Pennsylvania Traffic Signal Systems: A Review of Policies and Practices (2004)

State Transportation Advisory Committee

Commonwealth of Pennsylvania

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Final

Executive Summary and Brief

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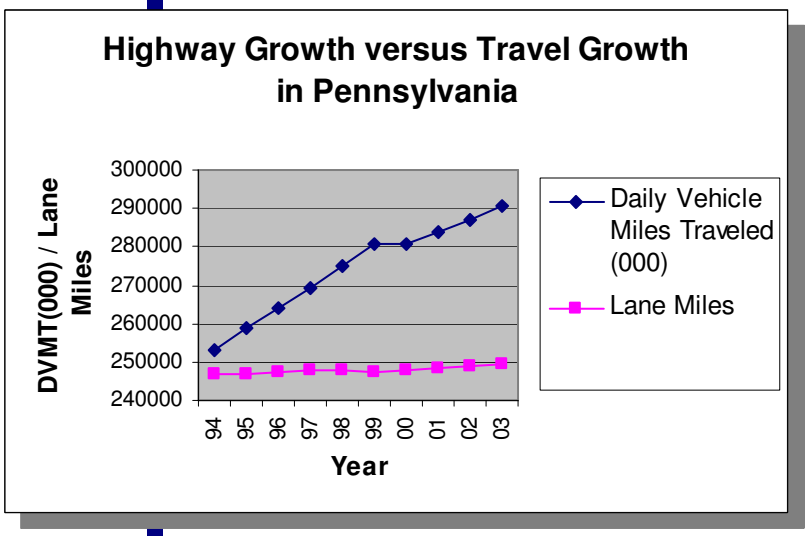
EXECUTIVE BRIEF: ISSUES AND BROAD PERSPECTIVE

This Transportation Advisory Committee (TAC) examined Pennsylvania's Traffic Signal Systems and the policies and practices associated with their management and operation. In particular, traffic signal systems were considered in the context of their role in congestion relief.



Traffic signals are part of the paradigm shift of how we think about transportation. **Historically, the transportation industry has focused on building additional capacity to address congestion**. As a result, traffic signal practices were centered on design, construction and maintenance. **More recently, the focus has shifted to managing and optimizing capacity as well as reducing demand** by promoting alternative modes of travel and land use strategies. **Transportation operations are the means and the methods to better manage existing capacity.** Transportation operations include elements, such as intelligent transportation systems (ITS), incident management, highway and transit operations, as well as traffic signal system operations. Traffic signal operations include:

- Operational oversight to ensure the signal is safely and efficiently meeting traffic demands at that intersection
- Safely and efficiently meeting traffic demands on a corridor and regional level via interconnected and coordinated traffic signal systems
- Consideration of non-recurring events such as incident management, homeland security, and special events
- Safely and efficiently accommodating pedestrians and other transportation modes
- Safely and efficiently processing emergency vehicles.

Improved transportation operations represent one especially important strategy given the relatively low cost compared to the benefits of increasing system capacity. While each strategy (new capacity and operations) is important and has its rightful place, efforts to improve operations should not be overlooked, particularly in this fiscally constrained environment.

The future of transportation operation is best illustrated by the concept of an integrated arterial/freeway corridor, and the transportation systems utilized. In an integrated arterial/freeway corridor, arterial travel times, speeds, and conditions may be shared with freeway management to adjust Changeable Message Signs (CMS), Highway Advisory Radio (HAR), and freeway ramp meters. Conversely, freeway travel times, speeds, and conditions may be shared with arterial management and used to optimize traffic signal timings and inform arterial travelers. Such integration may also use incident response timing plans to respond to traffic diverted from the freeway to the arterial.

BACKGROUND

Currently, there are more than 13,600 traffic signals in Pennsylvania that are owned and maintained by 1,192 (47%) of Pennsylvania's 2,655 municipalities. Of the municipalities owning traffic signals, 80 percent have 10 or less signals, 64 percent have five or less signals, and 25 percent have one signal. Many of these municipalities have neither the technical expertise nor the resources to maintain and operate their traffic signals. There is minimal operational oversight at the state level after initial installation as PennDOT's authority is limited. As a result, many traffic signals are viewed on a "microscopic" jurisdictional level. Regional implications and opportunities as to how to best manage and operate the signal systems may not be fully realized or even considered.

CORE THEMES

Pennsylvania signal systems are a $1 billion asset that are not managed and operated to their fullest. That is important context for evaluating the issues associated with the policies and practices of traffic signal systems. Key themes identified in this study include:

- Signal systems are an asset that should be better managed as such so that systems can be better planned, maintained and operated to reduce congestion
- Signal systems need be both maintained and operated. Operations include the development of appropriate operations parameters/standards, addressing special needs such as events, homeland security and incidents, and providing oversight to ensure systems are functioning properly and efficiently.
- Signal systems should be a shared responsibility that requires the multi-jurisdictional cooperation and input of local municipalities, PennDOT, planning organizations and other stakeholders.
- Signal systems cannot only be considered on a microscopic, jurisdictional level, but should also be considered on a corridor and regional level.
- A number of policy and procedures such as signal permitting need to be evaluated to address appropriate roles and responsibilities; the importance of signal systems and the highway occupancy permit process with regard to signal systems.
- Technology is rapidly changing, requiring continual training and education to ensure that signal systems can be designed, maintained and operated efficiently.
- Procurement policies can discourage technology implementation. Creative approaches are needed to both encourage continued research, and more importantly, to test and disseminate that research in an applied way throughout the Commonwealth.

These themes are addressed in the study through twelve core recommendations along with nearly 30 secondary recommendations.

FINANCIAL CONSIDERATIONS

Texas Transportation Institute and the Federal Highway Administration (FHWA) figures indicate that five percent of the nation's $72 billion in delay costs and wasted fuels can be attributed to the congestion associated with traffic signals. This equates to approximately $12,000 in delay and fuel costs per traffic signal annually. **In Pennsylvania, total delay and fuel costs at signalized intersections is estimated to be $120 million to $160 million annually.**

According to the Institute of Transportation Engineers (ITE), **the average annual maintenance cost per signal is $2,760**.ITE also estimates signal maintenance is under funded nationally by 20 percent. In Pennsylvania, the estimated average amount spent on maintenance (of those surveyed) is around $1,950 annually. These dollar values reflect basic maintenance which includes items such as changing light bulbs and utility service, but do not include operational costs**.** Based on ITE's figures, it is estimated that **annual operational costs for effectively managed systems could range from $500 to $3,000 per year per signal** depending on the complexity and level of oversight. Study stakeholders indicate maintenance and operations does not get sufficient priority to other priorities and financial constraints.

Presently, there are three primary funding sources for traffic signal systems. However, most funding is for design and installation with less emphasis on maintenance and operations.

- State Liquid Fuels funds can be spent on the acquisition, maintenance, repair, and operation of traffic signs and signals. Most stakeholders, however, noted that the funds are used for utility service and basic maintenance. As a result, funds are not often available to improve signal operations.
- Traffic signals may also be funded through the Transportation Improvement Program (TIP). The TIP sometimes funds the design and construction of new signal systems, but has limited use in addressing operational requirements of signal systems. The TAC believes PennDOT and planning organizations should give more systematic attention to traffic signals in the regional programming process – where TIP development occurs.
- PennDOT regulates access to state roads through the issuance of Highway Occupancy Permits (HOP). If traffic impacts require new or upgraded traffic signals, PennDOT will typically require the developer to pay for installation of such signals. The developer, however, is seldom responsible for the cost of maintenance or operations. This situation is exacerbated in tax-free areas when a developer may not have to pay taxes, which could be used for signal maintenance and operations.

Although much can be accomplished without increased funding, a new funding source would allow the TAC recommendations to be implemented more quickly and to a far greater level as well as provide additional support for operations and maintenance. Further, the TAC recommendations reflect an overall integrated strategy: one that could be better leveraged with additional resources. Funding for improved traffic signal systems should be considered as part of any future state transportation funding increases. This will serve to emphasize the

importance of efficient operations. New funding can also leverage many other favorable results including a performance-based approach for receiving funds based on updated standards.

BENEFITS

By improving the coordination and performance of our traffic signal systems through better maintenance, operations and management practices, the following benefits can be realized:

- Reduced congestion on many of our major arterials
- Optimize the capacity of our existing infrastructure
- Improved air quality and decreased fuel consumption
- Reduced congestion-related crashes
- Improved response of emergency vehicles/services
- Promote more efficient transit system(i.e., transit signal preemption which allows transit vehicles to control signals)
- Respond to non-recurring special needs such as incident management, homeland security and special events
- Improved regional cooperation on signal system management and related transportation issues
- Improved utilization of existing and future resources by better planning, deploying and managing signal systems
- Stimulate economic development by making our roadways and our cities more accessible.

Important Note: TAC's recommendations reflect a systematic approach. Although some of the recommendations could be pursued individually, most recommendations are inter-related and the maximum benefit would be achieved through a more comprehensive approach. TAC believes increased funding for traffic signals is not only justified on a benefit-to-cost basis, but fits with the Secretary's direction of improving the efficiency and effectiveness of existing facilities.

EXECUTIVE SUMMARY

- **TRAFFIC SIGNAL** – A POWER-OPERATED TRAFFIC CONTROL DEVICE BY WHICH TRAFFIC IS WARNED OR DIRECTED TO TAKE SOME SPECIFIC ACTION
- **SIGNAL INSTALLATION** – ALL OF THE EQUIPMENT OR MATERIAL INVOLVED IN THE CONTROL OF TRAFFIC AT ONE INTERSECTION BY A TRAFFIC SIGNAL
- **SIGNAL SYSTEM** – TWO OR MORE SIGNAL INSTALLATIONS OPERATING IN COORDINATION

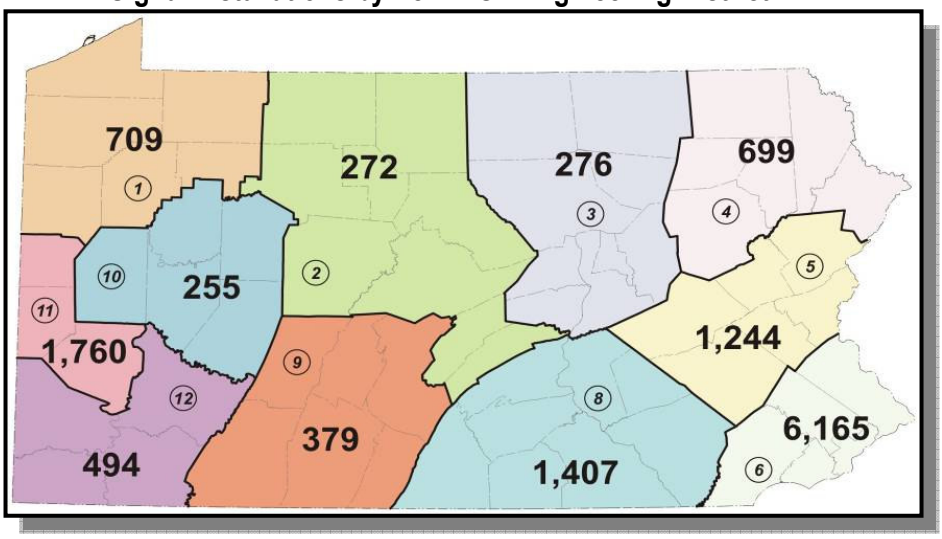
INTRODUCTION

This Transportation Advisory Committee (TAC) examined Pennsylvania's Traffic Signal Systems and the policies and practices associated with their management and operation. In particular, traffic signal systems were considered in the context of their role in congestion relief.

Even with the primary focus on congestion, issues and recommendations are identified that directly or indirectly have implications for safety, intelligent transportation systems (ITS), traffic control centers, and other facets of the total transportation system that interface with traffic signals.

Currently, there are more than 13,600 traffic signals in Pennsylvania that are owned and maintained by 1,192 (47%) of Pennsylvania's 2,655 municipalities. Of the municipalities owning traffic signals, 80 percent have 10 or less signals, 64 percent have five or less signals, and 25 percent have one signal. Many of these municipalities have neither the technical expertise nor the resources to maintain and operate their traffic signals. There is minimal operational oversight at the state level after initial installation as PennDOT's authority is limited. As a result, many traffic signals are viewed on a "microscopic" jurisdictional level. Regional implications and opportunities as to how to best manage and operate the signal systems may not be realized or even considered.

Signal Installations by PennDOT Engineering District



Traffic signals are representative of the paradigm shift of how we think about transportation. **Historically, the transportation industry has focused on building additional capacity to**

address congestion. As a result, traffic signal practices have focused on design, construction and maintenance. **More recently, the focus has shifted to managing and optimizing capacity as well as reducing demand** by promoting alternative modes of travel and land use strategies. **Transportation operations are the means and the methods to better manage existing capacity.** Transportation operations include elements, such as incident management, highway and transit operations, as well as traffic signal system operations.

TAC Study Objectives

The TAC set three objectives to guide this study:

- Produce an evaluation of relevant issues associated with the policies and practices of traffic signal systems throughout the Commonwealth.
- Identify alternatives to reduce congestion.
- Make feasible recommendations for ways traffic signal systems might be better planned, deployed, and managed to improve safety and congestion management.

While the following text is longer than a typical vision statement, it is encompassing of the broad – based approach required:

A Recommended Vision

The vision of **Pennsylvania's 21st Century traffic signal systems** includes a ***holistic approach*** to the operations and maintenance of signal systems driven by renewed ***policies and practices*** that identify ***institutional responsibilities and accountability***. In addition to being adequately maintained, the systems will be ***efficiently operated*** so that they properly respond to traffic demands including incidents, homeland security needs and special events. The systems will be planned, designed, constructed, maintained and operated by an ***effectively trained*** interdisciplinary staff and utilize a level of ***technology*** appropriate for the signal systems and the staff supporting them. ***Education*** of the importance and operations of signal systems to stakeholders and the public would elevate awareness.

Methodology

This TAC report was developed using a three phase process:

Phase I – General Assessment – This phase included stakeholder involvement and research for the purpose of issue identification and to focus Phase II on issues of greatest importance. A statewide stakeholder workshop was held in Camp Hill on July 1, 2004. Stakeholder

participants identified many issues related to Pennsylvania's Traffic Signal Systems.

Once the initial issues were identified through the workshop, in-depth research occurred drawing from more than 80 publications/sources. Research results were used to determine over 50 best and innovative practices.

Phase II – Issues Evaluation – This phase provided an in-depth evaluation of issues identified during the first phase. The results from this phase were used to develop draft findings and recommendations.

Phase III - Final Report Development and Presentation – The third and final phase of the study process entailed the development of a draft final report which took into consideration all information collected during the first two study phases. A preliminary draft was presented to the TAC Task Force for review. A revised draft final report was presented to the full TAC in December 2004 and a final version to the State Transportation Commission in January 2005.

JULY 1ST WORKSHOP CORE THEMES

- FUNDING
- HOLISTIC APPROACH TO SIGNAL SYSTEMS
- TRAINING
- OPERATIONAL MONITORING AND AUDITS
- PENNDOT AUTHORITY
- EMBRACE TECHNOLOGY
- ACCESS MANAGEMENT AND LAND USE
- MAINTENANCE & OPERATIONS GUIDELINES
- OWNERSHIP

RESEARCH RESULTS

The study included a significant research and benchmarking effort. This research along with input from Task Force Members, PennDOT Central Office, other states and PennDOT Districts was used to move toward the study outcomes. Key research results are organized around the following seven major themes:

Holistic Approach

- The need to think at a larger scale, be it corridor, county, region, district, or statewide, is imperative to getting the maximum benefit of traffic signal systems that cross municipal boundaries. This presently does not routinely occur, but represents the most broad and strategic opportunity for a paradigm shift toward comprehensive traffic signal system management.

Planning / Policy Driven

- A representative slate of lower-cost traffic signal projects with higher benefit-to-cost ratios fail to be included on the TIP when compared to other higher-profile, higher-cost construction projects.
- Traffic signal technology continues to evolve as part of the overall technology revolution, yet Pennsylvania has many antiquated signal systems.
- There are several innovative ways to overcome jurisdictional problems. These include formal and informal agreements between municipalities for corridor and region wide signalization projects.

Institutional Responsibilities / Accountability

- Institutional structures and disconnects can limit the ability of traffic signal systems to adapt to changing policies, technologies, and corridors/regional approaches. One way to overcome this obstacle is thru an interjurisdictional, oversight committee, as in Arizona which defines and enforces oversight policies.

Efficient Operations

- Efficient operations are essential to getting the most out of installed traffic signal technology and maximizing lane capacity. There are varied examples of daily oversight and fine tuning of traffic signals to ensure maximum performance.
  - A study entitled *ITS Benefits: The Case of Traffic Signal Systems* (A. Skabardonis) concluded that optimizing traffic signal timing plans, properly coordinating signal systems and implementing adaptive signal systems at some locations resulted in a 24.9 percent reduction in delay in the 76 corridors studied.
  - An Institute of Transportation Engineers article *entitled The Benefits of Retiming Traffic Signals* (April 2004) presented eight examples where retiming reduced delay by eight to 40 percent.
  - An ITE publication entitled *Traffic Control System Operations: Installation, Management and Maintenance* helped quantify the efficiency benefits. Each dollar spent optimizing signal timings could yield as high as a 20 gallon fuel saving. In York County, Virginia, traffic signal improvements along a 1.5 mile corridor decreased fuel consumption by 11 gallons per 1,000 vehicles in the corridor.
  - PennDOT's Traffic Signal Enhancement Initiative and Congested Corridor Improvement Program have produced delay savings of 15 to 20 percent for the 35 corridors studied with a benefit to cost ranging from 7.2 to 15.9.

Effective Training / Education

- Education and training for public sector officials and the public at large is a key to increasing support for traffic signal improvements and ensuring the maximum efficiency of existing systems.
- When linked with ITS capabilities, there are many options to engage the public via websites and cable television to educate and inform the public of traffic conditions and issues.
- Training for traffic engineers and public officials can also improve efficiency, whether it is an extensive course over several days or a more localized course covering a broader range of issues. Discussions with PennDOT District Traffic Engineers revealed an interest in development of standardized education and training courses or training signal employees.

Effective Use of Technology

- Innovations in traffic signal technology are happening every day and it can be hard to keep up. This makes the ongoing evaluation of traffic signal technology through pilot

programs a key strategy, and the reporting and sharing of the results an essential follow-up.

Improved Funding Strategies

- ❑ Several studies on signal funding include innovative strategies.
- ❑ One fundamental step to improving funding for traffic signals is to educate the public as to the cost of maintaining these systems, the benefits of doing so, and the importance of well maintained traffic signals.
- ❑ There are many different approaches to how funding is allocated as well.
  - Denver Regional Council of Governments (DRCOG) has led the way in regional funding for traffic signals at the MPO/RPO level with their Regional Traffic Signal Improvement Program (RTSIP).
  - In the Las Vegas Area Computer Traffic System (LVACTS), cost sharing is determined by formula. The basic rate structure is determined initially after a division of fifty (50) percent from the City of Las Vegas and proportionately from the other member agencies. Agreement formulas include functions such as number of signals under LVACTS control.
  - TranStar (Texas) Executive Committee is comprised of a representative from TxDOT, the Metropolitan Transit Authority of Harris County, Harris County, and the City of Houston. Each agency contributes to the annual operating budget of the TranStar Traffic Control Center on a prorated basis relative to their occupancy and utilization of building components.
- ❑ State policy makers should consider designating some percentage of future funding increases to operations and traffic signal systems as a relatively low cost way of enhancing capacity and safety.

PENNSYLVANIA BEST PRACTICES

A study of this nature often focuses problems in order to identify potential improvements. It should be noted, however, that there are several innovative and best practices taking place within the Commonwealth.

- ❑ Several PennDOT districts are utilizing some form of asset management. In some cases, it involves a simple spreadsheet while other districts have implemented a geographic information system (GIS) application.
- ❑ Most PennDOT districts work informally with municipalities to identify and address operational issues.
- ❑ Most PennDOT districts have tried to provide specialized training utilizing national training programs such as the Center for Intelligent Transportation Engineering (CITE), Synchro training programs, Highway Capacity Software training programs, and the Northwestern University Traffic Signal Workshops.

- PennDOT's Traffic Resources Education and Computing Support (TRECS) group meets quarterly to assess software and hardware needs including training as well as to discuss publication needs.
- There are a few cross-jurisdictional signal systems currently deployed in Pennsylvania.
- Both the Traffic Signal Enhancement Initiative (TSEI) and the Congested Corridor Improvement Program (CCIP) are valuable tools in congestion reduction. The goal of the TSEI is to reduce travel times and delay on specified signalized corridors. The TSEI focuses primarily on signal issues such as timing, operations, maintenance, and technology. The objective of the CCIP is to reduce delay by 20 percent on selected corridors. CCIP improvements are directed at activities such as roadway geometry, signal operations, access management, multimodal initiatives, intelligent transportation systems (ITS), traffic regulation techniques, transportation demand management (TDM) measures, and planning and zoning practices that are appropriate for a particular transportation corridor.

RECOMMENDATIONS

The TAC Task Force members identified approximately 50 potential solutions or recommendations. Twelve of these potential solutions were identified as Tier I solutions – those having the greatest potential in problem solving.

Tier I Solutions

Develop an Asset Management System

Asset management is a strategic approach to managing transportation infrastructure. It includes a set of principles and practices for building, preserving and operating facilities more cost-effectively and with improved performance, delivering the best value for public tax dollar spent, and enhancing the credibility and accountability of the transportation agency. The vision for a PA traffic signal asset management system would be a multi-agency database tool that could be used to perform a variety of functions and querying capabilities. PennDOT, for example, has robust systems that include conditions for state and local bridges, but not for traffic signals—both are important assets that using today's database technology can be better managed. In the long-term, all asset management system may be unified so that all disciplines have access to needed information. Ultimately, an asset management system would give stakeholders a tool to strategically manage a $1 billion asset and their maintenance and operational needs estimated at $60 to $90 million per year.

Pursue Tiered Operations and Maintenance on Critical Corridors

Operations on critical corridors are a primary concern. Under current conditions, many of the signal systems along a specific corridor are operated individually by a local authority and sometimes without the broader consideration of the entire corridor. A holistic approach would be to pursue tiered operations and maintenance along critical corridors across jurisdictional boundaries. Tiered operations may include municipal maintenance with some PennDOT operational oversight and responsibility (during incidents/ events, peak hours, etc.). This is consistent with the new Mobility Strategic Focus Area Executive Goal to "effectively and efficiently operate the transportation system."

Ensuring that critical transportation corridors function to the best of their ability should be a concern of all stakeholders. As such, a need exists to facilitate better communications between the respective organizations and work together to determine solutions that promote traffic signal coordination along critical corridors, which includes the identification these critical corridors. Critical corridors should include the development of a Corridor Consortium that meets on a regular (but not time intensive) basis to discuss issues that relate to efficient transportation along each corridor. The MPO/RPO can be one forum for facilitating this activity.

Tier I Solutions

Pursue Tiered Operations and Maintenance for most Signals

A tiered, interjurisdictional effort along critical corridors may be the best approach in the short-term, long-term solutions may consider tiered operations and maintenance of all signal systems.

Regional Signal Committees would work with planning organizations as well as PennDOT and other transportation partners in the regional oversight and prioritization of signal system enhancements as well as promoting the importance of addressing signal systems. Regional Signal Committees should be coordinated by planning organizations and may be similar to ITS subcommittees that exist within many planning organizations. This would be a natural extension of the regional ITS architectures that are currently being developed.

Promote a "Holistic" Approach to Signal Management

The development of an asset management system and a tiered approach to operations and maintenance establishes a conduit for PennDOT and planning organizations to develop a Regional Traffic Signal Improvement Program (RTSIP).

To establish a holistic approach to signal management several elements need to occur:

- ❑ Stakeholders need a tool to assess regional traffic signal needs (asset management tool) and need to prioritize signal enhancement projects (RTSIP).
- ❑ Operations needs to be considered in the funding process through the involvement of ITS Coordinating Councils and Regional Signal Committees.
- ❑ Traffic signal enhancements and operation need to be consistent and supported by the District's Transportation System Operations Plan (TSOP).
- ❑ Projects/ investments need to demonstrate quantifiable benefits.

Furthermore, this solution is consistent with PennDOT's Transportation Systems Operations Plan. The Transportation System Operations Plan (TSOP) defines: Why, What, and How with regard to managing capacity. "Traffic Signal Operations" is one of four critical elements of the TSOP. As the TSOP continues to be developed, it will be presented to District Executives and to planning partners. This will be a significant opportunity to promote signal systems management at a holistic level.

Expand Traffic Signal Enhancement Initiative (TSEI) and Congested Corridor Improvement Program (CCIP)

Both PennDOT's Traffic Signal Enhancement Initiative and Congested Corridor Improvement Program are valuable tools in congestion reduction.

The current funding levels of TSEI and CCIP are $1.2 million per year. These funding levels only begin to address the funding needs for signal improvements. Nevertheless, to make both programs more successful, each program should be expanded at a minimum rate of 10 percent per year up to 150-200 percent of existing funding levels. Additionally, both processes should be refined, if needed, in order to make implementation of improvements as timely as possible. Program results should focus on improvements such as timing plans that can be implemented without additional study.

Review and Update the Traffic Signal Permit Process

The review and update of the existing traffic signal permit process offers a mechanism for shared accountability, but also offers opportunities to more efficiently operate and manage signal systems by tracking critical characteristics and attributes. The review and update should be organized by two phases: Technical and Legal.

Tier I Solutions

Establish Operational Audits Program

Several stakeholders cited that critical signal systems are not evaluated frequently enough due to data collection and analysis costs. Critical systems are typically those on major arterials or state routes. Ideally, critical systems should be extensively evaluated every three to five years. An efficient and cost-effective procedure should be considered that periodically assess critical systems in order to improve operations.

Several districts perform informal operational assessments of critical corridors on a periodic basis or when issues arise; however, no formal process and protocol exists for performing these assessments. Guidelines and protocols for performing operational audits should be established so that key stakeholders are involved/ aware of the process (including resource needs) and as such can promote needed improvements. This could be piloted in one PennDOT District

Complete Updates and Revisions to PennDOT Traffic Signal Publications

PennDOT publications and guidelines provide a vital tool for both PennDOT and local authorities in designing, constructing, maintaining and operating signal systems. Signal systems involve a variety of disciplines and evolving technologies. PennDOT is currently updating several traffic signal publications. These publications should continue to be updated. Where deficiencies in PennDOT publications exist, national publications should be identified or additional materials should be developed. The Internet provides an important resource for keeping these publications current and for disseminating changes on a broad scale.

Allocate a Portion of Any New Funding Increase to Signals

The TAC believes that a dedicated traffic signal systems funding source is not only needed, but justified as traffic signals often become a low priority given competing needs by local government planning partners, and the Department in broader planning and programming activities. These funds could be applied to the operations as well as maintenance of the systems. TAC recommends that some portion of any new funding source (i.e., an increase in the gasoline tax) be allocated for operations including signal systems operations and maintenance. The operations and maintenance of Intelligent Transportation Systems should also be considered, but was not the focus of this study.

Provide Incentives for Operational Enhancements

Presently, there are not direct incentives for operational enhancements; therefore, municipal practices focus on maintenance keeping the signals operating in a red/yellow/green mode and to avoid liability issues, not necessarily on operational efficiency. Operational enhancements could significantly improve safety and mobility at a low cost.

If additional funding is secured, financial incentives should be extended to municipalities for implementing operational enhancements. Financial incentives should be used to encourage municipalities to invest in proactively monitoring, operating, maintaining and managing their traffic signal systems. Often, these enhancements can be implemented at a relatively low cost. The incentive should cover a percentage of the evaluation, design and implementation of the enhancement provided that the benefits can be demonstrated/documented. The exact percentage of incentive should be further evaluated to determine an appropriate level that encourage municipal participation, but does not result in unlimited requests.

Encourage Regional Maintenance Contracts with Operational Incentives

Shared maintenance across jurisdictional boundaries provides an opportunity to decrease signal maintenance contract costs and also provides an opportunity to improve operations through better coordination and communication as well as through operational incentives to maintenance contractors.

Shared maintenance contracts provide an opportunity to share resources thus reducing costs. Shared maintenance practices are most beneficial in rural areas, where limited ownership of signal systems may result in higher per signal maintenance costs. As part of the update to PennDOT Publication 191, *Guidelines for the Maintenance of Traffic Signal Systems,* standard shared maintenance and regional maintenance contracts should be developed for use by municipalities and regional consortiums. Existing Publication 191 provides a sample traffic signal maintenance contract. These sample specifications should be updated and municipalities should be encouraged to use them.

Tier I Solutions

Provide Incentives for Interjurisdictional Coordination

Interjurisdictional coordination can help promote a regional, as well as a holistic system approach to managing and maintaining traffic signal systems. As part of this recommendation, funding preferences would be given to projects that are requested using collaborative funds by multiple entities. The approach would encourage MPOs/RPOs, counties, etc. to work closely together and to think beyond their political boundaries.

This recommendation is one that should be carried out in balance so that it does leverage transportation resources but at the same time does not result in an oppressive degree of "strings attached."

OTHER RECOMMENDATIONS

In addition to the Tier 1 Solutions, many other potential solutions could provide short-term as well as long-term guidance for the operations and maintenance of traffic signal systems. More than 30 other recommendations are presented in **Section 8** of the full report. These solutions are important but were not examined in depth as those of the high priority. A few specific examples include:

- ❑ Consider the statewide implementation of a "systems" permit
- ❑ Streamline timing modification process
- ❑ Require timing plan development for homeland security/incidents/special events
- ❑ Revise HOP process to address corridors or signal systems in addition to the present single signal approach
- ❑ Revise HOP process to require signal fine-tuning through road bonds and/or escrow
- ❑ Implement a developer impact assessment/fee mechanism for operations and maintenance cost participation
- ❑ Produce an annual report on the "State of Signal Systems" to assess progress against goals and broad system level performance measures
- ❑ Create modernization/controller replacement program and interconnection programs
- ❑ Review sole source restrictions or consider innovative procurement methods to ensure "compatible" technology along key corridors
- ❑ Encourage more statewide training by vendors
- ❑ Establish hotline/ website for traffic signal concerns and questions.

CONCLUSIONS

The State Transportation Advisory Committee recognizes the effective and efficient movement of people and goods will require new investments, additional capacity, expanded infrastructure and improved operations of transportation facilities.

Improved transportation operations represent one especially important strategy given the relatively low costs in relation to the benefits. While each strategy is important and has its rightful place, efforts to improve operations should not be overlooked in this fiscally constrained environment.

This study fosters a comprehensive approach to assessing traffic signal improvement needs statewide and advancing a strategy that addresses those needs in some priority fashion. Improved traffic signal systems will help ease congestion, will enhance safety, and have indirect benefits such as improved air quality.

Pennsylvania signal systems are a $1 billion asset that are not managed and operated to their fullest. That is important context for evaluating the issues associated with the policies and practices of traffic signal systems. Key themes identified within this study include:

- Signal systems are an asset that should be better managed as such so that systems can be better planned, maintained and operated to reduce congestion
- Signal systems need be both maintained and operated. Operations include the development of appropriate operations parameters/standards, addressing special needs such as events, homeland security and incidents, and providing oversight to ensure systems are functioning properly and efficiently.
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- A number of policy and procedures such as signal permitting need to be evaluated to address appropriate roles and responsibilities; the importance of signal systems and the highway occupancy permit process with regard to signal systems.
- Technology is rapidly changing, requiring continual training and education to ensure that signal systems can be designed, maintained and operated efficiently.
- Procurement policies can discourage technology implementation. Creative approaches are needed to both encourage continued research, and more importantly, to test and disseminate that research in an applied way throughout the Commonwealth.
- Funding for improved traffic signal systems should be considered as a part of future state transportation funding increases. This will serve to emphasize the importance of efficient operations. New funding can also leverage many other favorable results, including a performance-based approach for municipalities receiving funds based on updated standards.

  Although much can be accomplished without additional funding, a new funding source would allow recommendations to be implemented more quickly and to a far greater level as well as provide additional support for operations and maintenance.

TAC's recommendations reflect a systematic approach. Although many of the recommendations can be pursued individually, most recommendations are inter-related and the maximum benefit would be achieved through a systematic approach. TAC believes

increased funding for traffic signals is not only justified on a benefit-to-cost basis, but fits with the Secretary's direction of improving the efficiency and effectiveness of existing facilities.

BENEFITS

By improving the coordination and performance of our traffic signal systems through better maintenance, operations and management practices, the following benefits can be realized:

- ❑ Reduced congestion on many of our major arterials
- ❑ Optimize the capacity of our existing infrastructure
- ❑ Improved air quality and decreased fuel consumption
- ❑ Reduced congestion-related crashes
- ❑ Improved response of emergency vehicles/services
- ❑ Promote more efficient transit system(i.e., transit signal preemption which allows transit vehicles to control signals)
- ❑ Respond to non-recurring special needs such as incident management, homeland security and special events
- ❑ Improved regional cooperation on signal system management and related transportation issues
- ❑ Improved utilization of existing and future resources by better planning, deploying and managing signal systems
- ❑ Stimulate economic development by making our roadways and our cities more accessible.