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16. Abstract

The process of purchasing, storing, handling and disposal of hazardous waste is demanding. The Texas Department of Transportation deals with many such compounds every day in performing its duty of maintaining over 70,000 miles of Texas roadway. With the new demands being placed on all users of hazardous materials by the new EPA guidelines, procedures must be enacted to ensure TxDOT's compliance with these ever-changing regulations. The placement of full-time safety and hazardous materials coordinators in each district office will help to ensure that employees follow reporting procedures and use disposal guidelines. This report will discuss these actions and others that might help TxDOT in this task.

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Sponsored by the
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IMPLEMENTATION STATEMENT

This report discusses options for better handling and tracking of hazardous materials used by the Texas Department of Transportation. Information has been provided to help employees understand the dangers of improper handling, use and storage of hazardous compounds. Unfortunately, it is the conclusion of this study that TxDOT currently does not possess the computer resources to adequately implement any statewide hazardous materials tracking program. These computer resources would also be necessary to implement a database for employee recommendation of less hazardous materials to be substituted for materials currently in use.

Also, this report concludes that each district office should contain a safety position and hazardous materials position. These positions should be established as full time positions and not as additional responsibilities added to a present employee's workload and responsibilities.

Since this project was not funded through its completion, it is impossible to make any more than cursory recommendations or conclusions.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department Of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

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SUMMARY

The primary goals of this endeavor were to perform an assessment of the current hazardous materials and practices utilized daily by the Texas Department of Transportation and to develop tools to aid TxDOT in the management of these materials. A two part assessment consisting of a written questionaire and selected office visits was performed and several management tools were being developed. However, due to the premature cancellation of the project these tools were never completed.

TEXAS DEPARTMENT OF TRANSPORTATION

RESPONSIBILITIES

The Texas Department of Transportation (TxDOT) is a large organization that must deal with hazardous materials on a day-to-day basis to perform its job of constructing and maintaining the highways in Texas. These duties require the use of a variety of hazardous materials. Some of these materials may include traffic paint for striping roadways, solvents for cleaning equipment, herbicides for controlling roadside vegetation, gasoline for fueling the equipment, asphalt for surfacing the roadways, acetylene for welding operations, and motor oil, antifreeze, or freon used for engine maintenance. Not only are these types of materials being handled, but TxDOT must also contend with underground storage tanks encountered during right-of-way acquisition or construction, and abandoned materials left on the right-of-way. Keeping track of such a large variety and volume of hazardous materials requires a fine-tuned material management system and an effective organizational structure.

ORGANIZATION

The Texas Department of Transportation (TxDOT) oversees the construction and maintenance of over 75,000 miles of state and federal highways, creating the largest paved, toll-free highway network in the world (1). To perform these duties efficiently requires a complex organizational structure. TxDOT uses a pyramid structure of management consisting of county or area offices at the bottom of the pyramid, district offices in the middle, and division and administrative offices at the top. Figure 1 shows a representation of this structure.

The county offices handle all of the day-to-day maintenance and construction work on the highways. Their duties include roadway surfacing or paving, roadside vegetation maintenance, equipment cleaning, and some vehicle maintenance. In performing these duties, they work with solvents, gasoline, asphalt, herbicides, and a number of automotive fluids, such as motor oil, antifreeze, freon, and hydraulic fluid.

The district offices are like small regional centers that oversee from six to seventeen counties each. These offices handle the various accounting, design, vehicle maintenance, material testing, and traffic operation activities in their region. They handle hazardous materials daily in their vehicle maintenance, roadway striping, and material testing duties, requiring them to use gasoline, engine and brake fluids, traffic paint, and solvents.

The division and administrative offices, located in Austin, comprise the headquarters of TxDOT and are primarily responsible for providing guidance to the districts and ensuring that the Department runs in a uniform and efficient manner. Hazardous materials are also handled at the division level, primarily in material testing procedures and at the main warehouse that stores materials for the entire Department.

TxDOT

Administration

18 Division Offices

25 District Offices

Area Offices

(254 Counties)

TABLE 1. TxDOT's Organizational Structure.

Overhead operations, such as photocopying, occur in all the offices mentioned, and they also require the use of hazardous materials; however, these materials will not be addressed in this research. A future investigation of these materials may be necessary to get a complete understanding of the types and volumes being handled, as well as the handling and disposal procedures being followed. This research is primarily concerned with the hazardous material management activities of the county and district offices.

DEFINITIONS, REGULATIONS, AND AGENCIES

FEDERAL REGULATIONS

The handling and use of toxic and hazardous chemicals is subject to compliance with a number of regulatory provisions and requirements. The following section covers various federal regulations that apply to hazardous substance usage, discharge, transportation, and disposal. Since the primary objective for most of these laws is the preservation and restoration of the environment, these laws are only covered with regard to toxic or hazardous substances, as defined by each regulation. A brief discussion of the law's objectives are covered, along with the federal agency responsible for the management and enforcement of each statute.

Federal Insecticide, Fungicide, and Rodenticide Act

One of the first environmental laws ever enacted was a pesticide control law in 1947. This law basically required the registration of pesticide products with the Department of Agriculture. Since that time, the law has been amended a number of times, and the jurisdiction for administering the law was passed to the Environmental Protection Agency (EPA) in 1970 (2). The basic concept of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was conceived in 1972. The objective of this law is to help provide protection for persons, animals, organisms, and environments which come into contact with pesticides. This goal is accomplished by regulating the production, packaging, marketing, transportation, application, and use of pesticides through a registration process (3). The EPA is primarily responsible for all pesticide registration activities, whereas the state agencies may assume responsibility for inspection, the certification of pesticide applicators, and for the enforcement of pesticide use violations (4; 3).

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 was established to ensure the health and safety of employees working in areas that contain toxic or hazardous substance dangers (5). The regulation includes minimum safety standards for accidental injury in the workplace and standards for occupational hazards concerned with chemical use. In 1983, the Hazard Communication Standard was published by the Occupational Safety and Health Administration (OSHA), amending this act, requiring manufacturers and importers to develop labels and material safety data sheets (MSDS) to inform their employees about the hazardous chemicals they handle (5). Under this standard, a hazardous chemical refers to any chemical that is a physical or health hazard. A physical hazard may be any chemical that is explosive,

flammable, or reactive, and a health hazard refers to chemicals that may be carcinogens, toxins, irritants, or corrosives (6). These regulations are enforced by OSHA, which is a division of the Department of Labor, and the various state agencies that have been assigned responsibility for inspections (5).

Clean Air Act

The Clean Air Act (CAA) was passed in 1970 and amended in 1977 and 1990 (5). The principal objective of this piece of legislation is to protect and enhance the quality of the nation's air resources in order to promote the health and welfare of the public (4).
In order to meet this goal, two types of controls were established, national ambient air quality standards (NAAQS) and point source emission standards. NAAQS determine the concentration of pollutants allowed in the surrounding air, while point source emission standards limit pollution emission at the source, regardless of ambient air concentrations (3). Two types of pollutants are addressed under this act, criteria pollutants and hazardous pollutants. Table 1 shows a listing of each of these pollutants. Criteria pollutants are regulated under the NAAQS, and hazardous pollutants are regulated under the National Emission Standards for Hazardous Air Pollutants (3). Compliance with the CAA is delegated to state and local governments concerning air pollution control, whereas the federal governing agency, the EPA, is responsible for providing the states with guidance and financial assistance (3).

TABLE 2. Criteria and Hazardous Pollutants Regulated Under the Clean Air Act

Criteria Pollutants	Hazardous Pollutants
sulfur oxides	asbestos
particulate matter	beryllium
nitrogen dioxide	mercury
carbon monoxide	vinyl chloride
photochemical oxidants	benzene
lead	radionuclides
	inorganic arsenic
	coke oven emissions

Clean Water Act

The Clean Water Act was established to help restore and maintain the integrity of our nation's surface waters, chemically, physically, and biologically. It was originally enacted in 1972 as the Federal Water Pollution Control Act, and later became known as the Clean Water Act, after several amendments in the 1970s and 1980s (4). The act regulates the direct discharge of pollutants into surface waters through a permit process called the National Discharge

Elimination System (NPDES) and prohibits the discharge of toxic pollutants in toxic amounts (1; 4). Under this act, three types of pollutants are addressed, conventional, toxic, and nonconventional. Conventional pollutants are those that alter the water pH levels, deplete oxygen in the water, or add suspended solids, oil, grease, or fecal matter to the water. Toxic pollutants are usually considered to be hazardous materials as classified by other regulations, and consist primarily of metals and organic chemicals. Asbestos and cyanide also fall under the toxic pollutant category. Nonconventional pollutants are neither conventional or toxic, but may be reclassified as such at a later date if warranted. Ammonia and phosphorus are examples of nonconventional pollutants (3). The EPA is the federal agency that authorizes the states to administer this act, and allows the states to set standards that are more stringent than those of the federal government (3).

Hazardous Materials Transportation Act

The transportation of toxic and hazardous substances is governed by the Hazardous Materials Transportation Act (HMTA) of 1974, through the federal Department of Transportation (DOT) and the EPA (6; 3). Hazardous substances, under this act, refer to materials that are explosive, flammable, corrosive, oxidizing, poisonous, or radioactive (3). This act was passed to help address the safety aspects of hazardous material transport by establishing regulations concerning packaging, handling, labeling, marketing, placarding, and routing of hazardous substances (5). In addition to these requirements, a shipping paper must accompany any hazardous waste shipment. This shipping paper is called a uniform hazardous waste manifest and includes information about the hazardous waste, the waste generator, the waste transporter, and the facility that receives the waste for further treatment, storage, or disposal (3). The DOT regulates the labeling and packaging requirements of this act, whereas the EPA regulates the transporters of hazardous waste through the Resource Conservation and Recovery Act, which incorporates the requirements already established under the HMTA. States and municipalities are responsible for enforcement of the HMTA standards including licensing and permit requirements, as long as they are consistent and not more stringent than the federal DOT regulations (3).

Toxic Substances Control Act

In 1976, the Toxic Substances Control Act (TSCA) was enacted to close gaps in the federal government's authority to regulate chemical substances that pose an unreasonable risk of injury to health and the environment (1; 5). This act places certain controls on the production, distribution, use, and disposal of different chemicals to help reduce the environmental or health risks associated with these substances. Under this act, chemical substances refer to

most chemicals produced, except for pesticides, tobacco, foods, food additives, drugs, cosmetics, firearms, and nuclear materials (3). This act allows broad administrative power by the EPA over most chemicals, unless a chemical risk can be controlled under another statute. One of the unique things about TSCA is that it is one of the only environmental laws that has no provision for delegating authority to the state agencies. Despite this issue, the EPA has decided to delegate some of the authority and decision-making power for implementation of TSCA to the states (3).

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976 was passed to help reduce or eliminate the generation of hazardous waste through cradle to grave regulation of wastes. The objective of RCRA is to conserve valuable material and energy resources and to promote the protection of health and the environment (6). This act is considered to be the basic law governing the management of solid and hazardous waste. Under RCRA, solid wastes include garbage, refuse, or sludge, and any solid, liquid, semi-solid, or contained gaseous material which is discarded, has served its intended purpose, or is a manufacturing by-product. Hazardous wastes are defined as solid wastes that may contribute to an increase in serious illness or mortality, or may pose a substantial hazard to human health or the environment when improperly managed. Hazardous wastes must also exhibit a characteristic of ignitability, corrosivity, reactivity, or toxicity. The hazardous waste regulations include a comprehensive system of requirements for hazardous waste generation, storage, transportation, treatment, and disposal, including a manifest system for tracking wastes to ensure that they end up at a regulated disposal site (1). In 1984, RCRA was amended by the Hazardous and Solid Waste Amendments which included new requirements for small quantity generators (between 100 kg (220 lbs) and 1000 kg (2200 lbs) of hazardous waste per month), a new regulatory program for underground storage tanks, and more stringent land disposal regulations (4). RCRA is administered at the state level, after final authorization by the EPA, allowing for states to regulate more materials than EPA and to impose stricter standards (3).

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 , also known as the "Superfund Act", provides for governmental response to hazardous substance leaks or threatened leaks at abandoned or inactive sites. This act also sets liability, compensation, cleanup, and emergency response requirements for hazardous substance spills (6). Under CERCLA, hazardous substances refer to any material or waste regulated by law. The Superfund Act was amended in 1986 with the Superfund Amendments and

Reauthorization Act (SARA), which provided stricter standards for clean-up, and promoted waste treatment and destruction over land disposal. The EPA enforces CERCLA, but delegates many of the responsibilities to the states, and often coordinates CERCLA-mandated cleanups with the state and local governments (3).

"Right-To-Know" Act

From the Superfund Amendments and Reauthorization Act emerged the Emergency Planning and Community Right-To-Know Act. This act requires state and local agencies to develop emergency plans in the event of a hazardous material spill and requires owners and operators to provide information regarding the manufacture, use, and storage of chemicals present on all facilities (1; 4). This information is compiled on Tier I and Tier II reports. A Tier I report is a summary of the categories of hazardous chemicals that a facility has on inventory. A Tier II report contains information on individual chemicals, their quantities, and their locations, and must be maintained and made available upon request (4).

The EPA delegates authority of the "Right-To-Know" Act to the state and local level.

TEXAS STATE LAWS AND AGENCIES

State Agencies

State agencies are often delegated the authority for enforcing federal regulations within their state. This is especially true concerning many of the previously mentioned environmental regulations governing hazardous substance use and handling. This section covers the state agencies in Texas that have assumed many of these regulatory responsibilities, along with a discussion of those responsibilities, and a list of the requirements that an organization such as TxDOT must comply with in handling hazardous substances in their organization.

Texas Department of Health

The Hazard Communication Branch of the Texas Department of Health (TDH) is primarily responsible for enforcing the Occupational Safety and Health Act regulations and the "Right-To-Know" Act. Their main goal is to ensure the health and safety of employees working around hazardous substances. TDH's main requirements for organizations such as TxDOT would include keeping up-to-date material safety data sheets (MSDS) and Tier I or II reports for hazardous materials kept on the premises. They also require current employee training on hazardous materials to ensure that the employee properly understands the procedures necessary to safely perform his job.

Texas Natural Resource Conservation Commission

The Texas Natural Resource Conservation Commission (TNRCC) was formed September 1, 1993, to consolidate and deal more effectively with environmental regulations concerning air pollution, water quality, and waste management. This new commission merges the former Texas Air Control Board and the former Texas Water Commission together, and assumes many of the responsibilities that these agencies were in charge of previously.

The TNRCC is responsible for enforcing many of the EPA designated statutes, including RCRA, CERCLA, CAA, CWA, and TSCA. Because of these responsibilities, they require annual waste generator reports and hazardous waste manifests, and request that the manifests be kept on hand for at least three years.

HAZARDOUS MATERIALS USE BY TXDOT

The district and county offices handle most of the hazardous materials used at TxDOT in their traffic control, maintenance, and material testing activities. These materials include solvents for equipment cleaning and material testing, paints for roadway striping and traffic signs, weed and pest control products, such as herbicides, fertilizers, and pesticides, and petroleum products including gasoline, asphalt, and engine fluids. Table 2 is a list of some of the most commonly used hazardous materials in TxDOT, along with average quantities and office occurrence percentages. This list was developed from the hazardous material management survey used for this research, and from their 1992 Tier II reports. These materials are defined as hazardous according to the Occupational Safety and Health Act, and represent a physical or health hazard that is explosive, flammable, reactive, carcinogenic, toxic, corrosive, or irritating to humans.

HANDLING AND STORAGE

Most of the hazardous materials used in the county offices are for roadway surfacing, roadside vegetation maintenance, and equipment fueling and maintenance activities. Thus, they use large amounts of gasoline and diesel, solvents, engine fluids, and weed control products. The district offices deal primarily in roadway striping and signing, vehicle maintenance, and material testing activities, and so they work with large amounts of paints, solvents, fuel, and engine fluids. Of course these activities are not set in stone, so each district has the option of contracting out these activities or delegating whatever activities it deems necessary to the county offices to ensure a smoother operating organization. Most of the offices keep their hazardous materials stored in cool, dry areas either in the office warehouse or a separate storage shed away from the regular stock of materials. The exceptions to this are gasoline and diesel fuel, which are generally stored in underground tanks, and asphalt, which is often stored in above ground tanks.

INVENTORY AND MSDS FILING

Because of the variety of hazardous materials used at TxDOT, hazardous material inventory and Material Safety Data Sheet (MSDS) filing is an area that requires a substantial amount of effort for keeping up-to-date information as required by the Occupational Safety and Health Act.

TABLE 3. Hazardous materials most commonly used by TxDOT (based on written survey)

Hazardous Material	% Of Offices Material Occurs	Average Quantity Per Office
unleaded gasoline	91.6	9500 l (2500 gal)
diesel gasoline	91.2	9500 l (2500 gal)
motor oil	77.0	760 l (200 gal)
asphalt	76.6	570000 l (15000 gal)
cement	59.8	11360 kg (25000 lbs)
kerosene	55.6	1900 l (500 gal)
round-up herbicide	45.2	760 l (200 gal)
acetylene	35.1	28 m^3 (1000 CF)
oxygen	26.8	85 m^3 (3000 CF)
salt	25.1	1820 kg (40000 lbs)
anti-freeze	20.9	950 l (250 gal)
propane	20.5	199 l (500 gal)
traffic paint	20.1	17100 l (4500 gal)
crack sealant	14.6	16360 kg (36000 lbs)
naphtha	14.6	285 l (75 gal)
lime	14.2	15910 kg (35000 lbs)
toluene	13.8	1140 l (300 gal)
velpar herbicide	11.3	380 l (100 gal)
varsol	9.2	380 l (100 gal)
oust herbicide	7.5	210 l (55 gal)
marker adhesive	7.5	5000 kg (11000 lbs)
fertilizer	3.8	910 kg (2000 lbs)
exterior paint	3.8	1330 l (350 gal)
orange terpene	3.4	570 l (150 gal)
alcohol	2.5	210 l (55 gal)
battery acid	2.5	228 l (60 gal)
safety kleen	2.5	not reported
trichloroethane	2.5	380 l (100 gal)
methylene chloride	2.1	not reported
freon	1.7	57 m^3 (2000 CF)
asbestos	1.3	365 kg (800 lbs)
methyl ethyl ketone	0.8	570 l (150 gal)
trichloroethylene	0.4	380 l (100 gal)

Most of the offices update their inventory as the hazardous materials are charged out for use, with an annual accounting and inventory update. Some offices require quarterly or monthly updates to ensure more accurate inventory records. A few of the offices have unused products in stock that are no longer needed and difficult to dispose of, or are no longer in use because of its hazardous properties. Almost all of the offices maintain accurate hazardous material locations on their inventory forms or on site layouts of the office, and several of the district offices are capable of printing an inventory report of only hazardous materials for use in filling out Tier II reports and annual generator reports. All of the offices keep paper copies of MSDS sheets on file in a notebook or filing cabinet and do their best to keep them current for every hazardous material in stock. Often the MSDS sheets do not come with each hazardous material shipment and must be requested several times before it is received from the manufacturer. There are also some problems receiving MSDS sheets with district or division warehouse shipments.

HAZARDOUS WASTE

From conducting the various activities that utilize hazardous materials, hazardous wastes are often generated. Hazardous wastes are defined by the Resource Conservation and Recovery Act as a solid waste that exhibits one of the characteristics of ignitability, corrosivity, reactivity, or toxicity. These wastes may come in the form of leftover, unusable, or spilled materials, wash-water or rinsate from equipment cleaning, empty containers with hazardous material residue, or abandoned materials from the highway right-of-way. Because of this hazardous waste generation, many of the district offices fall within either the large quantity generator (LQG) status or the small quantity generator (SQG) status as set forth in the Resource Conservation and Recovery Act regulations. The LQG is any facility that generates over 1000 kg (2200 lbs) of hazardous waste per month and requires a permit. LQG's are only allowed to store hazardous waste for 90 days. The SQG status applies to a facility that generates 100 kg (220 lbs) to 1000 kg (2200 lbs) of hazardous waste per month. SQG's are allowed 180 day storage of waste and do not require a permit. The district offices that fall under the LQG status include Dallas, Fort Worth, Abilene, and Corpus Christi. Most of the other district offices fall under the SQG status, as well as several of the county offices. While most of the county offices generate less waste than a SQG, TxDOT encourages all of its offices to get permitted in the event that their waste generation increases due to abandoned waste or any unforeseen circumstances.

Handling

All of the county and district offices handle some type of hazardous waste. Generally the county offices must deal with used motor oil, old asphalt, spent solvents, abandoned materials on the right-of-way, and occasional spill materials. The district offices handle these same hazardous wastes, as well as, leftover paint, old batteries, and old or unused materials in the warehouse inventory.

Waste Collection/Storage and Disposal

Most of the offices collect their petroleum wastes such as used motor oil in barrels and have it recycled or disposed of by an independent waste oil company. Many of the county offices take their petroleum wastes to the district office for collection and recycling or disposal because they do not generate enough waste to warrant a disposal company coming out and picking it up.

Solvents and paint wastes are also collected and stored at each office. Many of the solvent manufacturing companies are handling the collection and recycling of these wastes as part of the service that comes with purchasing their product. The solvent wastes that are not handled this way, are generally contracted out for recycling or disposal. Paint disposal is also contracted out, but it is often more difficult to locate a company who will take the waste due to its lead-based composition. Weed control wastes are not considered a problem because there is rarely any of the product left except for the container which can be triple rinsed, punctured, and then disposed of as a solid waste in a local landfill. If there is any weed control material or rinsate left, it can generally be applied to the right-of-way or stored for later use. Abandoned materials on the right-of-way are generally taken to the district office for collection and testing. This centralized collecting of waste is often the reason for the LQG status mentioned previously. The transportation of waste to the district collection site adds another management area of concern.

Spill Response

Because TxDOT handles so many hazardous materials in their day-to-day maintenance work, there is always a chance for accidental hazardous material spills. Once a material is spilled, it is generally found to be contaminated and unusable, and therefore, may fall under the hazardous waste category. Being prepared for an emergency spill is an important part of working with hazardous materials. According to the surveys, it was found that many of the offices have a good understanding of the required procedures to follow in case of a spill. For small spills, less than 95 l (25 gal), most of the offices try to contain the spill, absorb the material with sand or some other absorbent, and then place the contaminated sand in proper storage containers for testing. The testing is required to determine the proper method of disposal. For

large spills, greater than 95 l (25 gal), most of the offices try to contain the spill until a contracted, spill response team can come and clean it up, along with notification to the local fire department and the Texas Natural Resource Conservation Commission (TNRCC). However, there are still several offices that are attempting to cleanup spills on their own. In the case of third party spills on the roadway, TxDOT is only required to help with traffic control under the instruction of the Department of Public Safety and the TNRCC, whereas a private contractor is usually responsible for the actual cleanup and disposal of the material. Many of the offices reuse any asphalt contaminated spill material in their black base for driveway turnout and edge treatment repair. And several of the offices are using spill carts for small spills. These spill carts contain protective gear that can be worn during cleanup operations, absorbent materials used for soaking up the spilled material, and cleaning supplies that may be needed for the cleanup.

Integrated Management Techniques

TxDOT is using a number of innovative techniques in handling hazardous materials and wastes, from recycling and reuse of materials, to reduction of hazardous materials. Many of the offices have contracts for recycling used motor oil, parts cleaning solvent, oil filters, and antifreeze. And several of the offices are saving and separating paper, plastic, aluminum cans, and scrap metal for recycling purposes. TxDOT is also looking into the purchase of freon recyclers for each of the district offices. Reuse of waste products such as water-based paint rinsate, herbicide rinsate, and old asphalt is incorporated in the majority of the offices surveyed. This reuse of potential waste products reduces the amount of hazardous waste generated at each office, and the amount of hazardous waste that requires disposal. All of the offices are actively trying to reduce the hazardous materials used in their work. These materials may include the use of water-based paint over enamel or lead-based paint, less toxic pesticides and herbicides, asphalt emulsion in lieu of straight asphalt products, biodegradable solvents instead of chlorinated solvents, and natural gas as an alternative fuel source. They also try to use only what they require in a day's work, for example when mixing weed control products.

Problem Areas

Although TxDOT is actively incorporating a number of integrated management techniques in their hazardous material handling, they still have problem areas of concern. Many of the offices surveyed have trouble with abandoned materials on the right-of-way. The problem with these materials is first, one of identification as to what the material is and second, whether it is hazardous or not. This identification requires testing of the material which is

often quite costly and takes a lot of time. There is also some trouble with charging the expense for disposal or recycling contracts. Currently, the accounting system is not set up to adequately handle these types of charges, and so there is no real record of how much money is being spent toward hazardous waste disposal and abandoned material testing. There also seems to be some misunderstandings concerning proper spill response procedures. Some of the offices are still attempting to clean-up large spills or third party spills on their own, and there is some confusion on when to notify the proper agencies after a spill. Another problem area is locating state approved disposal or recycling companies in the more rural areas of the state. Many of the disposal companies will not travel to these remote areas and do not want the liability associated with transporting the hazardous waste over such long distances. When a disposal company can be found, there is no way of knowing whether the price they are charging is reasonable.

Keeping the MSDS sheets current is a big problem for many of the offices, especially the larger district offices that keep a large variety of hazardous materials in stock. Because TxDOT uses a low-bid system for material purchases, the vendors or material manufacturers change frequently, requiring updated MSDS sheets. Many of the offices are also having trouble with vendors and the district or division warehouse not supplying the MSDS sheet upon delivery of the material. And finally, the area of equipment cleaning was expressed as an area of concern for many of the offices because of difficulty in catching and collecting the rinsate from cleaning asphalt and striping equipment before it reaches the local storm drain. Most of the offices were built decades before and were never equipped with proper equipment cleaning stations that will allow for collection of rinsate.

PRACTICES IN OTHER STATES

Regulatory compliance of hazardous material handling and disposal is required of all the state transportation agencies in the United States. Even though some state's may pass stricter environmental requirements, the basic federal requirements must still be adhered to as a minimum. Occasionally, reviewing other state transportation agencies can lead to alternative or innovative management ideas that have not been previously considered. This section is a review of the hazardous material management plans of several state transportation agencies all over the United States.

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

The Pennsylvania Department of Transportation is set up in districts or regional offices that are responsible for handling the hazardous materials in their region. Their hazardous material management system consists primarily of policy letters concerning hazardous material and waste storage, abandoned material handling, and emergency response procedures. All of their hazardous waste is disposed of by contract, and in case of an emergency or a waste management problem, the districts can contact their state department of environmental resources for help.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

The New Jersey Department of Transportation sends out waste management and spill response guidelines for its maintenance offices to follow in dealing with hazardous materials and wastes. Their waste management policy requires the maintenance sections to segregate their wastes according to a series of waste streams for ease in disposal. Once their wastes are separated, they are then disposed of by contract.

VIRGINIA DEPARTMENT OF TRANSPORTATION

The Virginia Department of Transportation (VDOT) is comprised of 9 district offices which handle the majority of the hazardous materials. These materials include herbicides, solvents, and petroleum based products. Each district has an environmental section that falls under the supervision of the headquarters environmental office, located in Richmond. VDOT sets up contracts in each district to handle abandoned material testing, solvent recycling, and hazardous waste disposal. These contracts are signed on a yearly basis, with the option to extend the contract a second year for work well done. Any hazardous material spills are handled by the Department of Emergency Services, another state agency of Virginia, and charged back to the responsible district.

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

The Washington State Department of Transportation (WashDOT) keeps track of their hazardous material management through facility environmental supervisors, located at each maintenance area. They also have district and state-wide waste coordinators to provide assistance with any hazardous waste problems encountered. WashDOT recently developed a waste management manual to help improve their material management system, which previously consisted primarily of guidance documents. This manual is set up for both solid and hazardous wastes, and utilizes a series of flow charts describing specific procedures to follow for each type of waste generated. WashDOT's hazardous wastes are contracted out for disposal. Other state DOT's were contacted for information on their hazardous material and waste handling, but most were still trying to catch up to all the current regulatory requirements and did not have much information to offer in the way of innovative hazardous material management ideas. Many of these agencies are just getting started on proper hazardous material handling procedures and will be looking to states such as Texas and Washington to lead the way concerning environmental issues.

DATABASE-SUPPORTED HAZARDOUS MATERIALS ALTERNATIVES

The ability to explore alternatives to currently used materials in the maintenance and construction fields is of great importance to any organization such as TxDOT. For that reason, an alternatives list for hazardous materials currently used by TxDOT is being compiled. This list was created on a database manager produced by Borland, called Paradox. The primary reason for using a database type media is the ability to search for particular fields of information throughout the list. For instance, a search can be implemented for all of the products that currently contain a particular chemical compound, or every product that is used for a specific task. The help of TxDOT employees is vital in determining the uses of each product, as well as, development of a rating system of such properties as efficiency, clean up time, and health concerns. This list should be continuously updated as new products and responsibilities arise. After completion of such a list, an economic analysis can be performed on each of the alternative materials for a given task, so that the material which has a smaller overall cost associated with its use is chosen. During this analysis factors such as initial cost, effectiveness, associated health and spill risks, and disposal costs should be considered. When this type of analysis is complete the product which is truely the most economical can be chosen. An electronic copy of the work which has been performed on the Hazardous Materials Alternatives Database is included with this report. The list is designed to be accessed by Paradox, a database management program distributed by Borland International.

In addition to the alternatives list, over 300 listed hazardous chemical information sheets have been compiled on electronic media. These information sheets give detailed descriptions of the possible health and environmental impacts of each of the chemicals. The goal was to link these information sheets with the hazardous materials alternatives list, so that the associated health and environmental effects of a product which contained one of these listed chemicals could be determined. Along with the alternatives list, this task was not completed due to the unexpected termination of the project. Appendix A provides an index of the listed chemical information sheets compiled.

DISTRICT ASSESSMENTS OF HAZARDOUS MATERIALS HANDLING

In order to obtain a better understanding of the difficulties TxDOT employees face in dealing with hazardous materials, an assessment of selected district offices was conducted. The offices visited were Bryan, Ft. Worth, El Paso, Austin, San Antonio and the area office in Georgetown. Additional meetings with hazardous materials coordinators in Houston and Dallas were planned. Unfortunately, due to time and scheduling constraints, these interviews could not be conducted. At each of these meetings the goal was to identify the primary difficulties being experienced at that office with hazardous materials. New and innovative solutions to common problems were also discussed, so that this information could be passed along to the coordinators at the subsequent assessments. The larger, urban districts in the state were the primary targets, because it was felt that these offices would be experiencing a broader range of problems than the smaller offices. The following is a brief summary of identified problems and solutions discovered at a vast majority of the offices visited.

HAZARDOUS MATERIALS RISK ANALYSIS EXPERT SYSTEM

Risk analysis is a two fold process: risk assessment and risk evaluation.

Risk assessment of a hazardous material is the process of identifying the risks associated with the use of a hazardous material and assigning values or rankings to those risks.

Risk evaluation of a hazardous material is a policy oriented, decision process. It is the process of taking the known risks and values from the risk assessment and, through policy, determine the level of risk which is acceptable to the organization. An action plan generally accompanies the evaluation.

In order to help **assess** the risks associated with the use of a hazardous material by TxDOT, a computer-based model is being developed. Using a material safety data sheet and general knowledge of the hazardous material application, the model will

- assist the user in identifying the life-cycle risks associated with the use of the hazardous material,
- assist the user in assigning values to the identified life-cycle risks,
- give an overall risk factor associated with the hazardous material application,
- identify federal and state regulations relevant to the hazardous material application,
- classify, according to EPA regulations, the type of hazardous waste which would be formed as a result of the hazardous material application, and
- give possible disposal methods for the hazardous waste.

The life-cycle risks will take into account the following categories:

- environmental impact,
- workplace exposure,
- general population exposure, and
- synergistic effects.

Finally, the user can apply the identified life-cycle risks and values to a risk **evaluation**.

The expert system which will be used to build the risk assessment model is CLIPS which was designed by NASA. The model can be used on an IBM pc compatible or Macintosh computer.

POST-ASSESSMENT RECOMMENDATIONS

After compilation of the data which was collected during the mail-out survey conducted in 1993 and a review of the topics discussed at the assessment meetings, we believe that the following actions would greatly improve TxDOT's ability to manage its hazardous materials and waste stream.

(1) A District Hazardous Material Manager,
(2) Computerized Forms and Reports,
(3) Detailed Accounting Charge Codes,
(4) Equipment Wash Areas, and
(5) Hazardous Material Guidelines and Information.

The intent of these recommendations is to solve some of the problem areas that many of the offices must deal with, and to provide a more efficient, streamlined hazardous material management system that falls within compliance of the hazardous substance regulations. The following section is a discussion of each of those recommendations and the problem areas that can be improved upon from the implementation of these recommendations.

DISTRICT HAZARDOUS MATERIALS COORDINATOR

Each of the district offices needs to hire at least one full-time hazardous material manager, whose sole role is to oversee all operations which involve the use and disposal of hazardous materials. Currently, the districts have assigned hazardous material coordination to one or more of their employees. However, many of these people already have full-time positions as safety coordinators, maintenance supervisors, or other supervisory positions that dominate the majority of their time.

A full-time hazardous materials coordinator would be responsible for filing regulatory reports; keeping track of MSDS sheets; setting up contracts for hazardous waste testing, recycling, and disposal; monitoring hazardous material handling and storage within the district; teaching hazardous material continuing education classes; and staying abreast of the current regulatory requirements concerning hazardous materials, solid waste, and hazardous waste.
A hazardous material manager would be able to devote the time and energy necessary for running and maintaining an effective hazardous material management system at the district and area office level.

COMPUTERIZED FORMS AND REPORTS

Many of the required hazardous material forms need to be transferred to the computer to cut down on typing, copying, and filing time, and to help improve the organization of TxDOT's

hazardous material management system. Currently, TxDOT keeps track of over three volumes of MSDS sheets that change daily. If all the MSDS sheets were on a centralized computer database, many of these corrections could easily be made on a computer at the division level and printed out for each office stocking the hazardous material. This system would also allow an area office to printout an MSDS for warehouse material received, to ensure up-to-date MSDS sheets. The current material inventory record could be further automated to include a hazardous material code designation and hazardous material locations. The hazardous material code would allow for a generation of hazardous material reports, ans a showing of quantities and locations that must be kept on hand according to the "Right-To-Know" Act. Once the MSDS sheets and hazardous material inventory were computerized, a list of required forms, such as a Tier II Report, could easily be computer generated by pulling the required information from the computerized office inventory and corresponding MSDS sheets.

Computerization of reports would decrease the paperwork and effort required for report generation and regulatory compliance records.

EQUIPMENT WASH AREAS

TxDOT needs to build proper equipment wash areas to handle the hazardous material rinsate collection. Many of the offices at TxDOT were built decades ago and do not contain equipment cleaning areas. Therefore, rinsate collection is difficult if not impossible to handle. Many of the offices are still letting the rinsate runoff into the storm drain or onto adjacent land which could result in severe fines. Proper equipment wash areas should be constructed at each office, with catch basins to collect any hazardous material rinsate that accumulates. This material could then be tested and disposed of properly, according to the regulatory requirements set forth by the Resource Conservation and Recovery Act.

HAZARDOUS MATERIALS GUIDELINES AND INFORMATION

TxDOT needs to send out updated hazardous material guidelines and information concerning Texas Natural Resource Conservation Commission (TNRCC) procedures and approved treatment, storage, and disposal (TSD) facilities. Many of the offices are still uncertain of the proper regulatory or TxDOT recommended procedures concerning spill response actions for small, large, or third-party hazardous spills; abandoned material on the right-of-way; and general hazardous substance handling, storage, and disposal methods. A new set of guidelines on these subjects would be helpful to all the offices and provide a more uniform hazardous material management system that complies with the law. Current information concerning approved TSD facilities would also be beneficial to the area and district offices. Many of the

offices are having trouble locating TNRCC approved disposal or recycling companies, and when they find a company to handle this work, they are uncertain about the fairness of cost. This problem could easily be solved if the division office of Environmental Affairs kept a computer database of these companies, updated monthly, along with recent contract bid prices for the work. This would allow the district offices access to this information, thereby helping them to locate disposal and recycling companies in their area at reasonable prices.
Many of the districts would like to have an annual contract with a selected disposal company which would make periodic pick-ups of their hazardous wastes at the area/maintenance/district offices. This would give the districts assurance that their wastes are being disposed of in a timely manner and would prevent many of the offices from increasing their classification from a small quantity generator to a large quantity generator status. Circulation of up-to-date guidelines and information concerning hazardous materials and waste is imperative to maintaining a hazardous material management system that follows the scope of the law.

DETAILED ACCOUNTING CHARGE CODES

Detailed accounting charge codes need to be implemented for hazardous waste testing, recycling, spill response, and disposal contracts. TxDOT currently has a general waste code and a general laboratory testing code to charge out this work, but has no real budget or charge code to account for specific hazardous waste handling methods. The districts find it difficult to pay for this work because it has to come out of other budgets. By adding more detailed charge codes to the current accounting system, TxDOT could gain a real understanding of the amount of money being spent in the various areas of hazardous waste management. Once they understand how much and where the money is being spent, they can concentrate on integrating new management techniques to further reduce or reuse their hazardous materials and wastes.

QUARTERLY MEETINGS OF HAZARDOUS MATERIALS COORDINATORS

One of TxDOT's greatest assets is the tremendous wealth of knowledge and experience possessed by its employees. There are many district hazardous materials coordinators, who have invested a great deal of time and effort in recent years to reach a level where they are abreast of all of the current issues and regulations involving hazardous materials. While others are still struggling to find time to devote to investigating these areas between the performance of their other duties, the knowledge required to give TxDOT an efficient and safe management program exists, but it is not being shared on an inter-district level. A program should be implemented where communication links are established between the various hazardous materials coordinators. This could be accomplished electronically via a computer

bulletin board or through more conventional means, such as regular hazardous materials conferences.

APPENDIX A
Index of Compiled Listed Chemical Information Sheets

Bis (2-Ethylhexyl) Phthalate
Bromoform
Butyl Acrylate
Butyraldehyde
Cadmium
Cadmium Acetate
Cadmium Bromide
Calcium Cyanamide
Captan
Carbaryl
Carbon Disulfide
Carbon Tetrachloride
Carbonyl Sulfide
Chloramben
Chlordane
Chlorine
Chlorine Dioxide
Chloroacetic Acid
Chlorobenzene
Chlorobenzilate
Chloroform
Chloromethyl Methyl Ether
Chloroprene
Chlorothalonil
Chromic Acetate
Chromic Acid
Chromic Sulfate
Chromium
Chromium (III) Oxide
Chromium (VI) Oxide
Chromium Nitrate
Chromium Oxychloride
Cobalt
Cobalt Naphthenate
Copper
Copper Cyanide
Cresylic Acid
Cumene
Cumene Hydroperoxide
Cupferron
Cupric Nitrate
Cupric Sulfate
Cyclohexane
Di-n-Butyl Phthalate
Di-n-Octyl Phthalate
Diallate
Diazomethane
Dichlorobromomethane
Dichlorvos
Dicofol
Diepoxybutane
Diethanolamine
Diethyl Phthalate
Diethyl Sulfate
Dimethyl Phthalate
Dimethyl Sulfate
Dimethylaniline
Dimethylcarbamoyl Chloride
Diphenyl
Epichlorohydrin
Ethyl Acrylate
Ethyl Benzene
Ethyl Chloride
Ethyl Chloroformate
Ethylene
Ethylene Dibromide
Ethylene Glycol
Ethylene Oxide
Ethylene Thiourea
Ethyleneimine
Fluometuron
Formaldehyde
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexachloronaphthalene
Hexamethyl Phosphoramide (HEMPA)
Hydrazine
Hydrazine Sulfate
Hydrogen Chloride
Hydrogen Fluoride
Hydroquinone
Isobutyraldehyde
Isopropyl Alcohol
Lead
Lead Arsenate
Lead Chromate
Lead Dioxide
Lead Fluoborate
Lead Sulfide
Lead Sulphate
Lindane
Maleic Anhydride
Maneb
Manganese
Manganese Dioxide
Manganese Nitrate
Mercuric Acetate
Mercuric Chloride
Mercuric Cyanide
Mercuric Nitrate
Mercuric Oxycyanide
Mercuric Subsulfate
Mercuric Sulfate

Mercurous Oxide
Mercury
Mercury Iodide
Mercury Thiocyanate
Methoxychlor
Methyl Acrylate
Methyl Alcohol
Methyl Chloride
Methyl Chloroform
Methyl Ethyl Ketone
Methyl Hydrazine
Methyl Iodide
Methyl Isobutyl Ketone
Methyl Isocyanate
Methyl Methacrylate
Methylene Bromide
Methylene Chloride
Michler's Ketone
Molybdenum Trioxide
Naphthalene
Neochromium
Nickel
Nickel Ammonium Sulfate
Nickel Carbonyl
Nickel Cyanide
Nickel Hydroxide
Nickel Sulfate
Nitrilotriacetic Acid
Nitrobenzene
Nitrofen
Nitrogen Mustard
Nitroglycerin
Octachloronaphthalene
Osmium Tetroxide
Parathion
Pentachlorophenol
Peroxyacetic Acid
Phenol
Phosgene
Phosphoric Acid
Phosphorous (yellow)
Phthalic Anhydride
Polychlorinated Biphenyls
Potassium Chromate
Propoxur
Propylene
Propylene Imine
Propylene Oxide
Pseudocumene
Pyridine
Quinoline
Quintozene
Saccharin
Safrole
n-Nitrosodiphenylamine
n-Nitrosomorpholine
n-Nitrosonornicotine
o-Anisidine
o-Anisidine Hydrochloride
o-Phenylphenol
o-Toluidine
o-Toluidine Hydrochloride
p-Benzoquinone
p-Cresidine
p-Nitrosodiphenylamine
p-Phenylenediamine
sec-Butyl Alcohol
tert-Butyl Alcohol