Commodity flow study: Clark County, Nevada, USA

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Abstract

The United States Department of Energy has designated Clark County, Nevada as an "Affected Unit of Local Government" due to the potential for impacts by activities associated with the Yucca Mountain High Level Nuclear Waste Repository project. Urban Transit, LLC has led a project team of transportation experts from the University of Nevada Las Vegas Transportation Research Center and Visual Risk Technologies of Nashville, Tennessee to conduct a hazardous materials community flow study along Clark County's rail and truck corridors, as well as a critical infrastructure analysis in order to assess the potential impacts of transportation within Clark County of high level nuclear waste and spent nuclear fuel to a proposed repository 90 miles away in an adjacent county. These studies were designed to obtain information relating to the transportation, identification and routing of hazardous materials through Clark County. Coordinating with the United States Department of Energy, the U.S. Department of Agriculture, the U. S. Federal Highway Administration, the Nevada Department of Transportation, and various other stakeholders, these studies examine the risk factors along the entire transportation corridor within Clark County.
Keywords: commodity flow, hazardous materials, nuclear waste, spent nuclear fuel, transportation, risk analysis, impact assessment, critical infrastructure, highway, rail.

1 Introduction

This hazardous commodity flow survey documents and examines shipments of hazardous materials in Clark County, Nevada. Specifically, this report examines truck movements of hazardous materials to, from, through, and within Clark

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County in 2005, which is the latest period for which a complete data set is available. The purpose of this study is to empirically quantify baseline conditions of existing shipments of hazardous material by truck mode. The study examines what hazardous commodities move on Clark County highways, what the volumes of these flows are, what level of use these highways experience, and what the accident rates are on these highways. The baseline conditions revealed by this examination of vulnerability from hazardous waste shipments by truck will establish parameters for future detailed risk assessment.

Clark County is one of the fastest growing metropolitan areas in the United States, and is traversed by an Interstate Highway and a major transcontinental rail route. Hazardous materials are transported by highway, rail, air, and pipeline every day, and there are accidents and incidents involved in the transportation and delivery of federally regulated hazardous materials. This study investigates the regulated flow of these materials in Clark County by truck on highways, and presents results from an analysis of the distribution of these flows. Future estimation of the risk from hazardous commodity flows by truck will use this baseline investigation to evaluate the elevated risk from adding shipments of spent nuclear fuel and other nuclear wastes to the proposed Yucca Mountain Nuclear Waste Repository should it become licensed and operational.

Protecting public health and safety is the primary mission of local government. From a public health and safety perspective, it will be critical to understand the cumulative effects of combining known or predictable levels of hazardous materials transport with potentially hundreds of shipments of high-level radioactive waste, commercial spent fuel, and naval defense waste, albeit at an uncertain start date, frequency and volume. It will be important to also assess the incremental and projected long-term gaps in public safety service levels, and the ability of local government to absorb the (most likely) unfunded mandate of costs associated with funding public safety requirements to support these future shipments.

2 Commodity flow surveys

The purpose of a hazardous commodity flow survey is to identify and document the types and volumes of hazardous material moving within, to, through, and from a specific geographic location. Identifying movements of hazardous material is of interest to government agencies responsible for transportation planning; public safety, and emergency response. Often a hazardous materials (HAZMAT) study is a component of an integrated risk assessment. Clark County commissioned this report in part not only to comply with Department of Homeland Security directives, but also to support strategic planning goals, and more importantly, to provide a baseline for the study of potential impacts should the shipment of high-level nuclear waste occur. After data for shipments of hazardous substances by all modes of transportation are assembled, assessment of risk will be addressed in future studies.

The U.S. Hazardous Materials Transportation Act of 1975 (HMTA) is the major transportation-related statute affecting transportation of hazardous cargoes. The Federal Hazardous Material Transportation law (Federal HAZMAT law), 49 U.S. Code (U.S.C.) 5101 et seq. is the primary statute regulating these flows in the United States. By regulating these flows, the U.S. Department of Transportation (USDOT) protects life and property from accidents in handling and shipping these materials. Included in this legislation are provisions for federal grants involving emergency preparedness training for response to shipping accidents. Federal regulations contained in Title 49 of the Code of Federal Regulations (CFR) Parts 100-180 outline the federal requirements for transporting hazardous materials and includes five distinct elements: 1) hazardous materials identification and classification, 2) hazard communication, 3) packaging requirements, 4) operational rules, and 5) training. Each of these components has different requirements for the various sectors of the economy and for different portions of the workforce.

The U.S. Census Bureau conducts national-scale commodity flow surveys for use by government agencies, industry analysts, and private individuals to assess changes in the economy (BTS, [1]). These surveys have been conducted at five-year intervals since 1967 and utilize samples of establishment data of shipments of commodities. Mining, manufacturing, wholesale trade, and selected retail industry establishments meeting certain criteria report to the federal government within standard guidelines and in standard formats what they are shipping. The reporting entities are commercial establishments within specific sectors of the economy and exclude private movements of freight and movements by entities not required to report commodity movements to the U.S. Census Bureau. Starting in 1993, the national reports have been augmented by state reports detailing individual state commodity shipments and trends.

The 1993 Commodity Flow Survey (U.S. Census, [2]) included the findings of a truck inventory and use survey as a first step to address this deficiency (U.S. Census, [3]). For the first time in 1993, characteristics of trucks using the highways and their cargoes were introduced. In 1997, data tables were added reporting flows between certain selected states (U.S. Census, [4]). The states selected for examination included those states with a large manufacturing base predicating large commodity exchanges. Nevada was not one of those selected states. Since 1997, these economic census reports have included a supplemental report on the movement of hazardous materials. Again in 2002, national hazardous material flows were available but no detailed information was provided for Nevada (U.S. Census, [5]). During the same time period, the Nevada Department of Transportation (NDOT) conducted a Goods Movement Study (NDOT, [6]) to estimate state level commodity flows. This effort involved the use of estimates from the TRANSEARCH statistical model based on national transportation, commerce, and other economic data. The TRANSEARCH database models all modes of commodity transportation in the United States at state, BEA area, and county scales. Numerous railroads, trucking carriers, state and federal agencies, and private industry employ this same database for estimating commodity flows at various scales. At that time of this

TRANSEARCH model development, it did not include details regarding flows of hazardous commodities. Following the shift in federal focus and its reporting requirements, additional information was included in the TRANSEARCH database related to HAZMAT cargoes.

Subsequent to the September 2001 attacks on the World Trade Center, parts of the federal government were reorganized under the U.S. Department of Homeland Security. Changes occurred in the attention of the federal government to vulnerability as well as the acquisition and dissemination of information by government. Protection of vital assets and mass population areas altered the emphasis in much of the interaction between the federal agencies and state and local governments. As a result, maintaining federal revenue-sharing eligibility in many programs now requires identifying critical assets and vulnerabilities. Continued economic vitality is directly related to the timely and efficient exchange of goods and services in the market economy composed of these assets.

3 Methodology

With the goal of assembling and characterizing Clark County truck flows of hazardous commodities as the objective, the following methodology outlines the sources of data in the report and describes how they are prepared and interpreted. Guidance on the methodology for conducting hazardous commodity flow surveys comes from the USDOT Research and Special Programs Administration (USDOT, [7]). While much of this guidance document pertains to the estimation and acquisition of cargo characteristics, it also includes recommendations for additional information to collect for estimation of highway use and accident rates. Specifically, truck flow and truck accident rates are the components of interest in addition to the commodity flows.

The best source of information at the local level for a commodity flow survey is primary data collected from a carefully constructed survey. However, collecting primary data is an expensive and time-consuming operation. For this HAZMAT study of Clark County, the quality of the TRANSEARCH modeling data, as used by federal agencies, NDOT, numerous railroads, and other commercial firms was deemed appropriate for baseline estimates. Concerns about data issues led to an expanded methodology to collect additional data. Data assembled for study fall under three distinct categories: 1) Utilization data include estimates of the level of use of highways. These use estimates include the proportion of truck traffic on highways. 2) Accident and fatality rates on the highways provide a measure of efficiency in the flows. 3) The final data element includes the estimation of total tonnage or volume of movements, the number of truckloads of HAZMAT, and the distribution and concentration of those flows in Clark County.

NDOT estimates usage of the highways within its jurisdiction through several data collection methods. Continuous counts of hourly traffic volumes are monitored at 92 fixed locations throughout the state (NDOT, [8]). Shorter

counts of seven-day duration are collected at mobile sites and factored to Annual Average Daily Traffic (AADT) counts. From these data, estimates are computed for Annual Vehicle Miles Traveled (AVMT) and reported in millions of miles (NDOT, [9]). For every segment of NDOT highway, estimates are calculated for annual usage including the proportion of total in the truck category. As in studies examining discrete sections of highways (Matranga and Semmons, [10]), we define highway segments as the portion of any state, federal, or interstate highway between its intersection with any other state, federal, or interstate highway. Additional rates of use by other aggregated categories such as county totals, functional class, urban or rural location, and others are also tabulated and presented in annual reports. Similar tabulations can be requested from NDOT for higher resolution within the state.

Another important component and typical of most hazardous materials flow studies is an assembly of information of accidents and accident rates on the highways on which hazardous commodities move. Several USDOT divisions maintain accident records for different purposes. The Federal Motor Carrier Safety Administration (FMCSA) maintains accident and safety data at the John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts (Volpe, [11]). The Volpe Center is part of USDOT's Research and Innovative Technology Administration and is a federal fee for service organization specializing in transportation and technology issues. The Volpe Center prepares annual reports of crash statistics for large trucks and buses involved in fatal and non-fatal crashes. Sources for these data are the Fatality Analysis Reporting System (FARS) and the Motor Carrier Management Information System (MCMIS).

FARS is a database that is used to provide an overall measure of transit safety and objectively evaluate safety standards and programs. FARS contains data on fatal crashes in the 50 states, the District of Columbia, and Puerto Rico. FARS analysis utilize numerous local sources to compile data including the following (NHTSA, [12]): police accident reports (PARs); state vehicle registration files; state drivers license files; State Highway Department data; vital statistics; death certificates; coroner/medical examiner reports; hospital medical records, and emergency medical service reports.

A second source of accident data is FMCSA, whose responsibility is "to reduce crashes, injuries, and fatalities involving large trucks and buses" (FMCSA, [13]). FMCSA was established as a separate administration within USDOT on January 1, 2000, pursuant to the Motor Carrier Safety Improvement Act of 1999. Understanding motor carrier accidents is essential to reducing them, so FMCSA collects data including a national inventory of motor carriers and shippers subject to the Federal Motor Carrier Safety Regulations and Hazardous Materials Regulations. Accident data assembled by FMCSA is maintained in the MCMIS Crash File. The agency maintains personally identified information (PII) for monitoring performance of individual carriers in addition to non-personally identified information. Access to portions of the data is restricted, but the Volpe Center utilizes fatal crash data in their annual national and state reports of large truck crashes.

The MCMIS crash data is known for the under-reporting of fatalities (Blower and Matteson, [14]), and the Volpe Center adds a caution on the report download page that states "Although efforts have been made to provide the most accurate and complete MCMIS Crash data possible, data quality can vary from state to state. Please use caution when interpreting MCMIS crash data" (Volpe, [15]). In an evaluation of the MCMIS data for FMCSA, the overall level of state data reporting was found lacking (Blower and Matteson, [14]). While the Volpe Center provides state profiles, NDOT also compiles accident data on Nevada highways.

Detailed data on the existing flows of hazardous materials are not aggregated in a manner amenable to analysis at the local level desired for this study. While USDOT does maintain records for individual shipments of commercially transported commodities, these records are deemed proprietary for the information they could reveal about individual firms (U.S. Census, [2]). These data have been used for mandated reporting on commodity flows and other economic census reports. National and state-level data are prepared, evaluated, and presented in numerous government reports. Sample data on individual shipments are used with other information to model data sets of flow estimates. Such integrated data modeling of origin/destination transportation flows are particularly useful for analysis of commodity flows between counties.

Renewed interest in commodity flows in the early 1990s stimulated development of new federal transportation reports and the gathering of new information to produce these reports (BTS, [16]). The Center for Transportation Analysis (CTA) at Oak Ridge National Laboratory (ORNL) constructed an integrated transportation model to matched linked pairs of origin/destination zip codes to calculate distance for the 1993 U.S. Commodity Flow Survey (U.S. Census, [2]). The U.S. Census Bureau gathered cargo shipment data from approximately 100,000 establishments of over 800,000 national establishments and used the ORNL network model to reliably estimate flows and characterize the delivery of these commodities.

Additional information is included in each Commodity Flow Survey cycle and resulting report, and collection methods are constantly evaluated and refined. The linear network dataset developed by ORNL is combined with USDOT and U.S. Census Bureau data for increasing geographic detail of commodity flows and for reliability in the estimates. All of these data sources are incorporated in the TRANSEARCH model used by NDOT for their State Goods Movement Study. These data are updated annually and have been refined since the NDOT use, to include movements of hazardous commodity cargoes.

TRANSEARCH flow estimates (Global Insight, [17]) are used to investigate and present information related to the transportation of HAZMAT on the route segments of Interstate, U.S., and state Highways from, to, within, and through Clark County, Nevada.

Title 49 CFR Part 171 defines HAZMAT in nine classes of substances as shown in Table 1.

The model of all commodity flows by all modes is a national-scale model that includes international shipments from Canada and Mexico to the United States.

A geographic information system (GIS) network is used to model this flow of goods. This model captures the flow estimates originating in or delivered to the United States as well as flows within the states. An iteration of the model can extract specific flow information for different scales of analysis.

Table 1: Classes of hazardous materials.

Class	**Hazardous Material**
1	**Explosives** Potential for mass detonation likely · Potential for mass detonation unlikely
2	**Gases** · Flammable · Non-Flammable · Poisonous
3	**Liquids** (flammable and combustible)
4	**Flammable solids** · Spontaneously combustible materials · Dangerous when wet materials
5	**Oxidizers and organic peroxides**
6	**Toxic materials and infectious substances**
7	**Radioactive materials**
8	**Corrosive materials**
9	**Miscellaneous dangerous goods**

4 Movement of hazardous commodities in Clark County

This investigation of the movement of hazardous commodities by truck includes a presentation of three distinct components: 1) the volume of traffic on the national, state, and county highways and an estimate of the proportion of truck traffic in that flow; 2) the rate of accidents on the national, state, and county highways and an estimate of the proportions of truck accidents in that total; and 3) an estimate of the type and volume of federally regulated hazardous commodities moving on the national, Nevada, and Clark County highways. The purpose of the investigation is to establish baseline conditions regarding these transportation elements, and to determine where the data is adequate for use in a risk assessment, or where the available data requires enhancement for use in a risk analysis of adding nuclear waste flows to Yucca Mountain.

The second key component of this examination is the presentation of highway accident data. Information on the nation's highway accident fatalities maintained by the Volpe Center is now available from web-based queries for national and state components (NHTSA, [18]) and special reports that provide county-level data (NHTSA, [19]). Sharp increases in traffic fatalities in Nevada and Clark County are partly explained by the overall growth in the state and Clark County population during this time.

The final pertinent data element extracted from the FMCSA data is the estimate for class of hazardous commodity released from large truck accidents. While these data are available at a national level, no estimates area available at the state, county, or municipal level. Prior to conducting a meaningful risk assessment, estimates for truck accidents with hazardous cargo releases in Nevada and Clark County will be required. With estimates for highway use and highway accidents assembled and presented, we now move to the discussion of the movement of hazardous commodities by truck.

Transportation of HAZMAT by truck in Clark County is dominated by the flow through the state. Almost three-quarters of the HAZMAT highway flow in Clark County passes through Nevada. Inbound hazardous commodities heavily outweigh the export of HAZMAT from Clark County. Bulk materials such as flammable liquids, flammable gases, and corrosive materials dominate the distribution of HAZMAT truck cargoes in Clark County. Fuels in liquid and gaseous form account for much of the tonnage moving in and through the County. The movement of highly toxic and dangerous commodities is relatively minor, but increases the potential for and probability of disastrous accident results. Over 1.5 million tons of Class 3 flammable and combustible liquids traveled Clark County highways in 2005, and over a million tons each for Class 2 gases, Class 8 corrosive materials, and Class 9 hazardous cargoes moved by truck on county highways.

5 Conclusion

While the economy of Clark County is diversifying, tourism remains the primary sector. This sector has been shown to be particularly vulnerable to stigma-related impacts such as those associated with hazardous material accidents (UER, [20]). Although the nature of the local economy is service-related, large quantities of hazardous materials travel by truck on County highways. Details about local flows removed from the highway network are practically non-existent. Estimating these local flows will be a formidable task.

Clark County's commodity flow study assembles and presents results for commodity flows by motor carriers required to comply with federal regulations regarding commercial movements of these goods. Private motor carriers and private shipments of these commodities are not as well-regulated and experience little documentation. Distribution of quantities below certain quantities to retail outlets for private purchase and consumption are not regulated and reported at all. Attaining an estimate of the total flow of these commodities is probably not realistic. The distribution of gasoline to retail outlets is an example of large

volume movements that are also missed by this and similar studies. Movements between distributors and wholesalers are regulated and recorded, but local distribution of smaller quantities to retailers is not. This type of local cargo movement, the delivery of gasoline, could be tracked and estimated. These types of movement are primarily local flows. This study documents movement of commercial commodities in supply chains, and the movement on highways at the state and national level are probably reasonable estimations. There is no way to test and prove that assumption from these data.

Truck transportation of nuclear waste to Yucca Mountain would occur on federally designated highways, unless the Governor of the state designates an alternate route. This study provides baseline estimates of the hazardous commodities that flow on those highways. This study, based on information available to date, provides a defendable estimate of those movements within the stated parameters that did not previously exist. For future examination of highway transport risk from the addition of nuclear waste, additional detail on local highway accident rates, utilization on new highway segments, and information on local distribution of hazardous commodities can be used to supplement Clark County's efforts to identify and address hazardous materials transport and effectively prepare for and respond to potential accidents or incidents and protect public health and safety.

References

[1] Bureau of Transportation Statistics, 2004. *2002 Commodity Flow Survey*. Research and Innovative Technology Administration (RITA). <http://www.bts.gov/publications/commodity_flow_survey/2002/united_states/pdf/entire.pdf>

[2] U.S. Census Bureau, 1994. *1993 Commodity Flow Survey*. Census of Transportation, Communication, and Utilities.

[3] U.S. Census Bureau, 1994b. *1993 Commodity Flow Survey Truck Inventory and Use Survey State - Nevada*. Census of Transportation, Communication, and Utilities.

[4] U.S. Census Bureau, 1999. *1997 Commodity Flow Survey*. Census of Transportation, Communication, and Utilities.

[5] U.S. Census Bureau, 2004. *2002 Economic Census, Vehicle Inventory and Use Survey*. Issued December 2004 <http://www.census.gov/prod/ec02/ec02tv-us.pdf>

[6] Nevada Department of Transportation (NDOT), 2000, *The Goods Movement Study*.___<http://www.nevadadot.com/reports_pubs/goods_movement /pdfs/GoodsChpt5Part1.pdf>

[7] U.S. Department of Transportation (USDOT), 1995. *Guidance for Conducting Hazardous Materials Flow Surveys*. Research and Special Programs Administration. <http://hazmat.dot.gov/training/state/hmep/guide_flow_surveys.pdf>

[8] NDOT, 2006. *The 2005 Annual Traffic Report*. Traffic Information Division.

[9] NDOT, 2006b. *2005 Annual Vehicle Miles of Travel.* Roadway Systems Division. December 2006.
[10] Matranga, Eric and Semmons, John, 2000. *Traffic and Expenditures on Arizona State Highways*. Arizona Department of Transportation Report Number FHWA-AZ00-484-II.
[11] Volpe, 2007. *Volpe Center Highlights.* http://www.volpe.dot.gov/infosrc/highlts/02/mayjune/ d_excel.html
[12] National Highway Traffic Safety Administration (NHTSA), 2007. *Fatality Analysis Reporting System (FARS)*. National Center for Statistics and Analysis. < http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/TextVer/FARS.html>
[13] FMCSA, 2007. *About FMCSA*. <http://www.fmcsa.dot.gov/about/aboutus.htm>
[14] Blower, Daniel, and Matteson, Ann, 2003. *Evaluation of the Motor Carrier Management Information System Crash File, Phase One*. March, 2003, Center for National Truck Statistics, University of Michigan Transportation Research Institute. Accessed 2007. <http://www.umtri.umich.edu/content/UMTRI_2003_6.pdf>
[15] Volpe, 2007b. *Crash Statistics National Overview*. Maintained by Volpe National Transportation Center, Cambridge, MA. 3-6-07 download <http://ai.volpe.dot.gov/CrashProfile/n_overview.asp>
[16] Bureau of Transportation Statistics (BTS), 1993. *Purpose and Status of the Multimodal Commodity and Passenger Flow Surveys*. http://www.bts.gov/programs/commodity_flow_survey/methods_and_limitations/html/purpose_and_status.html
[17] Global Insight, 2007.
[18] NHTSA, 2007b. *Fatality Analysis Reporting System (FARS) Web-based Encyclopedia.* National Center for Statistics and Analysis. < http://www-fars.nhtsa.dot.gov/finalreport.cfm?title=States&stateid=0&year=2005&title2=Fatalities_and_Fatality_Rates >
[19] NHTSA, 2007c. *Fatality Analysis Reporting System (FARS) Web-based Encyclopedia.* National Center for Statistics and Analysis. < http://www-fars.nhtsa.dot.gov/finalreport.cfm?year=2005&stateid=32&title=States&title2=Fatalities_and_Fatality_Rates&SpecialRpt=query1_county&SpecialRpt_lvl=2 >
[20] Urban Environmental Research (UER), 2002.