No |
| Blankout Signs | $1,945 | Large | No |
| Cabinet | $9,000 | X-Large | Yes |
| Concrete Pole | $5,400 | X-Large | No |
| Conflict monitor | $550 | Small | Yes |
| Controller | $1,650 | Medium | Yes |
| Detector Cards | $87 | Small | No |
| Junction Boxes | $250 | Medium | No |
| LED Modules | $35 | Small | No |
| Load Switches | $45 | Small | No |
| Mast Arms | $10,000 | X-Large | No |
| Pedestrian LED Modules | $130 | Medium | No |
| Pedestrian Heads | $350 | Medium | No |
| Pedestrian Poles | $500 | X-Large | No |
| Pedestrian Pushbuttons | $150 | Medium | No |
| Power Supply | $550 | Small | No |
| Signal Heads | $400 | Large | No |
| Steel Pole | $5,500 | X-Large | No |
| Video Detection Cameras | $2,500 | Medium | Yes |
| Wireless Detectors | $500 | Small | No |
| Wireless Repeaters | $625 | Small | No |
| Wood Pole | $1,200 | X-Large | No |
| Backplates | $110 | Medium | No |
| Battery Backup | $5,175 | Medium | No |
| Blankout Signs | $1,945 | Large | No |
| Blankout Signs | $2500 | Large | No |
| Cabinets | $9,000 | X-Large | Yes |
| Concrete Pole | $5,400 | X-Large | No |
| Conflict monitors | $550 | Small | Yes |
| Controller Cards | $200 | Small | No |
| Controllers | $1,650 | Medium | Yes |
| Detector Cards | $87 | Small | No |
| EMS unit | $515 | Small | No |
| Ethernet Rack | | | |
| Ethernet Switch | $1000 | Small | Yes |
| Junction Boxes | $250 | Medium | No |
| Junction Boxes | $250 | Medium | No |
| LED Signal Head Modules | $35 | Small | No |
| Load Switches | $45 | Small | No |
| Mast Arms | $10,000 | X-Large | No |
| Pedestrian Heads | $350 | MediumLarge | No |
| Pedestrian LED Modules | $130 | Medium | No |
| Pedestrian Poles | $500 | X-Large | No |

| Equipment Type | Value | Size | Serial Numbers |
|---|---|---|---|
| Pedestrian Pushbuttons | $150 | Medium | No |
| Power Supply | $550 | Small | No |
| Signal Heads | $270-$470 | Large | No |
| Solar Flashers | $3,000 | Medium | No |
| Steel Pole | $5,500 | X-Large | No |
| Time Clocks | $400 | Small | No |
| Video Detection Cameras | $2,500 | Medium | Yes |
| Video Detection Cards | $2,000 | Small | No |
| Wireless Detectors | $500 | Small | No |
| Wireless Repeaters | $625 | Small | No |
| Wood Pole | $1,200 | X-Large | No |

# Appendix E

## TEAMS Completion Schedule

# Improvements to Inventory Tracking

In order to provide a more complete tracking of all high value assets as well as certain expendable items, additional modules will be added to TEAMS. This effort has been broken down into three distinct phases.

## Phase I

The first phase is well on its way to completion and includes the addition of a warehouse module with basic entry capability. Warehouses will be added to TEAMS to house equipment and supplies and will have associated GPS coordinates so that they can be displayed on the map. Equipment types can be designated as accountable through the administrative pages. Accountable equipment can only have a quantity of one at a given location since it must be tracked by serial number. Currently cabinets, controllers, and video detection equipment are likely to be treated as accountable items. The serial number for accountable equipment is added when the equipment is first entered at a warehouse. The inventory module on the warehouse allows users to enter equipment that has been purchased and that is currently located in the district signal shop warehouse. As equipment arrives at the warehouse the equipment information such as the equipment type, serial number, manufacturer, and other equipment specific details may be entered into TEAMS. The selection of equipment types and their associated attributes that can be tracked is determined based upon SCDOT's configuration settings. Expendable items can also be added in the materials section. These materials have a general on-hand count that can be reconciled periodically as dictated by SCDOT. A summary of on-hand count information for each material type and equipment type will be presented as a summarized statement, and additional information can be viewed in the ledger section that is to be developed in Phase II. The ability to create a template for the layout of required equipment types and materials will be configurable in the administrative section of TEAMS. This will be a template of the minimum required equipment types and materials carried by each district, as each district will be allowed to extend this list to suit their needs. Reorder levels for equipment types and material types can be entered at the district warehouse level. These reorder levels provide obvious color coded visual indications as to whether a particular equipment type or material type needs to be reordered. The ability to produce reports either for individual warehouses or the entire state can be performed in the reporting section of TEAMS. A search capability that allows the users to quickly find the location where a particular piece of equipment is located has been added. This work will be completed no later than January 16, 2015.

## Phase II

### Task 2.1

The layout for the materials and equipment inventory sections in the warehouse module will be modified so as to allow the users to quickly determine the on-hand count of accountable and expendable items. This will require viewing the equipment types by category and then by type and will likely be presented as a tree-view control that the user can expand as needed. A corresponding list view to the right of the tree control will provide additional details for the selected equipment type or material type. This ledger will provide an accurate accounting of when equipment or materials arrived or were utilized for a specific project. The ledger will permit users to enter either positive counts (the arrival of equipment or materials) or negative counts (the usage of equipment and materials), as well as the party

assuming responsibility for the appropriate use of the equipment and/or materials. The ability to perform inventory reconciliation will be permitted. If there are differences between the manual count and the entry in TEAMS an authorized user will be able to provide comments and/or reasons for the discrepancy and reset the inventory levels at this point. Once the inventory has been reconciled the ledger can be truncated to show only the transactions that have occurred since the last reconciliation period, thus simplifying the user's view of the ledger. Special permissions might be required for users that are to complete activities at the warehouse. For instance, users that reconcile counts might need special permissions and users that receive equipment into the warehouse might also need special permissions. The time required to complete this task will be approximately 3 weeks or 120 man hours and can be started immediately.

### Task 2.2

Equipment will need to have assigned states to help users more fully understand what has been committed for a particular use, what may be physically absent due to repair or salvage, etc. Equipment may be deployed to a location, available for use and located in a warehouse, present at the warehouse but not available as it is reserved for use on a particular project, in a state of repair and therefore not physically present, or is no longer physically available as it has been sent to salvage or surplus. TEAMS will be modified to allow users to assign these states to equipment and be generally available in the reporting section of TEAMS. The time required to complete this task will be approximately 2 weeks or 80 man hours and can be started immediately.

### Task 2.3

It will be required that equipment that is accountable be traceable back to the project and funding source which authorized purchase of the equipment. Currently only locations can be assigned to projects, this will be extended such that if equipment was purchased on a specific project it can be tied to the specific project as well. Equipment does not necessarily have to be tied to a project. Having the ability to tie the equipment to a project will also help to identify its intended purpose and ensure accountability. This system will need to be flexible as sometimes an emergency situation dictates that any available equipment be utilized and equipment will be ordered to replace anything that was used. The time required to complete this task will be approximately 2 weeks or 80 man hours and can be started immediately.

### Task 2.4

Sometimes it is necessary to borrow equipment or materials under certain circumstances. Warehouse managers have the ability to view and report on their own warehouses but could also benefit from knowing what might be available at other warehouses. TEAMS will be extended so that warehouse managers can view equipment and material levels at the other warehouses across the state. Once they determine that equipment or materials might be available a request can be made via email to another warehouse manager to borrow the equipment. The warehouse managers will only be allowed to edit equipment and material levels within their own warehouse but will be able to view equipment levels at other warehouses. When inventory levels drop below the established minimum an email will be sent to the warehouse manager letting them know the equipment or material type that needs to be reordered. This will require that each warehouse have the ability to assign a specific user to the role of warehouse

manager. The time required to complete this task will be approximately 2 weeks or 80 man hours and can be started immediately.

### Task 2.5

Information will be captured in the field that will likely need to be pushed to HMMS. Items already identified that will be of importance are the materials and equipment utilized on the job as well as an accounting of the time for each individual performing the work. The equipment may need to include usage of vehicles and record the time and/or mileage for each vehicle. Work history is already captured for each location but will likely need to be extended in order to account for time and materials. Work history reports would likewise need to be extended to capture this additional information. Meetings with the HMMS team will be required to finalize the data that should be captured and forwarded to HMMS as well as to determine the integration plan. The time required to complete this task will be approximately 4 weeks or 160 man hours and can be started immediately.

## Phase III

### Task 3.1

An RFP is currently being prepared in which respondents will be required to provide signal equipment as well as a barcoding system to help track inventory from cradle to grave. Since the RFP has not yet been publicized we are unsure of exactly what solutions will be presented. The TEAMS software will need to integrate with the vendor's proposed solution. The details of this section will be better understood once responses to the RFP are received and discussions about the level and nature of integration have taken place. Possible solutions are the purchasing of scan guns to read the bar codes which can be read by tablets in the field and which integrate with the TEAMS field software. Other options could be to utilize cameras on the tablets to read the barcodes but this approach would need to be field tested to see if it is viable.

Emphasis for the third phase of implementation will be placed on ease-of-use of the software and on the process for inventory management. The software will need to permit the users to quickly select equipment from the warehouse inventory list and place it at a specific location. This action should also adjust inventory levels and produce a work history record for that location. Field testing will likely need to take place and an iterative software process will be required to ensure that the hardware and software solutions accommodate the technician's needs as well as management's needs. Possible approaches to expediting the process may include the use of barcodes as actions such as repair, replace, etc. Extensions to the find location page can be made which allow a location to be loaded based upon a scanned barcode for equipment at the location. For instance, a barcode on a cabinet can be scanned and then the location that has that cabinet can be loaded. The user can then quickly perform an inspection or complete work at that location. Another example of use would be when the user is replacing a defective piece of equipment with a new piece of equipment. Scanning the barcodes will make the process faster and the data entry will be less prone to human error as the fields can be auto-populated.

The details of this task will be better known once the responses to the RFP are received, however a good estimate for the level of effort required would be approximately a three month time frame to complete the work with the full development team participating.

All of these modifications might impact the off-line version of TEAMS as well as the TEAMS Lite versions. If needed changes will be made to these applications as well. The behavior will be similar between the applications but may have some differences.