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PUBLIC WORKS MANUAL

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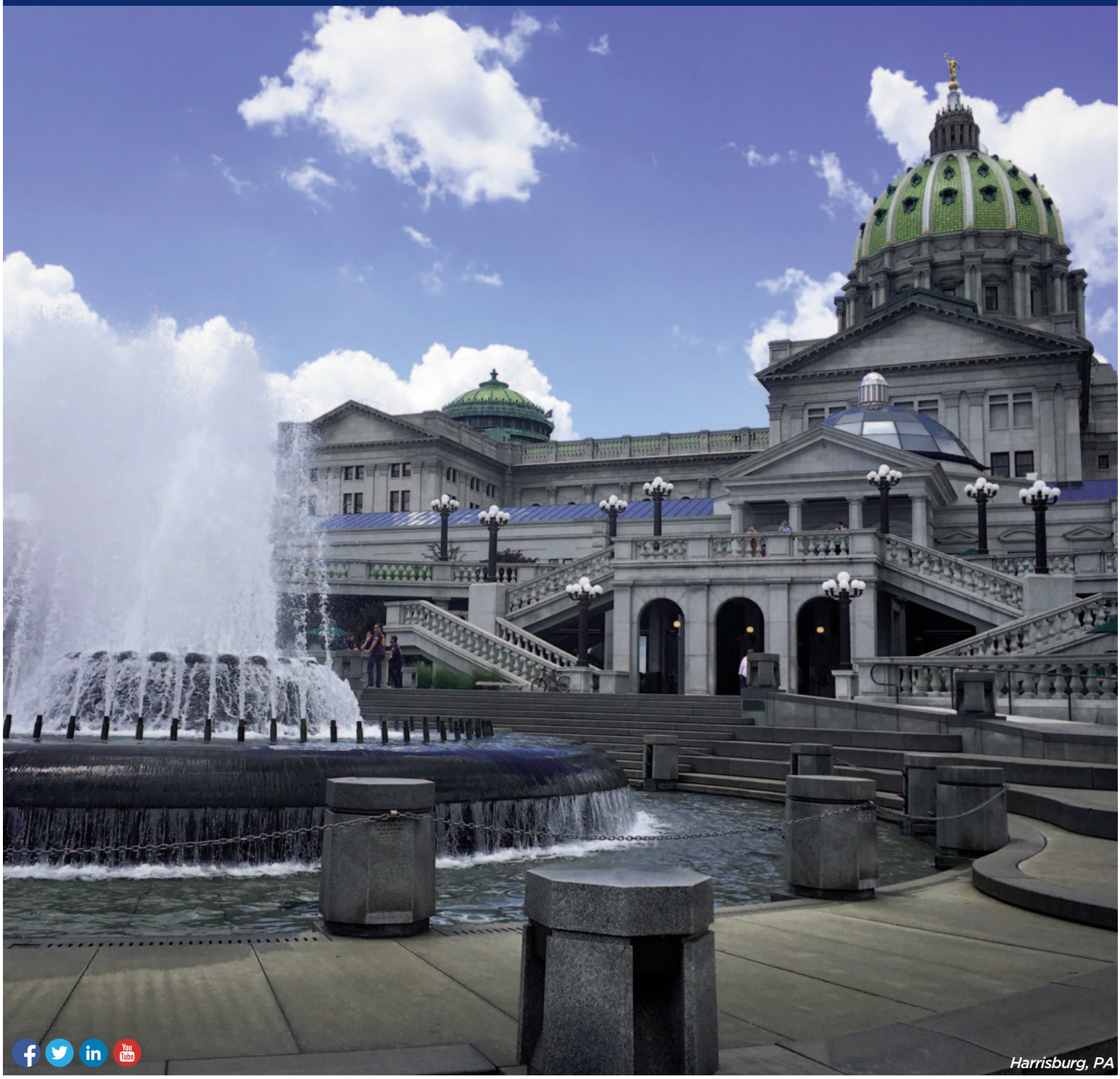

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I. Introduction

History of Public Works

While the profession today known as "public works" has only been so identified over the past half century, the fact is that the profession has its genesis many thousands of years ago when industrious individuals, whose names are long lost in history, decided to build cities with specific street patterns, drainage systems, water supplies, and, in many cases, fortifications. The ancient cities of Ur, Troy, and Babylon (dating to 3000 to 4000 B.C.) all had these common traits – a street grid system to allow the orderly movement of people and animals throughout the city (and also to make sure the "rabble" were not housed too closely to the royalty), drainage systems to allow rainwater to flush the wastes from the city, fortifications to keep the enemy out, and a water supply to sustain the populace during sieges by the enemy.

There was little advancement to the public works infrastructure over the next several millennia, until the rise of the Roman Empire. While many historians attribute much of the success of the Roman Empire to its well-oiled war machine, the fact is the Romans appreciated the importance of civil (public) works and advanced the profession to its greatest heights in antiquity. The term for civil engineering, which closely parallels the public works profession, originated by the Romans to distinguish those engineers who were responsible for roads and bridges from those who were responsible for catapults, siege engines, and other instruments of the military (hence, military engineer as opposed to civil engineer). The Romans were true masters of road and bridge building (there are several examples still in use after 2,000 years), and water supply and transmission systems (many of their aqueducts exist today, although not in use). They also built underground drainage systems and even developed the use of clay pipe. However, most of these advancements were lost after the fall of the Roman Empire, and there was little improvement in any area of public works throughout the next 1,200 years. Finally, just before the dawn of the Industrial Revolution, came the dawn of a new and exciting era in public works.

In the late 17th century, as North America began to be settled and "urban centers" began to spring up, many of these urban centers had specific street grid systems planned and implemented so as to provide orderly development. Some of these urban centers ultimately became such great cities as Boston, New York, Philadelphia, and Washington, D.C. This was the beginning of the public works profession as we know it in North America.

After these great cities were laid out and significant population growth occurred through the first half of the 18th century, it was obvious that there was a great need for infrastructure to take care of the masses immigrating to these urban centers and to protect life and property.

Most urban centers were located adjacent to waterways. In colonial times, these waterways were considered an advantage as they provided a steady supply of drinking water, power for waterwheels, conduits to carry away wastes, and, in many cases, transportation. Most of the earliest public works facilities in this country were water related – docks and harbors to handle shipping, flood-control projects to protect property (started as early as 1712 in New Orleans), and underground stormwater systems (started in Boston in 1704).

Arguably, the most significant contribution to public works in the 18th century was the advent of a centralized public water distribution system, first constructed in 1754 in Bethlehem, Pa. After the early success of this system, other larger urban cities, most notably Philadelphia, began similar systems.

By the turn of the 19th century, many cities had become packed with people, with no reasonable way to get rid of the wastes generated by such a concentration of humans. The urban streets of this period were strewn with refuse, garbage, litter, sewage, animal droppings, and dead animals. In what was the only "formal" street cleaning of the period, many cities allowed dogs and pigs to roam the streets to eat some of the garbage. Is it no wonder that urban historians called many of the cities of that period "...abominably foul and feculent, filthy, with appalling conditions..."? Solving this problem was high on the political agenda.

As early as 1800, Washington, D.C., attempted to solve this problem by organizing a street cleaning force of private contractors. Much later in the century, New York City became more famous for its efforts to formally create a department of sanitation, which was staffed by "legions of men in white coats" with push carts and brooms who roamed the city in a structured pattern to clean up debris and litter. This program was successful, and the health benefits so measurable, that most other urban areas adopted similar programs.

As noted earlier, the public works profession closely parallels the civil engineering profession. During the middle decades of the 19th century, most urban areas (those greater than 10,000 population) had the formal position of city engineer. In the larger cities, this would have been a full-time municipal position and sometimes even an elected position, although the practice of electing a city engineer seems to have ended by World War II (elected positions in the public works function remain in some localities, notably in West Virginia). In the smaller municipalities, a local civil engineer or surveyor in private practice would have been hired as a consultant by the city council, much like many small communities handle their municipal engineering needs today.

The city engineers of the latter half of the 19th century were largely responsible for advancing the public works profession to possibly its greatest heights. During this period, bridge building ascended to its highest achievements with the first cast-iron arch bridge constructed in 1838 in Brownsville, Pa. Bridges, such as this and the Brooklyn Bridge (1883), stand as examples of bridge design still in use today. Other notable achievements of the profession at that time were the beginning of community-wide sanitary sewer collection systems, the expansion of public water systems to include adequate supplies for firefighting (after tragic fires in Chicago and Seattle), the location of distant reservoirs for storage of great quantities of water and transmission of that water great distances to cities, and the creation of mass transportation systems.

As the 20th century unfolded, new methods and materials were developed for use in the construction of public works. "Macadam" was a material developed in England for use as a hard-surfaced road-building material. Once introduced into the United States, it quickly overtook bricks and stones as the material of choice for paving streets in urban areas.

Portland concrete, another material developed in England, also gained quick acceptance in the United States. It was used extensively in large public works projects in the first decade of the 20th century, including the Panama Canal in 1907 and the Eighth Street Bridge in 1909 in Allentown, Pa. (at the time of its construction the largest concrete arch bridge in the world).

However, as the 20th century unfolded into its middle decades, it was obvious that the growing public works infrastructure required someone to maintain it. Thus, in the 1920s and 1930s, most large municipalities developed workforces in areas such as street maintenance, street sanitation (sweeping), water and sewer operations, and engineering.

These operations, which required similar technical expertise, evolved into the public works departments of today. The terms of director of public works and department of public works were little used prior to World War II but caught on in the post-war era.

Public Works in Pennsylvania

Public works has always been, and will remain, the most important function performed by many Pennsylvania municipalities. Historically, the vast majority of municipalities in the commonwealth – rural townships and boroughs – performed this function nearly exclusively from other traditional municipal services. Even in urbanized areas and heavily populated suburbs, public works services receive more attention from municipal customers (residents, taxpayers, property owners, and citizens) than the other visible and important services, including police, ambulance, and fire protection. We call upon emergency services when in need; however, we demand public works services on a daily or, at least, weekly basis.

The importance of public works services is diminished only to the extent that expected service levels are maintained. Few could debate the importance of snow removal when failure to efficiently accomplish that function prevents citizens from getting to their places of employment, emergency equipment from reaching the site of the emergency, and commercial and industrial operations from conducting their daily business. The efficient provision of utility service to residential, commercial, or industrial customers is critical to quality of life and safety of a community. Economic development is made more difficult if inefficient utility operations or degraded transportation systems are typical in a community.

This handbook is not designed to be a technical manual to outline how roads should be plowed, streets improved or installed, or catch basins reconstructed. It provides general guidance on the significant issues and responsibilities faced by public works departments, suggestions on alternative approaches to providing services, and suggested organizational frameworks. In most cases, more detailed information can be obtained from other Governor's Center for Local Government Services publications or from the Department of Transportation.

The authors of this publication, which include municipal managers and professionals in public works, risk management, and related fields, have attempted to frame this material to address the diversity of Pennsylvania municipalities. What works in an urbanized area might be completely impractical in rural municipalities. While there are some issues addressed in this manual that are universal in application, such as purchasing or Liquid Fuels requirements, much of the material needs to be considered in light of an individual municipality's situation.

II. Factors Affecting Public Works Organizations

Collective Bargaining Agreements

Many municipalities in Pennsylvania have unions representing their municipal workers. It is incumbent upon the head of the public works department to have a thorough knowledge of the current agreement between the municipality and the workers represented.

The agreement is a document that legally binds the two parties together and lays out in some detail the stipulations agreed to by the two parties. These stipulations may include any or all of the following:

- Management rights and directives
- Union security
- Dues deductions
- Work hours (rest periods, meal periods, eating and sanitary facilities)
- Holidays
- Leave (personal, vacation, sick time, bereavement, civil, military, parental, and absence without pay)
- Salaries and wages (overtime, shift differential, call time, and standby time)
- Life insurance
- Health benefits
- Work-related injuries
- Discharge, demotion, suspension, and discipline
- Seniority
- Uniforms, clothing, and equipment
- Discrimination
- Part-time employees
- Grievances and arbitration
- Safety and health
- Pay schedules
- Classification titles

The public works head should deal with all elements of the agreement on a regular and per-occurrence basis and within the parameters of the agreement. A thorough knowledge of the procedures outlined in this agreement will help prevent problems from going to or beyond the grievance stage. The public works head must also be a part of forging new contract agreements, be it by direct negotiation or through continuous involvement in the agreement elements being decided.

Geographic / Physical Characteristics

Pennsylvania is a diverse state with many geographic and physical differences; most significant are our soil types and varying weather patterns.

The public works head must understand the unique characteristics of his or her municipality and adjust the approach to best meet the needs of the area.

Budgeting and Finance

In most municipalities, especially if utilities and solid waste are included in the public works functions, the public works department's portion of the municipal budget can exceed 50 percent. Indeed, in many rural townships and boroughs, the only major governmental function is public works, which might consume virtually all of the municipality's revenues.

Because of its importance, the person at the head of the public works department must be well versed in municipal finance, especially as it relates to budgeting. Budgeting is the process of allocating available resources or developing a financial plan for a specified period, generally one year. An important objective of budgeting is to ensure acceptable levels of service delivery while maintaining expenditures so as not to exceed resources. The public works director, in consultation with the chief appointed official or elected body, must first determine the "acceptable level" for each function or responsibility. After determining this level, he must then determine the manpower, equipment, and supplies required to do the job. From this compilation, unit costs must be applied to determine the cost of the service for the budget year.

Capital budgeting is a critical aspect of public works planning. A multiyear plan that lists all capital equipment, roads, bridges, and sewers (sanitary and storm) will ensure that funds are available to meet future capital needs. It is important to include unfunded mandates (federal or state) within the budget also. Traffic sign replacements, stormwater runoff, and the Americans with Disabilities Act (ADA) requirements can be expensive programs to implement. Additionally, the plan creates an accurate listing of all capital equipment and infrastructure to form an inventory and ensures that the municipality has effective insurance protection.

After the elected body has approved the budget, the work of the public works director is not finished. It is important throughout the budget year to accurately track costs for each function. This information will be useful in preparing succeeding years' budgets and, in the event privatization is proposed for any given service, comparing municipal costs with private sector costs.

A transportation funding package approved in 2013 will assist municipalities with additional funds in future years. Act 89 of 2013 amends Titles 74 (Transportation) and 75 (Vehicles) to provide a comprehensive transportation funding package. The legislation would generate an additional $2.3 billion per year by fiscal year 2017-18 for the commonwealth's comprehensive transportation system. Projections are that local governments should expect to see in their March 1, 2018, Liquid Fuels payment approximately 60 percent more than they received in 2013. Local government will see a partial increase in their Liquid Fuels payments in 2015, 2016, and 2018 when the act is fully implemented. The legislation would minimally increase licenses and registration fees in the initial year, after which they would be indexed for inflation; eliminate the cent-per-gallon state gas tax and adjust the Oil Company Franchise Tax to offset the elimination; remove the artificial cap on the wholesale price of Liquid Fuels under the Oil Company Franchise Tax over a five-year period; sunset the Turnpike's annual obligation to Pennsylvania Department of Transportation (PennDOT) per the requirements of Act 44 of 2007; raise the speed limit to 70 mph on limited-access highways; increase seven existing surcharges on certain serious moving-traffic violations; increase the allocation to the Dirt and Gravel Roads program from $4 million to $35 million; and raise the cap on the Prevailing Wage threshold to $100,000 for local government transportation projects. The legislation also provides for new programs to address the new signalization of traffic lights and bridge bundling programs.

To this end, appropriate public works cost accounting forms should be used so that expenses can be accurately documented on a daily basis.

Functional Operations

The actual functional operation of a public works department depends on the size of the municipality, whether it is urban, suburban, or rural, and to what degree it is developed. For instance, a small, rural township might only have two functional operations of note: road maintenance and park maintenance. On the other hand, a larger, urban city might have most or all of the following functions:

- Street/road maintenance
- Utility cut management
- Traffic signal and sign maintenance
- Bridge and culvert maintenance
- Engineering and code enforcement
- Storm sewer system and MS4 program
- Wastewater treatment plant
- Sanitary sewer system
- Water filtration plant
- Water distribution system
- Fleet maintenance
- Building maintenance
- Solid waste and recycling (leaf collection, yard waste, and electronics)
- Parks and recreation maintenance
- Zoning and planning

No matter how few or many of the functions a municipal public works department has, it is important to recognize them on an organizational chart and in the budget to properly document the chain of command in each area and provide accountability in the budget process. Refer to *Organizational Structure* in this manual for more information on functional operations and a sample typical organizational chart.

Population Expectations

While the population of Pennsylvania over the last decade has remained relatively constant, certain areas in the state have experienced either a significant growth or a decline in population. These changes affect the entire municipal budget, specifically all of the public works operations from a budgetary and scope of services standpoint.

Stagnant or declining populations can cause budgetary limitations and, thereby, consideration of lower service levels or direct fee for services for existing services. For example, a pre-existing recycling program might require a monthly or annual fee. In some communities, waste removal services have been eliminated or privatized due to budgetary constraints and to ensure that other more essential services were maintained.

In those areas where population has increased, resultant increases in development typically occur. Obviously, this increases the amount of road mileage to be maintained while increasing the demands on other services provided by the public works department. Another consideration is changing expectations of newer residents who may have relocated from a region where greater services were provided. They may be surprised that certain public works services are not provided and may press the governing body to consider the expansion of the public works function.

Road Mileage

Since 50 percent of the Liquid Fuels Fund grant is based upon road mileage, it is important that the municipality keep track of any changes in its road inventory. Someone in the Public Works Department should be assigned the task of keeping track of the municipal road mileage. It should be updated on an annual basis with additional mileage submitted to the Department of Transportation before September 1 of each year so that mileage changes can be reviewed and credited to the municipality for the following year. Particular attention should be paid to new or upgraded roads and to

those accepted roadways within new subdivisions. Additionally, public works crews need to be kept informed when the municipality officially accepts new roadways. Upon acceptance, the maintenance of these roadways becomes the responsibility of the municipality. This is especially critical for snow plowing. Public works officials should be involved in the process of roadway acceptance to ensure that cartways are properly constructed to at least meet the requirements of the Department of Transportation for Liquid Fuels reimbursement and thereby not require premature repair.

Training

Anyone working in the public works function should receive training. Although some training, such as safety training, is universal, training needs are different for different positions. For instance, a newly hired laborer will need to receive basic training in a variety of areas, including the full range of safety issues and departmental procedures. A newly promoted equipment operator might need instruction in equipment operations and maintenance. On the other hand, a worker promoted to foreman might need supervisory training or a course in dealing with difficult employees. The public works director should be encouraged to participate in local public works organizations and be allowed to attend regional, state, and national conferences and symposiums.

Anyone performing flagging duties on any public roadway in Pennsylvania is required to be trained as per the most recent version of *PennDOT Publication 408*, Section 901.3, Flagger Training.

An important and evolving training requirement for all public works positions is computer training. Computer literacy for all public works employees will be crucial for public works efficiency in the future.

The Pennsylvania Local Technical Assistance Program (LTAP) was created to share transportation knowledge, improve road maintenance and safety skills, and put research and new technology into practice at the municipal level. The Roads Scholar Program provides an opportunity for municipal employees to receive free training by LTAP's professional team in the latest road-related technologies and innovations. Training is available in nearly 30 different programs. The courses are offered year-round across the state. LTAP staff is also available by phone, by email, and in person to help troubleshoot specific maintenance and safety problems on municipal roadways.

Public Relations

All areas of municipal government should be aware of the importance of public relations. The public works function of a municipality is often the most visible function that the residents see, and the day-to-day impact of public works services is probably most noticeable to the average resident. Additionally, the work of the public works department influences directly on neighborhoods. It is important to keep residents informed as the need for street reconstruction or the perception of inefficient snow removal can result in negative publicity.

It is important, therefore, to have a good working relationship with the local press and to use that relationship to keep citizens informed. Quite often, negative citizen feedback to a project or operation can be traced to the lack of information provided to them before or during the project. A successful public works public relations effort needs to be aggressive and proactive.

Some municipal operations have relied upon the use of social media and municipal websites to keep their residents and motorists informed about public works operations and special projects. Having an up-to-date website, using flyers to notify residents of upcoming projects, and reporting road activities at municipal meetings will all aid in keeping the residents informed.

Purchasing

Public works officials need to be familiar with the specific laws in Pennsylvania governing the purchase of goods and services by a municipality. While the majority of the requirements typically used by local governments are found in the various municipal codes, there are other important requirements. In particular, any public works official responsible for the

expenditure of Liquid Fuels Funds must be familiar with the particular requirement of that program. Additionally, familiarity with the Davis-Bacon Act, Steel Products Procurement Act, Motor Vehicle Procurement Act, Pennsylvania Prevailing Wage Act, and Workmen's Compensation Act, which all have applicability to public works purchasing, is critical.

Those responsible for purchasing must understand how the Pennsylvania Department of General Services (DGS) can aid them in making cost-effective purchases of goods and services. DGS can help municipalities find surplus property, piggyback on an existing state contract, or use the COSTARS Cooperative Purchasing Program.

Some municipal operations have found the services provided by various online auctions helpful for purchasing equipment or selling used municipal equipment.

While larger municipalities may have a separate bureau to deal with purchasing, the vast majority of municipalities leave these responsibilities to the secretary or other appointed official. The complexity of these requirements suggest that a prudent purchaser consult with the municipal solicitor, the Department of Community and Economic Development, the Department of Transportation, or other competent authority before engaging in unfamiliar procurement.

III. Organizational Structure

The structure of the public works organization varies, depending on several factors. Factors that influence the organization include the type of government, the policy objectives of the elected officials or municipal manager, the number of employees to be supervised, variations in the nature and complexity of the work to be accomplished, and the personal qualifications and capacity of both the employees and the department administrator. Always remember no matter what your organizational structure, your job is to serve the citizens of the community.

Experience has proven that it is exceedingly difficult for a single individual to adequately supervise the work of more than 10 persons. Certainly, the nature of the work to be accomplished might have a bearing on the upper and lower limitations of the span of supervision.

As previously noted, a large percentage of the revenue collected by most municipalities is used to finance the public works function. Therefore, it is quite natural and essential for the chief administrative officer or elected officials to employ a competent individual to focus on the supervision of employees engaged in those activities.

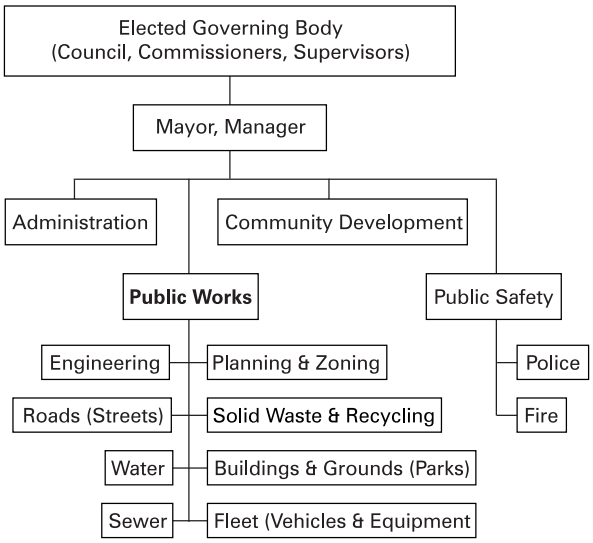
In larger municipalities, the person selected for this position could be a professional engineer. In all cases, the individual should possess the technical and administrative ability to manage the operations of the public works function. The person should also have the capacity to develop into a competent manager who can assume decision-making responsibilities. The degree of responsibility delegated to the public works director can vary depending upon the involvement and personality of the elected officials and the government's organizational structure.

When a particular function, such as supplying water or treating wastewater, grows to the point that it requires the full-time attention of several professional, skilled, or semi-skilled employees, consideration should be given to assigning that function to a specially created division or bureau of the department. In a larger municipality, the organizational framework of this multi-purpose department might consist of a water and/or sewerage division, street and/or traffic division, solid waste and recycling division, fleet maintenance division, and grounds division. In some cases, park maintenance might be considered a public works function. In a smaller municipality, the department might consist of some, but not necessarily all, of the subunits described above. The local condition will necessarily determine the organizational structure of the department.

Shown at right is a typical organizational chart, which illustrates the major departments of a municipality and the major divisions under public works. There is no right or wrong as to what is included under a public works department. Planning and zoning may be separate functions or operate under a community development department separate from public works. Engineering may be a separate department with design, construction management, and inspection as major functions and may even include planning, zoning, and code enforcement.

Even within the public works department, operations can be broken many various ways to determine divisional responsibilities. Streets and roads usually entail traffic signs, signals, and markings, but they could be set apart as a separate traffic division. Buildings and parks may be combined or made into two separate

TYPICAL ORGANIZATIONAL CHART



divisions. Water and sewer may be combined under a utilities division, which also incorporates other municipal-owned utilities such as gas or electric. New federal regulations and requirements have made stormwater management a critical component of municipal operations, and larger municipalities may either incorporate a separate stormwater management department or create a stormwater management division under the public works department.

Public works should also be actively involved in various municipal authorities or commissions. Many water and sewer authorities exist, some as separate operating authorities with their own personnel. Others are created as the financial vehicle to finance the facilities through bonds and then lease back those facilities to the municipality for operation and maintenance. A large municipality with parking garages, parking lots, parking meters, etc., may have a parking authority.

Various commissions are usually implemented depending on the needs and resources of the municipality. For instance, a recreation commission is normally formed to develop recreational programs and leagues, which use the recreational facilities maintained by the public works department. A shade tree commission is in charge of street trees and/or other trees on public property.

Public works must have active input into these different entities to coordinate operations and responsibilities, and supervisors might be placed in charge of specially organized sections of the bureaus or divisions to provide direction to the employees providing specialized services. For example, survey and design, construction, and maps and records might be organized separately within an engineering bureau. These units may or may not be fully staffed, depending upon the amount of work assigned to the bureau. Under this arrangement, the survey and design section would perform the duties that the name implies; the construction section would supervise projects done by municipal forces and perhaps prepare contract documents and inspect work done by private contractors; and the maps and records section would prepare various types of maps, keep detailed records of the location of all utilities and other facilities on municipally owned property, and review all subdivision plats, applications for street excavation permits, and other miscellaneous functions. Outside consultants might also be employed to provide technical assistance for the engineering staff. The preceding description is applicable to a large multipurpose municipality. However, when these functions are performed by the appointed engineer in small municipalities, the municipal officials should expect the engineer or his or her firm to provide similar services.

If conditions warrant, depending upon the number of employees, the public works department might find it advantageous to employ a deputy or assistant director and reallocate certain responsibilities from the director.

Organization is not just an inflexible chart or wiring diagram. To organize is to divide the work of an agency among the persons employed by a municipality. No amount of classification can reduce workers to completely standardized units. Positions in an operating organization will vary to some extent with the persons holding them. Relationships between positions in an organization consequently are affected by a change of personnel in these positions. To the greatest extent possible and within the limitations of labor contracts, the organization should be designed to permit a crossover of employees to adjust for immediate needs, workloads, vacation/holiday schedules, or emergencies.

The public works department head must be the chief planner for the department. It is his or her responsibility to take the budget estimates of the department, including, if appropriate, the various divisions or bureaus, and blend them into a balanced departmental program for the next fiscal year. In the previous section *(Factors Affecting Public Works Organizations)*, we delineated budgeting as two separate but tightly entwined financial plans. Short-term, usually annual budgeting, meets the ongoing finances to keep a community functioning. Long-term or capital budgeting permits a community to finance, in an affordable way, the large projects and the expensive capital equipment required to sustain a community need or public service. Regardless of the size of the municipality, it is crucial and prudent for the department head or roadmaster to convey budgetary needs to the governing body. In addition to the budget, other public works plans and programs, including both short-term and multiyear, require the guidance of the department head. Certainly, the plans formulated by the public works director or roadmaster are subject to modification by the chief administrator or governing body, but within the public works function the department head retains both an important management planning function and management responsibility.

One of the more common titles for the head of the public works department is director of public works. In smaller municipalities, the title is variously called roadmaster, road superintendent, or public works superintendent. This person is hired by the municipality or appointed by the elected officials to carry out duties under the specific municipal code. Regardless of the exact title, this position emphasizes the responsibility of the individual to direct public works activities. The term "direction" includes command, coordination, and control. The public works director is usually delegated significant authority to issue orders, both specific and general. Likewise, he must coordinate the activities of his subordinates. Disagreements over priorities, conflicting demands for equipment, management of emergencies, and scores of related problems place significant coordinating responsibilities on the public works director. His control functions are also numerous and important. Through such devices as inspection, reports, and cost accounts, the director can maintain a continual check so that plans are carried out according to design and schedule, and orders and issued instructions have been implemented.

In municipalities where all or most administrative departments are integrated under a single chief administrator, the public works director ordinarily reports to the governing body through the mayor or chief administrative officer. In most cases, the responsibility for the preparation of reports to the governing body will remain with the public works director. Most public works heads attend the elected officials' public meetings.

IV. Responsibilities of Public Works Departments

Engineering

The engineering function of a municipality is usually considered a public works function. This is especially true in larger municipalities where the municipal engineer and staff are often full-time employees. Depending on the size of the municipality and the resources available, sometimes the engineer and public works director are combined into one position. In smaller municipalities, a consulting engineer usually performs the engineering function.

The engineering function for a municipality should provide, as a minimum, the following:

- Accurate, up-to-date maps of the municipality
- Engineering standards for new subdivisions
- Design services for public works infrastructure projects
- Performance or review of engineering and traffic studies
- Permitting and inspection of work in the public rights-of-way
- Liaison with PennDOT, including updating Liquid Fuels-eligible road mileage
- Long-term planning for future public works projects
- Surveying services for municipal projects
- Advice to the municipality on current governmental regulations affecting public works operations

Maintenance-Efficient Design

Maintenance-efficient design is a consideration too often neglected. You need to recognize the importance of maintenance and the role maintenance should play throughout the developmental processes of a facility.

Maintenance represents a major part of any facility or infrastructure with substantial associated costs over the life of that facility. When you look at the life of a facility starting from the development concept, there are four major considerations: planning, design, construction, and maintenance. First comes the plan and from that comes the design. What is designed has to be constructed, and what is constructed has to be maintained forever after. The total process is the combination of all four of these, and they are all interrelated.

Maintenance must start with planning and design. If maintenance is not considered, maintenance costs and frustrations can become major problems. A minor change in design may result in major savings in future maintenance.

Maintenance-efficient design demands the involvement of all maintenance personnel and not just the maintenance supervisor. Everyone needs to recognize the importance of maintenance and play a part. Everyone has to work together to establish a process by which maintenance becomes a consideration in the planning and design of all new facilities.

The responsibilities are clear and concise, and the public works director as the major maintenance supervisor needs to initiate the process. Just, what are these responsibilities?

FOR ELECTED GOVERNMENT OFFICIALS:

- Develop the ability to relate maintenance costs to design features and level of service to aid in decision making.
- Establish policy and procedures to ensure clear lines of communication between planners / designers and maintenance personnel and ensure maintenance input into all phases of design and development.

FOR ADMINISTRATORS AND MANAGERS:

- Develop a format to convey how future maintenance costs relate to decisions made during initial planning.
- See that budget-makers have cost projections and information on design, maintenance, and service alternatives.
- Adopt design criteria, maintenance standards, and facility checklists for practical guidance for new facility design.
- Assure maintenance participation in the planning and design processes.
- Give firm direction to consultants that maintenance impacts are important and are to be considered.

FOR PLANNERS AND DESIGNERS:

- Recognize the importance of maintenance in the overall facility use.
- Discuss with maintenance staff the purpose, use, design concepts, and construction methods.
- Work with maintenance personnel to determine maintenance tasks and whether they can adequately support design concepts to ensure a maintenance-efficient design.

FOR MAINTENANCE SUPERVISORS:

- Mobilize support of all line staff to improve design and tap the expertise of every individual.
- Keep accurate records of maintenance – how performed, what frequency, etc.
- Observe and document the effect of design on maintenance operation and user behavior.
- Provide feedback on advantages and disadvantages of design features to designers and administrators/managers.
- Stay current on products, equipment, and trends in maintenance and provide this information that bears on design to designers and administrators/managers.

Water Operations

Municipalities may provide water service, but they must first review the appropriate municipal code to determine the rights and restrictions of a particular class of municipality. The operation of a water utility is subject to state and federal laws and regulations designed to protect public health, to assure certain levels of service, and to require a fair system of assessing the costs for water service. A municipality may provide water service directly, contract for water service, create a water or municipal authority to provide this service, or allow the formation of a private water utility within its boundaries. A municipality may also provide water service or obtain it from a neighboring municipality or municipal authority.

Municipal drinking water planning is essential to maintaining customer satisfaction and to meeting regulatory requirements. County planning agencies may commission studies to project regional needs, but the local utility is responsible for the service it provides. The major planning issues are quantity and quality of flow. Plans should project demand of existing and projected service areas throughout the planning period and identify water sources and their safe yield, source protection requirements, and withdrawal, treatment, and distribution facilities necessary to provide a safe and satisfactory product.

Municipal water utilities are responsible for obtaining legal rights of access to water sources and to develop and maintain facilities to deliver safe drinking water. The federal Safe Drinking Water Act and the Pennsylvania Safe Drinking Water Act provide the basis for regulations and standards to assure adequate service and quality. Managers and operators must be aware of applicable requirements and ensure compliance at all levels of the utility.

Municipal codes regulate fees, including service fees for purchase of water, assessments for the installation of new facilities, and tapping fees to recover previously incurred capital costs from new customers. Utilities must institute a

sound billing system and account for funds obtained. Municipal ordinances and rules associated with borrowings or grants typically require that water funds be used only for utility expenses.

Careful management of a water utility is especially important because of the immediate health consequences associated with failure or degradation of the water service. Long-term plans for the replacement of equipment and facilities, the installation of backup units, and the documentation of operations and maintenance (O&M) procedures protect the product. Management plans should address all elements of withdrawal, treatment, and distribution systems, especially source protection, water intakes, treatment facilities, distribution facilities, fire protection devices, cleaning, cross connections, meters, pumping, storage, and disinfection. Plans should include schedules and procedures relating to certifications, inspections, testing, monitoring, public notification, interruption of service, and safety.

Water regulations and associated requirements are changing rapidly. In the face of increasing requirements, the consolidation of smaller private and public water utilities should be considered to spread the costs required for upgrades across a larger customer base.

Municipalities must retain professional staff and/or contractors to provide legal, design, and operational services for the water utility. Municipalities may obtain information, guidance, and assistance from various sources. The regulatory agencies — the Pennsylvania Department of Environmental Protection (DEP) Bureau of Water Supply Management and the U.S. Environmental Protection Agency (EPA) Bureau of Water, and industry associations, including the American Water Works Association and the American Public Works Association, offer technical expertise, telephone hotlines, and websites of value to water utilities.

Sewage Operations

Municipalities are required by Act 537 of 1966, as amended, and Title 25, Chapters 71 and 72, of the Pennsylvania Code to prepare plans for private and municipal sewage systems. The municipal Act 537 Facilities Plan provides the basis for managing domestic wastewater and regulating onlot disposal systems and community sewage collection and treatment systems. An important element of the land development process is the amendment of the 537 plan by the submission of sewer modules that address sanitary waste management.

Municipalities must retain a certified sewage enforcement officer to permit the installation of onlot disposal systems in accordance with the plan and Act 537. Municipalities must update their 537 plans whenever the municipality or DEP determines that the plan is inadequate to meet the existing or future sewage disposal needs of the municipality or a portion thereof. DEP provides several grants and loans, as well as rebates, to assist individuals, municipalities, and businesses with a host of environmental issues.

Municipalities are authorized by the various municipal codes to acquire or construct sanitary sewers on public or private property and to construct treatment works with the consent and permission of DEP. A municipality may provide sewer service directly, contract for sewer service, create a sewer or municipal authority to provide sewer service, or allow the formation of a private sewer utility within its boundaries. A municipality may also provide sewer service to or obtain it from a neighboring municipality or municipal authority.

The operation of a sewer utility is subject to state and federal laws and regulations designed to protect public health, to ensure certain levels of service, and to require a fair system of assessing the costs for sewer service. As a potential source of pollution that can threaten public health and the environment, sewage systems are subject to provisions of the federal Clean Water Act and the Pennsylvania Clean Streams Law. Federal and state permits are required for the construction of sewage works. The DEP Bureau of Water Quality Protection is primarily responsible for administering these permits. A (Part I) National Pollutant Discharge Elimination System (NPDES) permit is required for a discharge of treated sewage. This permit establishes conditions to protect water quality. A (Part II) Water Quality Management Permit is required to construct sewage facilities. This permit indicates DEP approval and provides a record of facilities put in place to meet the NPDES conditions.

The NPDES permit includes specific treatment, monitoring, and reporting requirements. Renewal is required every five years, and renewed permits may contain new conditions. Failure to operate in accordance with the permit, intentional mismanagement, or false reporting may lead to civil or criminal sanctions, including imprisonment of operators and/or public officials.

The management of sewage sludge is an important element of the operation of sewage facilities and is subject to separate regulation under the federal Clean Water Act and the Pennsylvania Solid Waste Management Act. Sewage sludge may be converted to biosolids for land application in agriculture or land reclamation. Sludge may also be land filled or incinerated. Land application requires the use of digestion (liquid composting) or other stabilization techniques because raw sewage sludge is attractive to disease vectors and is potentially pathogenic. Biosolids may be land applied in liquid or solid form, but sludge must be solidified, typically by pressing or centrifugation, for land filling or incineration.

Management of a sewer utility is subject to close regulatory scrutiny. The NPDES permit and Title 25, Chapter 94, of the Pennsylvania Code requires the submission of annual Municipal Wasteload Management reports documenting treatment plant loading and plans to prevent existing or projected overloads. These authorities also require the control of industrial waste discharges into the sewage system to prevent overload of facilities or the introduction of pollutants that may interfere with, pass through the treatment plant, or present a threat to worker health and safety. Although joint treatment of industrial and municipal waste may be practical and beneficial in many cases, municipalities must limit and/or require pretreatment of certain industrial wastes to protect the sewage system.

In addition to the required 537 Facilities Plan and Chapter 94 Wasteload Management Plan, municipalities should also maintain management plans for the replacement of equipment and facilities, the installation of backup units, and the documentation of operations and maintenance (O&M) procedures, including spill-control procedures. Management plans should address all elements of collection, pumping, and treatment systems, especially installation of sewer connections, cleaning, inspection, repair of the collection system, including the control of infiltration and inflow, operation, and maintenance of sewage pumping stations and sewage treatment facilities. Plans should include schedules and procedures relating to certifications, inspections, testing, monitoring, public notification, interruption of service, and safety. Plans are intended to prevent environmental hazards, including drain field or sewer overflows, incomplete treatment, or treatment failure. Plans are also valuable to monitor costs and determine if elements of the operation should be changed or provided to contractors with special expertise.

Municipalities must retain professional staff and/or contractors to provide legal, design, and operational services for the sewer utility. Municipalities may obtain information, guidance, and assistance from various sources. The regulatory agencies — the Pennsylvania DEP Bureau of Wastewater Management and the EPA Bureau of Water — and industry associations, including the Water Environment Federation and the American Public Works Association, offer technical expertise, telephone hotlines, and websites that are of value to sewage utilities.

Roads and Streets

Managing our roads and streets demands a comprehensive professional approach. Not only does our road and street system represent a major capital investment, but it also serves as a major means through which the public evaluates its government. If we are to preserve this investment and provide safe and effective transportation to the public, positive and timely action must be taken by local officials responsible for road and street maintenance.

Historical Perspective: Our earliest streets and roads were dirt trails, which were gradually improved by gravel, cobblestone, brick, and other readily accessible materials. It became apparent from the start that road maintenance responsibility had to become a government responsibility in order to properly serve the public. With the advent of the automobile, road and street maintenance became an important function of government. By 1905, the number of automobiles hit 50,000. Today, that number, including all vehicles, has surpassed the 253 million mark.

Not only are our roads and streets subjected to these ever–increasing astronomical traffic volumes, but they are also subjected to ever-increasing heavy loads. With most of our roads having been designed and built years ago, a major portion of our system is carrying traffic loads and volumes far in excess of the designed capacities. We are therefore faced with both the maintenance and the upgrading of these facilities to meet the present traffic conditions.

Deferred Maintenance: Road and street maintenance has not been a top priority over the past decades. Deferred maintenance has been the rule, more often leading to extensive deterioration and the need for more substantial rehabilitation costs. *Figure 1* compares the condition of a road over its life in years and shows the normal deterioration curve. This depiction means that as the road deteriorates, that deterioration accelerates. The need for early preventive maintenance is stressed in terms of costs. As the figure shows, each dollar spent on early preventive maintenance to bring the road back to good condition will end up saving a bundle of money against much more extensive reconstruction in the future. Deferred maintenance always equals increased costs.

FIGURE 1

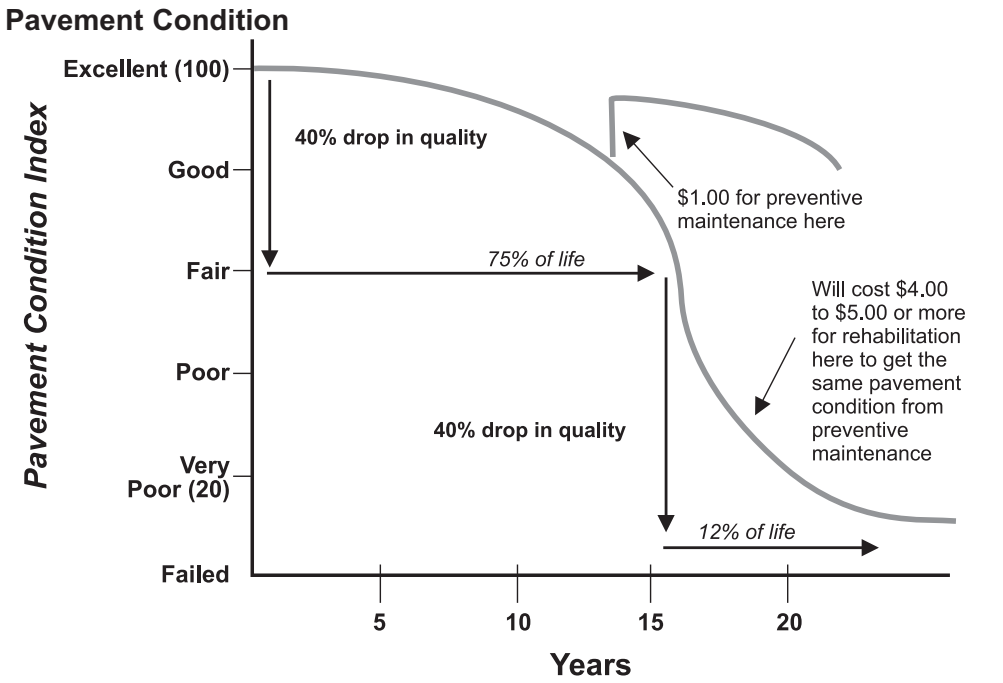


Figure 1. The significance of this figure shows that there is a 40 percent drop in quality over the first 75 percent of the road's life, but it only takes another 12 percent of time to drop another 40 percent in quality.

Proper road and street maintenance is more than throwing some asphalt patch material in a pothole and running over it with the truck tire. Proper road and street maintenance means knowing how to recognize the different distresses that exist and the causes of those distresses and then choosing the appropriate maintenance method using proper materials and equipment and carrying out the work in a timely manner.

Most of our local roads and streets are paved with asphalt. Listed below are some of the many types of distresses that can develop:

Fatigue cracking	Transverse cracking	Bleeding/flushing
Block cracking	Patch/patch deterioration	Polished aggregate
Edge cracking	Potholes	Raveling
Longitudinal cracking	Rutting	Lane to shoulder Drop-off
Reflection cracking at joints	Shoving	Water bleeding and pumping

The personnel in charge of roads and streets must be able to recognize these distresses and causes and then select a proper method of maintenance repair.

Information Resources: We all know the importance of establishing standards and specifications. There are a few items that we definitely ought to be aware of concerning roads and streets. PennDOT has established various standards and specifications through their publications. Five major publications for roads and streets are:

> ***Publication 408: Highway Construction Specifications –*** These PennDOT roadway specifications cover all aspects of road construction from paving to drainage to roadside accessories. These are the specifications that are required when using Liquid Fuels Funds *(See Pub. 9 below)*.
>
> ***Publication 72: Roadway Construction Standards –*** These PennDOT roadway construction drawings supplement the specifications.
>
> ***Publication 70: Guidelines for the Design of Local Roads and Streets –*** This publication is invaluable as guidelines for design specifications. The manual contains design criteria for both urban and rural roads and for new construction, rehabilitation, or reconstruction. Your municipal consulting engineer should be aware of this manual and should be putting it to use when doing municipal engineering work for roads and streets. All new roads and streets in new developments should follow the design guidelines for minimum depths of pavement courses contained in the manual.
>
> ***Publication 9: Policies and Procedures for the Administration of the Liquid Fuels Tax Act 655 –*** This manual covers requirements for the use of the Liquid Fuels Funds that every municipality receives from PennDOT. These funds, generated from the State Fuels Tax, are distributed to municipalities based on population and miles of road and are required to be used to maintain their transportation system. The road mileage used in calculating each municipality's amount of funding is based on the total miles of eligible roads meeting the criteria of the program.
>
> ***Publication 447: Approved Products for Lower Volume Local Roads –*** This publication contains a listing of approved products or processes that meet the Bureau of Municipal Services specification requirements and are eligible for Liquid Fuels Funds for use on municipal maintenance and construction projects. Products or processes listed in this publication must perform satisfactorily and be in compliance with the terms of this publication. All materials accepted on any project must comply with the applicable section of the department's specifications or be approved by a department representative.

All new roads being constructed and all existing roads having major rehabilitation work should be built to meet the minimum funding criteria in terms of right-of-way and traveled cartway. These criteria may differ with type of municipality and are as follows:

Right-of-Way Requirements:

Townships, Second Class	33 feet minimum
Townships, First Class	33 feet minimum
Boroughs	16 feet minimum
Cities	16 feet minimum

Road or Street Cartway:

Paved or unpaved	16 feet minimum

The criteria that govern dead-end roads or streets and cul-de-sacs are as follows:

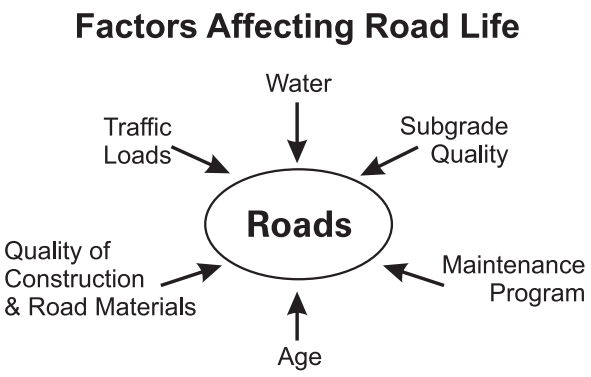
Cul-de-Sacs:

Length	250 feet minimum
Radius	40 feet minimum

Accessible from an existing public road or street

Drainage: When it comes to roads and streets, drainage has to be the #1 priority. Drainage is the key to longer road life, and all roads and streets need to be properly drained. Whatever maintenance method is used, it will not last as long as it should without proper drainage. Proper drainage is essential to getting the greatest value out of any subsequent maintenance performed.

A 1916 handbook published by the New Hampshire Highway Department stated: "Always remember and apply this most important rule: Keep water OFF your road, OUT of your road, and AWAY from your road." This statement is just as appropriate and as important today, nearly 100 years later.



The Effects of Water: When we look at all the factors that can affect our roads, water has to be at the top of the list. Water alone or combined with any other problem factors can be disastrous.

Proper drainage cannot be overemphasized in road maintenance and construction. Water affects the entire serviceability of a road. Whether mud in the spring or frost heaves in the winter, the presence of water in roads provides nothing but trouble. Building a good drainage system and maintaining it is the best way to lessen water's damaging influence.

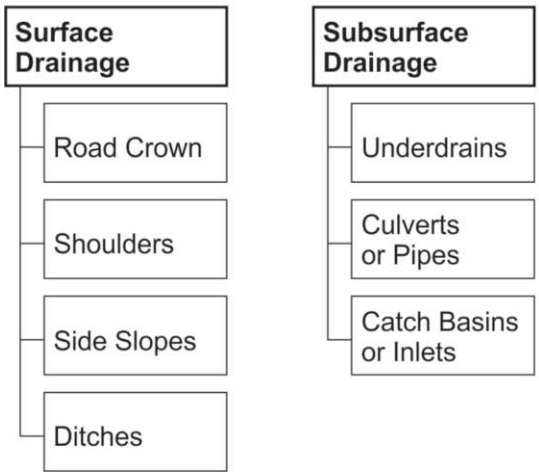
Here's what happens when water enters the road structure and does not drain properly. In summer, water acts as a lubricant and "softens" the road base by allowing the materials to move more readily. Then, traffic loads can cause greater pavement deflections over this softened base causing cracking and other distresses that in turn will allow more water to enter. The road becomes further weakened; cracks widen and eventually develop into potholes leading to complete road failure if left unmaintained.

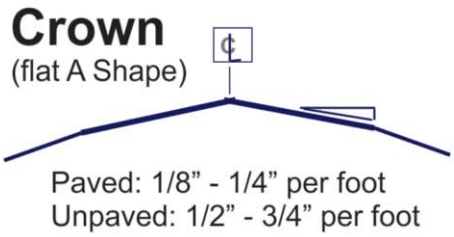
In winter, another problem is encountered due to the expansion of water upon freezing. When water freezes in the road base, it forms what are called ice lenses, causing expansion and pressure. Deflection of the pavement is upward and can again cause cracks, allowing more water to enter and freeze and causing greater deflections. As the conditions worsen, frost heaves or blowouts occur.

Three conditions are needed for frost damage to occur: freezing temperatures, frost-susceptible soils, and water. If one of these is eliminated, frost damage can be prevented. Since we cannot control temperatures, we have to look at the other two conditions. Removal and replacement of frost susceptible soils is no small undertaking and is probably not cost effective unless it is a rather small localized area. However, water can be controlled with good drainage.

During spring thaws, the large volume of ice lenses melts, resulting in excess water. Since thawing occurs from the top down, this excess water is trapped from draining downward. It is the excess water that causes the spring "mud season," and the excess of potholes in the pavement, when the road cannot drain water properly. Again, one can see the importance of a well-drained road structure.

Drainage Systems: Drainage systems are a combination of surface and subsurface systems. A proper drainage system can include all of the following:





One of the first lines of defense against water is the road surface. Whether paved or unpaved, the road surface needs to be as waterproof as possible and provide proper water drainage. The road "crown" or cross slope becomes a major component in getting water off the road. Maintaining this road crown is most important.

The cross slope on the shoulder should continue at a slightly steeper rate than the road surface to allow water to flow further away from the road.

In discussing cross slope, it is important to have a cross slope not only for the road surface but also for the road base, subbase, and subgrade to provide for proper drainage of the entire road structure and keep water out of the road. Proper construction for drainage and the use of subsurface drains as needed are all-important aspects of proper drainage to keep the water out of the road.

Shoulders, unless paved, need to be cut or shaped routinely with no vegetation growing on the shoulder area. A road with no shoulders and with only vegetated berms must be maintained along with the vegetation. Otherwise, material will tend to build up along the road edge, forming secondary ditches that will lead to pavement edge breakdown, washouts, and other road deterioration. Shoulder or berm areas must be maintained so that they are extensions of the road surface; this will allow for the continued flow of water away from the road and into the next drainage system — either roadside ditches or pipe systems with inlets or catch basins.

Curbed streets need to maintain water flow along the gutters, which are usually outletted into inlets or catch basins. Keeping the joint along the curb sealed and watertight keeps the water out of the road. Likewise, joints around inlets and catch basins must be kept sealed so the water flows into the drainage facility and not into the soils around it to cause undermining of the structure.

Road crews must be trained in the proper construction of drainage facilities, such as subsurface drains, pipe installation, inlet construction, and inlet grate placement, to ensure proper drainage and longer road life. Road crews should be trained to read their roads — puddles mean problems!

Field studies and research on road drainage conducted by Harry Cedergreen compared the life of an "undrained" road to that of a well-drained road. The stated results of his work found that the life of an "undrained" road is reduced to less than a third of the life of an adequately drained road. This result definitely emphasizes the importance of having a good drainage system and properly maintaining it.

Road and Street Maintenance Techniques: Even if starting with a good roadway drainage system, roads and streets are going to develop distresses and will need to be maintained by the use of various methods and materials. No one maintenance technique will suffice to solve all the problems. Instead, personnel in charge of roads need to recognize the various distresses and the causes behind them. They also must be familiar with the various maintenance methods and materials available. Only then can they analyze the problems and select the proper materials, methods, and equipment to do the most effective and efficient job.

Many factors must be considered when deciding on alternative maintenance techniques that could be used and whether to accomplish the task with in-house crews or by contract. The first and prime factor is the available resources of personnel and equipment. Proper equipment and trained personnel are the prerequisites to in-house work. The availability of experienced contractors plays an important part if contract work is contemplated. Factors such as traffic control, the time or length of construction, and the impact on local business all need to be considered when determining what method or technique will be used. Utility interference and possible required relocation may play a part in the decision. Also, the costs of different alternatives, both initially and over the life cycle, must be considered. Finally, federal, state and local regulations may also influence the decision.

No matter which alternative technique is chosen, using proper materials and equipment and following proper procedures are essential. To ensure the most effective, efficient, and safe job, training is also critical for in-house crews, whether these crews perform the work themselves or they become inspectors on the contract work performed for the municipality. Contract work requires adequate protection to ensure proper performance and materials and to protect the huge dollar investment that a municipality has in its transportation infrastructure.

Following is a description of the most common maintenance techniques useful to road and street departments in their maintenance programs. The information does not include detailed manuals on "how to" but instead focuses on short descriptions that highlight the benefits of using these techniques as part of an overall road and street maintenance program.

A. Crack Sealing – One of the first early distresses that may develop in new asphalt pavements is cracking, and an effective preventive maintenance method for prolonging road life is crack sealing. The importance of keeping water out of the pavement structure has already been emphasized. Cracks in the pavement indicate the pavement is leaking. Like a leaking roof on a house, delaying action on any leaks will only result in further and more serious deterioration. Cracks need to be sealed, particularly in new pavement, to preserve useful pavement life.

Cracking is caused by a variety of factors. Cracks are identified by type, indicating their origination and development. *Reflection cracks,* usually found in new asphalt overlays, are cracks formed by the old underlying pavement joints or cracks existing in the original pavement. *Edge cracks* form longitudinally along the pavement edge and are normally caused by poor pavement edge support or the poor structural strength of a widened portion of pavement. *Longitudinal cracking,* normally associated with pavement joints, is usually caused by poor cold joint preparation and construction. *Transverse cracks* can be thermal or reflective in nature. *Block cracking* refers to the large "blocks" that form in the pavement due to age and shrinkage of the asphalt. *Slippage cracks* form in crescent shapes in asphalt that has been shoved or pushed by traffic, particularly heavy traffic at a braking location. All of these types of cracks can be crack sealed to prevent water entry and prolong pavement life.

Fatigue cracking, also known as chicken wire or alligator pattern cracking, appears as many small interconnected cracks, which form many small pavement segments that resemble a piece of chicken wire or the back of an alligator. This cracking is normally due to base or subbase failure and requires more extensive repairs to remove the affected area and rebuild the total pavement structure. To attempt crack sealing of all of these cracks would be very labor intensive, would look like a mess on the surface, could be a safety issue (e.g., creating a slippery spot for motorcycles), and would be short-lived. Fatigue cracking that is just beginning to show or what would be termed "low severity" could be covered with a thin surface seal to keep additional water out. This technique would be at best a temporary patch because the problem will reappear. The time factor would depend on many site condition variables, such as drainage, the extent of the distress, traffic volumes, and weight.

Although many types of cracks can be sealed, crack movement becomes an important factor in determining which ones. Cracks can be working or non-working. A working crack is one that experiences horizontal and /or vertical movement of greater than 0.1 inch (2.5 mm) because of temperature change or traffic loads. Cracks with movements of less than 0.1 inch (2.5 mm) are considered non-working cracks. Usually, transverse cracks are working type cracks, and longitudinal cracks are non-working. However, different types of cracks can fall into either category, depending on the conditions.

Recent research through the federal Strategic Highway Research Program (SHRP) has shown that the new rubberized asphalts provide the best crack sealing materials to produce a cost-effective, longest-lasting seal. Use of these materials requires the proper equipment, such as a double-jacketed or double-boiler kettle with pump and wand.

Higher quality sealants are required for working cracks as compared to non-working cracks. If the majority of cracking is of the working type, the most effective practice is to stay with the high-quality sealant for all cracks. Material cost for the sealant is usually the smallest part of the overall cost in a crack sealing program.

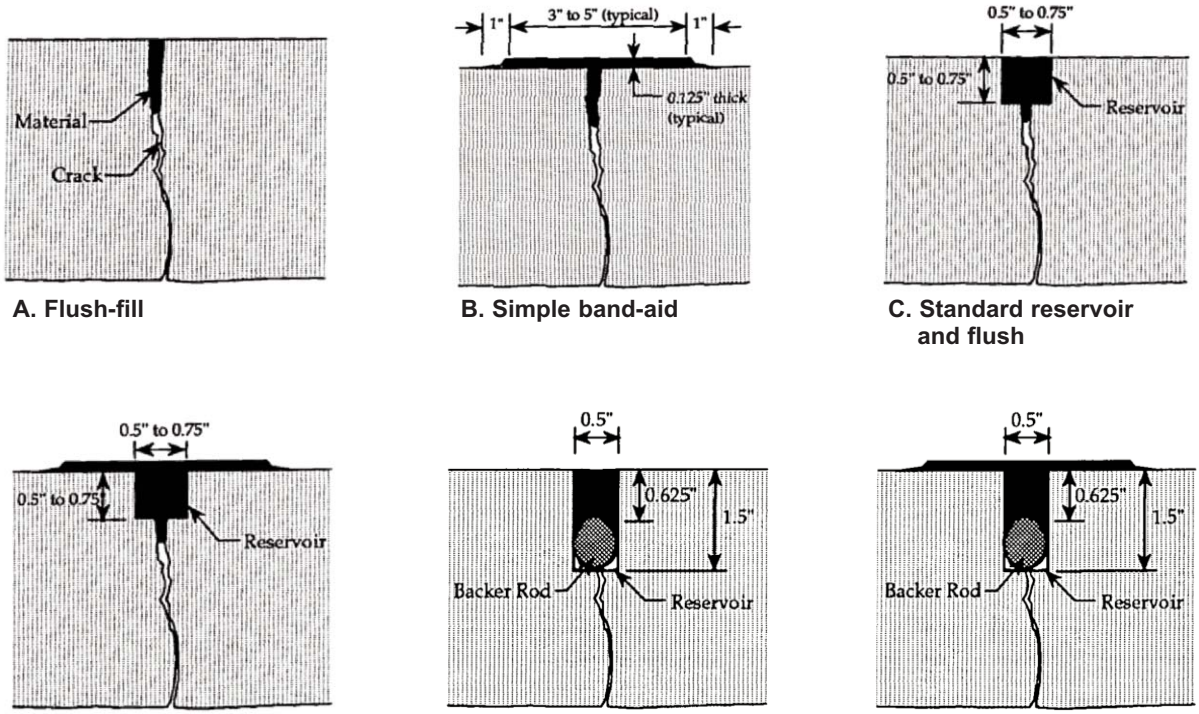
Crack sealing is best done in the spring or fall of the year when temperatures are moderate and cracks are partially opened. The air temperature and pavement surface temperature should be above 40 degrees F. At these times, the crack channel is at the middle of the working range and will be subject to the minimum expansion and contraction forces.

No matter how good the sealant, the results will not be effective without proper installation. The two most critical steps in crack sealing are crack preparation and material application. The crack needs to be clean and dry. Compressed air is an accepted method for cleaning the crack. The use of a hot-air lance enhances the drying of damp cracks and helps heat the existing pavement, particularly when temperatures are approaching the 40 degrees F minimum. Vacuum equipment is also available for crack cleaning in areas where air pollution is a concern.

In preparing the crack, consider the material placement configuration. Typical configurations are listed below in *Figure 2*.

FIGURE 2

Material Placement Configuration



A. Flush-fill **B. Simple band-aid** **C. Standard reservoir and flush**

D. Standard-recessed band-aid **E. Deep-reservoir and flush (backer rod)** **F. Deep-recessed band-aid (backer rod)**

Routing out the crack channel creates the reservoir configuration. A ratio of 1:1 for width-depth is common although other configurations are used. Several types of crack routing machines are available. Routing opens small cracks to allow greater penetration, provides a reservoir for the sealant, and produces uniform edges for better adhesion. On the other hand, routing is very labor intensive and can result in extra time and costs. It can also be difficult to follow meandering cracks. Routing may not be suitable for older, aged asphalt pavements (more than six years old) or thin asphalt pavements (less than 2 inches). Routing is not needed if pavement is crack sealed before an overlay.

The three important items to employ during application are consistently maintaining application temperature, maintaining a sufficient supply of heated material in the kettle, and properly dispensing the right amount of material into the crack. The band-aid configuration can be formed with a squeegee or a special nozzle head. A squeegee needs to be operated closely behind the wand and kept free of material buildup. Tracking of the material by traffic can become a problem. Thus, crack seal manufacturers have developed a biodegradable liquid detackifying solution that is sprayed on the sealant to reduce traffic-control issues.

Most municipalities rent crack sealing machines through a rental company. When doing so, it is important that all employees fully understand the safety features of a crack seal melter and wear appropriate personal protective equipment.

Crack sealing is one of the best early preventive maintenance methods for prolonging the life of your roads and streets.

B. Asphalt Patching – Asphalt patching can be divided into several maintenance activities, which will be further explored below:

1. ***Pothole patching*** is the repair of surface holes that have formed from further deterioration of unmaintained cracks or other distresses or from frost heaves and blowouts.

2. ***Base repairs*** refer to deep patches and repaired alligator cracked areas or larger deteriorated areas due to base or subbase failure.

3. ***Trench patching*** is the restoration of utility trenches, including storm drainage facilities.

The two main elements of asphalt patching are the material selection and the repair procedures. For each agency, different combinations of materials and procedures will produce optimum cost effectiveness. Factors that may affect this decision-making process include safety and rideability, level of traffic, resources (personnel, materials, equipment), management philosophy or knowledge, time until pavement overlay or rehabilitation, and the tolerance of the public.

Proper pothole repair is more than just throwing some asphalt patch material in a hole and whacking it with the shovel or running it over with the truck. Although this procedure may be used in emergency adverse weather conditions, there are better ways to ensure a more permanent type patch. Any trade-offs between productivity and quality need to be balanced.

The research carried out through the Strategic Highway Research Program included the following statement: "Bituminous hot mix has shown the longest service life of all materials when it is placed using permanent procedures in a dry hole." Although Pennsylvania has one of the best asphalt cold patch materials, cold-mix asphalt was never designed as a permanent patch.

Pothole Patching – Permanent pothole patching involves nine steps:

1) *Proper work-zone traffic control* – This is a prerequisite for worker and motorist safety.

2) *Marking the hole* – This step communicates to the cutting crew how to avoid excess cutting and reduce additional costs for materials and crew and how to avoid insufficient cutting that can result in a poor patch.

3) *Cutting* – Performing this step ensures that all the weak deteriorated areas have been removed, thus leaving only firm material around the repair. Cutting results in vertical sides that are necessary for proper compaction and confinement of the material in the hole under traffic. Cutting should begin at the center of the hole and continue outward to the mark, thus leaving a more firm edge to patch up against.

4) *Cleaning* – Cleaning means to remove all loose material, dust, and/or water. Thorough cleaning can only be accomplished with compressed air or vacuum equipment. Tacking is not recommended for cold-mix asphalt patch material.

5) *Tacking* – For this step, a thin coating of the appropriate asphalt tack material is sprayed or brushed on the vertical side of the hole.

6) *Filling* – To fill the hole, directly dump or shovel the hot-mix asphalt material directly into the hole and tamp the edges and corners with a square-edge shovel. Hot-mix asphalt material must be maintained at the correct temperature, which may necessitate the proper equipment to keep the asphalt hot, such as an asphalt hot-box, maintainer, or reclaimer.

7) *Compacting* – Compaction of the asphalt mix is critical since poor compaction will cause a depression under traffic loads or the raveling or shoving of the asphalt. Proper compaction can only be accomplished with proper compaction equipment, which will be determined by the size, depth, and surface geometry of the patch. Vibratory plate compactors are good for small flat areas, and vibratory portable drum compactors are effective for a variety of patches. Large areas dictate a larger self-propelled roller (4- to 6-ton) for proper compaction and desired rideability. Asphalt should be compacted in layers with a maximum 3-inch lift. The completed compacted patch should be uniformly slightly higher (the thickness of a pencil) than the surrounding pavement surface. This condition should not be noticeable to motorists and will ensure against formation of "bird bath" depressions if traffic further compacts the patch.

8) *Edge sealing* – Once the patch is compacted, an edge seal can be applied with the same tack material. This is an optional step to ensure waterproofing the joint. A thin layer of asphalt seal is squeegeed onto the joint around the patch. Edge seal is not recommended for cold patch. Blotting to prevent tracking of the material by traffic may be necessary.

9) *Cleanup*

Base Repairs – Base repairs are just deep pothole repairs. Alligator cracked areas and other major distresses can be caused by base and subbase failures. Surface renovations for these types of conditions would only result in a temporary repair since the underlying cause needs to be addressed. Many times the underlying cause relates to poor drainage.

Similar to pothole repair, all unsuitable and deteriorated materials must be removed. This may mean removal of all base and subbase materials down to the subgrade and could even include removal of subgrade material if deemed unsuitable because of water-saturated conditions. Drainage needs to be addressed, and proper subsurface drainage facilities may need to be installed to correct the situation. Then, each layer must be properly replaced — placed and compacted in layers — with like material, ending with restoration of the final asphalt surface.

Trench Repairs – Trench repairs, likewise, are similar. Utilities of whatever form should be properly bedded and surrounded by a protective fine aggregate. The trench then needs to be backfilled and compacted in layers with a specified select material aggregate or flowable fill with final restoration of the road or street structure as the last step. In trench restoration, a final cut to shelf back the final asphalt paving will not only provide a clean edge to patch against but also provide a better structural repair. This procedure also provides a more aesthetic appearance for the restored trench.

C. Seat Coat Applications – As asphalt pavements age, surface deterioration becomes evident. The surface asphalt undergoes oxidation or drying out from the hot sun and becomes hard and brittle. The surface starts to have a grayish appearance, which shows the weathering that has taken place. With additional time, this weathering initiates raveling as the hard brittle asphalt starts to break up and the surface aggregate loosens. Other pavements with heavy traffic volumes can become polished and lose their skid resistance.

All of these types of distresses – weathering, raveling, and polishing – are surface distresses that need attention before further deterioration of the pavement structure occurs.

Various seal coat applications are appropriate for different conditions. We will explore bituminous seal coats, slurry seals, microsurfacing, and ultra-thin friction course applications.

Bituminous Seal Coats – A bituminous seal coat is comprised of the application of a liquid asphalt emulsion to a road surface followed immediately by a layer of nearly uniform size aggregate or chips. Bituminous seal coats can be either single or double applications. PennDOT uses the term bituminous seal coat for a single-application bituminous seal coat and bituminous surface treatment for a double-application bituminous seal coat. Bituminous seal coats are used to correct the asphalt surface distresses previously mentioned. Bituminous surface treatment should be used on gravel roads to provide a better riding surface and prevent dust. They are most common for rural roads (paved and unpaved) because there will always be some loose aggregate upon completion of the work.

Special asphalt emulsion enhanced with various polymers can also be used. These materials will result in better chip adherence and retention.

When a bituminous seal coat is to be used, proper rates of application for both the asphalt and the aggregate must be determined. The condition of the road surface plays a large part in application rate along with the aggregate characteristics. In addition, the aggregate and asphalt emulsion must be compatible, and testing is an essential step. The asphalt vendor, upon receiving a sample of the aggregate to be used, usually does this testing.

Surface preparation is important. The existing asphalt surface needs to be clean of all dust and debris before the application of the asphalt emulsion. Dirty, dusty services will not allow the asphalt to bond to the existing surface and will result in loss of the seal. Potholes or other distresses should be repaired as part of the preparation process.

Proper well-calibrated equipment is necessary to produce a good bituminous seal coat, along with proper materials and procedures. Well-trained, experienced crews should only apply bituminous seal coats.

The asphalt distributor is probably the most important piece of equipment. The asphalt distributor applies a uniform layer of hot asphalt emulsion over the surface. The distributor has to be properly calibrated with correct spray nozzles at the proper angle and height to deliver the required uniform asphalt coverage. The chip spreader then applies the aggregate at a specified uniform rate immediately following the asphalt emulsion application. The rolling should then begin immediately behind the chip spreader. Timing is critical to establish the asphalt-aggregate bond before the emulsion breaking (curing).

Pneumatic (rubber)-tired rollers are required, as they do not crush the aggregate and will not create dust, which would interfere with proper aggregate bonding. Rubber tires also do not bridge surface depressions, which would tend to not seat the aggregate properly into the asphalt. The chips must be properly embedded in the asphalt film to prevent loss through traffic abrasion. Any excess aggregate should be removed by brooming.

Trucks must be available in sufficient numbers to ensure that the operation proceeds on a continuous basis with the minimum number of interruptions.

Bituminous seal coat operations should not be carried out when temperatures dip below 60 degrees F or when it is raining or predicted to rain.

Expected service life under ideal conditions should be five to seven years. Following are details on two specific types of bituminous seal coats:

- *Bituminous Fiber-Reinforced Seal Coat:* Bituminous fiber-reinforced seal coat is composed of the application of a liquid asphalt emulsion with a sandwiched blend of fiberglass strands to a road surface followed immediately by a single layer of aggregate. The application rates of emulsion and fiber need to be adjusted to address the conditions of the surface to be treated. Surfaces with wide cracks or severely cracked surfaces require additional asphalt emulsions. Any cracks greater than a quarter of an inch need to be sealed prior to applying any bituminous fiber reinforced seal coating.

  A specifically designed trailer system applies the emulsion and the fiber at an adjustable rate in accordance with the specific project requirements.

The surface preparation, use of calibrated spreaders, and pneumatic tired rollers are similar to a bituminous seal coat project.

- *Bituminous Fiber-Reinforced Stress-Absorbing Membrane Interlayer (SAMI):* Stress-absorbing membrane interlayer involves an application of bituminous fiber reinforced seal coat followed by an application of cover aggregate. The cover aggregate is then followed with the construction of an approved surface overlay. The surface overlay could be composed of any of the following products: Superpave, FB-1, FB-2, microsurfacing, ultra-thin friction course, or slurry seal.

Slurry Seals – Slurry seal is a mixture of well-graded fine aggregate, mineral filler (Portland cement), asphalt emulsion, and water. The seal is applied to the pavement as liquid slurry with a specialized slurry truck. For most municipalities, an outside contractor with specialized equipment would apply slurry seal.

Slurry seals are used for preventive and corrective maintenance. Timely applications will seal minor surface cracking, stop raveling, seal open and/or oxidized surfaces, and improve skid resistance.

Slurry seals do not increase the structural strength of the pavement. Localized pavement distresses must be repaired as part of the pavement preparation for a slurry seal.

Slurry seals have varied thicknesses and are usually defined as Type I, II, or III based on their maximum nominal aggregate size. Type I is used for maximum crack penetration and sealing in low-traffic density areas. Type II is used to correct severe raveling and oxidation and to improve skid resistance in areas of moderate to heavy traffic. Type III is used as the first course on multicourse applications to correct severe surface conditions and improve skid resistance in areas of heavy traffic.

Slurry seals have advantages over bituminous seal coat in that they can be rapidly applied with no loose cover aggregate and have an excellent surface for pavement striping. Like most seals, there is minimum loss of curb reveal with no need to adjust manholes and other structures.

Slurry seals are more suited to residential streets in subdivisions and other built-up areas with driveways and pedestrians.

Pavement preparation is the same as for bituminous seal coats, and it is imperative that there are proper repairs of any structurally failed areas and major depressions, filling in of wide cracks, and a clean surface. A thin tack coat of diluted emulsified asphalt of the same type and grade used for the slurry is recommended for all pavement surfaces except relatively new asphalt surfaces. For these surfaces, a pre-fogging with water to dampen the surface will suffice.

Rolling is usually not needed, except in selected areas, such as heavily traveled areas subjected to steering turns, braking, and acceleration forces.

Slurry should be placed only when the temperature is 50 degrees F and rising and no rain is in the forecast.

Expected service life under ideal conditions should be three to five years.

Microsurfacing – Microsurfacing can be a versatile tool in a road maintenance program. Microsurfacing is a polymer emulsified asphalt paving system that can remedy a broad range of pavement distresses. Like slurry seal, it is a mixture of dense-graded aggregates, asphalt emulsion, water, and mineral fillers. It also has added special polymers. Although conventional slurry seal is used as an economical treatment for sealing and extending the service life of roads, microsurfacing has many added capabilities due to the use of high-quality, carefully monitored materials, including advanced polymers.

Microsurfacing is applied with a special slurry truck that carries all the components, mixes them, and spreads the high-tech slurry mixture onto the road surface. With various design mixes, techniques, and equipment, microsurfacing can be used successfully in a number of situations.

In quick applications, microsurfacing can increase skid resistance, color contrast, surface restoration, and service life to high-speed, heavy traffic roadways, including interstates. These applications often reopen to traffic within an hour. Microsurfacing creates a new stable surface that is resistant to rutting and shoving in the summer and to cracking in the winter. Microsurfacing is a thin restorative surface that does not alter drainage, does not result in loss of curb reveal, and does not require manhole or utility structure adjustments.

Micro surfacing can be used as a leveling course to be followed by a surface course. It is capable of filling wheel ruts when the pavement has stabilized.

Expected service life under ideal conditions should be three to seven years.

Ultra-Thin Friction Course – Ultra-thin friction course is a paver-laid seal leveling course, which consists of a tack/seal coat of polymer modified asphalt emulsion spray applied immediately ahead of an ultra-thin overlay of gap graded hot-mix asphalt.

A specially designed machine places the ultra-thin friction course in one pass. The machine sprays the polymer modified asphalt emulsion binder at the proper rate just inches ahead of applying the overlay of gap graded hot-mix asphalt. The road can be opened to traffic immediately after rolling and cooling.

The surface texture is open graded, allowing water to enter the surface and run off laterally, thus reducing surface water and spray from traffic tires onto windshields of other vehicles. Its macro-texture yields high skid resistance suitable for all traffic volumes.

The aggregate is a cubical stone chip usually applied as a one-stone thickness hot-mix asphalt overlay and then rolled to orient the aggregate. Like all seal coats, ultra-thin friction course does not add structural strength to the road.

Expected service life under ideal conditions should be seven to 12 years.

D. Maintenance Alternatives – Asphalt overlay, or asphalt resurfacing, is a common rehabilitative technique with widespread use. Asphalt overlays are sometimes not used appropriately as to the existing condition of the street or road. Pavements with severe distresses and poor drainage may well be past the stage of overlay. An asphalt overlay on severely deteriorated pavements is like putting a band-aid over a major wound. Covering the problem will not fix it, and the overlay will not last as long as it should.

Looking from the other direction, a pavement with surface distresses of raveling, polishing, minor cracking, etc., may not require an overlay. If the pavement is structurally strong enough for traffic loadings and is experiencing only surface distresses, a preventive maintenance seal coat would be a lot less expensive and would properly restore the pavement to good condition. An overlay, in this case, would not be the most cost-effective method to use.

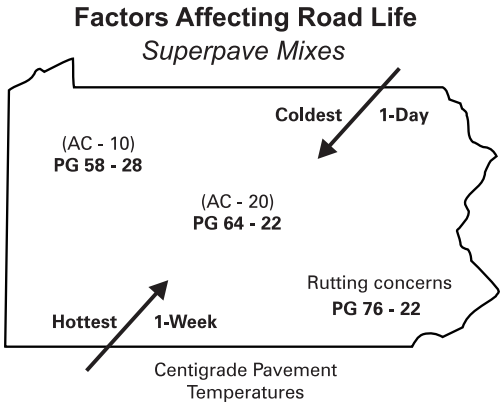
A pavement analysis of the existing street or road becomes an important step in the decision-making process of selecting a maintenance alternative. Overlays should be used, with proper pavement preparation, to add structural strength where displacement has occurred such as rutting, corrugations, and depressions. Preparation of the existing pavement means that repairs need to be made. Sections of failed base (alligator cracks) need to be removed and replaced with new base material. Cracks must be sealed, and potholes properly patched. Drainage problems must be corrected. The overlay will only be as good as the foundation that supports it.

When the existing pavement is deteriorated to a severe degree, it is wise to plan to use other methods, such as full-depth recycling or complete reconstruction.

As a rule of thumb, the minimum thickness for an overlay should be equal to at least one and one-half times the maximum size of the aggregate in the mix.

E. Superpave – Superpave is a system for designing asphalt mixes at the plant to improve their durability and rut resistance on the roadway. It is a process that more consistently produces superior asphalt pavement courses. In fact, Superpave is an acronym for **Su**perior **Per**forming Asphalt **Pave**ments.

The Superpave system for the design and analysis of asphalt mixtures was a result of the federal Strategic Highway Research Program (SHRP). This system includes two major improvements: the use of performance graded (PG) binders and the use a gyratory compactor for testing mixtures at the plant. Thus, Superpave or Gyratory Pavement Courses were developed to more effectively address asphalt pavement failures, particularly due to rutting, fatigue cracking (alligator cracking), and low-temperature cracking. With increases in truck weight, tire pressure, and vehicle volumes, asphalt pavement distresses such as rutting and fatigue cracking have become common. Low-temperature cracking also remains a common asphalt distress in all levels of service.



Because the asphalt binders are performance graded (PG) under the Superpave system, an understanding of binder terminology is necessary. The Superpave PG system for specifying binder (simply the asphalt in the mix) relates binder performance to anticipated pavement temperatures. The PG specification for a binder is represented by two numbers that are the pavement temperature extremes in which the binder should perform satisfactorily. For example, in a binder that is graded PG 64–28 (read as "64 minus 28"), the 64 stands for the average maximum Celsius temperature that the binder should withstand in a seven-day period. The minus 28 is the minimum Celsius temperature the binder should withstand in any given day.

Because a gyratory compactor produces samples that mimic how a mixture will lie once installed, the technician can design mixes with strong aggregate structures. Superpave mixes are designated metrically, based on the nominal maximum size of the aggregate gradation. Explaining nominal maximum size of the aggregate, gradation, or PennDOT's maximum top-size aggregate becomes complicated.

Superpave Course
9.5 mm wearing course
12.5 mm wearing course
19 mm wearing course
25 mm binder course
25 mm base course
37.5 mm base course

F. Skid Resistance Level (SRL) – Consideration of proper skid resistance levels (SRL) is important when deciding which bituminous seal coat or treatment, slurry seal, microsurfacing, ultra-thin friction course, or Superpave mix to use on a specific road.

The *Figure 3* will assist you in determining what SRL rating you should specify based upon your average daily traffic (ADT).

It is important to remember that road personnel need to be well trained in asphalt mixes and their uses as well as asphalt paving operations and procedures.

FIGURE 3

Skid Resistance Level (SRL) Determination

ADT	SRL
20,000 & above	E
5,000 to 20,000	H or E, Blend of E&M or E&G
3,000 to 5,000	G or E, H, Blend of H&M or E&L
1,000 to 3,000	M or E, H, G, Blend of H&L, or G&L, or E&L
1,000 & below	L or ANY

All blends are 50% by weight and shall be accomplished by an approved method.

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G. Vertical Control – When overlays are suitable, vertical elevation control becomes a prime concern. Curb reveal for ADA access, sign height, guiderail height, overhead structure clearances, along with drainage inlets and catch basins, and utility structures such as manholes and valve boxes all have to be considered in planning any overlay project. Milling of certain areas may be required before the new overlay to maintain proper elevations. Adjustments of drainage and utility structures may be required to maintain safety and rideability of the new overlay.

Shoulders may need additional work to match the elevation of the new overlay and prevent the occurrence of "shoulder drop-off," a situation getting more attention and causing tort liability problems.

H. Overlay Operations – A normal asphalt overlay project consists of several important steps. After proper pavement preparation, including a final cleaning of the existing surface, a tack coat of asphalt emulsion is applied and allowed to cure. The asphalt mixture is then spread and finished true to crown and grade by an automatically controlled asphalt-paving machine. Asphalt mixes may be spread and finished by hand methods only where an asphalt paver cannot be used.

Superpave mixes can be hot-mix asphalt (HMA) or warm-mix asphalt (WMA). Warm-mix asphalt technologies have been developed to provide a better Superpave mix.

The biggest difference with warm-mix asphalt is how the asphalt mixture is produced and placed at lower temperatures than hot-mix asphalt. Production and placement temperatures of warm-mix asphalt can be reduced 50 to 100 degrees F compared to hot-mix asphalt. These lower temperatures not only benefit the producer, but they are also an advantage to the municipalities in the field. The following are benefits of warm-mix asphalt over hot-mix asphalt:

- Better compaction = better performance
- Warm-mix asphalt cools slower and results in more time for workability
- Good for the environment and workers due to less fumes and cooler working conditions
- Asphalt binder aging is not increased because the material is not heated above 285 degrees F
- Pavement stays blacker longer
- Less asphalt binder absorption into the aggregate

The temperature of the asphalt mix is critical. It needs to be delivered to the job site at a high enough temperature to permit laying and compaction before cooling to 175 degrees F. Once the job begins, the asphalt paver should be in continuous motion with the least number of interruptions as possible. Both mix temperature and continuous paver operations demand an appropriate number of haul trucks with cover tarps to keep the heat in the mix.

The asphalt paver should spread the mix at the proper grade and thickness with appropriate crown with minimal need for any other finishing except compaction. The work crew is there to correct any flaws in the surface and handle joint construction. Hand working with hot-mix asphalt demands the use of an asphalt "lute," an asphalt rake. A garden rake tends to desegregate the aggregate in the mix and should not be used.

Rolling the new asphalt overlay for compaction to the proper density is both art and science. Roller operators should be trained in approved techniques. Proper joint construction and compaction, both longitudinal and transverse, is critical to long pavement life. Compaction is usually accomplished in three phases: breakdown, intermediate, and finish, each within specific temperature ranges and with the correct type of roller. Proper compaction (95 percent density) should be obtained through the breakdown and intermediate rolling. Finish rolling irons out the roller marks and smoothes the surface for good ride quality.

Traffic should be kept off the mat until the temperature cools to at least 140 degrees F. Cooling the mat by flushing with water after final rolling can be considered if needed to open intersections to traffic.

Asphalt overlays are designed to last 15 to 20 years. This life span, however, can only be reached if the overlay is correctly placed with proper materials, equipment, and procedures on a sound road or street that has been properly prepared with good drainage.

I. **Asphalt Recycling –** With the rising costs of aggregates and asphalts, not to mention environmental concerns, many municipalities are turning increasingly to recycling pavements instead of replacing them with completely new materials. Various methods of asphalt recycling are used, including on-site cold-in-place recycling and full-depth reclamation (FDR).

Cold-in-place recycling involves breaking up the existing pavement, crushing to a specified size, mixing with new bituminous, aggregates, and /or other additives to bring the mixture up to specification, and then laying it back down with proper compaction. The total operation is accomplished on-site and is typically completed in one pass of an equipment train. The process requires very little hauling, and the road is only closed for a short period. This process produces a new recycled asphalt base that requires a new surface course application.

Full-depth reclamation and pulverization consists of in-place pulverization and uniform blending of the existing roadway materials and a predetermined thickness of underlying material to create a homogenous mixture of reclaimed base material. This reclaimed base material will need a surface course to complete the project.

Full-depth reclamation, mechanical stabilization consists of incorporating imported granular material during the pulverization or mixing pass to create a homogenous mixture prior to surfacing.

Full-depth reclamation can also be accomplished using chemicals (calcium chloride, cement, lime, or fly ash) as stabilizing agents during the mixing pass. This process also needs to be surfaced to keep moisture out of the reclaimed roadway.

Another type of full-depth reclamation involves using bituminous material during the pulverization or mixing pass of a full-depth reclamation project.

Evaluating and determining which full-depth reclamation stabilization method is appropriate for a roadway is part of the project evaluation. The evaluation will consist of a roadway condition survey (grade, slope, water damage, drainage, and existing surface) followed by determining how much and what type of traffic travels on the roadway or is anticipated to use the roadway in the future. The final step involves sampling and testing the roadway asphalt materials, granular base, and subbase soils by either coring or excavation with a backhoe. A qualified lab or technical representative will then be able to determine the quantities of the recommended additives to stabilize the road. It is important to note that a combination of stabilizers could be used together for various reasons.

With cold-in-place recycling and full-depth reclamation, the entire asphalt pavement structure is recycled, thereby eliminating all existing pavement distresses, returning the pavement to the desired profile and original standards. The result is a brand new pavement at substantially less cost than the conventional total reconstruction with replacement of existing materials with all new materials.

J. **Other Maintenance Techniques –** There are various other road and street maintenance techniques in addition to those previously mentioned here. Road personnel should be aware of and have the opportunity to review and explore all techniques that could be used as part of a municipality's total road program. Each maintenance technique has its uses and advantages and can help make a road program more effective and cost efficient.

Evaluation and approval by PennDOT on other products used on local roads is contained within PennDOT Publication 447, *Approved Products for Lower Volume Roads.* Other items not previously mentioned include the following:

- Bituminous binder course CP-2
- Fast tack
- Small-diameter pipe
- PVC storm drains and basins
- Dust palliatives
- Driving surface aggregate (DSA)
- Trenchless pipe rehabilitation
- Sign post reflective panels
- Thermoplastic crosswalks
- Thermoplastic manhole protection rings

Winter Operation: One of the most important tasks in the maintenance of streets and roads is controlling snow and ice during the winter months. Winter storms can be devastating to the safety and economic well-being of your municipality. Accidents resulting in injuries and death, hampered emergency operations, traffic congestion, downed communication lines, stranded businesses — all of these shout to the importance of efficient, effective, and safe winter operations.

In addition, because your municipality has a responsibility for a safe transportation system and every responsibility carries liability, good winter planning and operations is good risk management policy.

A winter maintenance program is more than just sending out plow trucks in response to citizen complaints. An effective winter program requires planning, assigning, and delegating responsibility and authority, coordinating and communicating with other agencies and services, having equipment in working order, and training personnel.

When we talk about efficient, effective, and safe winter operations, what does it mean? It means that you know:

- the importance of a comprehensive winter plan covering all aspects of winter operations,
- all about the materials that will be used and how to use them effectively and safely,
- about all the materials available for fighting snow and ice,
- all about the kinds and types of equipment and what you need to do to perform an effective and efficient job,
- all about the operations, how and when to plow and spread materials and at what rates, and all about anti-icing operations and deicing with prewetted materials,
- the potential liability stemming from ineffective operations and ineffective or unsafe handling of chemicals and the potential of environmental problems, and
- the importance of establishing an effective public relations program and effectively using the media as part of that program.

The establishment of a comprehensive winter operations plan will address all your needs. In addition, it is important to evaluate and update these plans on a regular basis. Key elements of such a plan should include:

- Level of service
- Areas of responsibility – streets, alleys, sidewalk, parking areas, etc.
- Organizational chart
- Personnel policies
- Employee training and safety program
- Storm warning system
- Snow map indicating route priorities
- Material policies
- Equipment policies
- Operations policies
- Use of outside contractors
- Intergovernmental agreements
- Interdepartmental cooperation
- Public policies
- Public/media relations

The first key element mentioned above is determining the "level of service" for your municipality. The level of service should establish a maintenance goal after the storm. Since we can experience storms of all magnitudes and need time to fight whatever comes our way, we cannot expect to meet the goal during the storm. Often the level of service is stated in "time" after the storm (i.e., complete all plowing and spreading of materials within 12 hours after the storm ends).

The level of service must be doable and practical. It has to be based on the funding available to support the resources of personnel, equipment, and materials that need to be available. This can have large liability implications. It is better to promise the minimum and do better most of the time than to fail to meet set standards on a regular basis.

The optimum level of service is "bare pavement maintenance." This becomes optimum not only for safety but for mobility and economic stability. However, different levels of service may be adopted for different priority routes (i.e., bare pavement maintenance for major streets (arterials) with plowed and salted intersections for local streets).

The method of snow removal needs to be addressed. Plowing the streets and roads may be sufficient for most storms, but heavy snow accumulations may dictate pickup, hauling, and disposal off site. Downtown business areas, particularly with on-street parking and parking meters, become prime targets for hauling snow away. This remains, however, a costly operation in terms of dollars, time, equipment, and personnel.

Another major decision may involve parking restrictions and the establishment of emergency snow routes.

A local advisory committee can be a real advantage in helping you determine areas of service levels. You can review your level of service and the basis on which decisions were made: the amount of resources in dollars allocated to the available personnel and equipment, and materials to be used and their effectiveness.

Suggestions for committee members would be the Chamber of Commerce, the school district, AAA, business organizations, service organizations, emergency operations (police, fire, EMS, and hospitals), neighborhood groups, and the media.

The benefits of such a committee are multifold. You get a buy-in for the program. You can transmit information on all operations to the group and use them for dissemination to others. You can solicit their advice and evaluation feedback on the program.

You can decide how your program should best fit your community's needs and establish policies accordingly. Professional snowfighting requires both policy-making leadership as well as effective management. Policy alone cannot clear roads of ice and snow to make them safe. That takes adequate budget, proper equipment, and trained and committed personnel. It takes the whole team.

Bridges: Bridges are a necessary part of a transportation system. Bridges come in many types and designs, are made of a wide variety of materials, and can consist of minor to major spans across waterways, roadways, and other facilities. In addition, like all other infrastructure, bridges must be maintained.

Many of our nation's bridges are deteriorated or deteriorating due to delayed or improper maintenance. In 1988, Pennsylvania passed Act 44 in conjunction with the federal National Bridge Inspection Standards (NBIS). This act requires all bridges with spans of 20 feet or greater to be inspected and load posted as necessary every two years. Municipalities are required to have their bridges inspected under this act.

To ensure compliance, municipalities have several options. They can elect to have their bridges inspected by municipal personnel who are certified NBIS inspectors, to hire their own consultant, or to request that PennDOT do the work under a Consulting Contract Agreement. Some Pennsylvania counties have chosen to become a lead agency for inspection of all local bridges in their respective county (both for county- and municipal-owned bridges).

If a municipality fails to take the necessary steps, Act 44 authorizes PennDOT to inspect the bridges after a 60-day written notice and deduct the local share cost from the municipality's Liquid Fuels allocation.

Bridges that fall under this act should still receive routine maintenance and cleaning as needed. In addition, municipalities should not forget about or neglect any bridge under the 20-foot span. These bridges and/or large culverts can also fail, and replacement costs are usually substantial, particularly when compared to the cost of a good preventive maintenance program.

Instead of conventional bridge support technology, geosynthetic reinforced soil (GRS) integrated bridge system (IBS) technology uses alternating layers of compacted granular fill material and geotextile fabric reinforcement to provide support for a bridge. Construction time and cots are reduced to 25 to 50 percent with GRS-IBS versus conventional construction. GRS-IBS is easy to build with common equipment owned by most municipalities. GRS-IBS technology is also environmentally better since no deep foundations are needed and it can reduce the construction footprint.

Traffic-Control Devices: Another important area concerning streets and roads is traffic-control devices. Traffic-control devices include traffic signals, traffic signs, pavement markings, delineators, and all the devices for temporary traffic control.

Traffic-control devices are governed by laws and regulations stemming from the federal Manual of Uniform Traffic Control Devices and including a series of PennDOT publications promulgated under the Pennsylvania Vehicle Code.

The Pennsylvania Vehicle Code, Title 75, Chapter 61, states that local authorities may exercise powers in this chapter only by duly enacted ordinances (Section 6102) and that action can be taken only after completing an engineering and traffic investigation as required by PennDOT (Section 6109). This means that to erect any traffic sign (regulatory or warning), a municipality must conduct an engineering and traffic study in accordance with PennDOT regulations to see if the sign will meet the warrants of the study and, if so, then will adopt an ordinance for the sign. Then and only then can a municipality erect the sign.

These laws and regulations apply to all streets and roads in Pennsylvania that are open to the public for vehicular travel, whether they are state, county, or local streets and roads. A municipality should be familiar with the following significant PennDOT publications:

- Publication 46: *Traffic Engineering Manual*
- Publication 111: *Pavement Markings and Signing Standards TC-8600 and TC-8700*
- Publication 148: *Traffic Standards and Signals TC-7800 Series*
- Publication 149: *Traffic Signal Design Handbook*
- Publication 191: *Guidelines for the Maintenance of Traffic Signal Systems*
- Publication 212: *Official Traffic Control Devices – PennDOT's Supplement to FHWA's MUTCD*
- Publication 213: *Temporary Traffic Control Guidelines*
- Publication 236: *Handbook of Approved Signs*

The purpose of these publications is to secure uniformity in the design, location, and operation of all official traffic signs, signals, and markings in the commonwealth. The regulations apply to the installation, revision, removal, operation, and maintenance of all traffic signs, signals, and markings.

In addition, every traffic signal installation requires a PennDOT permit, which sets forth all conditions for equipment, timing of the signals, supplementary signing, etc., for the total installation. Any revision to the installation, whether to the physical facilities or to the timing and sequence, requires a revision to the permit and approval of PennDOT.

Publication 213, *Temporary Traffic Control Guidelines*, sets forth the basic principles and guidelines for control of traffic within construction and maintenance work areas to ensure the safe and efficient traffic movement through these work

zones and provide safety for the work crews. These regulations require a traffic-control plan, contain typical layout figures, and govern all signs (color, size, message, location, etc.), channelizing devices (cones, barricades, etc.), pavement markings, lighting devices, and flagging procedures.

These regulations apply to contractors; federal, state, county, and municipal employees; public utilities; and all others performing applicable construction, maintenance, or utility work on roads or streets.

This means that anyone working in your road or street right-of-way has to abide by these regulations. In addition, since they are in your right-of-way, you have liability and could end up in a tort liability suit if work zones are not set up properly and an accident and resulting injury or death occur.

Traffic signs and work-zone traffic control have the highest number of tort liability claims, not only in Pennsylvania but across the nation. It is essential that a municipality does everything possible in accordance with these regulations.

Other Laws and Regulations: The following list contains various other laws and regulations pertinent to maintaining roads and streets:

Pennsylvania One Call, Act 287 of 1974, as amended by Act 187 of 1996. This law protects the public health and safety by preventing excavation work from damaging underground lines. It requires anyone to notify the One Call system three working days before any excavation takes place.

The law defines "facility owner" as any person or entity who owns or operates a line. A "line" (or facility) is defined as an underground conductor, pipe, or structure used in providing electric or communication service or an underground pipe used in carrying or providing gas, oil, sewage, water, or other service. The definition includes storm sewers and traffic-signal loop detectors.

The law further requires that all facility owners be a member of One Call. A facility owner is required to mark, stake, or locate underground lines within two days of a One Call request. The facility or line has to be marked within 18 inches using the required color code (APWA/ULCC Standard).

To reach Pennsylvania One Call, dial 8-1-1 or 1-800-242-1176 or visit www.pa1call.org.

Worker and Community Right-to-Know Act, 1984. This act communicates information about chemicals to protect the health and safety of everyone. The law, administered by the Pennsylvania Department of Labor and Industry, requires that every employer, including municipalities, to: 1) post the official Employee Workplace Notice, 2) post a Hazardous Substance Survey Form (HSSF) listing all chemicals used in the workplace, 3) maintain a file of Material Safety Data Sheets for each chemical listed on the HSSF, 4) label all chemical containers properly, 5) provide annual employee training, and 6) maintain appropriate records.

Recently, the Occupational Safety and Health Administration (OSHA) published a final rule to align its Hazard Communication Standard (HCS) regulations with the Globally Harmonized System (GHS) of classification and labeling of chemicals. The primary goal of GHS is improved protection of human health and the environment by providing chemical users and handlers with enhanced and consistent information on chemical hazards.

Pennsylvania Pesticide Control Act 24, 1973. This act requires all pesticides sold in the state to be registered with the Department of Agriculture, which administers the act. The Department of Agriculture maintains a list of all restricted use pesticides and requires license and certification for applicators and records to be maintained.

Anyone applying pesticides in a municipal operation must follow the Pennsylvania Pesticide Control Act. Pesticides are substances that control, kill, or mitigate pest organisms. Pesticides include, but are not limited to, herbicides, fungicides, insecticides, and rodenticides. A person must pass two written examinations (core and category) to be eligible for certification. To maintain certification, applicators must attend updated training programs on a regular basis. Municipalities need to be aware of the Pennsylvania Pesticide Hypersensitivity Registry and contact anyone on the registry whose listed location is within 500 feet of a pesticide application site. Typically, municipal applicators are trained in the following categories:

- Right-of-way and weeds
- Public health – invertebrate pest
- Parks/school pest control
- Swimming pools
- Sewer pest control

Commercial Motor Vehicle Safety Act, Federal, 1986, and the Pennsylvania Commercial Driver Licensing Program. These regulations require anyone operating a Commercial Motor Vehicle to have a commercial driver's license (CDL). A commercial motor vehicle is any single vehicle with a Gross Vehicle Weight Rating (GVWR) of more than 26,000 pounds, or a combination of vehicles with a GVWR of more than 26,000 pounds provided the vehicle being towed is in excess of 10,000 pounds, or any size vehicle that transports hazardous materials and is required to be placarded in accordance with PennDOT regulations.

The law sets forth different license classes and defines certain endorsements and restrictions. Municipalities with any type of commercial motor vehicle should implement a CDL annual check and update program for all involved operators.

In conjunction with this law, the U.S. Congress also passed the Omnibus Transportation Employee Testing Act of 1991, which requires commercial motor vehicle drivers to be tested for alcohol and drug use. Municipalities are responsible for implementing and conducting testing programs and providing information about alcohol and drug misuse, the employer's policy, testing requirements, and information on help for abuse. Training should also be provided for supervisors on misuse symptoms and indicators and for reasonable suspicion testing.

Municipal employees are exempt from CDL regulations that require driving time limits when performing the following functions: roadway maintenance, snow-plowing operations, and traffic-control support operations.

In addition, municipal employees are still exempt from CDL regulations that require possession of a current medical card.

Other recent changes require municipal employers to maintain daily and historical records for every vehicle they operate on public roads that has a gross vehicle weight rating or operating weight of more than 17,000 pounds.

Facilities Management

In any analysis of the management of property, budgeting should be a prime consideration. Unfortunately, it is often overlooked. The two major components of ongoing costs for the operation of any facility include maintenance and energy costs. Facility maintenance costs can include labor, fringe benefits, maintenance supplies, expendables, water (potable water and sewage costs), and all contract maintenance costs. Energy costs can include electricity, natural gas, gasoline, oil, steam, and propane. In some operations, additional exotic forms of energy may be employed. For example, one northeastern Pennsylvania community (Kingston in Luzerne County) uses a mine water heat exchange system to heat and cool its recreation facility.

As a general guide, 5 percent of the value of a property should represent its annual maintenance budget. Another measure often used is setting aside 10 percent of the revenue associated with a facility for maintenance. Obviously, these numbers vary from operation to operation and may be less than applicable for certain municipal operations, but some reasonable guideline should be established. Without guidelines, maintenance budgets over a period of time remain unchanged while all other revenue and property conditions change. Additionally, failure to adequately budget for facility maintenance can result in ineffective preventive maintenance and larger future repair costs.

Organizationally, the budget permits managers to track actual costs with proposed budgeted costs on a category-by-category basis and a year-to-year basis. This provides information to evaluate the effectiveness of the budget process, identify problem areas, and analyze performance. One significant uncontrollable variable remains — unexpected building repair. Any budget forecast must include some consideration of this variable since it does have an impact on budgetary reliability.

The actual operation of facilities must include knowledge of electrical systems; heating, ventilation, and air conditioning (HVAC); lighting systems; water systems; telecommunication systems; and security and safety systems. While extensive technical knowledge of these systems is not necessary, some basic background can be helpful to the manager.

The electrical system consists of a source of electricity, a distribution system, and control devices connected to various pieces of equipment. The electrical utility supplies a facility with a specified voltage, the proper number of phases, and the capacity to deliver a rated amount of current at a given frequency. After the electricity is metered, a distribution system within the building, which is typically the sole responsibility of the owner, distributes it throughout the facility. If the voltage supplied by the utility is not appropriate for all uses within the facility, the system will include transformers to step up or step down the voltage. The system and equipment within the facility is clearly the responsibility of the facility manager. The manager should possess a current set of electrical plans, have trained personnel or contractors to maintain it, have written maintenance procedures including procedures for preventative maintenance, and have an understanding of all related safety and code book issues – typically, the National Electrical Code, which is recognized by the courts, municipalities, various code organizations, and insurance companies.

While there are many types of HVAC systems, the underlying manner in which they operate are similar. In any case, they come in two general categories: centralized or decentralized. In determining which type of system is most appropriate, factors that the facility manager should consider are room air temperature, room air movement, relative humidity of room air, activity level in the room, type of activity in the room, clothing worn by room occupants, and temperature of room surfaces. Additional considerations affecting comfort include noise, odor, general quality of the air, and the impact of molds, spores, and airborne particles. The bottom line is that facility managers need to be highly concerned with the quality of ventilation being supplied. Too little results in an excess of unacceptable contaminates in the system, and too much results in excessive use of energy.

Advances in technology and HVAC allow systems to be “turned back” during non-use times (evening and weekends) to reduce energy costs.

Lighting of a facility is another area of concern for the facility manager. The use of natural light can significantly decrease energy costs. However, where natural light is impractical or unavailable, effective use of artificial light sources can control energy costs, ensure safety, and meet the needs of the users. Managers should recognize that while incandescent lighting is common, the equipment has a short life span and is relatively inefficient when compared to electric discharge lamps. These lamps, including fluorescent, mercury vapor, metal halide, and low- and high-pressure sodium, generate light by passing a spark through a space filled with a mixture of gases. These lights require ballasts or transformers as part of the system to make them operate. In making decisions regarding the most appropriate type of lighting, consider the following: First, the correct light source must be applied to the proposed use. Second, the proper light level should be provided for the activity. Finally, a planned lighting maintenance program should be developed to ensure the proper functioning of the system.

As incandescent lighting is being phased out, more municipalities are turning to the use of compact fluorescent lamp (CFL) and light emitting diode (LED) bulbs as replacements.

Another obvious utility are water systems, including potable water, wastewater, storm sewer water, hot water and firefighting water. All of these systems require periodic maintenance but are generally not a major consumer of maintenance time and money.

Electronic systems that require the building manager's attention include telecommunication systems and security and safety systems. Most facilities are serviced by Private Branch Exchange (PBX) systems supplied by telephone companies. The facility manager should assure that all telephone equipment is installed in appropriate areas where it will not be easily damaged yet is accessible for repair work. Other electronic or related equipment include fire protection, fire detection, fire notification, fire suppression, and fire-control systems. These types of equipment are essential safety related and need to be properly maintained to ensure the safety and security of the facility and its occupants.

Facility managers are often requested to provide input into capital projects. They are additionally asked to solicit bids for capital projects from various vendors, to assist in writing the specifications, to review the bids, and to make recommendations.

The facility manager of any significant property has a challenging job. It is highly important for the manager to coordinate all activity and all maintenance considerations in a manner to benefit the ongoing operations within the facility. The manager must be aware and sensitive to the loss of income or service responsiveness that may occur during failures of any system in the building. Additionally, the manager must be aware and seek the goodwill of all building employees and operations managers. Energy management is a significant concern for facility managers. Managers should ensure that normal operating procedures promote effective energy conservation and investigate methods to make the facility more energy efficient. While that could take many forms, the primary way to save energy is in the electrical area. New lighting technology and the control of air conditioning costs are fruitful areas of energy savings.

Vehicle Fleet Maintenance

The responsibility for maintenance of the municipality's fleet of vehicles should reside within the public works department. Depending on the size of the fleet, a single person within the department should be delegated with the responsibility to oversee vehicle maintenance. Because municipal fleets vary significantly in size, different methods of overseeing this operation should be considered, depending on the size of the fleet:

- **Small fleets (fewer than 25 vehicles):** Generally, the most effective way of dealing with a small fleet is to contract with local garages to perform the work. However, it is still important to have a designated person oversee the work to make sure it is done properly and at a reasonable cost.
- **Medium-size fleet (25 to 100 vehicles):** This size fleet allows a municipality to consider having a full-time staff to perform fleet maintenance functions. However, some specialty work, such as body work, major accident repairs, fire equipment, and construction equipment, could be accomplished by local garages or specialized equipment repairers.
- **Large fleets (more than 100 vehicles):** Most municipalities with fleets this large have full-time service staffs to provide fleet maintenance services. Some municipalities, however, have opted to privatize or outsource this service.

Regardless of the maintenance methodology employed, the municipality should adopt policies and procedures requiring employees to monitor equipment condition and perform routine equipment servicing. Aggressive preventive maintenance can considerably reduce municipal fleet maintenance costs.

Each driver of a vehicle weighing more than 17,000 pounds is required to perform a daily vehicle inspection during that shift or day. It is beneficial in smaller fleets to assign each employee to a certain vehicle(s) to ensure responsibility of equipment and equipment maintenance. Each employee should be responsible to keep his or her equipment clean, greased, and fluid levels full on a regular (monthly) basis.

Capital budgeting should include a projected vehicle replacement schedule, such as a 15-fiscal year replacement program. The vehicle replacement schedule should include a detailed listing of the age and condition of all equipment. A planned approach to vehicle replacement ensures an efficient vehicle fleet that accomplishes the public works mission at minimum cost.

Stormwater Management

Municipalities are required to control development to manage stormwater and prevent flooding. Municipalities are also authorized by the various municipal codes to install drainage structures and sewers to control stormwater. Stormwater management and flood control are related activities that demand careful management. Increasing regulation and costs present a challenge to municipalities that have limited resources to address them.

Although Pennsylvania is infamous for flooding, the municipal codes have no specific provision for stormwater or flood-control fees. Municipalities must fund construction, operation, and maintenance of stormwater systems with general funds or in some cases with Liquid Fuels Funds. Developers may be required to install new facilities. The City of Sunbury Municipal Authority, in conjunction with the city, has successfully imposed a flood-control fee. It is imposed as a flat fee graduated at three levels against residential, commercial, and industrial properties.

The Pennsylvania Stormwater Management Act requires counties and municipalities to control runoff associated with new development through the institution and enforcement of stormwater regulations. The Stormwater Management Act requires each county to prepare and adopt a plan for each watershed in consultation with the municipalities in the watershed. Municipalities are then required to adopt the county plan with any appropriate amendments and implement ordinances and regulations as necessary. Generally, developers must control runoff so that the calculated post-development runoff does not exceed the peak rates before development. Control is generally achieved through non-structural and structural means. Non-structural controls would include adoption of regulations through various ordinances, such as zoning, subdivision, and land development. Structural controls include the installation of various structures and facilities that provide storage and delay drainage to surface waters or divert storm drainage into the ground. Municipalities must also provide a means for continual maintenance of facilities by either the municipality or property owners.

Municipalities are also subject to erosion- and sediment-control regulations of the Pennsylvania Department of Environmental Protection (DEP). The County Conservation District usually handles these regulations with the required plans and permits. Municipalities should ensure that all construction and development meet these regulations or their own adopted regulations based on the state regulations.

The Pennsylvania Municipalities Planning Code and the Pennsylvania Flood Plain Management Act require municipal control of development within special flood hazard areas that generally are below the 100-year flood elevation. Development in these areas is restricted to provide public safety and to not adversely affect the capacity of the channels or floodways. Generally, controls are provided through the zoning ordinance.

Municipal stormwater facilities have become subject to the U.S. Environmental Protection Agency NPDES (National Pollution Discharge Elimination System) program. The NPDES stormwater management regulations were adopted to reduce the discharge of pollutants from a regulated storm sewer system to the maximum extent practicable to protect water quality and satisfy the appropriate water quality requirements of the federal Clean Water Act. Phase I regulations of this program aimed at permitting Municipal Separate Storm Sewer Systems (MS4s) serving a population in excess of 100,000. Only Allentown and Philadelphia were required to obtain permits under Phase I.

NPDES Stormwater Management Phase II was signed into law in October 1999 and set a timetable for permit application and implementation. Phase II redefined the extent of control. Under Phase II, many small Pennsylvania municipalities operating stormwater systems in urbanized areas were required to submit applications and acquire the necessary permit by March 2003. An urbanized area is defined as a central place (core) and the densely surrounding territory (fringe) with a minimum population of 50,000 people and a minimum average density of 1,000 people per square mile. The NPDES permits require the implementation of best management practices (BMPs) to protect water quality. The following six basic elements must be addressed and included in the plan:

1. **Public education –** To inform individuals and households about ways to reduce stormwater pollution.
2. **Public involvement –** To involve the public in the development, implementation, and review of an MS4's stormwater management program.

3. **Illicit discharge detection and elimination –** To identify and eliminate illicit discharges and spills to storm drain systems.
4. **Construction –** To address stormwater runoff while construction activities are completed.
5. **Post-construction –** To address stormwater runoff after construction activities have completed.
6. **Pollution prevention/good housekeeping –** To address stormwater runoff from their own facilities and activities.

A good resource is *The Pennsylvania Stormwater Best Management Practices Manual* (December 2006), which presents planning concepts for stormwater management and conservation design along with detailed information on many BMPs.

Until the institution of the NPDES program for stormwater systems, DEP permits were not required for storm sewers, except where they encroached upon streams or wetlands under the Dam Safety and Encroachment Act.

Beyond the regulatory requirements to control runoff from development and building in flood plains and obtaining an NPDES permit to protect water quality, municipalities should plan to provide stormwater management and flood-control facilities to provide drainage of streets and public areas to protect public and private properties. Defined goals and objectives will lead to the development of projects based on a reasoned approach, whereby the public cost is exceeded by the reduction of losses from flooding.

The science of stormwater management is well developed, but its principles may be ignored in the face of demands for protection after flood losses have been suffered. Projects may be built that will not provide a reasonable return. The principles may also be ignored after memories of losses have faded. The public and municipalities then fail to support cost-effective projects until new losses are obtained.

Municipalities should consider stormwater in their comprehensive plans and provide a rational basis for the installation of new facilities. Municipalities should also develop procedures for the operation and maintenance of facilities. The new NPDES regulations require the development of training programs and operational procedures for many municipalities operating stormwater systems. Municipalities that are not covered should consider implementation of similar procedures.

Municipalities need to be prepared for an EPA audit. Evaluations of MS4 programs are being conducted to determine permittee compliance with the NPDES permit requirements and to evaluate satisfactory implementation of the storm water regulations.

Municipalities may obtain information, guidance, and assistance on stormwater management from the U.S. Environmental Protection Agency (EPA) and DEP Bureau of Water Quality Protection and from such associations as the American Society of Civil Engineers and the American Public Works Association.

Solid Waste and Recycling

Many municipalities do not directly collect and dispose of trash and recycling material. They generally mandate by local ordinance the removal of solid waste. Indeed, the trend in this area is to move away from municipal collection to a privatized service. Generally speaking, as a municipality's population exceeds 20,000, contracting for this service becomes more efficient. Additionally, many smaller and rural communities, particularly townships, historically leave this responsibility to the property owner.

If the municipality is engaged in the collection and disposal of these materials, then the function should be delegated to the public works department. Issues of particular concern include the capital budgeting for solid waste removal equipment, the staffing of the function, and the solid waste removal schedule. Equipment for this purpose is greatly subject to wear and tear, and municipalities typically face the highest equipment replacement costs (with the exception

of fire equipment) for waste collection. Removal schedules and personnel use are also critical issues since the largest single expense faced by any municipality is total personnel costs. Carefully managing the removal schedule and the manning of removal equipment can significantly reduce the total cost of operating the function.

Even when a municipality contracts for this service, the responsibility for administering the contract should be delegated to a responsible individual with the public works department. This individual should prepare specifications for bidding, administer the contract after it is awarded, and respond to citizen complaints regarding the service. Additionally, this individual should ensure that the contractor(s) conform to the requirements of the county's solid waste plan.

Pennsylvania counties have the responsibility to dispose of solid wastes generated in their county. Act 101 of 1988, along with other provisions, charges counties with preparing, implementing, and operating a plan for its disposal. Municipalities of the county have a part in developing and ratifying the county plan. If you are not familiar with your county's plan, become knowledgeable about its contents.

Act 101 also requires municipalities with populations of more than 5,000 to implement recycling programs and provides grant money to assist. The reduction of solid waste is very important to protect and preserve the earth's environment. But, in almost all instances, this reduction will not be financially self-sufficient and should not be entered into with that in mind. Grants for these programs have been well received, and demand for them is increasing; therefore, the criteria to receive grants are evolving. Your county can assist you in learning more about recycling and grant money.

Several larger municipalities that have previously collected leaf material in the fall months now find themselves operating yard waste facilities or regional transfer sites to deal with leaf and yard waste recycling. Some locations are even operating year-round and offering electronic recycling at their facilities, too.

If a municipality does not have the internal resources or expertise to prepare the specifications for solid waste management, then a consultant well versed in solid waste issues should be hired to prepare the specifications, coordinate the bidding, and contract award activities.

Planning Zoning and Code Enforcement

Many communities, particularly smaller ones, often place land planning, zoning, and code enforcement responsibilities on the public works department. The public works function has an interest in land use and building construction and condition by virtue of its responsibility for the public facilities of the community after they are built. As a municipality grows, the land planning function and code programs often expand as rapidly as the utility function, and the social issues of planning, zoning, safety, and utility growth along with the increased staff needs create the potential for each to have a separate focus. Whether or not they become separate departments with the same or separate leaders is not as important as is the need to coordinate programmed growth through joint participation. What is best for your community is up to the elected officials to decide.

Some municipalities use their zoning maps and comprehensive plans as a tool to determine priorities for winter maintenance operations or deciding which roads to maintain or widen.

Miscellaneous Public Works Functions

Some communities have extraordinary and/or unique facilities that do not fall under "normal" public works categories. In most cases, maintenance of the facility is similar to other public works infrastructure and, therefore, should be assigned to the public works department. A good example would be a small, general facility airport. Maintenance of such a facility includes the maintenance of paved or concrete runways, clearing and repairing storm drains, and snow plowing – all functions normally provided by a street department. For a small airport, it is generally not necessary to create a separate bureau with a municipal staff. Most of the functions can be spread out through the existing organization.

Water and sewer utilities are highly common and dealt with separately in this manual, but some municipalities operate gas or electrical distribution utilities. Gas or electric utilities are quite different as they are operationally intensive and require a full operational and administrative staff. These utilities can be assigned to the public works department or, as is the case in many municipalities, operated by municipal authorities. One of the primary differences between gas and electric utilities and water and sewer is regulation by the Pennsylvania Public Utilities Commission (PUC). Electric and gas are heavily regulated by the PUC, whereas water and sewer utilities are generally not regulated by this state body. *(Note: There are exceptions, particularly water or sewer operations owned by public utilities.)*

The extent of unique functions delegated to public works departments in Pennsylvania, as gleaned from random sampling, is quite extensive. Following is a list of extraordinary functions that fall under the jurisdiction of at least one public works department in Pennsylvania:

- Airport
- Asphalt plant
- Building inspection
- Canals and locks
- Cemetery
- Code enforcement
- Dam
- Dog catcher
- Electric utility
- Farmer's market
- Flood-control pumping system
- Forested watershed
- Gas utility
- Golf course
- Marina
- Minor league baseball team
- Planning
- Recycling drop-off centers
- Shade trees
- Swimming pool
- Zoning
- Zoo

V. Risk Management

Risk management can be defined as the process of protecting assets from loss. Risk management works best when it is a fundamental, integral part of ongoing operations, ingrained in what managers do day in and day out. Risk management has been called "structured common sense," implying correctly that it is not a complicated process. It does require managers to be aware of possible loss exposures as they perform their duties and to be trained on how to address those exposures. This chapter is designed to help you accomplish these tasks.

At the outset, try to imagine how you would perform your responsibilities differently if you could not rely upon insurance. Many of you may already be conducting yourselves in a highly professional manner. However, by applying a heightened level of concern and attention that comes from an imaginary world of no insurance, you may discover a new focus to aggressively manage risk. By following the risk management process and applying certain techniques as outlined in this chapter, you can successfully reduce the number of accidents and lower costs.

Scientific Problem-Solving Model to Protect Assets

- Identifying assets subject to potential loss.
- Analyzing risk exposures.
- Examining alternative techniques for dealing with the exposure.
- Selecting the most promising technique.
- Implementing the selected technique.
- Monitoring the results to see if the exposure has been dealt with effectively.

Identifying Assets and Loss Exposures: How would you first begin to identify assets subject to loss of your public works department? Risk managers use many tools to identify assets and how those assets are exposed to potential loss. Examples of these identification tools include:

- General observations
- Personal inspections and site visits
- Claim forms and accident reports
- Checklists
- Inventory
- Surveys and questionnaires
- Financial records and budget information
- Records, files, and archives
- Complaint forms from citizens
- Minutes of board meetings
- Interviews
- Experts

There are five main categories of risk exposures for public entities:

- Physical property
- Loss of income
- Contingent expenses
- Human resources
- Legal liability

All of these assets can be exposed to perils that may result in total or partial loss. The art of risk management is to make sure all assets have been identified and then to find ways to counteract identifiable perils. Perils include acts of nature, human acts, property losses, indirect exposures, and third-party liabilities.

As an example, your major facility may be the public works garage. What could happen to it? It could be subject to loss because it is a building: property losses from collapse, corrosion, explosion, fire, obsolescence, and failure of environmental controls (heat or air conditioning). It could be subject to loss because of acts of nature: land movement (earthquake, erosion, or landslide), water damage (flood, sewer backups, or sprinkler system), windstorm (tornado, hurricane), lightning, or falling objects. The building may also be subject to loss caused by human acts (vandalism, arson, civil disorder, accidents). A contractor could slip on grease in one of the bays and sue to recover for his or her injuries (liability).

The final peril — loss of income and additional expenses or expediting expenses — is often overlooked. You may rely on water revenue receipts to pay capital costs financed through bonded debt. Perhaps revenue from swimming pool receipts is essential to keeping the facility open. What would happen if the revenue stream were interrupted? How long could you continue to operate? These indirect exposures typically have a time element associated with the loss. The exposure is measured in how long you could operate without an asset, what additional expenses would you need to continue operating in at least a limited manner, and what expenses would you need to expedite a fast return to normal operations.

Your workforce as an important asset is subject to a number of exposures, including injuries both on and off the job, physical and mental illnesses, and death. Employees can decide not to show up for work, or they could find other employment. Studies have shown that good personnel management does make a difference in loss experience. One study looked at pairs of companies, similar in work force size, geographical sector, and industrial operation, but dissimilar only in that one pair had half as many workplace injuries as its counterpart. The study found eight reasons for the substantially lower loss rates:

- Greater management concern and involvement in safety matters.
- More open, informal communications between workers and management.
- Tidier work areas, better ventilation, better lighting, and less noise.
- Workforce comprised of older, married workers, with longer service and less absenteeism and less turnover.
- More understanding of the use and effectiveness of measures other than suspensions and dismissals when safety rules were violated. More of an emphasis on coaching and counseling.
- Greater availability of recreational facilities for workers during off-hours.
- Greater efforts to involve workers' families in safety campaigns and awareness, both on and off the job.
- Well-defined selection, placement, and job advancement procedures with opportunities for training and developing new skills.

How are your department's financial assets subject to potential loss? You can lose financial assets through human acts (employee dishonesty, burglary, fraud). Today, litigation through third-party actions is a major concern of public officials (allegations of negligence, products liability, personal injury, contractual liability, auto liability, property of others in your care custody and control).

Analyzing Risk Exposures: After identifying assets and how these assets are exposed to loss, you can now begin to analyze the risks. The Perils and Exposures Survey form, found in ***Appendix I,*** has a series of columns asking you to evaluate the degree of expected loss frequency and expected loss severity. This is a worthwhile exercise to help you identify appropriate risk-control and risk-financing techniques. Frequency is how often an event is likely to occur, and severity is the level of hardship created by the loss. Grids with high and low frequency on one axis and high and low severity on the other axis can help pinpoint problem areas using both measures. A risk manager will apply much different risk-control and risk-financing techniques to a high-frequency/low-severity risk than to a low-frequency/high-severity risk.

Examples of high-frequency/low-severity risk are minor auto accidents or medical-only workers' compensation claims. Financially, these types of claims are both affordable and fairly predictable. Low-frequency/high-severity claims, however, are intermittent and costly.

Examining Alternative Techniques: The next step in the risk management process is to examine alternative techniques for addressing the exposures. As mentioned, the two primary techniques are **risk-control** and **risk-financing techniques**.

The primary **risk-control** measures are:

- Avoidance
- Prevention
- Reduction
- Separation
- Duplication
- Contractual risk transfer

Avoidance is the most effective risk-control measure. If the elected officials decide not to offer municipal police services, in effect they have avoided the risks associated with operating a police department. These exposures include third-party liability claims resulting from allegations of false arrest or abuse of force and worker's compensation costs associated with a high-cost payroll classification, among others. Deciding whether or not to set up a water utility or to offer refuse collection services or to build a skateboard park are other examples. Corresponding considerations include the claims resulting from failure to supply or the effectiveness of the water treatment, the higher frequency and severity of workers' compensation costs for refuse workers, and the likelihood of injury from a youth-oriented sport.

Some argue that this is not true risk avoidance since other agencies or businesses will need to offer the public safety, public health, or recreational services if you do not. They argue that it is actually a non-contractual risk transfer to another organization. In any event, the important concept is that avoidance of risk for your organization is a very effective method of controlling risk.

The next most effective technique is ***prevention***. If the policy makers decide to offer a municipal refuse collection service, avoidance is no longer an available risk-control option. A viable alternative, however, is preventing a loss from occurring. Refuse workers can be trained on how to lift properly and how to stay in good physical condition to avoid back injuries. Training programs on how to safely operate the vehicle in and out of traffic, how to safely work around traffic, how to travel on the back of the packer, and even how to deal with irate citizens to avoid a liability claim may help prevent losses. Maintaining the equipment properly to prevent a malfunction that may lead to downtime, extensive damage, and injuries to workers and others is also an effective preventive measure.

If it is impossible to avoid the exposure and if the preventive measures fail, the next approach focuses on containing the effect of a loss. ***Reduction*** addresses the severity of the loss. Seatbelts are a loss-reduction device. Although seatbelts do nothing to prevent the accident itself, once an accident occurs, they are very effective at lessening the injuries to the driver and passengers. A sprinkler system is another example of a risk-control measure. Personal protective equipment such as gloves, safety shoes, eye protection, hard hats, and back braces are loss-reduction measures.

Managers must guard against becoming too complacent about the effectiveness of personal protective equipment. It is easy to overlook the injuries that did not occur because of luck or good fortune ("near misses"). Part of first-line management's responsibility is to be aware of when preventive and reduction measures work. Remind workers and top management of instances when the hardhat absorbed the shock of a falling object, the safety shoe protected the foot from a "struck against" injury, worn-out gloves protected hands from sharp objects, or the reflective safety vest allowed motorists to see a highway worker.

Risk control does not stop with an accident. Training on how to conduct oneself at the scene of a vehicle accident, how to report an accident and how to care for those who are injured can help keep a small accident from becoming a large loss. Consider taking photographs after the accident to record how the scene looked at the time. Photos are worth a thousand words. Post-accident work is an essential loss reduction technique.

Another risk-control device that may have implications in selected circumstances is ***separation***. Divided highways and keeping flammable materials away from sources of ignition are two very different examples of applying separation to control risk. Similarly, ***duplication*** may help prevent a loss or reduce its impact. A backup of computer files is good example of duplication. Performing and storing backup offsite is an example of using both duplication and separation to control risk. The files are duplicated with the backup, and, as further protection, the files are separated from the computer site in case the building housing the computer suffers a loss.

Finally, ***contractual risk transfer*** is a technique that is involved and requires expert legal help. The intent is to transfer your operations to another organization and to specify that the other organization is to manage the operation as if it were the owner. For example, a municipality may own a small airport but may not wish to obtain the expertise or staff needed to operate the airport. The municipality may opt to contract with a fixed base operator to manage the airport and assume all of the aviation risks of the owner. This technique should not be confused with financial risk transfer, which will be addressed later in this publication.

Besides testing for significance using frequency and severity, a risk manager also will apply the objectives of the organization in choosing appropriate risk-control and risk-financing techniques. The organization may decide that under no circumstances is the public works garage ever to be out-of-service. A strong organizational objective like this heavily impacts on the risk management operation. To meet this forceful of an objective, management will need to consider a number of factors including 24-hour security, liquidity of emergency funds, computer backups and hardware support, dedicated telephone lines, power generators, time element insurance coverage, emergency lighting, building construction materials, and on-site fire suppression systems, among others.

Besides risk control, the risk manager must also apply one or more **risk-financing techniques**. The primary risk-financing measures are:

- Insurance
- Financial risk transfer
- Risk retention
- Risk sharing

Insurance is the most widely used risk-financing technique for small- to medium-sized public entities. Insurance is a contract between your municipality and an insurer, whereby the insurer agrees to indemnify the municipality in the event of a loss, subject to the terms, conditions, and limitations of the contract, in exchange for payment of the premium. A typical insurance policy requires the insured to report claims in a timely fashion and to cooperate fully with the insurer during its investigation of the claims. For third-party liability claims, the insurer has the authority to decide whether or not to settle with the claimant or to defend the allegations in court.

Someone is assigned the responsibility of administering the insurance program in your organization. A typical municipal insurance package includes the following policies:

- **General liability –** Provides legal defense and indemnification for claims filed by third parties alleging bodily injury or property damage caused by the negligent condition of the premises, operations, or products of your organization.
- **Automobile liability –** Provides legal defense and indemnification for the negligent use of a motor vehicle.
- **Automobile physical damage –** Provides collision and comprehensive coverage for damage to automobiles owned by your organization.

- **Public officials' liability –** Provides coverage for damages (other than property damage and bodily injury) caused by the wrongful acts of public officials acting within the scope of their official duties. This form also typically provides coverage for employment practices liability.
- **Police professional liability –** Provides liability coverage for the professional exposures associated with providing law enforcement services.
- **Property/boiler and machinery –** Provides coverage for first-party real and personal property losses.
- **Workers' compensation –** Provides no-fault coverage for employees injured within the scope of their employment. Benefits include payment of medical costs and lost wages. Also covers work-related diseases.
- **Crime –** Provides coverage for the organization's money and securities lost because of criminal activity or lack of fidelity on the job.

It is not necessary for the public works professional to become well versed in the inner workings of a complex insurance program, but some familiarity is helpful. More importantly, how the municipal assets are managed under your control will have a direct bearing on losses paid by the insurer and ultimately on the premium paid by the public entity. You may be responsible for maintaining sidewalks around public facilities. Poor condition of the sidewalk or snow and ice build-up could lead to a slip, trip, or fall claim filed with the general liability insurer. If the insurer pays a claimant, the loss is charged to the municipality's loss experience, which may result in higher premiums upon renewal.

Financial risk transfer requires another party in a contract to assume and finance your risk under the contract. This is handled by adding a hold harmless clause to the contract (see ***Appendix II***), by specifying what type and how much insurance the other party needs, and by requiring your public entity to be named as an additional insured to their policy. If you decide to hire a contractor to repave a street, you do not want to be in a position of defending and paying liability claims emanating from the repaving work simply because you own the street. The contractor should agree to insulate you from claims resulting from their work by agreeing to defend and indemnify you in the event of a claim. Agreeing to assume this risk is not enough. The contractor must show proof of financial responsibility to support the hold-harmless clause. The contractor's agent will issue a certificate of insurance showing proof of coverage. The certificate should show your public entity named as an additional insured to fully protect your interests.

Insurance is not the only way to finance risk. In fact, although the most effective in many circumstances, it is generally regarded to be the most expensive risk-financing alternative. A municipality may choose to retain risk. The term self-insurance is commonly used interchangeably with risk retention, even though the term is somewhat of a misnomer. It is always the public entity's risk unless it chooses to transfer the risk to another party like an insurer. Since insurance refers to a method of transferring risk, self-insurance improperly implies a transfer of risk to oneself.

The term self-insurance does help to distinguish a proactive risk management approach from non-insurance or uninsured. The term non- or uninsured infers that a risk was overlooked and unbudgeted and thus requires the municipality to pay for a loss out of fund balances without the opportunity to plan for the expense. ***Risk retention***, self-funding, and self-insurance all imply a concerted effort to prefund losses using a dedicated risk management fund or account. The risk is evaluated using the frequency/severity grid, and a conscious decision is made to retain the risk and prefund for expected losses. Risk retention is a viable risk-financing alternative for larger municipalities.

Besides appropriations, there are other ways to self-fund risk. Municipalities typically do not buy property insurance to cover infrastructure. The pricing is usually prohibitive, and the exposure to loss is different from most buildings, upon which property insurance premiums are typically based. More specifically, water lines rarely catch fire yet property insurance premiums are priced to consider fire as a major exposure to loss. The risk-financing techniques typically applied to underground infrastructure are capital planning and financing using a variety of funding sources, which are a viable method of risk retention. This further illustrates the importance of following the risk management process. Although insurance will continue to be the primary risk-financing technique applied by municipalities, other methods are at times not only more cost effective, but also better.

Deductibles are a type of self-funding, although technically the risk has been transferred to the insurer. Since it is expensive for insurers to process and pay small claims, they will offer premium discounts to insurers who are willing to assume smaller losses. For some coverage lines, insurers insist on deductibles because of the uncertain nature of the risk. The special municipal lines of Police Professional and Public Officials Liability usually are written with deductibles of a few thousand dollars.

Finally, to complete the discussion on risk financing, hybrids, bridging the gap between self-funding and risk transfer, are now available. Some municipalities have joined to form ***risk-sharing*** pools through state associations and intergovernmental agreements. Pools offer the advantages of risk retention to small- and medium-sized public entities. The municipal member transfers the risk to the pool and simultaneously becomes a part owner and trustee of the pool and its operations. A number of municipal liability and workers' compensation pools are operating in Pennsylvania today.

The advantages to retaining risk, either collectively through pools or by self-funding, are:

- The municipality saves the costs of insurance company overhead, profit, and taxes that are part of the premium charged by insurers.
- The pool, not the insurer, keeps the investment income.
- Control of the disposition of claims and lawsuits is maintained.
- An incentive for adopting aggressive loss-control measures is instilled.

The disadvantages are:

- Funding integrity for reserves and other liabilities must be guaranteed.
- Pools are assessable, and if additional money is needed to stay solvent, each member must pay its fair share.
- There is a lack of regulatory oversight.

Looking at the frequency/severity grid, the low-frequency/high-severity claims are best suited for insurance. Some method of retention can be carefully applied to the two quadrants above the center line. High-frequency/high-severity claims are usually indicative of larger social problems, such as pollution and medical malpractice claims of several decades ago. These exposures require solutions that are more complex.

Selecting, Implementing, and Monitoring: The next steps in the risk management process require little in the way of explanation. An example will suffice. Just to recap, the remaining steps are:

- Select a technique
- Implement the technique
- Monitor the results

To illustrate, let us tackle the exposure created by leasing equipment for highway construction. Your municipality will be assuming the risk though a contract. As explained, risk managers apply at least one risk-financing technique and one risk-control technique to handle an exposure, sometimes more. In this case, the risk-financing technique will be insurance. Make sure the insurance agent adds this rented equipment to your vehicle inventory for the period of time of use. In fact, the vehicle's owner will insist on seeing proof of coverage through a certificate of insurance issued by your agent and being named as an additional insured to your policy. The owner wants to make sure that his or her liability, as the owner of the equipment, will be covered by the municipality's insurer. An applied risk-control technique would be making sure you have a qualified operator of the equipment and that the equipment will be used only for its intended purpose. You may want to arrange for special controls to protect it after hours.

After the leased vehicle is returned, you will want to take the time to evaluate if the risk-financing and risk-control techniques worked well. Perhaps, next time, you may decide to do more to control the public at the construction site

because of some "close calls." Or, you might make a note to train a backup operator in case your equipment operator becomes ill during the term of the lease. Generally, there are always fine-tuning steps you can take to lessen the likelihood of loss.

For the departmental risk management program, it is a good idea to establish performance standards. Results standards are measurable results, such as a certain number of fewer vehicle accidents after initiating new safety measures. Activity standards measure the activities for reaching a desired goal, such as the number of inspections conducted at the playground by parks maintenance staff. As your loss exposures change, your methods need to change as well.

Liability Exposures

The evolving field of legal liability is a good example of the need to continue the risk identification process. The changing attitudes of the public regarding litigation as the preferred method of resolving disputes has resulted in the filing of complaints against public entities. This was uncommon several years ago. Ongoing training in case law is a good way to stay on top of changing case law. Your municipality's insurer may be able to arrange for training of this type of exposure.

Before the mid-1970s in Pennsylvania, municipalities and their agents enjoyed sovereign immunity, an English common-law term meaning the "king can do no wrong." In effect, no matter how negligent a municipality was in performance of its duties, claimants had no recourse for recovery. The Pennsylvania Supreme Court overturned this concept in 1973 with *Ayala v Philadelphia Board of Education*. After this, ruling municipalities and municipal corporations were held responsible for their acts under the same legal standing as corporations and individuals.

In response to a plea from local government, the Pennsylvania General Assembly passed the Pennsylvania Political Subdivisions Tort Claims (Governmental Immunity) Act in 1978. The Tort Claims Act reestablished the concept of governmental immunity except for eight areas, or exceptions to immunity, where a municipality could be held liable. These eight exceptions to immunity are:

- Streets
- Sidewalks (secondarily liable after the property owner)
- Care, custody, or control of animals
- Motor vehicle liability
- Trees, traffic controls, and street lighting
- Utility service facilities
- Real property
- Care, custody, and control of personal property

A fair number of the exceptions impact directly on the public works department. Because of negligent acts of the public works department, a municipality could be held liable. If a pothole is not promptly filled once it has been reported to you, your municipality or its insurer may have to pay for damages to a motorist's car. Note that you have to be aware of the defect in the roadway. If you are unaware of the defect, you cannot be expected to repair the pothole. However, the act goes on further to say not only are you responsible for known defects, but also for defects about which you "should have known." If your highway supervisor drives to work every day over the road with the pothole, it is not an adequate defense to say you were unaware of the defect simply because it was not reported by a motorist.

The act also limits the municipality's financial obligation to any uninsured portion of the loss. In the pothole example, the motorist is required to report the loss to his or her personal auto insurer. If the municipality were found to be liable, the municipality's general liability insurer would reimburse the motorist for his or her deductible only. The motorist's own auto insurer would pay for any loss above the deductible.

The above example is a relatively simple case. Circumstances would be different if the motorist was seriously injured. Plaintiffs with serious injuries can seek recovery for pain and suffering and other damages if certain medical cost thresholds are reached. The important thing to remember is to quickly respond to problems and known defects quickly and to document when you became aware of any defect. A good complaint intake and tracking system can help tremendously in defending cases with little or no merit. Defense counsel assigned to defend the public entity in litigation greatly appreciates records, timelines, and particularly photographs.

Recent Pennsylvania court decisions hold municipalities responsible for notifying PennDOT of traffic-control problems where state highways and municipal roadways intersect. If you know of an intersection where numerous accidents have occurred and an upgrade in traffic control may be justified (e.g., upgrading from two- to four-way stop, adding a traffic signal, restricting left turns), notify PennDOT in writing and ask the department to perform a traffic study. Make sure to follow up with the department on a regular basis.

Occasionally, questions arise about the liability of repairing a dangerous condition, such as a pothole in a state highway. If you know of a dangerous condition, notifying the proper agency is essential. If the defect creates a serious hazard, you may need to consider warning the motorists of the condition with cones or even consider closing the road. If you decide to warn the motorists or go as far as to repair the defect in another agency's road, you may be held responsible for negligently warning or negligently making the repairs.

As a final note on immunity, a separate statute, the Pennsylvania Recreational Land Use Act of 1968, confers immunity to any property owner who makes land available to the public for recreational use free of charge, provided the real estate is unimproved land.

You may also be involved in litigation in the U.S. federal court system or administrative law system. Plaintiffs will be alleging some constitutional violation of their civil rights. Cases may involve wrongful discharge or disciplining of an employee, zoning land use issues, discrimination in hiring or awarding contracts for service, licensing, restrictive ordinances, and deprivation of due process. Be sure to get legal advice before taking action that may result in a federal complaint. A labor attorney is a good source of advice on any personnel matter. Ask yourself if your actions are justifiable and defensible. Document conversations and follow legal advice.

Employment practices' liability is a new and growing area of litigation in federal court today. Employees have a new sense of awareness about their rights under federal antidiscrimination statutes. If you are considering action, you should:

- Establish grounds for disciplinary action, with good documentation.
- Use progressive discipline and be patient.
- Document all discussions with the employee, performance reviews and warnings.
- Ask employees to acknowledge, in writing, receipt of performance reviews.
- Seek advice of experts.

Organizing a Risk Management Program

A good first step to organizing a risk management program within your department is to appoint a coordinator. An administrative support person within the department can be assigned the duties of monitoring claims, speaking with loss-control and insurance experts about applying loss-control measures, and coordinating with the municipality's insurance administrator.

Safety organizations, such as the National Safety Council, consider supervisors to be a key component to any effective loss-control program. Supervisors are responsible for the job site and therefore responsible for assuring that the job is done correctly and safely. Make sure your supervisors understand that a safe worksite is their responsibility, and consider scheduling regular safety training designed specifically for supervisory personnel.

A policy statement is another step to consider. A policy statement establishes guidelines for the department's risk management program and addresses the department's risk management objectives, the authority of the coordinator, what to do in the event of an accident, and how and what records need to be maintained. A loss-control committee can help implement safety policy and safety rules. It can be given specific assignments, such as developing a regular inspection program, establishing an orientation program for new employees, or setting up a schedule of ongoing training programs. The committee could include supervisors and key members of staff, perhaps someone from your agency's administrative office.

Some jurisdictions have organized an accident review board to help investigate why accidents occur. The purpose of the review board is not to find fault but to fact find. The board reconstructs accidents through an independent review of the events and by interviewing witnesses and participants. Your insurer or insurance agent can help you with the setup.

Vehicle accidents continue to rank among the highest types of accidents, both in frequency and severity, for any public entity. The solution is to train and manage. Monitor the accidents of your drivers, paying particularly close attention to frequency. A large number of small accidents will eventually lead to a large loss if some measures are not taken to correct the trend. The same is true with workers' compensation claims. Safety engineers have determined statistically that if an act is performed incorrectly 500 to 600 times, even with no visible damage, it will eventually lead to 30 to 100 minor claims or injuries and one serious accident or disabling injury. Monitoring frequency is an important loss-control device. ***Appendix III*** contains tools to help you review the frequency and severity of claims. Make it a practice to send drivers to defensive driving classes at least once every three years and more often if accident frequency demands it. The employee driving records contained in ***Appendix IV*** can be used to track employee driving records.

Establishing common procedures addressing safety rules, accident reporting, emergency actions, contingency plans, compliance with state standards and laws, maintenance schedules, and personnel administration is essential. An example of a checklist that can be used to prevent such incidents can be found in ***Appendix V***. Forms used for reporting incidents can be found in ***Appendix VI***.

VI. Personnel Management

The management of personnel is probably the most complex task faced by employers and supervisors. Since the majority of most municipalities' budgets are composed of personnel expenses, it is obvious that virtually every Pennsylvania municipality must deal with laws governing employees. Additionally, virtually every municipality in the state operates a public works department, and, therefore, elected officials, managers, and supervisors must be trained and understand how to properly manage employees.

Personnel management is a highly complex subject. Some personnel situations go beyond the day-to-day, normal issues that face managers and supervisors. In those cases, it is wise and prudent for public works management personnel to transfer problems to the governing body and the solicitor. Some examples of problems beyond the normal scope of day-to-day supervision include gross misconduct, employee theft, or charges of harassment. The intent of this chapter is to suggest routine management practices that will help managers and supervisors avoid serious problems.

Employees need to understand the scope of their position and the rules governing their conduct and performance. An employer cannot expect, demand, or enforce requirements that are not clearly conveyed to the employee. Besides basic fairness, serious problems can be avoided if the municipality carefully defines its work rules and expectations. Except in cases where employees are covered by civil service or have certain contractual protections, employees in Pennsylvania are considered "at will," which essentially refers to the employer's right to employ at its discretion with limited employment protection afforded to the employee. Even with "at will" employees, abusive or indefensible management practices have been cause for legal action by aggrieved employees.

A basic document that each employee should have is a job description, which clearly delineates the responsibilities of the job and the knowledge or training requirements for that position. It should be drafted and approved by the governing body before hiring a new employee. For existing employees that have no job descriptions, a process should occur where a draft job description is prepared, with employee involvement in its final formulation. The job description is then used in evaluating the employee. Periodic evaluations are strongly suggested for all employees, but at a minimum, the job description should be used to evaluate the performance of new employees and, thereby, judge the successful completion of any probationary period. Copies of various public works' job descriptions are contained in ***Appendix VII***.

Another basic document is an employee handbook, which covers such issues as job classification and pay, job performance, leave benefits, employee conduct, benefits and insurance, and personnel actions. Harassment guidance also should be included within the handbook. By carefully defining these issues in a tailored handbook, the employer can minimize potential misunderstanding and be in a better position to defend any personnel actions. An employee handbook is a good place to identify use of personal protective equipment (PPE) within the workplace. The handbook could indicate when PPE is to be worn, who supplies the PPE, and what happens if an employee refuses to wear the proper PPE. Samples of an employee handbook and sample personnel procedures can be obtained from the Governor's Center for Local Government Services.

The most common personnel management problem is that supervisors fail to document problems with employees. Often a supervisor will apprise the chief appointed officer or the board of a serious problem, such as attendance issues or tardiness, but does not document the occurrences or any counseling provided to the employee. The supervisor may even suggest termination of employment without any background support. This lack of oversight documentation sets up the board for potential litigation and for a clear obligation to pay unemployment to the terminated employee.

Certainly, the governing body and the chief administrative officer cannot expect public works managers and supervisors to be familiar with the full range of laws affecting employers and employment. However, the governing officials can expect that managers and supervisors use common sense. Common sense dictates that arbitrariness or abuses of employees are actions that should not be condoned. Common sense also dictates that managers and supervisors be familiar with local personnel procedures and that they maintain careful records of their employees.

Employee relations are a two-way street. Merely keeping a detailed record of an employee's missteps is not advisable. Indeed, any counseling records should become part of the centralized personnel record of the employee. Employees have a right to review those records and take exception to the official record. The record of any counseling should be shown to the employee when it is completed so that the employee has the opportunity to suggest any changes. This type of approach emphasizes the real intent of employee counseling, which is to correct deviations from the standard and avoid the disciplinary process.

Certificates of completion for training programs, copies of special licenses, and records of training programs attended by the employee should be kept in the employee's personnel file. Some municipalities will keep copies of newspaper articles or letters of appreciation from residents about the positive praise or accolades that an employee receives.

Each May, some municipalities praise their public works departments by honoring them during National Public Works Week. Since 1960, the American Public Works Association (APWA) has sponsored a week to energize and educate the public on the important contributions of public works to their daily lives. This serves as a good reminder that public works provide the planning, building, managing, and operating at the heart of a local community and in the process improve the quality of life for everyone.

VII. Emergency Management

An emergency management program is designed to save lives and protect property in the event of an emergency.

Natural or manmade disasters and emergencies affecting large areas and many people can sometimes develop quickly. Flash floods and earthquakes, for example, can strike with little or no advance warning. Other types of disasters and emergencies are preceded by a buildup period that provides more time for taking protective measures.

Natural disasters include the following:

- Severe thunderstorms, including lightning hits and downed trees
- Floods
- Tornados
- Drought
- Severe winter weather
- Extended power outages

Manmade disasters include the following:

- Nuclear power plant incidents
- Hazardous material accidents
- Train derailments
- Airplane crashes
- Prison disturbances
- Terrorism

To find out the type and extent of resources required to handle a problem in a jurisdiction, a municipality must evaluate the threats that exist to a community and region.

Typically, the emergency management coordinator, public works, police, fire, and EMS will meet to perform tabletop exercises to prepare themselves for disasters or emergencies. All branches of local government will work together to discuss available resources available to assist them. These resources would include work centers with backup power sources, ample fuel, communication equipment, and supplies of food and water for nourishment during a disaster or emergency. Successful completion of National Incident Management Systems (NIMS) IS-100 and IS-700 training is necessary for everyone involved.

Risk Analysis

Each community must individually assess its own hazardous potential by listing its natural features, such as bodies of water subject to flooding, and its manmade facilities, such as industrial sites or highway and rail systems where chemical spills could occur.

The history or the record of occurrences of previous disasters is important in risk analysis. If a certain kind of disaster occurred in the past, it is already known that sufficiently hazardous conditions had existed to cause the catastrophe. Unless these conditions no longer exist or unless they have been substantially reduced, a similar disaster may happen again. It often becomes a case of when and not whether it will happen.

To keep risk analysis manageable, enumerate each kind of probable risk that may occur and its potential harm to the community. Then, take each event and determine how to deal with it. Each hazardous scenario must be analyzed as to its magnitude for the potential of loss in terms of lives and property value. This is done by predicting what is potentially

vulnerable or exposed to the particular hazard and the predictability or chance of an occurrence. The risk is then evaluated to determine if any of the possible losses are bearable or the exposure is acceptable. Each scenario should be evaluated to determine if it could be eliminated or reduced in severity by mitigation (i.e., stormwater recharge, impoundment, or channel clearance may reduce or eliminate flooding).

Mitigation

The concept of mitigation is to eliminate or reduce the long-term risk to human life and property from hazards. Mitigation activities include those taken to lessen or eliminate damages from future disaster events. After disasters, damaged property is often simply restored to predisaster conditions. However, in a sense, a return to a predisaster condition results in a "recycling" of damage when the next disaster occurs. Mitigation is needed to ensure that this "recycling" does not continue. Mitigation produces sounder, less vulnerable conditions, which in turn lessen the impact of any future occurrences. This post-disaster planning becomes predisaster planning, which is essential to the continued protection of lives and property. Mitigation can be financed through various means and should become part of the capital budget.

Critical mitigation goals include avoidance of new hazard exposures and reduced severity of existing ones. Communities are constantly undergoing change, mostly through development. Within the community planning process, public works must be a key technical participant and advocate effective disaster mitigation.

Reduction of exposures requires care in community land planning and building construction, along with good property maintenance. Structure and subdivision placement should avoid hazard-prone areas, or their design should minimize exposures. For example, avoid housing construction in low flood-prone areas, and avoid placing major points of public assembly near potentially hazardous locations.

VIII. Intergovernmental Cooperation

Pennsylvania's municipalities constantly face the challenge of delivering services with either diminishing or limited resources. While local governments have always informally worked together, today's municipalities are faced with the pressure to deliver more efficient and increased service levels, and they are turning more and more to other municipalities to share equipment, personnel, or other resources to accomplish their governmental functions.

The Intergovernmental Cooperation Law (Act 177 of 1996), which was previously enacted by the General Assembly in 1972, authorized any general-purpose unit of government to mutually cooperate. This exceptionally broad act permits cooperation not only with similar types of government, but also with state and federal governments. It is the prime impetus for a variety of intergovernmental activity, including councils of government (COGs), regional police organizations, the Department of Transportation's Agility Program, or simple arrangements to share resources with neighbors.

Methods of Local Cooperation

Many municipalities have operated for generations on handshake agreements. This type of arrangement typically involves a convenient tradeoff, such as plowing a road or swapping roadside brush clearing for street sweeping. Many of these agreements evolved primarily for convenience or availability of equipment. Possibly the road to be plowed was between two sections of roadway owned by your neighbor. Why pull up the plow, drive a couple hundred yards and then lower the plow once back in your territory when your neighbor could easily plow that section for you?

Or perhaps a borough owns a street sweeper or sewer cleaner while the neighboring township owns equipment that can cut the brush growing up alongside rural roads. The township trades the use of its equipment to clear brush along some borough roads in exchange for use of the borough's equipment to flush storm drains. Neither municipality has the need to purchase equipment that it will rarely use; however, a reasonable tradeoff gets the job done, and both municipalities benefit. The downside of these types of agreements is that they are easily misunderstood and could result in disagreements with your neighbor.

Based on the requirements of intergovernmental agreements and Act 177, the written agreement between municipalities must include the following:

a) The agreement must be enacted by ordinance (Section 2305).
b) The ordinance must specify (Section 2307):
    1) The conditions of the agreement.
    2) The duration of the agreement.
    3) The purpose and objectives of the agreement, including the powers and scope of authority delegated in the agreement.
    4) The manner and extent of financing the agreement.
    5) The organizational structure necessary to implement the agreement.
    6) The manner in which property, real or personal, is acquired, licensed, or disposed of.
    7) Empowerment of the entity created under this section to enter into contracts for policies of group insurance and employee benefits, including Social Security, for its employees.

Many municipalities choose to take cooperation a further step and form a council of government (COG), which is a general or multipurpose organization created by joint action of several municipalities. Not only does a COG accomplish joint tasks, but it also can study and propose new joint programs or projects. It is a voluntary organization of municipalities with a board typically made up of elected officials who offer joint programs in which member municipalities can participate. COGs can apply for grants, particularly with programs that promote multimunicipal involvement, and such funding can make their projects even more attractive to members. For example, one COG, which

applied for a crack-sealing machine on behalf of six of its members, was successful in covering half of the cost of the machine while dividing the local share among the other six participants. The plan is to jointly accomplish the work using the collective workforce of the six municipalities. The municipalities have entered into a separate written agreement to ensure that issues involving equipment storage, material cost, insurance and liability, and other issues are covered.

Another form of intergovernmental cooperation that is heavily used by municipalities is joint authorities. The Municipality Authority Act of 2001 (Act 22 of 2001) authorizes the creation of municipal authorities by two or more local governments. Joint authorities accomplish a significant number of projects in the public works arena, particularly involving water and wastewater utilities. Municipal officials should be aware that authorities that can accomplish certain tasks are a viable option. The Pennsylvania Municipal Authorities Association can provide more information.

PennDOT's Agility Program

The Department of Transportation's Agility Program addresses the potential synergy of resources that the state and municipalities can provide to ensure cost-effective and efficient services to residents of the commonwealth. A guiding principle is partnership development where county transportation maintenance districts contract with municipalities for maintenance services. Through partnership development, the department meets several other program principles, including customer enrichment, employee empowerment, and organizational change. Agility recognizes that state and municipal resources can be effectively coordinated to better meet the needs of travelers in Pennsylvania.

Commonwealth and municipal employees are encouraged to develop partnership concepts. Relationships developed with communities emphasize give-and-take, compromise, honesty, and success sharing. A key component is the decentralization of decision-making to the maintenance district level where local communication and available resources are best understood.

Municipalities and COGs desiring to participate in the Agility program must enter into written agreements with PennDOT. These agreements can best be described as bartering arrangements in which no cash is exchanged. A simple example of an agreement would be one in which a municipality exchanges its street cleaning capability on a state bridge for state berm brush clearing on a borough street. The concept is open-ended with numerous other potential areas of cooperation.

Municipalities or COGs interested in partnering with PennDOT should contact their local maintenance district or PennDOT municipal services office to obtain more information about Agility.

Other Examples

A number of examples of intergovernmental cooperation are evident across Pennsylvania. Many municipalities have jointly entered into projects that include joint purchasing, equipment sharing, solid waste removal, recycling, street signing and naming, and traffic signal maintenance with successful results. For further information about intergovernmental cooperation, obtain the handbook on *Intergovernmental Cooperation* from the Governor's Center for Local Government Services.

IX. Privatization

Privatization is the process of contracting with the private sector for work or services to be performed for a governmental entity. Other terms sometimes used in lieu of privatization are outsourcing and contracting out.

Public works professionals tend to take a neutral position on privatization in which they are not predisposed to a blanket position either for or against privatization. Instead, they will take an objective look at all factors relating to the function to determine whether privatization of a specific service is advisable for their municipality. Factors to consider when evaluating privatizing are cost, resources, time, accountability, and public acceptance. Privatized cost should be analyzed against the total current and future projected costs, as well as the level of service of the function. Costs should include total labor costs, equipment operating costs, material costs and equipment replacement cost. Resources include the capacity of the municipality's manpower, expertise, and specialized equipment to accomplish the service. It is important to evaluate whether the existing or projected workforce has the available time to perform the function.

A municipality should have accountability of present and, to the greatest extent possible, future unit costs and be able to specify and control a desired level of service. As an example, in outsourcing solid waste collection, the government must be able to ensure the level of service that has existed in the past and be reasonably sure that the cost of service will remain stable. If privatization fails, local government faces enormous costs to restaff and recapitalize the equipment to restore service. Finally, public acceptance should be gauged to ensure that the replacement of a public function with a privatized function will receive reasonable acceptance.

Many municipalities have a hybrid system when it comes to privatization. They perform some functions with their own crews and contract out other work. Commonly contracted functions include:

- Construction inspection
- Custodial services
- Fleet maintenance
- General engineering services
- Leaf collection
- Line painting
- Recreation
- Sewer line inspection and cleaning
- Street paving and reconstruction
- Street sweeping
- Surveying and engineering design
- Traffic signal maintenance
- Trash and recyclable collection disposal
- Winter operations

Other functions that have recently emerged in the privatization arena are operation and maintenance of water filtration and wastewater treatment facilities. The ultimate privatization is the sale of the utility asset, in which the municipality sells an asset such as a water or wastewater plant, pays off all current and debt obligations, and realizes typically a one-time budgetary infusion. The consequence is the total local loss of control over the operation and rates of the utility.

Privatization can optimize the resources of a municipality while relieving it of day-to-day responsibility. On the negative side, privatization reduces or eliminates the control that municipal officials extend over the operation of traditional municipal functions. Additionally, privatization can be difficult to reverse. For example, the privatization of waste removal can be a permanent choice due to the high cost of reentering the function. Therefore, while the current trend among municipalities is to consider privatization, the governing body should carefully review and deliberate before making a final commitment.

X. Environment

Municipalities are faced with a range of environmental responsibilities. Some of these come from demands of residents concerned with nuisances resulting from private or governmental activities. Others result from the demands of state and federal agencies charged with enforcement of the myriad environmental laws and regulations that govern water and waste management, land development, and commercial and governmental activities. Federal and state laws impose legal liabilities upon municipalities and municipal officials, and those who fail to manage environmental matters properly face possible public criticism, civil suits, and criminal prosecution.

Although compliance with the legal requirements is at times difficult and costly, procedures exist for practical compliance and grants and loans to help municipalities, especially with new mandates. Municipal officials should be knowledgeable of requirements, compliance procedures, and sources of funding themselves or else retain staff or consultants who are.

Federal, state, and sometimes county and local laws govern municipal environmental management. The Environmental Protection Agency (EPA) is responsible for enforcement of federal law and permits, but the EPA has delegated much of its authority in Pennsylvania to the Department of Environmental Protection (DEP). The EPA does engage in oversight and review of major permits and has instituted major civil litigation against municipalities separate from or in conjunction with the DEP for such things as sewage treatment plant noncompliance and failure to control sewer overflows. The EPA also retains primacy in Pennsylvania over the federal pretreatment program regulating municipal control of industrial waste discharges into sewer systems. The U.S. Army Corps of Engineers has special responsibility for protection of wetlands and issues permits associated with encroachment, dredging, and filling of waters. The U.S. Department of Agriculture Natural Resources Conservation Service reviews and approves sedimentation and erosion-control plans required for many land development and disturbance permits.

DEP is responsible and has assumed primacy for administration of most federal and state environmental regulations in Pennsylvania. Six regional offices locally administer air, energy, environmental cleanup and brownfields, mining, oil and gas, radiation protection, waste, and water programs. Each of these offices has planners, permit officers, inspectors, and enforcement personnel to manage the various programs. A local government liaison at each office provides assistance to municipalities. The DEP website includes environmental information, regulations, guidance documents, and permit application forms. The publication *Guide to DEP Permits* is available online and lists various activities that require environmental permits and how to go about obtaining them.

The Pennsylvania Infrastructure Investment Authority (PENNVEST) provides low-interest loans and supplemental grants for drinking water, stormwater, and wastewater projects. PENNVEST projects not only contribute to improving Pennsylvania environment and the health of the people, but they also provide opportunities for economic growth and jobs for local workers.

Municipalities are provided authority for regulating environmental matters, primarily through the Pennsylvania Municipalities Planning Code, the Sewage Facilities Act, the Safe Drinking Water Act, the Solid Waste Management Act, and the various municipal codes. Municipal ordinances should reflect the requirements of state or federal laws, which mandate sound environmental management and municipal control in areas of water and solid waste management.

Environmental planning and management is now required throughout public works operations. Municipalities should take steps to ensure that requirements are not neglected or ignored in any part of the organization. Municipalities may obtain assistance from the agencies mentioned above and from the American Public Works Association and other associations and trade groups.

XI. Geographic Information Systems (GIS)

Geographic Information Systems (GIS) and automated mapping have dramatically changed the way municipal engineers, planners, tax assessors, public safety directors, environmental scientists, and public works directors rely on geographic data to do their jobs. GIS is a rapidly evolving technology that can be so complex that it appears overwhelming. Since GIS involves the interaction of computer hardware and software, data, and people, there is no textbook solution for starting a GIS operation. Many resources are available that can help. A literature search through professional journals or the internet dedicated to GIS will go a long way toward educating public works managers who have no GIS background or experience on this important planning tool.

Strategy for Implementation

To prepare for the implementation of any GIS program, a public works manager must formulate a strategy and prepare a written plan. This plan should be developed after communicating with the various entities within the municipality who may be potential users of the system. The plan should include, at a minimum, the following components:

- Clearly defined objectives
- List of users and uses
- Short-term and long-term budgetary considerations
- Ownership (who will own the information)
- Future maintenance of database and hardware
- Use of consultants
- Preparation of a conceptual database design
- Accuracy expected of database and mapping
- Requirements for detail and layers of data
- Hardware and software requirements
- Additional staffing requirements
- Development of system standards
- Development of a request for proposal for hardware, software, aerial photographs, and digitizing of photo information
- Review of other municipal GIS systems
- Development of a specific list of deliverables
- Development of a realistic and implementable schedule
- Coordination of program with local college or vocational program to develop a partnership

Implementation

The first task should be for the selected vendor to conduct a pilot project and prepare an implementation plan. Building upon the previous steps, select a pilot area and identify priority data layers for the initial project. Select appropriate data development techniques for each layer and construct the database. Test the utility of the GIS with the pilot data and modify as needed. Prepare a technical implementation plan, including automation steps, updating/maintenance of data, and cost and time estimates.

Summary

Developing a GIS is a complex, long, and expensive process; so much so that most small municipalities (under 10,000 population) cannot afford, from a technical and cost standpoint, to implement their own system. Nevertheless, a GIS is an important engineering and planning tool, and all municipalities should eventually have access to one.

In some parts of the commonwealth, county governments are stepping in to fill this void, using their resources to develop a countywide GIS and offering the data to municipalities through agreements and partnerships. Because of their countywide planning and property assessment responsibilities, counties are logical partners in this process. In fact, DCED encourages such regional and intergovernmental cooperation. Prior to proceeding with a local system, a municipality should check with its county first to see if such a countywide system is already in place.

Appendix I – Perils and Exposure Survey

	Expected Frequency			Expected Severity		
	Low	Moderate	High	Low	Moderate	High
ACTS OF NATURE						
Land movement						
Earthquake or volcano	☐	☐	☐	☐	☐	☐
Landslide, avalanche	☐	☐	☐	☐	☐	☐
Collapse	☐	☐	☐	☐	☐	☐
Erosion	☐	☐	☐	☐	☐	☐
Water damage						
Flood	☐	☐	☐	☐	☐	☐
Sewer/pipes backup	☐	☐	☐	☐	☐	☐
Sprinkler system	☐	☐	☐	☐	☐	☐
Blizzard, ice storm, hail	☐	☐	☐	☐	☐	☐
Windstorm						
Tornado	☐	☐	☐	☐	☐	☐
Hurricane	☐	☐	☐	☐	☐	☐
Falling objects	☐	☐	☐	☐	☐	☐
Lightning	☐	☐	☐	☐	☐	☐
HUMAN ACTS						
Crime						
Employee dishonesty	☐	☐	☐	☐	☐	☐
Embezzlement	☐	☐	☐	☐	☐	☐
Robbery	☐	☐	☐	☐	☐	☐
Burglary	☐	☐	☐	☐	☐	☐
Larceny	☐	☐	☐	☐	☐	☐
Grand theft	☐	☐	☐	☐	☐	☐
Fraud	☐	☐	☐	☐	☐	☐
Forgery	☐	☐	☐	☐	☐	☐
Counterfeiting	☐	☐	☐	☐	☐	☐
Arson	☐	☐	☐	☐	☐	☐
Vandalism/malicious mischief	☐	☐	☐	☐	☐	☐
Riots/civil disorder	☐	☐	☐	☐	☐	☐
Unintentional employee errors	☐	☐	☐	☐	☐	☐
Accidents	☐	☐	☐	☐	☐	☐
Employee injuries	☐	☐	☐	☐	☐	☐
Illness						
Occupational disease	☐	☐	☐	☐	☐	☐
Drug/alcohol addiction	☐	☐	☐	☐	☐	☐
Mental illness	☐	☐	☐	☐	☐	☐
Death	☐	☐	☐	☐	☐	☐

	Expected Frequency			Expected Severity		
	Low	Moderate	High	Low	Moderate	High
PROPERTY PERILS						
Glass breakage	☐	☐	☐	☐	☐	☐
Breakdown of machinery	☐	☐	☐	☐	☐	☐
Collisions						
Auto	☐	☐	☐	☐	☐	☐
Non-auto	☐	☐	☐	☐	☐	☐
Structural collapse	☐	☐	☐	☐	☐	☐
Contamination	☐	☐	☐	☐	☐	☐
Corrosion, wear, abuse	☐	☐	☐	☐	☐	☐
Explosion	☐	☐	☐	☐	☐	☐
Utility loss or failure	☐	☐	☐	☐	☐	☐
Failure of environmental controls						
Heat	☐	☐	☐	☐	☐	☐
Air conditioning	☐	☐	☐	☐	☐	☐
Fire/smoke	☐	☐	☐	☐	☐	☐
Equipment obsolescence	☐	☐	☐	☐	☐	☐
Computer failure	☐	☐	☐	☐	☐	☐
INDIRECT EXPOSURES						
Business interruption	☐	☐	☐	☐	☐	☐
Extra expense	☐	☐	☐	☐	☐	☐
Loss of rental income	☐	☐	☐	☐	☐	☐
Loss of earnings	☐	☐	☐	☐	☐	☐
THIRD-PARTY LIABILITIES						
Advertisers	☐	☐	☐	☐	☐	☐
Festival sponsorship	☐	☐	☐	☐	☐	☐
Automobiles						
Owned	☐	☐	☐	☐	☐	☐
Non-owned	☐	☐	☐	☐	☐	☐
Leased	☐	☐	☐	☐	☐	☐
Property of others in public care/custody	☐	☐	☐	☐	☐	☐
Contracts						
Mutual-aid agreements	☐	☐	☐	☐	☐	☐
Lease agreements	☐	☐	☐	☐	☐	☐
Contracts of easement	☐	☐	☐	☐	☐	☐
Grants	☐	☐	☐	☐	☐	☐
Sales or purchase orders	☐	☐	☐	☐	☐	☐
Notes, mortgages, loans	☐	☐	☐	☐	☐	☐
Construction contracts	☐	☐	☐	☐	☐	☐
Joint facilities usage	☐	☐	☐	☐	☐	☐
Insurance	☐	☐	☐	☐	☐	☐
Pollution liability	☐	☐	☐	☐	☐	☐

	Expected Frequency			Expected Severity		
	Low	Moderate	High	Low	Moderate	High
Personal Injury						
Trespass	☐	☐	☐	☐	☐	☐
Libel	☐	☐	☐	☐	☐	☐
Slander	☐	☐	☐	☐	☐	☐
Mental injury	☐	☐	☐	☐	☐	☐
Defamation of character	☐	☐	☐	☐	☐	☐
Invasion of privacy	☐	☐	☐	☐	☐	☐
Improper detention or eviction	☐	☐	☐	☐	☐	☐
Malicious prosecution	☐	☐	☐	☐	☐	☐
Discrimination	☐	☐	☐	☐	☐	☐
Products liability	☐	☐	☐	☐	☐	☐
Negligence						
Elected officials	☐	☐	☐	☐	☐	☐
Employees	☐	☐	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐	☐	☐
Contractors	☐	☐	☐	☐	☐	☐

Appendix II – Indemnification

The following contractual language related to indemnification and the assumption of risk should be submitted to a review by the governmental jurisdiction's chief legal counsel prior to incorporation into any final agreement.

Indemnification

To the extent permitted by law, CONTRACTOR covenants to save, defend, keep harmless, and indemnify the Township/Borough/City/Authority of and all of its elected or appointed officials, consultants, agents, authorized volunteers, and employees (collectively the "Township/Borough/City/Authority") from and against any and all claims, loss, damage, injury, cost (including court costs and attorney's fees), charges, liability, or exposure, however caused, resulting from or arising out of or in any way connected with the (use or occupancy of the Township/Borough/City/Authority's premises) or (Contractor's performance of the work or Contractor's obligations under the contract).

Appendix III – Governmental Loss Analysis

Governmental Loss Analysis
Frequency and Severity

Fiscal Year		Losses Classified According to Size								
		- 500	501 1,000	1,001 5,000	5,001 10,000	10,001 25,000	25,001 50,000	50,001 100,000	Over 100,000	Total
20____	Number									
	Dollars									
20____	Number									
	Dollars									
20____	Number									
	Dollars									
20____	Number									
	Dollars									
20____	Number									
	Dollars									
Total	Number									
	Dollars									
Average	Number									
	Dollars									

Appendix IV – Employee Driving Record

Employee Driving Records				
Designated Drivers	**License Number**	**Years of Driving Experience**	**Driver's Training (Date)**	**Number of Traffic Violations (or points)**
Regular Drivers *(operate vehicles regularly as part of job)*				
Occasional Drivers *(operate vehicles infrequently)*				
Non-Drivers *(do not operate vehicles as part of job but authorized to drive in an emergency)*				

Appendix V – General Safety Checklist

	OK	Location if not OK	Recommendation
GENERAL POLICIES AND PRACTICES			
Each department has safety rules.	☐	_____	_____
Injuries must be reported immediately to the supervisor.	☐	_____	_____
Hazards must be reported to a supervisor immediately after they are discovered.	☐	_____	_____
Supervisors are required to investigate all accidents in a timely matter and to route reports to management.	☐	_____	_____
Smoking is permitted only in designated areas.	☐	_____	_____
Employees reporting for work under the influence of alcohol or drugs are subject to disciplinary action.	☐	_____	_____
Only public employees are permitted to operate publicly owned vehicles and equipment.	☐	_____	_____
All employees who operate a vehicle must have a valid driver's license.	☐	_____	_____
Horseplay and practical jokes are prohibited.	☐	_____	_____
Employees must notify supervisors when taking prescription medication that causes reactions, such as fatigue, dizziness, or impaired vision or judgment.	☐	_____	_____
Accident and injury reports are reviewed by supervisors and discussed with employees.	☐	_____	_____
GROUNDS AND BUILDING ENTRANCES			
Grounds are free of unusual hazards, such as holes, protrusions, and other obstacles.	☐	_____	_____
Trees are free of loose branches or protruding roots.	☐	_____	_____
Fences are structurally sound and free of holes.	☐	_____	_____
Sidewalks, entrances steps, and lawns are properly maintained.	☐	_____	_____
Walkways and paved areas are free of cracks and loose pavement.	☐	_____	_____
All doors and windows are in working condition.	☐	_____	_____
Outside lighting is sufficient around pedestrian traffic areas.	☐	_____	_____

	OK	Location if not OK	Recommendation
BUILDINGS AND STRUCTURES			
Ceilings are free of cracks.	☐	_____	_____
Restrooms are free of water hazards.	☐	_____	_____
Handrails and treads in stairways are in good condition.	☐	_____	_____
Stairway risers are of proper height.	☐	_____	_____
Lighting in stairways is adequate.	☐	_____	_____
Floors are free of holes, splinters, protruding nails, slippery areas, and loose boards.	☐	_____	_____
All openings in floors are covered and marked.	☐	_____	_____
Aisles and passageways have adequate width and are unobstructed.	☐	_____	_____
Aisles and passageways are well-defined, marked, or painted.	☐	_____	_____
Waste oil heaters or wood stoves are used.	☐	_____	_____
Work areas have adequate lighting.	☐	_____	_____
Work areas are well-ventilated and free of fumes.	☐	_____	_____
FIRE SAFETY			
All emergency exits are properly marked.	☐	_____	_____
Each building has an evacuation and emergency preparedness plan.	☐	_____	_____
Employees are trained in firefighting or are familiar with evacuation plans.	☐	_____	_____
Fire extinguishers and other firefighting equipment is checked regularly.	☐	_____	_____
Sprinkler system is in good working condition.	☐	_____	_____
Fire alarms and smoke detectors are checked regularly.	☐	_____	_____
Rubbish and used chemicals are disposed of properly.	☐	_____	_____
Explosive or flammable materials are properly stored and ventilated.	☐	_____	_____
Welding and cutting areas are separated from other locations.	☐	_____	_____
Compressed gas cylinders are stored upright and capped.	☐	_____	_____
Trash and rags are stored in self-closing, U.L.-approved, metal containers.	☐	_____	_____

	OK	Location if not OK	Recommendation
MACHINERY, TOOLS AND EQUIPMENT			
All machinery and equipment are maintained properly.	☐	_____	_____
Belts, gears, chains, clutches, and shafting are properly guarded.	☐	_____	_____
Effective point-of-operation guards are in place.	☐	_____	_____
Equipment and facilities are free of oil or grease spills.	☐	_____	_____
Gas cylinders are in working condition.	☐	_____	_____
Tampering or unauthorized use of any machinery or equipment is prohibited.	☐	_____	_____
Tools and machines are free of split or loose handles.	☐	_____	_____
All cutting edges are sharp.	☐	_____	_____
All tools are maintained in a good state of repair.	☐	_____	_____
Ladders, scaffolds, and horses are of standard construction and are in good condition.	☐	_____	_____
Ladders or self-locking step stools are of an approved design.	☐	_____	_____
Electrical tools, switch boxes, and fixtures are properly grounded.	☐	_____	_____
Wiring, fixtures, connections, and extension or portable cords are safely insulated and installed properly.	☐	_____	_____
Extension cords are free of frays and breaks.	☐	_____	_____
All electrical wall outlets and switches are in working order.	☐	_____	_____
Pressure washer grounded per NEC requirements.	☐	_____	_____
Safety light bulbs for illumination are protected from breakage.	☐	_____	_____
Lockout/tagouts are used for appropriate tasks.	☐	_____	_____
HOUSEKEEPING			
Materials are properly stacked and stored according to established guidelines.	☐	_____	_____
Overhead clearance is ample.	☐	_____	_____
Work areas are neat and clean.	☐	_____	_____
Work areas are free of hazardous materials.	☐	_____	_____

	OK	Location if not OK	Recommendation
HOUSEKEEPING *(CONT'D)*			
Desks, cabinets, and file drawers and/or doors are maintained properly.	☐	_____	_____
Aisles and walkways are kept clear at all times.	☐	_____	_____
Access to all emergency equipment, such as fire extinguishers, emergency eye wash, and showers are kept clear of obstacles.	☐	_____	_____
EMPLOYEE PRACTICES			
New employees are trained on safety procedures.	☐	_____	_____
All equipment and machinery are used properly.	☐	_____	_____
Materials are loaded and unloaded safely.	☐	_____	_____
Lifting is done in a proper manner.	☐	_____	_____
Assistance is available to lift or move heavy objects.	☐	_____	_____
Safety devices are used.	☐	_____	_____
Safety glasses, goggles, hard hats, vests, safety shoes, and other protective equipment are worn when required.	☐	_____	_____
Workers refrain from engaging in horseplay.	☐	_____	_____
Workers are prohibited from wearing jewelry while working on or around machinery or electrical circuits.	☐	_____	_____
Vehicles are operated in a safe manner at all times.	☐	_____	_____
Traffic cones, warning flags, and barriers are used in accordance with construction traffic-control standards.	☐	_____	_____
FIRST AID			
Employees are trained in first-aid procedures.	☐	_____	_____
Employees are trained in CPR/AED procedures.	☐	_____	_____
First-aid supplies/AED are available and easily accessible at each work site.	☐	_____	_____
First-aid supplies are checked and replaced periodically to ensure freshness.	☐	_____	_____
Emergency procedures and telephone numbers are posted.	☐	_____	_____

Appendix VI – Accident / Injury Investigation Form

Employee's Report of Injury Form

Instructions: Employees shall use this form to report all work related injuries, illnesses, or "near miss" events (which could have caused an injury or illness) – *no matter how minor*. This helps us to identify and correct hazards before they cause serious injuries. This form shall be completed by employees as soon as possible and given to a supervisor for further action.

I am reporting a work related: ❑ Injury ❑ Illness ❑ Near miss	
Your Name:	
Job title:	
Supervisor:	
Have you told your supervisor about this injury/near miss? ❑ Yes ❑ No	
Date of injury/near miss:	Time of injury/near miss:
Names of witnesses (if any):	
Where, exactly, did it happen?	
What were you doing at the time?	
Describe step by step what led up to the injury/near miss. (continue on the back if necessary):	
What could have been done to prevent this injury/near miss?	
What parts of your body were injured? If a near miss, how could you have been hurt?	
Did you see a doctor about this injury/illness? ❑ Yes ❑ No	
If yes, whom did you see?	Doctor's phone number:
Date:	Time:
Has this part of your body been injured before? ❑ Yes ❑ No	
If yes, when?	Supervisor:
Your signature:	Date:

Supervisor's Accident Investigation Form

Name of Injured Person _____

Date of Birth _____ Telephone Number _____

Address _____

City _____ State_____ Zip _____

(Circle one) Male Female

What part of the body was injured? Describe in detail. _____

_____

What was the nature of the injury? Describe in detail. _____

_____

_____

Describe fully how the accident happened? What was employee doing prior to the event? What equipment, tools being using? _____

_____

_____

Names of all witnesses:

_____ _____

_____ _____

Date of Event _____ Time of Event _____

Exact location of event: _____

What caused the event? _____

_____

_____

Were safety regulations in place and used? If not, what was wrong? _____

_____

Employee went to doctor/hospital? Doctor's Name _____

Hospital Name _____

Recommended preventive action to take in the future to prevent reoccurrence.

_____

_____

_____

_____ _____

Supervisor Signature Date

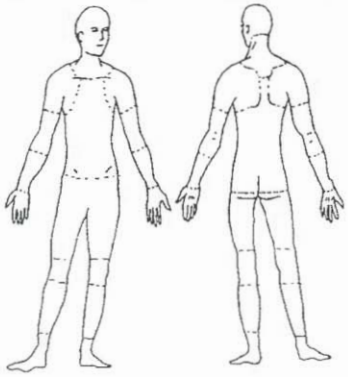
Incident Investigation Report

Instructions: Complete this form as soon as possible after an incident that results in serious injury or illness. (Optional: Use to investigate a minor injury or near miss that *could have resulted in a serious injury or illness.*)

This is a report of a: ❑ Death ❑ Lost Time ❑ Dr. Visit Only ❑ First Aid Only ❑ Near Miss	
Date of incident:	This report is made by: ❑ Employee ❑ Supervisor ❑ Team ❑ Other_____

Step 1: Injured employee (complete this part for each injured employee)

Name:	Sex: ❑ Male ❑ Female	Age:
Department:	Job title at time of incident:	
Part of body affected: (shade all that apply)	Nature of injury: (most serious one) ❑ Abrasion, scrapes ❑ Amputation ❑ Broken bone ❑ Bruise ❑ Burn (heat) ❑ Burn (chemical) ❑ Concussion (to the head) ❑ Crushing Injury ❑ Cut, laceration, puncture ❑ Hernia ❑ Illness ❑ Sprain, strain ❑ Damage to a body system: ❑ Other _____	This employee works: ❑ Regular full time ❑ Regular part time ❑ Seasonal ❑ Temporary Months with this employer Months doing this job:



Step 2: Describe the incident

Exact location of the incident:	Exact time:
What part of employee's workday? ❑ Entering or leaving work ❑ Doing normal work activities ❑ During meal period ❑ During break ❑ Working overtime ❑ Other_____	
Names of witnesses (if any):	

Number of attachments:	Written witness statements:	Photographs:	Maps / drawings:

What personal protective equipment was being used (if any)?

Describe, step-by-step the events that led up to the injury. Include names of any machines, parts, objects, tools, materials and other important details.

Description continued on attached sheets: ❑

Step 3: Why did the incident happen?

Unsafe workplace conditions: (Check all that apply)
- ❑ Inadequate guard
- ❑ Unguarded hazard
- ❑ Safety device is defective
- ❑ Tool or equipment defective
- ❑ Workstation layout is hazardous
- ❑ Unsafe lighting
- ❑ Unsafe ventilation
- ❑ Lack of needed personal protective equipment
- ❑ Lack of appropriate equipment / tools
- ❑ Unsafe clothing
- ❑ No training or insufficient training
- ❑ Other: _____

Unsafe acts by people: (Check all that apply)
- ❑ Operating without permission
- ❑ Operating at unsafe speed
- ❑ Servicing equipment that has power to it
- ❑ Making a safety device inoperative
- ❑ Using defective equipment
- ❑ Using equipment in an unapproved way
- ❑ Unsafe lifting
- ❑ Taking an unsafe position or posture
- ❑ Distraction, teasing, horseplay
- ❑ Failure to wear personal protective equipment
- ❑ Failure to use the available equipment / tools
- ❑ Other: _____

Why did the unsafe conditions exist?

Why did the unsafe acts occur?

Is there a reward (such as "the job can be done more quickly", or "the product is less likely to be damaged") that may have encouraged the unsafe conditions or acts? ❑ Yes ❑ No
If yes, describe:

Were the unsafe acts or conditions reported prior to the incident? ❑ Yes ❑ No

Have there been similar incidents or near misses prior to this one? ❑ Yes ❑ No

Step 4: How can future incidents be prevented?

What changes do you suggest to prevent this incident/near miss from happening again?

❑ Stop this activity ❑ Guard the hazard ❑ Train the employee(s) ❑ Train the supervisor(s)

❑ Redesign task steps ❑ Redesign work station ❑ Write a new policy/rule ❑ Enforce existing policy

❑ Routinely inspect for the hazard ❑ Personal Protective Equipment ❑ Other: _____

What should be (or has been) done to carry out the suggestion(s) checked above?

Description continued on attached sheets: ❑

Step 5: Who completed and reviewed this form? (Please Print)

Written by: Department:	Title: Date:
Names of investigation team members:	
Reviewed by:	Title: Date:

Appendix VII – Job Descriptions

DIRECTOR OF PUBLIC WORKS

Definition

This is administrative and civil engineering work directing and coordinating a city-wide public works program. This includes overall responsibility for all public works functions. General direction is received from the mayor through conferences and policy directives, and work is reviewed for the achievement of desired objectives.

Duties

1. Plans, organizes, and administers a program of public works; directs the program and activities of the bureaus of engineering, electricity, public building, refuse and disposal, sewers, sewage treatment, flood control, streets, and vehicle maintenance.
2. Reviews the work of technical and professional personnel involved in the various programs.
3. Confers with bureau heads to formulate and develop departmental plans and design for construction of public utilities and non-utilities, such as streets.
4. Coordinates the activities of the various bureaus comprising the department; supervises and reviews through bureau heads the preparation of proposals, the inspection of contractual work, the maintenance and repair of streets and bridges; confers with unit heads on operational, budgetary, personnel, equipment, and work program needs; and resolves the most complex situations.
5. Reviews the preparation of and processing of documents for all public works projects and capital budget proposals and schedules.
6. Coordinates all federal and state projects related to site improvements and sewer construction within the right-of-way of public streets, with the redevelopment authority, relative to engineering, planning preparation, bidding, and construction.
7. Performs other related duties as required.

Required Knowledge, Skills, and Abilities

Extensive knowledge of the principles and practices of civil engineering.

Extensive knowledge of modern engineering methods and techniques as applied to municipal public street construction, sewage treatment, and sanitation.

Extensive knowledge of modern engineering administrative methods and techniques required in directing a large operational department, employing technical, inspection, and skilled personnel engaged in a variety of public works activities.

Thorough knowledge of law, rules, and regulations controlling municipal street construction and maintenance.

Ability to apply engineering and administrative knowledge to the resolution of major technical and/or operational problems.

Ability to express ideas effectively, both orally and in writing.

Ability to establish and maintain effective working relationships with contractors, associates, and the public.

Ability to keep abreast of legislative and other activities that affect public works.

Minimum Education, Training, and Experience Required

Completion of a bachelor's degree program at an accredited college or university with major course work in civil engineering.

Extensive civil engineering experience, seven years of which in the field of highway or street construction and maintenance, including four years in an administrative capacity.
OR
Any equivalent combination of acceptable training and experience.
AND
Flagger training as per PennDOT publication

Licenses, Registrations, and/or Certificates

Registration as a professional engineer as issued by the Pennsylvania State Registration Board for professional engineers prior to appointment.

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

Possession of a valid Pennsylvania DEP operator's license for water and/or wastewater systems.

PUBLIC WORKS SUPERINTENDENT

Definition

This is administrative and supervisory work in maintenance of borough roads and streets, parks, pools, public buildings, and grounds. This position also directs the borough trash pickup and recycling program.

Work is performed under the policies and standards established by council with specific direction and review by the borough manager.

Duties

1. Assigns and directs the work of employees of the Public Works Department directly and through the assistant superintendent.
2. Directs the paving, patching, and general repair of borough streets, curbs, sidewalks, traffic-control signs and markings, and drainage-control systems.
3. Directs street cleaning and snow and ice-control operations.
4. Directs the maintenance and care of borough parks, swimming pools, recreational equipment, and structures.
5. Directs the borough's trash pickup and recycling program.
6. Formulates policies and procedures for carrying out the responsibilities of the Public Works Department.
7. Prepares recommendations and cost estimates for required construction, maintenance, and repair activities.
8. Purchases necessary materials, parts, and supplies for the department. Recommends purchase and replacement of major equipment.
9. Recommends hiring and disciplinary actions of department employees.
10. Deals with questions, suggestions, and complaints from residents.
11. Prepares and presents required reports and maintains records of departmental operations.
12. Investigates and resolves operational and administrative problems that cannot be handled by assistant superintendent.
13. Compiles and submits figures required for the preparation of the departmental capital and operating budget.
14. Performs other work as required.

Required Knowledge, Skills, and Abilities

Knowledge of the practices and procedures of road and street construction and maintenance.

Knowledge of the occupational hazards and required safety precautions of working on public roads and working around construction equipment.

Knowledge of the operational characteristics, capabilities, and maintenance requirements of road construction and maintenance equipment.

Knowledge of the laws, regulations, and requirements applicable to municipal public works operations. Ability to plan, schedule, and supervise the work of others.

Ability to calculate and estimate project costs in terms of material, money, time, and labor. Ability to establish and promote effective working relationships among employees.

Ability to deal courteously, tactfully, and firmly with the public.

Ability to detect, analyze, and devise solutions to problems relating to public works questions.

Ability to prepare clear reports and keep accurate records.

Ability to communicate clearly and concisely, orally and in writing.

Minimum Education, Training, and Experience Required

Five years of experience in the maintenance and repair of roads and streets with at least two involving work at the administrative level (planning, scheduling, designing, budgeting) and at least two directing the work of other employees.

Education equivalent to graduation from high school.
OR
Any equivalent combination of experience and training.
AND

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

Possession of a valid Pennsylvania DEP operator's license for water and/or wastewater systems.

ROAD SUPERINTENDENT

Definition

This employee is responsible for maintaining and supervising the maintenance of township roads, including drainage systems, traffic-control signs and markings, removal and control of snow and ice, and the maintenance and repair of motorized equipment. Projects are planned and carried out independently in accordance with overall road maintenance plans of the township supervisors. Work is reviewed by observation of completed projects for quality of workmanship and efficient usage of equipment, supplies, and labor.

Duties

1. Supervises and works with other employees in repairing road surfaces, installing and repairing signs and guardrails, and removing debris from drainage areas.
2. Constructs, repairs, and supervises the construction and repair of surface and subsurface drainage systems to control water on roadways.
3. Directs and participates in snowplowing, cindering, and salting operations when weather conditions require.
4. Makes recommendations to township supervisors regarding equipment and supply needs for road maintenance.
5. Makes recommendations to township supervisors regarding specifications for contracted road repair and construction work and for new equipment to be purchased.
6. Keeps maintenance records, work time records, usage reports for vehicles and materials, and other required reports and records.
7. Performs routine preventive maintenance and repairs to construction and maintenance equipment.
8. Interviews and makes recommendations on hiring of new road crew members. Trains new employees, assigns and evaluates their work, and recommends disciplinary actions if required.
9. Performs related work as required.

Required Knowledge, Skills, and Abilities

Knowledge of standard practices and techniques of road maintenance.

Knowledge of the roads, road conditions, and road maintenance needs of the township. Knowledge of occupational hazards and safety precautions of road maintenance operations.

Skill in the operation of dump trucks, snow plows, graders, backhoes, high lifts, mowers, salt spreaders, and similar maintenance equipment.

Ability to recognize road repair needs and to accurately estimate material and labor requirements for specific projects.

Ability to develop and maintain cooperative relationships with citizens whose property borders township roads and to schedule work in an effort to minimize inconvenience to the public.

Ability to assign and direct the work of other employees.

Sufficient physical strength and freedom from disabling defects to lift heavy objects and work under adverse weather conditions.

Minimum Education, Training, and Experience Required

Education equivalent to completion of the eighth school grade.

Experience in road and street maintenance and repair, which includes operation of maintenance vehicles, layout, and construction of drainage structures, and supervision of other workers or any equivalent combination of education and experience.

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

STREET SUPERVISOR

Definition

This is supervisory work directing the borough's Street Department in the general maintenance and repair of the borough's roads and all equipment related to this work.

Employee has freedom to make decisions concerning the Street Department's day-to-day operations.

Borough manager periodically reviews work and may give specific work instructions when unusual problems arise.

Employee supervises five (5) laborers; during summer months supervises an additional two (2) to three (3) temporary employees.

Employee is responsible for directing the maintenance, repair, and care of all borough streets and facilities to include the installation and maintenance of storm sewers and inlets, snow removal operations, the placement of street signs, the preparing of the department budget, the keeping of records, the preparing of reports, the advising of the manager in the hiring of new and/or temporary employees, and the disciplining of employees when necessary.

Employee must establish and maintain supervisory control over department employees. Contact with other departments may be necessary in requesting the use of various types of equipment, supplies, etc. Public contact occurs on a frequent basis.

Duties

1. Assigns work to, supervises, and works with department employees.
2. On a regular basis, inspects borough streets for maintenance and repair.
3. Schedules work assignments, taking into consideration seasonal priorities, and checks work upon completion.
4. Prepares department budget recommendations; recommends needed supplies; recommends replacement of equipment.
5. Informs borough manager of all Street Department activities on a daily basis.
6. Analyzes the need for supplies, materials, and equipment parts and obtains the necessary purchase orders.
7. Approves and submits the Street Department employees' time cards.
8. Schedules and supervises all street construction and maintenance, all leaf collection operations during fall months, and all street markings, repainting, and improving.
9. Updates and/or replaces all street signs for both parking and traffic control when required.
10. Schedules and supervises all street sweeping operations, including both general cleanup and cleaning before resurfacing.
11. Supervises all snow and ice removal operations to include preparation of all snow-related equipment, salting, and cindering of streets; plowing of all streets; loading snow; general cleanup of equipment after clearance.
12. Performs related work as required.

Required Knowledge, Skills, and Abilities

Thorough knowledge of supervisory methods and techniques.

Considerable knowledge of road maintenance and repair practices and procedures.

Complete knowledge of the operations and functions of all departments' motorized equipment.

Complete knowledge of occupational and safety hazards concerning street and equipment maintenance and repair, including related laboring work.

Minimum Education, Training, and Experience Required

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

EQUIPMENT OPERATOR 1

Definition

Performs semi-skilled work operating gasoline- or diesel-powered automotive equipment, such as dump trucks, snow plows, tractors, and mowers, and manual laboring duties in the construction and repair of township roads and associated areas and structures. Work requires strenuous physical effort and exposure to uncomfortable working conditions. Work may occasionally require the operation of more complex pieces of equipment on a training basis or in the absence of higher-level equipment operators.

Work is assigned and supervised by a work leader or higher-level equipment operator. Specific instructions are given on new duties, but once standard operations are learned, employees are expected to work without constant direction.

Duties

1. Drives dump trucks to transport equipment and tools and to apply construction material at work sites.
2. Operates snow plow and salting and cindering machinery.
3. Operates large grass and brush mowers and other equipment pushed or pulled by a tractor.
4. Checks vehicle for proper operating condition and performs routine maintenance such as lubrication and oil changes.
5. Assists mechanics in making major repairs to equipment.
6. Assists in the operation of heavy construction equipment as required.
7. Performs manual work on assigned projects when not driving.
8. Loads and unloads materials and tools from trucks.
9. Patches parks' surfaces by cleaning potholes, applying patching material, leveling, and packing.
10. Cleans and seals parks' surface cracks.
11. Digs drainage ditches; cleans out drains, pipes, streams, and flood-control structures.
12. Applies weed killers, snow- and ice-control materials, and other maintenance chemicals.

Required Knowledge, Skills, and Abilities

Knowledge of the proper operating procedures and safety practices associated with trucks and construction equipment.

Ability to recognize defective operation of trucks and to perform routine maintenance operations.

Knowledge of state laws pertaining to the operation of motor vehicles on highways and in parks.

Skill in the operation of trucks and attached equipment.

Ability to understand and follow oral and written instructions.

Sufficient physical strength and freedom from disabling defects to lift heavy objects and work under adverse weather conditions.

Minimum Education, Training, and Experience Required

One year of experience in the operation of trucks and construction equipment or any equivalent combination of experience and training.

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

DRIVER/LABORER

Definition

This is general maintenance work on borough streets, roads, parks, and properties that may require the use of a variety of hand and power tools and the operation of special-purpose trucks and mowers to pick up trash, plow snow, transport various maintenance materials, and cut grass and brush. Specific work assignments are given on a daily basis, and the employee is expected to complete them with only limited assistance and guidance.

Duties

1. Patches road surfaces by cleaning potholes, applying patching materials, leveling, and packing. Cleans and seals surface cracks.
2. Cleans dirt and refuse from streets and drainage structures.
3. Operates maintenance vehicles to load, transport, and apply construction materials to road surfaces.
4. Drives snow plow and applies snow-control materials. Clears snow by hand-shoveling where necessary.
5. Cuts grass, bushes, trees, and branches using tractor-mounted mowers and other hand and power equipment.
6. Drives trash truck on assigned pickup routes.
7. Loads trash from curb to truck, including normal household trash and various sorted recyclable and bulky items such as appliances.
8. Performs various park maintenance duties, such as cleaning pools, painting and repairing playground equipment, marking playing fields, etc.
9. Collects leaves by driving a truck with a vacuum collector or raking leaves to where they can be picked up by the truck.
10. Washes and performs routine maintenance on vehicles.
11. Performs other work as required.

Required Knowledge, Skills, and Abilities

Knowledge of state laws pertaining to the operation of motor vehicles. Skill in the operation of motor vehicles.

Ability to learn the operation of specialized pieces of maintenance equipment. Ability to learn and carry out routine mechanical operations.

Ability to understand and follow oral and written instructions.

Sufficient physical strength and freedom from disabilities to lift heavy objects and work under adverse weather conditions.

Minimum Education, Training, and Experience Required

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

TRUCK DRIVER

Definition

This is general maintenance work on township streets, roads, parks, and properties that involves skilled operation of vehicles, such as dump trucks, snow plows, tractors, and mowers, as well as manual labor duties.

Work requires strenuous physical effort and exposure to uncomfortable working conditions. Work may occasionally require the operation of more complex pieces of equipment on a training basis or in the absence of higher-level equipment operators. Employees may be assigned to direct other drivers or laborers in the performance of individual assignments.

Work is assigned and supervised by a work leader or senior truck driver. Specific instructions are given on new duties, but once standard operations are learned, employees are expected to work without constant direction.

Duties

1. Patches road surfaces by cleaning potholes, applying patching materials, leveling, and packing. Cleans and seals surface cracks.
2. Digs drainage ditches; cleans dirt and refuse from streets and drainage structures, pipes, streams, and flood-control structures.
3. Operates and drives dump trucks to transport equipment and tools, and applies construction materials to road surfaces.
4. Operates snow plow and applies snow and cindering machinery. Clears snow by hand shoveling where necessary.
5. Cuts grass, bushes, trees, and branches using tractor-mounted mowers and other hand and power equipment.
6. Applies weed killers, snow- and ice-control materials, and other maintenance chemicals.
7. Drives trash truck on assigned pickup routes.
8. Checks vehicle for proper operating conditions, and performs routine maintenance checks.
9. Assists mechanic in making major repairs to equipment.
10. Performs manual work on assigned projects when not driving.
11. Performs other work as required.

Required Knowledge, Skills, and Abilities

Knowledge of state laws pertaining to the operation of motor vehicles. Skill in the operation of motor vehicles.

Ability to learn the operation of specialized pieces of maintenance equipment. Ability to learn and carry out routine mechanical operations.

Ability to understand and follow oral and written instructions.

Sufficient physical strength and freedom from disabilities to lift heavy objects and work under adverse weather conditions.

Minimum Education, Training, and Experience Required

One year of experience in the operation of trucks and construction equipment or any equivalent combination of experience and training.

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

PUBLIC WORKS MAINTENANCE WORKER

Definition

Under general supervision, this employee will repair, upgrade, and maintain township roads and perform other general maintenance tasks to improve township grounds and facilities. May operate light, medium, or heavy equipment, or perform skilled work depending on level of experience and training and needs of the department.

Duties

1. Repair or perform general maintenance tasks on township roads; apply asphalt, cold patching materials, and concrete; repair or replace storm drainage pipes; grade and clean shoulders; widen roads; make road signs; erect and repair guiderail and signs; remove weeds and mow road banks; remove leaves with vacuum; use hand shovels to dig trenches, load trucks, and spread materials; operate manual, pneumatic, and power maintenance tools (e.g., rakes, picks, hammers, saws, jackhammer, hydraulic tamper, chainsaw).
2. May operate light- or medium-weight trucks to pull auxiliary equipment or haul materials (e.g., stone, sand, gravel, dirt, cinders, wood, trash, pipes, timber, machinery, tools, etc.).
3. May operate heavyweight equipment (e.g. graders, loaders, backhoe, rollers, etc.) to excavate, level terrain, move earth or materials, or load trucks.
4. Use light equipment or hand shovel to clear snow or debris from sidewalks and driveways. Spread salt, cinder, or stone. May operate snowplow to clear township roads.
5. Survey conditions of roads, informing Public Works foreman of poor conditions or problems.
6. Replace worn or damaged parts on vehicles and equipment (e.g., hoses, wiring, and belts). Perform routine maintenance tasks (e.g., change oil; check fluids, tires, battery, radiator, transmission, brakes). Wash and grease equipment and parts.
7. May perform major repair of engines, transmission, differentials, hydraulics, and coolant systems. Examine and determine cause of equipment failure. Perform repair procedures or arrange for repair work to be performed. Weld and fabricate tools and parts. Perform routine inspection.
8. Perform routine grounds and maintenance tasks at municipal building, parks, and recreational areas. Cut brush, mow grass, and weed. Plant trees, shrubbery, and grass. Remove refuge and trash.
9. Perform basic carpentry, electrical, plumbing, painting, and masonry tasks to improve township facilities. May install or repair plumbing systems, drainage systems, pumps, playground equipment, or shelters. May use portable hand and power tools, such as drills, saws, sanders, hammers, wrenches, chisels, squares, welder paint sprayer, etc.
10. Perform general maintenance and cleaning tasks in garage. Store tools in proper location. Keep work area clean and orderly. Keep designated records.

Education/Employment

Any combination of education and experience, which indicates possession of the skills, knowledge, and abilities listed below and possession of a Commercial Driver's License. Must be able to respond to emergencies on a 24-hour basis, especially during periods of snow.

Required Knowledge, Skills, and Abilities

Thorough knowledge of light, medium, and heavy equipment operating procedures.

Thorough knowledge of road maintenance and repair practices and procedures.

Thorough knowledge of safety practices and procedures for equipment and tools.

Thorough knowledge of department policy, procedures, and work rules.

Operation of light, medium, or heavy equipment under moderate supervision.

Operations of manual, pneumatic, and power tools.

Ability to diagnose problems with equipment, interpret detailed technical manuals, and determine proper course of action.

Ability to interpret prints, drawings, sketches, and rough drafts. Ability to carry out written and oral instructions.

Ability to walk, crouch, climb ladders, and exert 50 to 100 pounds of force occasionally, or 25 to 50 pounds frequently.

Ability to adhere to safety standards and recognize safety warnings and hazards. Ability to cooperate with coworkers on group tasks.

Ability to perform manual tasks or operate equipment for extended periods of time in possible adverse weather conditions.

Ability to demonstrate polite and courteous manner toward the general public. Ability to maintain a neat appearance.

Minimum Education, Training, and Experience Required

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

MECHANIC/TRUCK DRIVER

Definition

This is skilled mechanical work in the maintenance, repair, and operation of gasoline- and diesel-powered equipment.

This employee performs maintenance and repair jobs on automobiles, trucks, and other township road maintenance equipment. Work also involves operation of the equipment and performance of manual work in the care of township roads and property. This employee may lead other workers in accomplishing assigned projects.

Work is assigned and reviewed for satisfactory operation by the senior truck driver.

Duties

1. Lubricates, changes oil, tunes engines, and replaces parts on cars, trucks, and other maintenance equipment.
2. Replaces hydraulic and pneumatic hoses, cylinders, and associated parts on maintenance equipment.
3. Cleans and washes vehicles.
4. Road tests completed repair jobs for proper operation.
5. Instructs operators and drivers on proper operation and routine maintenance of equipment.
6. Keeps vehicle maintenance records.
7. Requisitions necessary parts and supplies.
8. Operates equipment requiring special skills, such as a pay loader.
9. Performs all the regular duties of a truck driver.

Required Knowledge, Skills, and Abilities

Knowledge of the methods, materials, tools and procedures of the automotive mechanic trade.

Knowledge of the principles of operation and construction of internal combustion engines.

Knowledge of the hazards and safety precautions of mechanical work and vehicle operation. Skill in the care and use of tools used in the maintenance and repair of motorized equipment. Skill in the operation of construction and maintenance equipment.

Ability to understand and carry out oral and written instructions.

Ability to instruct other employees in mechanical procedures.

Sufficient physical strength and freedom from disabilities to lift heavy objects and work under adverse weather conditions.

Minimum Education, Training, and Experience Required

Three years of experience in the maintenance and repair of automotive equipment or completion of a comparable repair course or apprenticeship and experience in the operation of trucks and construction equipment.

Flagger training as per PennDOT publication.

License Requirements

Possession of a valid Pennsylvania motor vehicle operator's license for the class of vehicle to be operated.

Possession of a valid Pennsylvania inspection mechanic certification.

Pennsylvania Department of Community & Economic Development
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