Hazardous Materials Transportation in Arizona

Final Report 624

Prepared by:

Kelly W. Kading and Kathryn E. Bender, Faisal Chowdhury
HDR Engineering, Inc.
3200 East Camelback Road, Suite 350
Phoenix, AZ 85018-2311

March 2010

Prepared for:

Arizona Department of Transportation
206 South 17th Avenue
Phoenix, Arizona 85007
In cooperation with
U.S. Department of Transportation
Federal Highway Administration

This report can also be found on our web site…

http://www.dot.state.az.us/ABOUT/atrc/Publications/Publications.htm

Technical Report Documentation Page

1. Report No. FHWA-AZ-10-624	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle HAZARDOUS MATERIALS TRANSPORTATION IN ARIZONA		5. Report Date March, 2010 6. Performing Organization Code
7. Author Kelly W. Kading, Kathryn E. Bender, Faisal Chowdhury		8. Performing Organization Report No.
9. Performing Organization Name and Address HDR Engineering Inc. 3200 East Camelback Road, Suite 350 Phoenix, Arizona 85018-2311		10. Work Unit No. 11. Contract or Grant No. SPR-624
12. Sponsoring Agency Name and Address Arizona Department of Transportation 206 S. 17th Avenue Phoenix, Arizona 85007 ADOT Project Manager: Estomih M Kombe, PhD, PE		13.Type of Report & Period Covered FINAL REPORT June 2008 – December 2009 14. Sponsoring Agency Code
15. Supplementary Notes Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration		

16. Abstract

The purpose of this report is to summarize the data that have been collected, provide references to other researched material that supports the findings of this study, and provide a set of viable recommendations for moving forward with the preparation of a hazardous materials transportation plan (HMTP) for ADOT. Overviews of other states' programs are documented and describe which plans or portions of the plans may be adapted for use by ADOT. This report includes an overview of the computer modeling software available, and discusses the evaluations of the models. State and federal regulations and guidance with regard to transportation of hazardous materials and incidents involving hazardous materials are discussed. Strengths and weaknesses of some of the available data are identified. It is concluded that ADOT should consider the Texas approach for preparing an HMTP. The following are actionable recommendations to begin the process for the HMTP preparation:

- Use the Texas Administrative Codes as a basis for Arizona to develop and pass similar statutes.
- Support a statute to require all trucks transporting hazardous materials to stop at ports of entry.
- Develop a Web site with GIS-based maps for designated routes and other suitable information.
- Create an alliance with AZSERC for using the commodity flow studies and prioritize corridors for completion of coverage of the state.
- Form an interagency task force consisting of representatives from ADOT, AZSERC, ADPS, EMD, FHWA, FMCSA, metro Phoenix and Tucson municipalities, and others.
- Fill in data gaps with air, rail, borders, and intrastate transport of hazardous materials.
- Participate in a peer-to-peer program with Texas DOT for experience and technical transfer related to the HMTP preparation and utilization.

17. Key Words Hazardous Materials Transportation Plan, Commodity Flow Study Data Gaps		18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia, 22161		23. Registrant's Seal
19. Security Classification Unclassified	20. Security Classification Unclassified	21. No. of Pages 37	22. Price	

SI (MODERN METRIC) CONVERSION FACTORS*

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: Volumes greater than 1000L shall be shown in m^3.			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000lb)	0.907	megagrams (or “metric ton”)	mg (or “t”)
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
		ILLUMINATION		
fc	foot candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE AND PRESSURE OR STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	Square millimeters	0.0016	square inches	in^2
m^2	Square meters	10.764	square feet	ft^2
m^2	Square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	Cubic meters	35.315	cubic feet	ft^3
m^3	Cubic meters	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
mg	megagrams (or “metric ton”)	1.102	short tons (2000lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE AND PRESSURE OR STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380

TABLE OF CONTENTS

LIST OF TABLES

List of Acronyms

ADOT	**Arizona Department of Transportation**
ADPS	**Arizona Department of Public Safety**
AHEOP	**All Hazards Emergency Operations Plan**
ALOHA	**Area Location of Hazardous Atmospheres**
AZSERC	**Arizona State Emergency Response Commission**
CFR	**Code of Federal Regulations**
CFS	**commodity flow study**
CFSR	**commodity flow study reports**
CHP	**California Highway Patrol**
CAMEO	**Computer Aided Management of Emergency Operations**
CoDOT	**Colorado Department of Tranportation**
DEGADIS	**Dense Gas Dispersion Model**
DEQ	**Department of Environmental Quality**
DHS	**Department of Health Services**
DOE	**Department of Energy**
EMD	**Emergency Management Division**
EPA	**United States Environmental Protection Agency**
FAA	**Federal Aviation Administration**
FHWA	**Federal Highway Administration**
FMCSA	**Federal Motor Carrier Safety Administration**
FRA	**Federal Railroad Authority**
GIS	**Geographic Information Systems**
HDR	**HDR Engineering Inc.**
ICS	**Incident Command System**
KDOT	**Kansas Department of Transportation**
HMTP	**Hazardous Materials Transportation Plan**
LLNL	**Lawrence Livermore National Laboratory**
MARPLOT	**spatial mapping software for CAMEO package**
MIOSHA	**Michigan Occupational Safety & Health Administration**

NHI	**National Highway Institute**
NHS	**National Highway System**
NMDOT	**New Mexico Department of Transportation**
NOAA	**National Oceanic and Atmospheric Administration**
NRHM	**non-radioactive hazardous materials**
OEM	**Office of Emergency Management**
PHMSA	**Pipeline Hazardous Materials Safety Administration**
SARA	**Superfund Amendments and Reauthorization Act**
SHIM	**State Highway Incident Management Plan**
TAC	**Technical Advisory Committee**
TxDOT	**Texas Department of Transportation**
TRB	**Transportation Research Board**
USCG	**United States Coast Guard**
UDOT	**Utah Department of Transportation**
USDOT	**United States Department of Transportation**

EXECUTIVE SUMMARY

HDR Engineering, Inc. (HDR) was contracted by the Arizona Department of Transportation (ADOT) to perform a study of hazardous materials transportation and routing throughout the state of Arizona. This final report and *Research Note* summarize the data that has been collected, provide references to other researched material that supports the findings of this study, and provide a set of viable recommendations for preparing a hazardous materials transportation plan (HMTP) for the state of Arizona.

For reasons of public health and safety, transportation of hazardous materials (“hazmat”) should be limited to designated routes. These routes should be chosen with consideration given to the sources and destinations of hazardous materials, as well as the different modes of transportation used. Arizona statutes should contain a suitable declaration of public purpose to this effect.

Rail transport is generally regarded as safer than highway transport and also takes place within corridors that are exactly defined (e.g. the locations of rail tracks are well known and not subject to sudden change). Hazardous materials can however, be transported via various modes, in addition to rail transport. The commodity flow study reports (CFSRs) owned by the Arizona State Emergency Response Commission (AZSERC) contain information regarding hazardous commodity flows on Arizona rail lines. Because the information relies to some extent on voluntary disclosures by private organizations, it is not complete.

The highest level of concern is engendered by truck transport on public roadways, because currently trucks have the ability to travel on virtually any road. In contrast, cargo aircraft is limited in where it can safely land or take off, and freight rail is limited to existing track. Therefore, the major focus of this report is on truck transport of hazardous materials. For long-distance traffic, the national interstate highway system is presumed to be the major trucking route for hazardous materials. All interstate routes should be regarded as hazardous material corridors and treated accordingly. In addition to interstate routes, other major transportation corridors may be designated as hazardous materials routes.

For this study, the planning of hazardous material transportation in nine states was reviewed. These states were chosen because of their location and/or similarity to Arizona regarding hazmat transportation, border crossings, and interstate and intrastate hazmat transportation by railroads, highways, and air. Most of the researched states do not include railroads and air traffic in their plans. Railroads are private entities and are regulated by the United States Department of Transportation (USDOT) Federal Railroad Authority (FRA) and by the Pipeline Hazardous Materials Safety Administration (PHMSA) regulations. Air transportation of hazardous materials is closely regulated by the Federal Aviation Administration (FAA) and also the PHMSA regulations.

This report also provides an overview of available computer modeling software packages and evaluates the potential use of the models in ADOT's preparation of an HMTP. Commonly transported hazardous materials have the potential to cause serious health and environmental effects if released. Simulation models are particularly valuable for assessing the impacts of discharges, the risk associated with these materials, and determining areas of concern adjacent to the transportation corridors.

After review of data gathered from the targeted comparison states (California, Nevada, Utah, Colorado, New Mexico, Texas, Michigan, and Kansas), HDR has determined that the Texas approach is best suited to the state of Arizona. A discussion of Texas' approach and methods that fit Arizona is in section 6.1 of this report.

HDR recommends that ADOT adopt the Texas approach for preparing an HMTP. The following are recommendations to begin the process for the HMTP preparation:

- Use the Texas Administrative Codes as a basis for Arizona to develop and pass similar statutes.
- Find a sponsor to support a statute to require all trucks transporting hazardous materials to stop at ports of entry (POE).
- Develop a Web site to be housed at ADOT, with Geographic Information System (GIS)-based maps for designated routes and other suitable information.
- Create an alliance with AZSERC for using the CFSRs already available, and prioritize corridors for complete coverage of Arizona.
- Form an interagency task force with representatives from ADOT, AZSERC, the Arizona Department of Public Safety (DPS), the Emergency Management Division (EMD) of the Arizona Department of Emergency and Military Affairs, Federal Highway Administration (FHWA), Federal Motor Carrier Safety Administration (FMCSA), metropolitan Phoenix and Tucson municipalities, and others as appropriate.
- Develop a public information and partnering process to allow public input to the rulemaking process.
- Fill in data gaps with air, rail, borders, and intrastate transport of hazardous materials by performing CFSRs for corridors not yet studied.
- Participate in a peer-to-peer program with the Texas Department of Transportation (TxDOT) to draw on its experience and technical expertise in HMTP preparation and utilization.

1. INTRODUCTION

HDR Engineering, Inc. (HDR) was contracted by the Arizona Department of Transportation (ADOT) to study hazardous materials transportation and routing throughout Arizona. This report provides the results of the research, including the review of current programs in place in various other states. The purpose of reviewing and presenting information from other states' programs is to identify plans or portions of the plans that may be adapted for use by ADOT. This report also provides an overview of available computer modeling software packages, and evaluates the potential use of the models in ADOT's preparation of a hazardous materials transportation plan (HMTP). This report also includes a summary of state and federal regulations and guidance with regard to transportation of hazardous materials and incidents involving hazardous materials.

1.1 LIMITATIONS

A literature review has been prepared for use by ADOT. The information presented in it is based on the project scope of work, which included research of other states' hazardous materials plans, state of Arizona plans and statutes, limited interviews, and a computer model analysis. HDR has relied on information provided in interviews with employees of state and federal agencies for its description of state hazardous materials plans. HDR makes no guarantees regarding the accuracy or completeness of the information provided or compiled by others. HDR made every attempt to gather reasonably ascertainable public data. No guarantee is made that all available information was gathered and reviewed (e.g., some information requested from public agencies was not released due to security issues).

2. PROJECT DESCRIPTION

This project provides ADOT with resource information for the preparation of an integrated HMTP, complete with modeling and a publicly accessible HMTP document. The goals of the study were to:

- Gather existing information.
- Review and assess literature from ADOT.
- Review and assess literature from other state DOTs.
- Review and assess literature from other state agencies.
- Review Arizona and federal regulations related to hazardous materials transportation.
- Assess available risk assessment computer models used by other states.
- Provide an analysis of information gathered (and identify gaps in needed information) to the Technical Advisory Committee (TAC), other ADOT stakeholders, or the Federal Highway Administration (FHWA).
- Summarize data gathered to date.
- Provide references to other researched material that supports findings and conclusions of this study.
- Recommend actions for Arizona agencies to take to progress towards preparation of an HMTP for the state of Arizona.

3. LITERATURE REVIEW

HDR performed a literature review of materials from various sources including states within the southwest region of the United States, states with hazmat transportation issues similar to those in Arizona, and from states with specific HMTP elements that have been effectively implemented. Similar issues include border crossings, interstate and intrastate transportation of hazardous materials, metropolitan and rural areas, railroads, and airports statewide. California, Colorado, Kansas, Michigan, Nevada, New Mexico, Texas, and Utah were contacted and researched for each state's HMTP or similar plan.

3.1 STATE PLANS

3.1.1 Arizona

The Arizona State Emergency Response Commission (AZSERC) was contacted to review the five commodity flow study reports (CFSRs), prepared by AMEC Earth and Environmental, Inc. for the state of Arizona. HDR personnel visited the AZSERC office of Mr. Roger Soden and reviewed the CFSRs. HDR filed a request for information from AZSERC for portions of the reports. Specifically, HDR requested copies of the report cover, submittal letter, acknowledgements, table of contents, executive summary, body of publication and the references page for all five reports. At a later date, another request for information was filed for the modeling appendix pages from each of the five reports.

The five reports provide information on the transportation of hazardous materials on Arizona's the interstate highway system, national highways, arterial state highways, railroads, and through its POE. These studies focus on the through the state. The studies include a survey of placarded trucks, railroad data reviews, identification of environmentally high risk areas, computer modeling of hazardous material incidents to delineate areas of concern along interstate corridors, and railroad corridors.

The specific reports reviewed were:

- *Santa Cruz County Hazardous Materials Commodity Flow Study Report*, 2003. This report covered from the U.S./Mexico border to Tucson, Arizona; Santa Cruz and Pima counties, Arizona; and the Tohono O'Odham Nation.[5]
- *Arizona I-40 Corridor Hazardous Materials Commodity Flow Study Report*, 2004. This report covered the I-40 Corridor, arterial highways and railways in Mohave, Coconino, Navajo and Apache counties, Arizona.[4]
- *I-8 and I-10 Hazardous Materials Commodity Flow Study Report*, 2006. This report covers the I-8 and I-10 Corridor, arterial highways and railroads in Yuma, Maricopa, Pinal, Pima, and Cochise counties, Arizona.[3]
- *US 60 Hazardous Materials Commodity Flow Study Report*, 2007. This report covers the US 60 Corridor, arterial highways and railroads in Pinal and Gila counties, Arizona.[2]
- *US 60 and US 70 Hazardous Materials Commodity Flow Study Report*, 2008. This report covers the US 60 and US 70 corridors, arterial highways and railroads in Gila, Navajo, Apache, Graham and Greenlee counties, Arizona.[1]

3.1.2 California

The California Highway Patrol (CHP) bases alternate route decisions on the state and federal regulations for route determination. Restricted routes and designated routes for hazmat cargo are defined by CHP.

The United States Environmental Protection Agency (EPA) Region IX, US/Mexico Border Program produced at least two hazardous material commodity flow studies. These are the Calexico Commodity Flow Study(33) and the San Diego Hazardous Material Commodity Flow Study,(34) dated January 2001 and June 2001 respectively.

Research of California information is continuing to determine what other literature is available relevant to this project.

3.1.3 Colorado

The Colorado Department of Transportation (CoDOT) Web site was researched, and an interview was conducted with the CoDOT Research Branch Librarian, Joan Pinamont. She provided a Web link for the Department of Public Safety (DPS) Division of State Patrol, Rules and Regulations Concerning the Permitting, Routing, and Transportation of Hazardous and Nuclear Materials and the Intrastate Transportation of Agricultural Products in the State of Colorado.(11)

Ms. Pinamont also provided the Web link for the Colorado Department of Transportation, 2006, *FINAL REPORT, Risk Analysis Study of Hazardous Materials Trucks through Eisenhower/Johnson Memorial Tunnels*, "Executive Summary."(12)

3.1.4 Kansas

Kansas Department of Transportation's (KDOT) Safety Highway Engineer, Mr. Steven Buckley, was unaware of anything that their department has concerning a HMTP. He advised contacting Mr. Tim Braxmeier, Safety Investigator at the Federal Motor Carrier Safety Administration (FMCSA) in Kansas. Mr. Braxmeier advised that KDOT does not have a HMTP, but that it follows the sections in the Code of Federal Regulations (CFRs) that apply to hazardous materials transportation.

Kansas State University produced a guide for small communities to handle emergencies resulting from the accidental release of hazardous materials during transport. This is referred to as the "Kansas Model."(22)

3.1.5 Michigan

The Michigan Emergency Management and Homeland Security Division of the Department of State Police produced two guides for hazmat response plans for communities.(15,16) The guides cover the Superfund Amendments and Reauthorization Act (SARA) Title III (Michigan Fire Fighter Right-to-Know), and the Michigan Occupational

Safety and Health Administration (MIOSHA) Hazardous Waste Operations and Response certification for fire fighters plans. Michigan also has a workbook for developing a site emergency plan.

In addition, the *Hazardous Materials Bulletin*, December 2007,[17] from the Michigan State Police, designates routing restrictions for the state of Michigan.

3.1.6 New Mexico

The New Mexico Department of Public Safety (DPS) compiled an *All Hazards Emergency Operations Plan* (AHEOP)[19] at the direction of the Governor's office in 1999. The AHEOP was updated in 2007. Cabinet secretaries are signatories to this document and each agency (New Mexico State Police, NMDOT, Risk Management Division, NM Environment Department, Governor's Office of Homeland Security, and all local jurisdictions) are responsible for fulfilling their responsibilities. The NMDOT has prepared a supplement to the plan, called the *State Highway Incident Management Plan (SHIM),* completed in 2001.[20]

3.1.7 Nevada

The state of Nevada has an incident-based approach to hazmat incident response and alternate routing involving the Nevada DOT and the Nevada Department of Public Safety. They do not have a HMTP. Metropolitan Las Vegas and Reno have some routes classified as restricted, but the state has not been involved in the process for designating these routes.

3.1.8 Texas

Mr. Charles Koonce at the Texas Department of Transportation (TxDOT), Traffic Operations Division, advised that the non-radioactive hazardous materials (NRHM) routing process establishes which roads may be used to transport certain hazardous materials. These routes are generally developed by local jurisdictions (cities and counties) and must follow federal regulatory guidelines. TxDOT's Administrative Codes contain the rules designating NRHM routes. The relevant Administrative Codes are Title 43, Part 1, Chapter 25, Subchapter F, Rules 25.101 through 25.104.[24] The Administrative Codes give TxDOT the responsibility to review and approve NRHM routes. The routes are listed, and maps are available on the TxDOT Web site at www.dot.state.tx.us/services/traffic_operations/non-radioactive_routings.htm. These NRHM route maps are listed by city and county. The Traffic Operations Division at TxDOT is the "keeper of the maps."

The City of Laredo, Texas, has a *Hazardous Cargo Community Risk Assessment and Transportation Route Alternative Analysis*.[10] This analysis follows the Texas Administrative Codes and is a good example of a metro-area plan that deals with issues related to the shipment of hazardous materials across a border.

3.1.9 Utah

HDR contacted Mr. Chad Sheppick, Motor Carrier Safety Manager, at the Utah Department of Transportation (UDOT). He reported that the only rules that govern hazmat transport in Utah are the Code of Federal Regulations. He reported that Utah does not have any restricted routes or modeling software for determining alternative routes, nor do they have special permits or registration requirements mandated by UDOT. Mr. Sheppick is listed as the contact on the Safety Regulations for Motor Carriers Transporting Hazardous Materials and/or Hazardous Waste.

3.2 STATE PLAN SYNOPSES

3.2.1 Arizona

The AZSERC CFSRs[1,2,3,4,5] focus on transportation of hazardous materials along interstate highways, arterial highways, and railways throughout the state of Arizona. They include the following data:

- Inventories of hazmat transported along the study corridors.
- Flow of hazmat into and out of the study corridors.
- Locations of high risk and environmentally sensitive areas.
- Placarded truck counts.
- Counts of rail cars carrying hazardous materials.
- Flow of hazmat through the Arizona POE.
- Review of databases identifying hazmat incidents.
- Computer modeling of potential releases of hazmat.

These studies do not include hazmat transportation into or out of Arizona by air. The current reports do not cover the entire state. In particular, Interstate 10 from its intersection with Interstate 8, south of Phoenix, to the California state line still needs to be studied. Interstate 15 at the northwesternmost corner of Arizona has not yet been studied. There are multiple crossings on the Mexican border that still need to be studied , as well as state line crossings with New Mexico, Colorado, Utah, Nevada, and California.

The studies state that there are placarded trucks which bypass the POE on the interstate highways where the studies were performed. Various reasons contribute to this including hours of operation at POE, weigh-in-motion sites, and the PrePass system. Apparently, commercial trucks using the PrePass system are supposed to stop at POE if they are transporting hazardous materials, but they don’t always stop. Stated in the studies, the POE officials indicated that no state law exists requiring that all trucks transporting hazardous materials stop at POE for inspection.

3.2.2 California

The United States Environmental Protection Agency (EPA) Region IX, US/Mexico Border Program produced at least two hazardous material commodity flow studies. These are the *Calexico Hazardous Commodity Flow Study*[(33)] and the *San Diego Hazardous Material Commodity Flow Study*.[(34)] These studies include:

- A regional overview of the counties and cities involved in the study.
- Identification of the nature, quantities, and routes of hazardous substances transported through the Calexico and San Diego areas.
- Import and export of hazmat by rail, truck, air, or water.
- Geographic and environmental data including environmentally sensitive areas, airports, brokerage warehouses, waterways, residential areas, business districts, educational facilities, and other public locations.
- Truck and rail traffic carrying hazmat.
- Maps of the study areas and maps of specific areas of concern.

These studies are similar to the studies from AZSERC, but include more information regarding air traffic, waterways, and warehouses.

3.2.3 Colorado

Colorado Department of Public Safety, Chief of the Division of State Patrol has the authority to promulgate rules and regulations for the permitting, routing, and safe transportation of hazardous materials and nuclear materials by motor vehicle within the state of Colorado. These rules cover:

- Colorado State Patrol agency information regarding hazmat, nuclear material, and agricultural products transportation.
- Permits, insurance, etc. (administrative requirements) for transporting hazmat.
- Hazmat route designation process.
- Minimal CoDOT role except for the purpose of petitioning for a hazmat route designation.
- List of designated hazmat routes.
- List of designated nuclear material routes.
- State map of designated hazmat and nuclear material routes including county maps.
- References to 49 CFR Parts 107, 171-173, 177, 178, 180, 387, and 397.

The information provided by these rules is comprehensive and allows for proactive compliance with the regulations of the Colorado State Patrol for motor vehicle transport of nuclear and other hazardous material. Maps depicting the designated hazmat and nuclear materials routes are very clear and useful. The rules promulgated by the State Patrol do not address hazmat and nuclear material transportation by rail or air. No discussion is provided regarding cooperative efforts with other state agencies during a state of emergency.

3.2.4 Kansas

Mr. Tim Braxmeier, Safety Investigator at FMSCA in Kansas, advised that the KDOT does not have a HMTP, but that they follow the CFRs that apply to hazmat transportation in their state.

The Kansas Model produced by the Kansas State University is a simple guide for small communities dealing with hazmat transportation emergencies.

3.2.5 Michigan

The Michigan Emergency Management and Homeland Security Division of the Department of State Police produced a guide for hazmat response plans for communities.[15,16] This guide includes:

- Extensive local entity planning and training information referring to SARA Title III plans.
- Extensive information for local level assistance from state police.
- Workbook for guiding local governments to develop site emergency planning.

This guide is for local governments looking at "site" emergency planning rather than creating a cumulative statewide, regional, or corridor plan. DOT involvement is not included. This is not a plan but purely a guide. SARA Title III regulations require each community to develop emergency response plans to address an accidental release of an extremely hazardous substance from a site within that community, and these regulations are referenced. The Michigan governor assigned the Michigan State Police‘s Emergency Management, and Homeland Security Division to assist the communities to develop their plans. These publications are copyrighted by the state of Michigan.

The *Hazardous Materials Bulletin*,[17] December 2007, from the Michigan State Police includes:

- References to federal regulations with regard to hazmat transportation.
- Lists of routing restrictions within the state of Michigan.

3.2.6 New Mexico

The New Mexico Department of Public Safety compiled the *All Hazards Emergency Operations Plan* (AHEOP)[19] in 1999 and updated it in 2004 and again in 2007. This is a general incident plan for natural disasters, hazmat, and terrorism. This plan includes:

- Specific guidance relating to emergency incidents on the National Highway System (NHS).
- Assumptions based on the Incident Command System (ICS). The ICS is a federally standardized, on-scene, all-hazard incident management concept, designed to provide a common framework within which multiple agencies can work together effectively.

- Details on establishing coordinated communications between agencies and the public.
- Clear guidance on procedures and organizational responsibilities for other agencies during an emergency event.
- A map of the NHS in New Mexico.
- An incident flow chart.
- Graphical representation of technical terms.
- A master contact list of state agencies, districts, FHWA, and railroads emergency personnel.

This plan is specific in many areas, but it is directed at individual incidents rather than proactive planning. Coordinated communication is a focus of the plan, which does not refer to any of the federal regulations regarding hazmat transportation or identify any routing restrictions.

The NMDOT State Highway Incident Management (SHIM)[20] plan generally parallels the NMDPS AHEOP and is titled as a supplement to the AHEOP. It includes:

- An overview of NMDOT's approach to emergency operations.
- The NMDOT organizational chart for chain of command for AHEOP.
- A matrix of NMDOT organization responsibility for entire agency.
- A list of critical points along New Mexico's interstate system that have no reasonable alternate routing available.
- A rating system for incident type and probable level of response required.
- Multiple attachments from a wide variety of sources which vary in applicability.

The NMDOT SHIM was written within months of the September 11, 2001 terrorist attacks, and provides a good basis for an HMTP. It does discuss airports and their specifics in New Mexico. The rating system for incident type is useful because of strategies identified in the SHIM for responding to different types and magnitudes of incidents. It does not refer to any federal regulations for hazmat transportation.

3.2.7 Nevada

The state of Nevada does not currently have an HMTP, according to Nevada DPS and DOT contacts.

3.2.8 Texas

Texas DOT's Administrative Code[24] includes rules designating non-radioactive hazardous materials routes. TxDOT is responsible for review and approval of the routes, while local jurisdictions are responsible for designating the routes following the federal guidelines. The TxDOT plan includes:

- City and county maps of hazmat routes (available online).
- City and county hazmat route descriptions (available online).
- State statutes for designating hazmat routes.
- References to Federal guidelines.

This plan does not include coordinated efforts with other state or federal agencies and does not include coordinated communications in the event of an emergency incident.

The City of Laredo, Texas, has a *Hazardous Cargo Community Risk Assessment and Transportation Route Alternative Analysis*.(10) This analysis follows the Texas Administrative Codes and includes:

- An executive summary with a detailed synopsis of the document.
- A community risk assessment.
- Route alternative analysis.
- Issues related to the transport of hazardous and materials across a national border.
- A focus on population risk assessment and sensitive sites.
- Consideration of congestion delay, environmental risk, and emergency response.

This is a good example of a community-based plan that is organized and thorough.

3.2.9 Utah

Utah does not have a plan, according to the UDOT Motor Carrier Safety Manager.

3.3 ARIZONA REGULATIONS

The Arizona State Legislature established the Emergency Management Division (EMDin the Department of Emergency and Military Affairs) with Arizona Revised Statute (ARS) section 26-305.02.(6) The EMD is the designated lead agency for developing and implementing a state hazardous materials emergency management program. It is also responsible for emergency planning and community right to know issues. The following agencies and departments are involved in the development and implementation of the program:

- Department of Environmental Quality
- Department of Health Services
- Department of Public Safety
- Department of Transportation
- Department of Agriculture
- Corporation Commission
- Industrial Commission

- State Fire Marshal
- State Mine Inspector
- Radiation Regulatory Agency

With regard to hazardous materials transportation in Arizona, DPS[8] is responsible for establishing a special hazardous materials emergency response unit as the initial response element of the hazardous materials emergency management program, pursuant to ARS 26-305.02.[6]

DEQ is responsible for the registration of and fee collection from transporters of hazardous waste, pursuant to ARS 49-929.[9]

ADOT is responsible, pursuant to ARS 28-5204,[7] for rules governing safety operations of motor carriers, shippers and vehicles transporting hazardous materials, hazardous substances or hazardous wastes. ADOT also may audit records and inspect these vehicles (as prescribed in Title 49), pursuant to ARS 28-5204.[7].

ARS 28-7045 [7] gives ADOT complete and exclusive operational control and jurisdiction over the use of state highways and routes, and for rules regarding the use of these highways and routes.

3.4 FEDERAL REGULATIONS AND GUIDELINES

Numerous federal guidance documents and regulations are available to provide direction in preparing an HMTP. The primary source for designating routes are the federal regulations found at 49 CFR 100 – 185 and 49 CFR 397.

Title 49, CFR Part 397, Subpart C - Routing of non-radioactive hazardous materials; authorizes a political subdivision of a state to establish NRHM route designations on roads and highways open to the public under the jurisdiction of the political subdivision.

Highway Routing of Hazardous Materials: Guidelines for Applying Criteria (USDOT/FHWA/NHI, 1996)[28] is a comprehensive document describing in technical detail the federal guidelines that must be followed by states, territories, and Indian tribes when designating NRHM routes. The National Highway Institute (NHI) provided training covering these guidelines in the past, but it appears that this training is no longer offered. These guidelines include the 13 criteria that are critical in identifying and designating a hazardous material transportation route.

The United States Department of Transportation (USDOT), Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Material Safety is the federal authority for ensuring safe transport of hazmat by air, rail, highway, and water. These regulations are found at 49 CFR Part 100 -185.[29]

The USDOT Federal Motor Carrier Safety Administration's (FMCSA) mission is to promote safe commercial motor vehicle operation through education, regulation, enforcement, and innovative research and technology, and to reduce truck and bus crashes resulting in fewer fatalities and injuries. The FMSCA strives to achieve a safer and more secure transportation environment through shared responsibilities with their partners and stakeholders. The FMSCA is responsible for the upkeep of *The National Hazardous Materials Route Registry* (NHMRR),[25].which is the national repository of motor carrier routes that are either designated or restricted for hazmat transportation (both radioactive and non-radioactive).

The FMCSA has a guidebook for building a model state hazardous materials program. *The FMCSA State HM Program Model Guidebook*[26] helps states develop plans for hazardous materials transportation.

Guidelines for Selecting Preferred Highway Route Controlled Quantity Shipments of Radioactive Materials was authored by the USDOT Research and Special Programs Administration in 1992.[30] This publication comprehensively details the federal guidelines for selecting highway routes for transporting controlled quantities of radioactive materials.

Hazards Analysis on the Move, SARA Title III (EPCRA) and *Conducting a Commodity Flow Study*, (USDOT, 1993)[27] are guiding documents for local planners and responders on how to conduct a commodity flow study through communities and priority areas.

4. MODEL ANALYSIS

4.1 INTRODUCTION

Numerous computer models are available for the purpose of analyzing the potential public risk resulting from an accidental release of hazardous materials during transport. This chapter gives a summary overview of various computer models and tools used to assess the risk within Arizona, as well as comparing other states' programs to one another. Widely used models have been evaluated in terms of their usability, input parameters, end results, limitations, and applicability, as well as the training and educational needs required to understand and implement the model.

4.2 SOFTWARE REVIEW

The most commonly transported hazardous materials in Arizona include gasoline, propane, diesel, sulfuric acid, ammonium nitrate, pesticides, and copper concentrate products.(1) These materials have the potential to cause serious health and environmental damage in the event of an accidental release. Computer models are particularly valuable for assessing the impacts of discharges and the risk associated with these materials; they are also useful in determining the areas of concern adjacent to the transportation corridors.

The models' appropriateness and efficiency are important considerations in the selection of a model to use in analyzing the risk resulting from an accidental release of hazardous materials transported on public routes. Many dispersion models and software packages are available that are designed to perform the dispersion analysis for various accidental releases. The data handling capabilities of each software program are such that an accurate output is based on the characteristics associated with the accidental release. These characteristics can include emission source characteristics (released chemicals, chemical properties, released source orientation, and release conditions), plume characteristics (dense or neutrally buoyant), release duration, and/or atmospheric conditions (wind, temperature.(13) Therefore, the characteristics associated with the release and the data handling capabilities of the model can play an important role in choosing a model.

The accuracy of the parameter data, such as emission and meteorological data, is important in assessing the risk, irrespective of the model type and use. The software can only provide accurate outputs if the data entered into the system is accurate. In addition to choosing a suitable model for the task (based on parameters), other significant factors that determine the quality and accuracy of the results are the availability of accurate source information, and the availability of accurate meteorological data.(18)

4.3 RISK ANALYSIS MODELS

Some of the commonly used models were identified to conduct a comparative analysis of their salient features. The following sections discuss the software model packages reviewed for this report.

4.3.1 Computer-Aided Management of Emergency Operations (CAMEO)

This application consists of three integrated tools: Area Location of Hazardous Atmospheres (ALOHA), Mapping Applications for Response, Planning, and Local Operational Tasks (MARPLOT), and Computer Aided Management of Emergency Operations (CAMEO). This package was developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration, to assist front-line chemical emergency planners and responders.[31] ALOHA is an emergency planning and response tool, while MARPLOT is a spatial mapping application integrated in the CAMEO suite. CAMEO provides a powerful search engine that lets users find chemical-specific information on fire and explosive hazards, health hazards, firefighting techniques, cleanup procedures, and protective clothing.

4.3.2 SLAB Simulation Model

This computer model simulates the atmospheric dispersion of denser-than-air releases. The types of releases treated by the model include a ground-level evaporating pool, an elevated horizontal jet, a stack or elevated vertical jet, and an instantaneous volume source.[14] SLAB was developed in the 1980s by Lawrence Livermore National Laboratory (LLNL), with financial support from the Department of Energy (DOE). .

4.3.3 Dense Gas Dispersion Model (DEGADIS)

This tool models the atmospheric dispersion of elevated or ground-level, area-source, denser-than-air gas (or aerosol) contaminants released with negligible momentum or as a jet from pressure relief valves, into an atmospheric boundary layer over flat, unobstructed terrain. DEGADIS Version 1.0 was developed for the United States Coast Guard (USCG) and Gas Research Institute (GRI) in 1985. In 1989, this model was modified (DEGADIS Version 2.1) to provide for an elliptical plume cross-section with air entrainment consistent with the Pasquill-Gifford plume dispersion coefficient representation of atmospheric turbulent entrainment.[23]

Another commonly used tool is RMP*Comp, which is used to perform the off-site consequence analysis (both worst case and alternative scenarios) required under the Risk Management Program rule published by the EPA. RMP*Comp is a planning tool and cannot be used for emergency response.[4] There are numerous other emergency management models capable of assessing the risks. However, this study is limited to the models which are commonly used, widely accepted, and have proven applicability throughout the nation.

4.4 MODEL OVERVIEW

Table 1 summarizes various emergency management computer models for assessing risks from accidental release of hazardous materials.

Table 1 - Overview on Various Modeling Packages

Review Items	ALOHA (used alongside CAMEO & MARPLOT)	SLAB	DEGADIS
Model Description	ALOHA computes time-dependent source strength for evaporating puddles, pressurized or non-pressurized gas, or liquid release from a storage vessel, and pressurized gas from a pipeline. It models pure non-reactive chemicals, Gaussian puff and plume, heavy gas dispersion. Wind speed and direction are assumed constant. It accounts for the effects of vertical wind shear on both Gaussian and heavy gas dispersion, and on pool evaporation.	SLAB is one of the simplest dense gas models to set up and begin using. It does not calculate source emission rates. It assumes that all source input conditions have been determined externally. The model can treat evaporating pool sources, jet releases at any height, and instantaneous volume sources. It produces outputs of chemical concentrations at various positions downwind and at specified heights above the ground.	DEGADIS models the atmospheric dispersion of denser-than-air contaminants released with negligible momentum or as a jet into an atmospheric boundary layer over flat, unobstructed terrain. It models the dispersion processes that accompany the gravity-driven flow, contaminant entrainment into the atmospheric boundary layer, and subsequent downwind travel from the release.
Application Limitations	ALOHA does not account for terrain steering or changes in wind speed and horizontal direction, nor does it model particulate dispersion. It does not account for initial positive buoyancy of a gas escaping from a heated source. Due to its non-robust Gaussian nucleus, improvements in its ability to address comprehensive scenarios, is limited.	SLAB does not calculate source emission rates. It handles jets in a simplified manner and does not calculate the details of the jet motions and thermodynamics. It is not suitable for use with strongly buoyant plumes.	Model has limited ability to address release scenarios in complex terrain. Application of the model is limited to releases where the depth of the dispersing layer is much greater than the height of the surface roughness elements. It does not provide for concentration time averaging in the wind direction.
Strengths	Downloadable at no charge from the EPA Web site with a user's manual. The ALOHA code has evolved over the years to add capabilities, improve algorithms, and correct errors.	SLAB is recognized as the easiest-to-use dense gas model. It agrees well with available field data.	It can address many types of dense gas releases and address atmospheric dispersion of contaminant releases in various fluid flow regimes.
Drawbacks	Results are less reliable for conditions of low wind speed or very stable atmospheric conditions. It does not account for the effects of fires or chemical reactions and terrain steering effects. It limits predictions to one hour after the release begins or to distances up to 6 miles and does not model the evaporation of chemical constituents in a mixture or solution.	It does not calculate source emission rates. Model is restricted to dense gas releases or liquid spills that evaporate into a dense gas. The model assumes a flat atmospheric flow with no obstructions and takes no sloping terrain into account.	It does not account for positive thermal buoyancy; unable to address complex meteorological flow phenomena; does not account for aerodynamic effects of nearby buildings; does not account for dry or wet deposition effects; can only address pure chemical releases. It does not consider chemical mixtures or chemical transformations.
Input Parameters	Mean wind speed, wind direction, and air temperature,ground roughness length, cloud cover, and relative humidity. Time, date, latitude, and longitude are required to compute solar radiation and atmospheric pressure.	Pollutant properties, source conditions, meteorological conditions, maximum receptor downwind distance, and receptor heights. There is an option of specifying either the traditional or a continuous discrete stability class.	Release type, rate, duration, source flux, initial density, initial temperature, average time, release Richardson number, wind speed at elevation, surface roughness, Pasquill stability class, ambient temperature and pressure, absolute humidity, surface temperature.

Output Summary	User inputs and model results; graphs of predicted source strength and on and off-centerline indoor and outdoor concentrations; dose over time at specified locations; and a "footprint" plot of the area downwind of a release where concentrations may exceed a user-set threshold level.	The output file contains distributions with downwind distance of the maximum pollutant concentration, the time when the maximum concentration occurs, the duration of the cloud, and the parameters that describe cloud geometry (width and depth).	Tabular reflection of input data and calculated source parameters (time, gas radius, height, mole fraction, density, Richardson number, etc.), mole fraction, concentration, density, temperature, half width, sigma-y, sigma-z as a function of various downwind distances.
User Friendliness	Designed to be extremely user friendly. It contains pull-down menus with prompts and warning and caution messages.	Model has a rudimentary command-line user interface. User manually prepares the input file using a text editor and executes the program by typing the program name.	DEGADIS is designed to be user friendly once the user becomes familiar with the physical principles of the model and the input-output details.
Program Operation	Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems.	Run-time error diagnostics are missing. The code appears to be robust and encounters any numerical problems and can be run in batch mode using DOS batch files.	Provides various diagnostic messages to assist the user in determining the source of problems in running the model. Program setup time is relatively minimal.
Source: Office of the Federal Coordinator for Meteorology,[21] User's Manuals for ALOHA, SLAB and DEGADIS			

Each model, described in Table 1, has its strengths and limitations. Choosing a proper model is a should be based on cost and technical expertise, as well as applicability for various release scenarios. The Richardson number[1] can help determine the type of model best used for analysis. Typically, a Richardson number greater than 32 indicates a continuous gas release, whereas Richardson numbers exceeding 700 indicate the instantaneous release of a dense gas. (32) Based on the capabilities of various computer models, Table 2 shows the model type that could be used for various release scenarios.

Table 2 - Various Models by Release Scenarios

Source Type	**Release Type**			
	Continuous	**Finite**	**Transient**	**Instantaneous**
Ground Level	ALOHA, DEGADIS, SLAB	ALOHA, DEGADIS, SLAB	DEGADIS	--
Evaporating Liquid Spill	ALOHA, DEGADIS, SLAB	ALOHA, DEGADIS, SLAB	--	ALOHA, DEGADIS, SLAB
Vertical Jet//Plume	ALOHA, DEGADIS, SLAB	ALOHA, DEGADIS, SLAB	--	--
Horizontal Jet	SLAB	SLAB	--	--
Instantaneous	--	--	--	SLAB

Source: Trinity Consultants, Dallas, TX (2004), User's Manuals for ALOHA, SLAB and DEGADIS

Results from various models could vary due to the inherent assumptions and limitations associated with each model. Therefore, choosing an appropriate model is important.

4.5 MODELING IN ARIZONA AND OTHER STATES

Review of the hazardous commodity flow studies conducted in various states indicated that the CAMEO package, including ALOHA and MARPLOT, is widely used for off-site consequence analysis in the states of Arizona, Michigan, California, Nevada, Oregon, Alaska, Florida, Ohio, and Washington. Spatial compatibility (through MARPLOT), availability at no cost, user-friendliness, and simplicity made this model very popular. In addition, the CAMEO package is EPA-recognized. RMP*Comp and TNT-EMA are additional models which are used occasionally within Arizona, depending on the task and objective of the study.

The Arizona State Emergency Response Commission (AZSERC) was contacted to conduct an overview on computer models used across the country for risk assessment. Texas uses the model HOTSPOT for initial emergency assessment or safety analysis

---

1 The Richardson number is the dimensionless number that expresses the ratio of potential to kinetic energy.

planning of a radionuclide release. Colorado does not use any particular computer model for assessing risk. Availability, user-friendliness, and accuracy of outputs appeared to be contributing factors in selecting a specific computer model throughout the states.

5. DATA GAP ANALYSIS

Data gaps are related to the availability of information encountered during the investigative and research processes that may affect the ability of the analysts/modelers to draw conclusions. The environmental professional thus estimates the relative importance of the data gaps. The environmental professional uses multiple data sources as a method to provide coverage for data gaps. For the purpose of developing an HMTP, the following items may constitute data gaps:

- Limited information offered due to the sensitive nature of the information.
- Lack of air transport information.
- Incomplete railroad transport information in the AZSERC CFSRs.
- Limited AZSERC CFSR coverage for the entire state.
  - I-10 from its intersection with I-8, south of Phoenix to the California state line, still needs to be studied.
  - I-15 at the northwestern corner of Arizona has not yet been studied.
  - Primary and secondary highways with multiple border crossings still need to be studied on the Mexican border as well as with New Mexico, Colorado, Utah, Nevada, and California.

The following items are considered to be significant data gaps for the purpose of developing an HMTP:

- The lack of complete coverage of the state with commodity flow study information.
- Lack of air transport information.
- Incomplete railroad transport information.
- Placarded trucks bypassing POE stations.

6. FINDINGS AND RECOMMENDATIONS

6.1 FINDINGS

Nine states (including Arizona) were researched for HMTPs. These states were chosen based on their locations and/or similar issues regarding hazmat transportation. Specifically, border crossings, and interstate and intrastate hazmat transportation by railroads, highways, and air. Most of the states do not include railroads and air traffic in their plans. Railroads are private entities and are regulated by the USDOT Federal Railroad Authority and by portions of the PHMSA regulations. Air transportation of hazardous materials is closely regulated by the Federal Aviation Administration and also by portions of the PHMSA regulations.

The CFSRs (which AZSERC owns) provide coverage for the interstate highway system, U.S. highways, arterial highways, railroads, and certain POEs across Arizona. These studies focus on the transportation of hazardous materials through the state. The studies include placarded truck surveys, railroad data review, identification of environmentally high risk areas, and computer modeling of hazardous material incidents to delineate areas of concern along both interstate and railroad corridors. The key component for analyzing various routes and options for transport of hazardous materials in Arizona is the CFSRs. These studies are absolutely critical as the basis for any work performed by a cooperative interagency task force looking at non-interstate route designations.

These reports do not completely cover the state. Incomplete areas of coverage include I-10 from its intersection with I-8, south of Phoenix to the California state line, and I-15 at the northwesternmost corner of Arizona. Multiple international and state border crossings with Arizona, which are primary and secondary highways, still need to be studied prior to the preparation of an HMTP.

The EPA Hazardous Material Commodity Flow Studies for San Diego and Calexico could be useful to ADOT in the preparation of an HMTP because they reference cargo flowing in and out of Southern California to Arizona.

HDR found a 1986 Transportation Research Board (TRB) study on handling hazmat transportation emergencies. This study states that little or no uniformity existed in state laws of the day, and that sources of data on hazardous material shipments were inconsistent or nonexistent. The research performed during this study for ADOT indicates that little has changed in the intervening years. Following the events of September 11, 2001, emphasis in the field seems to have changed from hazardous materials transport to terrorist threats. Information previously regarded as technical is now considered sensitive to homeland security, and is therefore difficult to obtain.

There appears to be no consistency among states or major metropolitan areas regarding planning for or responding to hazardous material transportation issues. After review of the data gathered from the targeted comparison states (California, Nevada, Utah, Colorado, New Mexico, Texas, Michigan, and Kansas), and the federal regulations and guidance documents, it appears that an adaptation of the Texas approach is best suited to Arizona.

The Texas approach has the most applicability and includes useful methods for route designation which Arizona could follow for hazardous material route designation. Texas specifies two parallel methods for designation of hazardous material routes, one at the local level and one at the state level. These methods are similar and use the 13 factors for determining the route designations found in 49 CFR 397. The local method allows political subdivisions to establish routes and requires municipalities with a population of more than 750,000 to establish routes. It includes a simple public involvement process, intergovernmental consultation, involvement by TxDOT, and specifications for posting the adopted route. An analogous state-level process is similar, but includes approval by the state transportation commission.

Applied to Arizona, this approach would require Phoenix and Tucson to develop local hazardous material routes, with approval from ADOT. The rest of the state designations would be performed by ADOT with appropriate input from other entities and agencies.

An important component of the Texas approach is the use of GIS-based mapping for all designated routes. The route maps are available online at the TxDOT Web site in a consistent format. TxDOT is the "keeper of the maps," providing single-point access to the maps, which are maintained and updated on a regular basis. It also ensures easy access to these maps in the event of a hazardous material accident.

The Colorado approach may be useful to supplement the HMTP process with regard to enforcement and for routing shipments of radioactive materials.

In general, the planning and route designation, enforcement, and incident response aspects of hazardous material transport are separate functions. While they may involve many of the same partners, the designated lead agency and appropriate processes are distinct and different. Incident response, in particular, includes widely differing scenarios; these require carefully designated procedures that will work well in stressful situations and extremely short timeframes. This is different from the planning aspect of route designations, which requires thorough consultation with all affected parties. It is also different from the routine aspect of year-in, year-out truck inspection and law enforcement.

6.2 RECOMMENDATIONS

6.2.1 Recommendations for Route Designation for Hazardous Materials

HDR recommends that ADOT adopt the Texas approach for preparing an HMTP. The following are viable recommendations to begin the process for the HMTP preparation:

- Use the Texas Administrative Code as a basis for developing and passing similar statutes.
- Find a sponsor to support a statute to require all trucks transporting hazardous materials to stop at POE.

- Develop a Web site to be housed at ADOT, with GIS-based maps for designated routes and other suitable information.
- Create an alliance with AZSERC for using the CFSRs already available, and prioritize corridors for completion of coverage of the state.
- Form an interagency task force consisting of representatives from ADOT, AZSERC, ADPS, EMD, FHWA, FMCSA, metro Phoenix and Tucson municipalities, and others as appropriate.
- Develop a public information and partnering process to allow public input to the rulemaking process.
- Fill in data gaps about air, rail, borders, and intrastate transport of hazardous materials by performing commodity flow studies (CFSs) for corridors not yet studied.
- Participate in a peer-to-peer program with TxDOT for experience and technical transfer related to the HMTP preparation and utilization.

6.2.2 ADOT and AZSERC

ADOT and AZSERC should work cooperatively to find the funding and conduct CFS in the corridors still lacking studies at the earliest possible opportunity. In the normal course of events, there may be little reason for these two agencies to cooperate closely, since both agencies have broad mandates and many responsibilities. In this case, the need for cooperation, coordination, and mutual understanding cannot be overemphasized. The two agencies should begin bilateral discussions at the earliest possible opportunity.

6.2.3 Interagency Task Force

ADOT should develop and lead an interagency task force to oversee the development of all hazardous material transport routes within the state. Many partners could be considered for membership in this task force, but in the interest of efficiency, the primary members should be ADOT, DPS, AZSERC, EMD, FHWA, and FMCSA. The task force should have close linkages to the EMD and that division's cooperative working group of departments and divisions as specified in section 3.3 of this report and in ARS 26-305.02. Additional representation should include the local governments of the Phoenix and Tucson metro areas, when appropriate, and could include the air and rail sectors, as well as mining interests.

The task force should work with AZSERC to prioritize CFS corridors that have not yet been assessed. The task force could serve as an advocate for needed funding for the priority CFS in the state legislature, if Homeland Security grant funds are no longer available to AZSERC. The task force would be responsible for assuring coordination among involved agencies for route designation, enforcement, and incident management.

The task force should work toward filling in data gaps in non-highway modes of transportation of hazardous materials. The borders of Arizona as well as intrastate transportation of hazardous materials are other data gap areas for which some kind of data is required.

6.2.4 Borders

It is probably not practical to expect to intercept and inspect all hazardous materials shipments at Arizona's borders. However, it may make sense to emphasize the international border with Mexico. Additional information may be available at this border (in comparison to internal U.S. borders with neighboring states). For example, the commodity flow studies owned by AZSERC indicate that explosives and other hazardous materials related to mining are entering Arizona by truck and rail (which may not be discovered at existing border checkpoints).

6.2.5 Mining

The widespread presence of mining interests in Arizona indicates a considerable intrastate component to hazardous material transport. In addition to the mines themselves, Arizona has facilities that support mining, such as sites for storage, processing, waste disposal, and manufacturing. The intrastate flows of materials resulting from these activities need to be incorporated into the various route designation analyses. The transport of hazardous materials for mining operations is conducted by truck and rail.

6.2.6 Airports

With regard to air transportation of hazmat, it does not appear that information is currently available for Arizona. Airports that have hazardous materials flowing through them, together with the types, quantities, sources, and destinations of these materials, need to be identified.

REFERENCES

1. Arizona State Emergency Response Commission.2008. *US 60 and US 70 Hazardous Materials Commodity Flow Study Report*. Phoenix, AZ.

2. Arizona State Emergency Response Commission. 2007. *US 60 Corridor Hazardous Materials Commodity Flow Study Report*. Phoenix, AZ.

3. Arizona State Emergency Response Commission. 2006. *I-8 and I-10 Hazardous Materials Commodity Flow Study Report*. Phoenix, AZ.

4. Arizona State Emergency Response Commission. 2004. *Arizona I-40 Corridor Hazardous Materials Commodity Flow Study Report*. Phoenix, AZ.

5. Arizona State Emergency Response Commission. 2003. *Santa Cruz County Hazardous Materials Commodity Flow Study Report*. Phoenix, AZ.

6. Arizona State Statutes, Title 26 Military Affairs and Emergency Management, Chapter 2, Article 1, Section 26-305.02. Accessed May 8, 2009 at http://www.azleg.gov/ArizonaRevisedStatutes.asp

7. Arizona State Statutes, Title 28 Transportation, Chapter 14, Article 1, Section 28-5204 and Section 28-7045. Accessed May 8, 2009 at http://www.azleg.gov/ArizonaRevisedStatutes.asp

8. Arizona State Statutes, Title 41 State Government, Chapter 12, Article 2, Section 41-1711. Accessed May 8, 2009 at http://www.azleg.gov/ArizonaRevisedStatutes.asp

9. Arizona State Statutes, Title 49 The Environment, Chapter 5 Article 1, Section 49-929. Accessed May 8, 2009 at http:///www.azleg.gov/ArizonaRevisedStatutes.asp

10. Cambridge Systematics, Inc. with Alliance Transportation Group, Inc. 2006. *Hazardous Cargo Community Risk Assessment and Transportation Route Alternative Analysis for the City of Laredo*. Laredo, Texas: City of Laredo.

11. Colorado, Department of Public Safety, Division of State Patrol (2007). *Rules and Regulations Concerning the Permitting, Routing & Transportation of Hazardous and Nuclear Materials and the Intrastate, Transportation of Agricultural Products in the State of Colorado.* Denver, CO. Accessed May 8, 2009 at http://www.csp.state.co.us/hazmat.cfm.html

12. Colorado Department of Transportation, 2006, *FINAL REPORT, Risk Analysis Study of Hazardous Materials Trucks through Eisenhower/Johnson Memorial Tunnels*, "Executive Summary".

13. Dai, W. 2004. *Applying Proper Dispersion Models for Industrial Accidental Releases.* Dallas, Texas: Trinity Consultants.

14. Ermak, D.L.1990. *User's Manual for SLAB: An Atmospheric Dispersion Model for Denser than Air Releases*, DE91-009 443.

15. Michigan Department of State Police, Emergency Management and Homeland Security Division (2008 updated). *Guidance for Community Hazmat Response Plans*. EMD-PUB 308.

16. Michigan Department of State Police, Emergency Management Division. 2000. *Site Emergency Planning Workbook*. EMD-PUB 602.

17. Michigan Department of State Police. 2007. *Hazardous Materials Bulletin, Highway Transportation*.

18. Ministry for the Environment. 2004. *Good Practice Guide for the Atmospheric Dispersion Modeling*, Wellington, New Zealand.

19. New Mexico Department of Homeland Security. 2007. *New Mexico Emergency Operations Plan.* Santa Fe, NM.

20. New Mexico Department of Transportation. 2001. *State Highway Incident Management Plan.* Santa Fe, NM.

21. Office of the Federal Coordinator for Meteorology. 2008. *General and Specific Characteristics for Models,* Silver Spring, MD. Accessed May 8, 2009 at http://www.ofcm.gov/atd_dir/pdf/

22. Russell, E. R., J. J.Smaltz,; J. P. Lambert, , V. P.Deines, ; and R. I. Jepsen., ,1986. *Community Model for Handling Hazardous-Material Transportation Emergencies.* , Manhattan, Kansas: Kansas State University.

23. Spicer, T. and Havens, J., *EPA's User's Guide for the DEGADIS 2.1 Dense Gas Atmospheric Dispersion Model*, EPA-450/4-89-019.

24. Texas Department of Transportation, (1998). *Texas Administrative Code*, Title 43, Part 1, Chapter 25, Subchapter F, Rule §25.101 through §25.104. Austin, TX.

25. U.S. Department of Transportation, Federal Motor Carrier Safety Administration *The National Hazardous Materials Route Registry.* Accessed May 8, 2009 at http://hazmat.fmcsa.dot-.gov/nhmrr/index.asp

26. U.S. Department of Transportation, Federal Motor Carrier Safety Administration, (2004). *The FMCSA State HM Program Model Guidebook.* Accessed May 8, 2009 at http://hazmat.fmcsa.dot.gov/safetysecurity/hazmat/state-hm-guidebook.htm

27. U.S. Department of Transportation, Office of Solid Waste and Emergency Response. 1993. *HAZARDS ANALYSIS ON THE MOVE.*

28. U.S. Department of Transportation, National Highway Institute. 1996. *Highway Routing of Hazardous Materials: Guidelines for Applying Criteria.*

29. U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, *Hazardous Materials Regulations* (HMR)Title 49 CFR Parts 100-185. Accessed on May 8, 2009 at http://phmsa.dot.gov/hazmat/regs

30. U.S. Department of Transportation, Research and Special Programs Administration. 1992. *Guidelines for Selecting Preferred Highway Route Controlled Quantity Shipments of Radioactive Materials.*

31. U.S. Environmental Protection Agency, Office of Emergency Management. 2008. *Computer-Aided Management of Emergency Operations* (CAMEO), Washington, D.C.

32. U.S. Environmental Protection Agency, Office of Emergency Management. 2006. *ALOHA Area Locations of Hazardous Atmospheres User's Manual.*

33. U.S. Environmental Protection Agency, Region 9, US/Mexico Border Program. (2001. *Calexico: Hazardous Material Commodity Flow Study.* San Francisco, CA.

34. U.S. Environmental Protection Agency, Region 9, US/Mexico Border Program. 2001. *San Diego Hazardous Material Commodity Flow Study.* San Francisco, CA.