FINAL SYSTEMS DEVELOPMENT REPORT

For the

Clark County

Socioeconomic Impact Assessment of the Proposed High-Level Nuclear Waste Repository at Yucca Mountain, Nevada

Prepared for the

Clark County

Nuclear Waste Division

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Executive Summary

The Systems Development Report is the third step in the Clark County Socioeconomic Impact Assessment of the Proposed High-Level Nuclear Waste Repository at Yucca Mountain, Nevada. The purpose of this report is to describe operationalization of variables and systems under development for monitoring changes in the socioeconomic conditions existing in Clark County as reported in the Base Case Analysis. The analytic areas for which monitoring systems are being developed include economic-demographic/fiscal characteristics, emergency planning and management variables, transportation characteristics, and social and risk related factors.

The economic-demographic/fiscal characteristics which are incorporated into the Systems Development Report include: the characteristics of the local economy; the distribution and characteristics of local population; residential and non-residential land use characteristics; government service and facility systems; and government finances. Because these areas are comprised of variables which are commonly used by local governments, the maintenance of a monitoring system is anticipated to be relatively straightforward and applicable to any number of proposed projects in Clark County.

The emergency planning and management section of this report expands upon the Final Base Case Analysis--Emergency Management Section Update: Systems Development Report Data Supplement. It describes data organization and analytic applications development but does not contain the data themselves. The data used for the development of monitoring systems for emergency planning and management are designed to be of optimal utility for planning purposes. Ultimately, the system under development will, for emergencies occurring at any location in the county, allow the user to determine immediately what jurisdiction the accident is within, what and where the closest emergency resources are, which whom the jurisdiction has mutual aid agreements, what the communications capabilities of responding agencies are, how many people live within any proposed evacuation area, and what medical facilities are nearby, among other variables, to facilitate critical incident response, planning, management, and training.

The Systems Development Report for transportation modeling uses the indicators of current transportation conditions in Clark County described in the Base Case Analysis to design connecting tools and data bases for long term monitoring. This design is structured by the input requirements for specific analytic tools such as TRANPLAN and RADTRAN but it is also compatible with geographic information systems so that integration of diverse data will be possible.

The social and risk related section of this report remains to be developed. As noted in the text, this area of research is "out of phase" with other areas but, due to an accelerated development schedule, will "catch up" to other areas within the near future.

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List of Acronyms and Abbreviations

(as used in Base Case and Systems Developments Reports and Appendices)

AADT	Average Annual Daily Traffic
ADJ SKD	Adjusted Skid Resistance
ADT	Average Daily Traffic
AFB	Air Force Base
ALARA	as long as reasonably achievable
AML	Arc Macro Language
ANP	Agency for Nuclear Projects, State of Nevada
AP	Ammonium Perchlorate
APC	Air Pollution Control Division, Clark County Health District
ARC	American Red Cross
ARC/INFO	A Geographic Information Systems software package
ATR	auto traffic recorder
BCFD	Boulder City Fire Department
BCPD	Boulder City Police Department
BCPWD	Boulder City Public Works Department
BEA	Business Economic Area
BLDR	Boulder City, City of
BLM	Bureau of Land Management
BMI	Basic Management, Incorporated
BRHS	Bureau of Radiological Health Services, State of Nevada
BR	Bureau of Reclamation, U.S. Department of the Interior
BWR	boiling water reactors
CAD	computer-aided dispatch
CAER	Community Awareness and Emergency Response Program
CAMEO	Computer Assisted Management of Emergency Operations
CC	Conservation Corps
CC	Clark County
CCCP	Clark County Comprehensive Planning
CCDA	Clark County Department of Aviation
CCP	Conservation Camp Program
CCPWD	Clark County Public Works Department
CCFD	Clark County Fire Department
CCHD	Clark County Health Department
CCNWD	Clark County Nuclear Waste Division
CCOEM	Clark County Office of Emergency Management
CCPWD	Clark County Public Works Department
CCRFCD	Clark County Regional Flood Control District
CCSSD	Clark County Social Services Department
CDNARS	Civil Defense National Radio System
CDNATS	Civil Defense National Teletype System
CDWS	Civil Defense Warning System
CEMP	City Emergency Management Plan
CHARM	Chemical Hazard Air Release Model
CHEMTREC	Chemical Tracking System (National)
CHERS	Chapter Environmental Resource Systems, American Red Cross
CHLOREP	Chlorine Emergency Management Plan (National)
CORR ACTION	Corrective Action to be Taken

CPU	cardio-pulmonary units
CPU	central processing unit
CRIS-RMS	a critical incident data management computer program
CVSA	Commercial Vehicle Safety Alliance
DARE	Drug Abuse Resistance Education
dB(C)	decibels
DCNR	Department of Conservation and Natural Resources, State of Nevada
DEM	Division of Emergency Management, State of Nevada
DFS	Department of Fire Services, City of Las Vegas
DMS	Data Monitoring System
DNWR	Desert National Wildlife Refuge, U.S. Fish and Wildlife Service
DOD	Department of Defense, U.S.
DOE	Department of Energy, U.S.
DOSP	Division of State Parks, Nevada Dept. of Conservation and Natural Resources
DOT	Department of Transportation, U.S.
DOU	Disaster Operations Unit, Nellis Air Force Base
DPS	Department of Public Safety, University of Nevada at Las Vegas
EBS	Emergency Broadcasting System
EERF	Eastern Environmental Radiation Facility, Environmental Protection Agency
EIS	Environmental Impact Statement
EKG	Electrocardiogram
EMAC	Emergency Management Advisory Committee
EMAP	Emergency Management Assistance Program
EMC	Emergency Management Coordinator
EMD	Emergency Management Division, U.S. Department of Energy
EMO	Emergency Management Office, Las Vegas Department of Fire Services
EMOP	Emergency Management Operations Plan
EMS	Emergency Medical Service
EMSL	Environmental Monitoring Systems Laboratory, USEPA
EMSL-LV	EMSL - Las Vegas
EMT	Emergency Medical Technician
EOB	Equal Opportunity Board
EOB	Economic Opportunity Board
EOC	Emergency Operations Center
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency, U.S.
EPB	Emergency Preparedness Branch, U.S. Department of Energy
ERD	Emergency Response Data
ESRI	Environmental Systems Research Institute, Incorporated
EXT%	Extent Percent
FAA	Federal Aviation Administration
FAO	Fire Alarm Office
FCDFRP	Flood Control District Flood Response Plan
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FNARS	Federal Emergency Management Agency National Radio System
FNATS	Federal Emergency Management Agency National Teletype System
FNAVS	Federal Emergency Management Agency National Voice System
FRA	Federal Railroad Administration
FRERP	Federal Radiological Emergency Response Plan
FRMAP	Federal Radiological Monitoring Assessment Plan

FSFIS	Facility/Service and Fiscal Information
GIS	Geographic Information System
GISMO	Geographic Information Systems Management Office
GOR	Gross Operating Revenues
gpm	gallons per minute
GRNDB	Geographic Road Network Database
HAZMAT	Hazardous Materials
HCM	Highway Capacity Manual
HEMOP	Henderson Emergency Operations Plan
HFD	Henderson Fire Department
HMTA	Hazardous Materials Transportation Act
HMTUSA	Hazardous Materials Transportation Uniform Safety Act of 1990
HMTUSA	Hazardous Materials Transportation Uniform Safety Act
HPD	Henderson Police Department
HPWD	Henderson Public Works Department
HRCQ	Highway-route-controlled quantities
HUD	Department of Housing and Urban Development, U.S.
Hz	Hertz
IAI	Impact Assessment, Incorporated
IBC	Interim Base Case
IBM	International Business Machines, Incorporated
ICC	Interstate Commerce Commission
ICP	Incident Command Post
ICS	Incident Command System
IEMS	Integrated Emergency Management System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IRI	International Roughness Index
ISO	Insurance Services Organization
IVHS	Intelligent Vehicle Highway System
Kw	Kilowatt
LAPD	Los Angeles Police Department
LEPC	Local Emergency Planning Committee
LGMAS	Local Government Monitoring and Assessment System
LID	Local Improvement District
LLW	Low-Level Radioactive Waste
LMNRA	Lake Mead National Recreation Area, National Park Service
LOP	line of position
LORAN C	Long Range Navigation
LOS	Level of Service
LSA	Low-Specific Activity Nuclear Waste
LV	Las Vegas, City of
LVACTS	Las Vegas Area Computerized Traffic System
LVDFS	Las Vegas Department of Fire Services
LVMPD	Las Vegas Metropolitan Police Department
LVPWD	Las Vegas Public Works Department
LVRTM	Las Vegas Regional Transportation Model
LVTS	Las Vegas Transit Service
M	Maintenance
MAC Group	Multi-Agency Coordination Group
MCC	Mobile Command Center

MDPW	Mesquite Department of Public Works
MDT	Mobile Data Terminals
MEDALERT	a system of notifying medical providers in case of a mass casualty incident
Metro	Las Vegas Metropolitan Police Department
MFD	Mesquite Fire Department
MGM	Metro-Goldwyn Mayer
MHz	Megahertz
MPD	Mesquite Police Department
MPO	Metropolitan Planning Organization
MRS	Monitored Retrievable Storage
MSDS	Material Safety Data Sheets
MTU	metric tons uranium
MVNWR	Moapa Valley National Wildlife Refuge, U.S. Fish and Wildlife Service
MW	Mountain West Research, Inc.
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NAFB	Nellis Air Force Base, U.S. Department of Defense
NASA	National Aeronautic and Space Administration
NAWAS	National Warning Alarm System
NCIC	National Criminal Information Computer Network
NDF	Nevada Division of Forestry, Nevada Dept. of Conserv. and Natural Resources
NDI	Nevada Division of Investigation
NDOT	Nevada Department of Transportation
NHFA	Nevada HAZMAT Facilities Application
NHP	Nevada Highway Patrol, State of Nevada Division of Motor Vehicles
NIS	Network Information System
NLETS	National Law Enforcement Teletype System
NLV	North Las Vegas, City of
NLVDEM	North Las Vegas Division of Emergency Management
NLVFD	North Las Vegas Fire Department
NLVOEM	North Las Vegas Office of Emergency Management
NLVPD	North Las Vegas Police Department
NLVPWD	North Las Vegas Public Works Department
NOR	Net Operating Revenues
NPS	National Park Service, U.S Department of the Interior
NRC	National Response Center (in Washington, D.C.)
NRC	Nuclear Regulatory Commission
NRS	Nevada Revised Statutes
NSA	National Sheriff's Association
NTS	Nevada Test Site, U.S. Department of Energy
NWPA	Nuclear Waste Policy Act (1982)
NWPAA	Nuclear Waste Policy Act as Amended (1987)
NWPO	Nuclear Waste Project Office, Nevada Agency for Nuclear Projects
NWRD	Nuclear Waste Repository Division, Clark County
NWRP	Nuclear Waste Repository Program, Clark County
NWS	National Weather Service
O	Overlay
OCRWM	Office of Civilian Radioactive Waste Management, U.S. Department of Energy
OEM	Office of Emergency Management, Clark County
OHM-TADS	Office of HAZMAT Technical Assistance Data System, EPA
ORP	Office of Radiological Programs, Environmental Protection Agency

ORP/LV	ORP - Las Vegas facility
OSC	On-Scene or On-Site Coordinator
OSHA	Occupational Safety and Health Administration
PC	personal computer
PEPCON	Pacific Engineering & Production Company of Nevada
PIC	Planning Information Corporation
PIO	Public Information Officer
PMS	Pavement Management System
POST	Peace Officer Standards and Training
PSC	Public Service Commission
PSCN	Public Service Commission of Nevada
PSI	Present Serviceability Index
PSTN	Pesticide Safety Team Network
PWR	pressurized water
R	Reconstruct
RACES	Radio Amateur Civil Emergency Service
RADTRAN	Radioactive Transportation Risk Assessment Code 4
RAP	Radiological Assistance Program, U.S. Department of Energy
REECO	Reynolds Electric and Engineering Company, Inc.
REIMN	Regional Emergency Information Management Network
RERP	Radiological Emergency Response Plan, Environmental Protection Agency
RFCD	Regional Flood Control District
RTC	Regional Transportation Commission of Clark County
RTP	Regional Transportation Plan
SA	Salvation Army
SAC	State Agency Coordinator
SAR	Search and Rescue
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SEV IN	severity measurement in inches
SLGPG	Nevada State/Local Government Planning Group
SLP VAR	slope variance
SNAPPE	Southern Nevada Area Population Projections and Estimates Committee
SNFCA	Southern Nevada Fire Chief's Association
SNIMG	Southern Nevada Incident Management Group
SOP	standard operating procedure(s)
SP	Southern Pacific Railroad
SR	State Route
SSD	Social Services Department
SSEB	Southern States Energy Board
STCC	Surface Transportation Commodity Category
SWAT	Special Weapons and Tactics
TAZ	Traffic Analysis Zone
TCG	Transportation Coordination Group
TDM	Transportation Demand Management
TEPP	Transportation Emergency Preparedness Plan
TMA	Transportation Management Associations
TMD	Transportation Management Division
TOFC	Trailer-On-Flat-Car
TOMES	Toxicology, Occupational Medicine, and Environmental Services database program
TRANSCOM	Transportation Tracking Communications System

TRB	Technical Review Board, U.S. Department of Energy
TRC	Transportation Research Center, University of Nevada at Las Vegas
TRI	Toxic Chemical Release Inventory
TSM	Transportation Systems Management
UES	Unified Emergency Services, Clark County
UHF	Ultra-high frequency
UNLV	University of Nevada at Las Vegas
UP	Union Pacific Railroad
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USDOE/NV	United States Department of Energy, Nevada Field Office
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service, U.S. Department of the Interior
USFS	United States Forest Service, U.S. Department of Agriculture
USGS	United States Geological Survey
UTPP	Urban Transportation Planning Process
VHF	Very high frequency
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
WAPA	Western Area Power Administration
WIEB	Western Interstate Energy Board

1.0 INTRODUCTION

This introduction serves two functions. It provides an overview of where the systems development phase "fits into" the overall study plan, and then describes the content and organization of this report itself.

1.1 OVERVIEW OF SYSTEMS DEVELOPMENT IN THE STUDY PROCESS

The Systems Development Report represents the third major step in the Clark County Socioeconomic Impact Assessment of the Proposed High-Level Nuclear Waste Repository at Yucca Mountain, Nevada. The first of these steps was to forge a Research Design that would serve as a guide for the overall research process. The second step was the construction of the Base Case, the purpose of which was to describe existing conditions in Clark County in the specified analytic areas of Economic-Demographic/Fiscal, Emergency Planning and Management, Transportation, and Sociocultural analysis.[1] The base case description will serve as a basis for assessing changes in these topic areas that might result from the Yucca Mountain project. These changes will be assessed by analyzing conditions "with" and "without" repository development in the county. Prior to performing such assessments, however, the "snapshot" type of data found in the base case must be operationalized or systematized to allow for more dynamic data utilization. In other words, a data system that can be used to analyze the consequences of the introduction of different variables (or variable values) in the Clark County context must be constructed. Such a system must be capable of being updated through subsequent data collection and monitoring efforts to both provide a "rolling base case" and supply information necessary to construct trend analyses. For example, during the Impact Assessment phase of the study process, the "without" repository analysis is accomplished by analyzing growth for the county given existing conditions and likely trends. These data are then compared to the "with" Yucca Mountain project conditions anticipated for the county. Similarly, once the emergency planning, management, and response needs associated with the repository are described, these needs will be juxtaposed against existing (and various future) capacity(ies) in order to determine the nature and magnitude of impacts in this analytic area. Analogous tasks will be performed for the other analytic areas detailed in the Base Case and outlined below.

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[1] The Sociocultural component was added as a separate analytic area after the formulation of the original research design. As a result, this component is not as fully developed to date as the other areas; it will "catch up" to the others in the research process within the next fiscal year.

This Systems Development Report evolved from proposed "Baseline Scenarios." Rather than describe specific scenarios as defined early in the study process, however, it was decided as a result of Steering Committee, Peer Review Committee, and other input to focus study resources on system operationalization. As described in the Final Research Design:

> *Following the development of the Base Case, Baseline Scenarios [now the Systems Development Report] will be constructed. Although the base case provides a measurable standard against which future comparisons can be made, the reality is that changes will occur in the Las Vegas Valley, Clark County as a whole, and state of Nevada whether or not a repository is built. In order to adequately establish the impact of the repository, it is first necessary to establish the socioeconomic future of Clark County in the absence of the repository. We then juxtapose this "future" against repository-related plans.*

This Final Systems Development Report is the last step in this study phase. The intention of this report is to identify the variables that will be used for system operationalization, and the analytic products that will result from the system being operationalized. While the Systems Development Reports precede the "Repository Related Plans," "Impact Assessment Studies," and the "Monitoring and Transfer Plan" in the overall study process, one of the goals of the Systems Development Report is to anticipate the data and analytic needs of these study products and plan accordingly. This anticipation, in the form of planned continuity, will be evident throughout systems development, as the variables that will be selected for operationalization are those particular variables that will be monitored in subsequent study phases. It is also important to note that while this is a "final" systems development report, the systems under development are not themselves "final." The purpose of this document has been to shape the development of the data systems for the various study components, through the process of allowing input from a wide range of reviewers. Much work is still being done on bringing the systems themselves to fruition, though great strides have been made. As the systems themselves become more fully operationalized, further opportunities for review and revision will, of course, be provided.

1.2 ORGANIZATION AND CONTENT OF THE FINAL SYSTEMS DEVELOPMENT REPORT

The systems described in this report, when fully developed, will ultimately be a foundation of the Clark County socioeconomic impact assessment formulation, and will follow the four topic areas developed (or under development) in the Final Base Case: Economic-Demographic/Fiscal; Emergency Planning and Management; Transportation; and Sociocultural.[2]

This report has several purposes:

- to establish the structure of the system description for each of the four topic areas under consideration;
- to define the variables for the description of those topic areas;
- to identify the existing data sources for the variables indicated;
- to identify the existing modelling tools for the variables indicated;
- to establish the points of common concern among topic areas and research teams and thus to enhance the process of study integration;
- to provide a review and comment point of the systems developments effort by Clark County NWRP staff, the Steering Committee, and other interested parties.

This Final Systems Development Report represents work in progress, in the sense that the systems described are still under development. It is intended to finalize the systems design, to the extent possible, to allow for efficient use of research resources. To be effective, these resources must be focussed on a data management and modelling system that will "tell us what we want to know" during subsequent study phases (Repository Related Plans and Impact Assessments) and will allow for the incorporation of ever-updated data, both for general update purposes and for selective monitoring efforts.

[2] This work, like others before it, has been a team effort. Planning Information Corporation has borne primary responsibility for the Economic-Demographic/Fiscal analysis; the Transportation Research Center at UNLV has been a major contributor to the Transportation section. Impact Assessment, Inc., is responsible for the overall work and has borne primary responsibility for the Emergency Planning and Management and Sociocultural sections.

Consequently, we identify variables that are important for description of each element, the data to describe those variables, and the techniques that will be employed to operationalize the system so that it will provide useful analytic tools. Thus we suggest attention to the dual issues of (1) the structure and (2) the relevance and completeness of the variables for describing each topic area.

As a continuing work, this document shows differences in the development of each of the four main topic areas addressed. The work of the Economic-Demographic/Fiscal Group (Section 2.0) is the most developed, reflecting the history of this Group with the topic area and data sources. Emergency Management (Section 3.0) and Transportation (Section 4.0) are earlier in the development of both the variables for description and assessment of sources and availability, but significant work is in progress by both of these Groups. The Sociocultural Group (Section 5.0) is undeveloped, reflecting the fact that this group is now in the Base Case phase of the study process. We emphasize that in all sections there are areas which are underdeveloped due to the fact that operationalization of the system itself is still taking place, and until that is completed systems design cannot truly be considered finished. There may be variables or issues absent from this report which readers may suggest be included. Furthermore, as a work in progress it is expected that both structure and content of this report will change as the base case for each of the study areas is updated and refined.

As noted previously, this Systems Development Report parallels the organization of the Final Base Case and focuses on four major areas where primary data collection has taken (or will take) place: Section 2.0 Economic-Demographic/Fiscal; Section 3.0 Emergency Management; Section 4.0 Transportation; and Section 5.0 Sociocultural. The reader should not expect a common organizational framework for each section. Each is organized to best illustrate the unique issues regarding the topic area addressed. For example, the Economic-Demographic/Fiscal and Transportation sections are organized topically to emphasize the importance of specific variables across jurisdictions. Emergency Management emphasizes both topical and geographical organization because jurisdictional issues need emphasis in this section. Despite this varying organization, each section addresses a standard set of issues: structure for describing the topic area, the variables for this description, the relevance of the variable for description of the topic area, the projective or modelling techniques that will serve as tools later in the study process, and indications about data availability.

2.0 ECONOMIC-DEMOGRAPHIC/FISCAL

2.1 INTRODUCTION

This introduction provides a brief overview of the economic, demographic, land use, government facility and service systems, and government finance (E-D/Fiscal for short) monitoring systems which were developed for the Clark NWD socioeconomic program in 1991, and which we hope to develop further, refine, update, maintain, transfer, and institutionalize as the program continues in 1992 and beyond. The overview has several topics:

- The general concepts and objectives for the E-D/Fiscal components of the Clark NWD socioeconomic monitoring and projection/assessment systems.

- Some particular characteristics of the repository program and the Clark County context that have been considered in developing these systems: i.e., how systems development strategy is dictated by and a reflection of systems design criteria.

- A brief introduction to the E-D/Fiscal monitoring systems developed in 1991 -- focusing on two key components (a system to monitor economic, demographic, and land use characteristics -- which we call "PEDaL" -- and a system to monitor local government facilities, services, and finances -- which we call "SING," and on the "systems character" of these two components.

- An introduction to the PEDaL and SING systems in current status. In considering where and how we go from here (the subject of the following discussion), it seems useful to provide a suggestion of where we are now -- i.e., our systems resources on which to build.

The following sections outline a 3-year strategy for development, refinement, update, maintenance, transfer, and institutionalization of the E-D/Fiscal components of an integrated Clark NWD socioeconomic monitoring (Task 1) and projection/assessment (Task 2).

2.2 GENERAL CONCEPTS AND OBJECTIVES

PIC's focus in FY 1991 has been on the development and "population" monitoring systems generating integrated and geographically disaggregated information on economic and demographic characteristics and local government systems and finances (Figure 2-1).[3] We think of E-D/Fiscal systems as the analytical core of a socioeconomic assessment system that includes emergency management, transportation, risk perception, socio-cultural, and other possible dimensions (Figure 2-2). Clark County may need to bring a range of possible concerns "to the table" with DOE in the course of the repository program. Whatever those concerns may be, Clark County will need convincing and defendable analysis of their economic, demographic, and fiscal implications.

The E-D/Fiscal components of a socioeconomic assessment system deal with topics that local governments deal with every day:

- The characteristics of the local economy
- The distribution and characteristics of local population
- Land use characteristics, residential and nonresidential
- Government service and facility systems
- Government finances

The challenge of the repository program, however, is to develop systems which, using current data in a defendable and traceable way, show the effects of the repository project on the economy and demography of Clark County, and on its local government systems and finances:

- However the proponent describes it, the project must be translated into socioeconomic terms -- employees, purchases, total spending, direct revenues, etc.

- Effects on the local economy and demography require (particularly in urbanized metropolitan areas) consideration of residential and nonresidential land use.

- Effects on government systems and finances require consideration of levels of service, service standards and mandates, and service deficiencies and capacities.

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[3] Figures 2-1 through 14 can be found at the end of Section 2-5.

- The distribution of these effects is critical. We are concerned, not just with the aggregate effects in Clark County, but with the effects on particular service areas -- whether these are metro "beat" area 51, sewer sub-basin 1007, water pressure plain 2420, traffic analysis zone 541, the US 95/I-15 Corridor, or Paradise, Indian Springs, or Mesquite.

For any such impact topic and any geographic focus within Clark County, we want to be able to describe current conditions and repository project impacts in consistent and coherent terms. All of this applies whether the "project" is the repository as in our case, or another major project such as Nellis AFB or the Excalibur, or the Henderson heavy industry "doughnut hole," or the NLV Potlach plant, or an ordinary land development -- a subdivision, PUD, or shopping center. We still need to describe the project in socioeconomic terms, then:

- Link that to local economy, demography, and land use
- Link that with local government systems and finances
- Consider the geographic distribution of impacts
- Use consistent terms of reference across jurisdictions, impact topics, and time

2.3 SYSTEMS DESIGN CRITERIA AND SYSTEMS DEVELOPMENT STRATEGIES

Any effective socioeconomic monitoring program must be tailored to particular local circumstances (circumstances "on the ground," so to speak), to particular characteristics of the project, and to the status of locally available information resources. Before presenting some of the key systems developed over the past year, it may be useful to mention a few Clark County circumstances that we have tried to consider in developing monitoring systems.

2.3.1 Rate of Growth and Change

Few urban areas in the U.S. have experienced the sustained and sometimes explosive growth experienced in the Las Vegas Valley over recent years and, in fact, decades. This "context condition" affects everything in Clark County -- regional and local traffic issues, social and emergency services, service patterns in rural Clark County (94% of total county land area) whose communities in some cases have not grown significantly, etc. (see Figure 2-3a, b).

Whatever the future growth trajectory, the area will spend years contending with the consequences of recent growth -- systems deficiencies of various types and distributions, deficiencies in information systems, and glitches in intergovernmental coordination, etc.

2.3.2 Local Government Scale and Complexity

Another context condition is the sheer scale and complexity of the combined local government enterprise in Clark County (Figure 2-4a, b). The scale of local government operations in Clark County are comparable to those of companies in Fortune's top 200, and the facility and infrastructure assets for which Clark County governments are responsible are substantially greater than those of most of the nation's top 200 companies.

Yet, unlike a top 200 company, Clark County government is dispersed among multiple entities and agencies, each with its own set of objectives (complex compared to a private enterprise), its own information systems, its own financial obligations and resources, etc. While government is expected to be efficiently managed, well-coordinated, and highly accountable, its information systems alone ensure continuing shortfall in meeting such expectations.

2.3.3 Distribution of Growth and Service Area Characteristics

A third context condition is the uneven distribution of growth in Clark County and the widely varying service area characteristics resulting in part from the intensity and distribution of growth (Figure 2-5a, b, c). The most obvious example, perhaps, is the distinction between Clark County's rural desert settlements and the Las Vegas Valley metropolitan area -- areas which have entirely distinctive government service systems and objectives. Within the Las Vegas Valley, the objectives for government service systems are more consistent, but service area characteristics vary widely. As a result, project effects encounter widely varying systems capacities and deficiencies, neighborhood concerns, and demographic conditions.

2.3.4 Repository Program/Project Time Line

What makes the repository project unique? Some focus on the perceptions of risk associated with high-level nuclear wastes. Others focus on the complex links between a high-profile national program and policy on the one hand and, on the other hand, the manifestations of that program and policy as a local project (in Nevada, southern Nevada, Clark County, Clark County communities, Clark County government systems service areas).

Or, at a very practical level, one can focus on the time line for the repository program and project, and the relationship of the Clark NWD program to that time line. This is not an ordinary "ad hoc" assessment report project. We hope to develop systems in the Clark NWD program that are maintained, developed, and institutionalized so that they are available and useful when the EIS process gets underway sometime after 1995, during license application review in early 2000, etc. (see Figure 2-6).

2.3.5 Uncertainty in Types of Impacts

A corollary of the above is that, while the current focus may be on impact categories "A" and "B," the types of repository impacts that will be of concern 5-10 years hence is in fact uncertain. We don't know for sure whether the focus will be on rail or truck shipments, a northern or a southern corridor, effects on visitor-gaming or retirement migration, effects on infrastructure deficiencies or social service mandates, focus on mitigation or avoidance, etc. (Figure 2-7).

Whatever specific concerns emerge in the repository program, we need to describe the project in socioeconomic terms and assess the implications for the economy and demography of Clark County, and on its government infrastructure and service systems and finances.

2.3.6 Systems Development Strategies

The above context conditions (growth and change, scale and complexity, distribution, time line, and uncertainty) require a state-of-the-art socioeconomic monitoring program, a "monitoring system" in fact not just in name, developed according to the following systems development strategies:

- Focus on computerized information systems, not ad hoc paper reports.

- Build on best currently available data, incorporating better data as it becomes available, but not allowing the better resource promised next year to stymie useful systems development this year.

- Build integrated information systems from existing sometimes fragmentary, often unintegrated information resources. We do not impose our information requirements or structure on existing service providers; rather, we build from what they have towards more comprehensive and integrated information systems.

- Incorporate service area geography, enabling communication with police, sewer, parks and recreation, transportation, and other officials in their own terms of geographic reference -- i.e., build a constituency among service providers in line agencies.

- Be comprehensive, in order to cast a "wide net" for uncertain future effects -- i.e., all government functions, all entities, rural and urban areas, capital and operating costs.

- As systems are developed, update and maintain, test, apply, and refine (use it or lose it).

- Transfer and institutionalize -- access to data resources, maintenance and update, systems applications.

2.4 E-D/FISCAL MONITORING SYSTEMS

Efforts in 1991 developed a variety of information resources, all of which are potential inputs to or components of an integrated E-D/Fiscal monitoring system: e.g.,

- Regional economic trends data access, analysis, and visualization
- 1980 and 1990 census data access, analysis, and visualization (ACCEN)
- Visitor-gaming data synthesis, integration, and visualization
- NTS information access, analysis, and visualization

In this introduction, however, we want to focus on three core components of the information systems under development:

- One deals with the repository program and project.

- A second deals with economic, demographic, and land use characteristics at the service area level.

- A third deals with local government service systems and finances.

2.4.1 Repository Program and Project (Figure 2-8)

The repository project presents particular challenges for socioeconomic assessment:

- It's a national program, not just a local initiative. One cannot validly describe the local project without considering linkages to the national program.
- It has a very long time line, with much uncertainty as to schedule.
- Many aspects which could affect Clark County are uncertain, with no early resolution in sight:
  - MRS (and functions and location of MRS)
  - Use of truck or rail
  - Choice of routes
  - Portions managed in NV/LV
  - Busing and other project management policies
- It involves a large and complex federal agency, for whom socioeconomic considerations have not been a traditional priority or strength.

Our strategy is not to force DOE to resolve all these uncertainties for us in 1992, because they really can't. We do, however, want to use the information they can provide to create the inputs that we need for socioeconomic impact assessment in Clark County, and this forces us to develop information systems that link program directions, funding, and scheduling at the national level with project spending, employment, purchases, shipments, etc., at the local level in Nevada generally and in Clark County in particular.

- Funding
- Scheduling
- Employment by place of work
- Employment by place of residence
- Purchases and procurement
- Project management policies

2.4.2 Service Area Economic, Demographic, and Land Use Characteristics (PEDaL)

Regarding the monitoring of economic and demographic conditions and land use (Figure 2-9), our challenges include the following:

- The most reliable economic data is generally available at the countywide level, while the best land use data is generally available for parcels. We need to make the link between the two (Figure 2-10).
- Starting, essentially, from the same information base on housing inventory, various agencies (the U.S. Census Bureau, Clark Comprehensive Planning, the state demographer, several localities) regularly produce different and often quite different estimates of total population.

The Clark NWD socioeconomic program needs to avoid Hobson's choices, in which any choice has political implications which are a diversion from socioeconomic monitoring systems development. It is not the role of Clark NWD to decide whether Henderson has a population of 60,000 or 80,000 (Figure 2-11). At the same time, we need demographic information other than total resident population -- e.g., various age groups, housing and household characteristics, perhaps household income, visitor and workplace population, etc.

- Drawing on an integrated information base of economic, demographic, and land use information, we need to present this information for any service area -- any sewer service area, fire response area, zip code area, school enrollment area, etc. (Figure 2-12a-e). Why?
    - Because we need to monitor the distribution of impacts, not just the aggregate.
    - Because we need to calculate types and levels of service for service sub-areas -- not just for the entirety of Henderson, the City of Las Vegas, or the unincorporated Las Vegas Valley.
    - Finally, because we believe we can develop a constituency for this information system among the many service providers who contribute to it -- they contribute information on their own functions in their own terms; they get back an integrated and multi-dimensional information resource presented in their own geographic terms of reference.

- Finally, we need to be able to update this data for any point in time -- annually, semiannually, quarterly -- which among other things means that the second-time database development costs need to be less than half the first-time costs, and third-time costs may be one-third.

Our system for meeting these challenges is called PEDaL. It is a parcel-level database which is assembled for presentation for any service area. It starts with the Clark County assessor's file, but uses several analysis model procedures to augment that file with additional demographic, economic, land use, land capacity, and service demand information. The resulting database has a record for every parcel and many existing potential fields with selected assessor file, demographic, economic, existing land use, land capacity, and service demand information. This data is then presented in tables, figures, or thematic maps (using ArcView) for any service area incorporated in the systems design.

2.4.3 Local Government Facility and Service Systems and Finances (SING)

Regarding the monitoring of local government systems and finances (Figure 2-13), our challenges include the following:

- Clark County includes several general governments and special districts, each of which has its distinctive organization for service delivery, and categories and terms for financial reporting. We want to be able to communicate with each entity in their own terms of reference, but also describe services in consistent terms of reference across the Las Vegas Valley for example, or between the rural and urban portions of the county.

- Each general government has numerous line departments, which we need to draw on for "ground-truth" information about the characteristics of particular fire, police, sewer, parks, and other services. But this information is in many forms -- ranging from well-maintained computer files to scraps of paper in a drawer, to a knowledge base in an individual's head. We need to draw on this information in whatever form it currently exists, building on it a much more coherent and integrated information resource.

- While current government information is generally maintained at the entity level, we need to monitor service levels and service requirements at the service area level -- i.e., not the City of Las Vegas as a large entity with a ragged jurisdiction boundary, but a particular service area in the northwest area, perhaps including unincorporated as well as incorporated areas. Consistent with control totals at the entity level, we need to monitor types and levels of service for service areas within or straddling jurisdiction boundaries.

Our system for meeting these challenges is called SING. It builds on existing government information resources but "dimensions" these by government function, object[4], and service area, linking financial with service and (we hope in FY 1992) PEDaL sub-area economic, demographic, and land use characteristics.

2.5 E-D/FISCAL SYSTEMS DEVELOPMENT PROGRAM

This section presents a multi-year program for development of economic, demographic, and fiscal monitoring and projection/assessment systems. The program is presented in tasks and sub-tasks, using an internally consistent numbering scheme separate and distinct from the section numbering used in the discussion of systems development in this and other parts of this report. To make the distinction visual, the task outline is presented in italic typeface, in a summary listing (Figure 2-14) and in the following work plan description.

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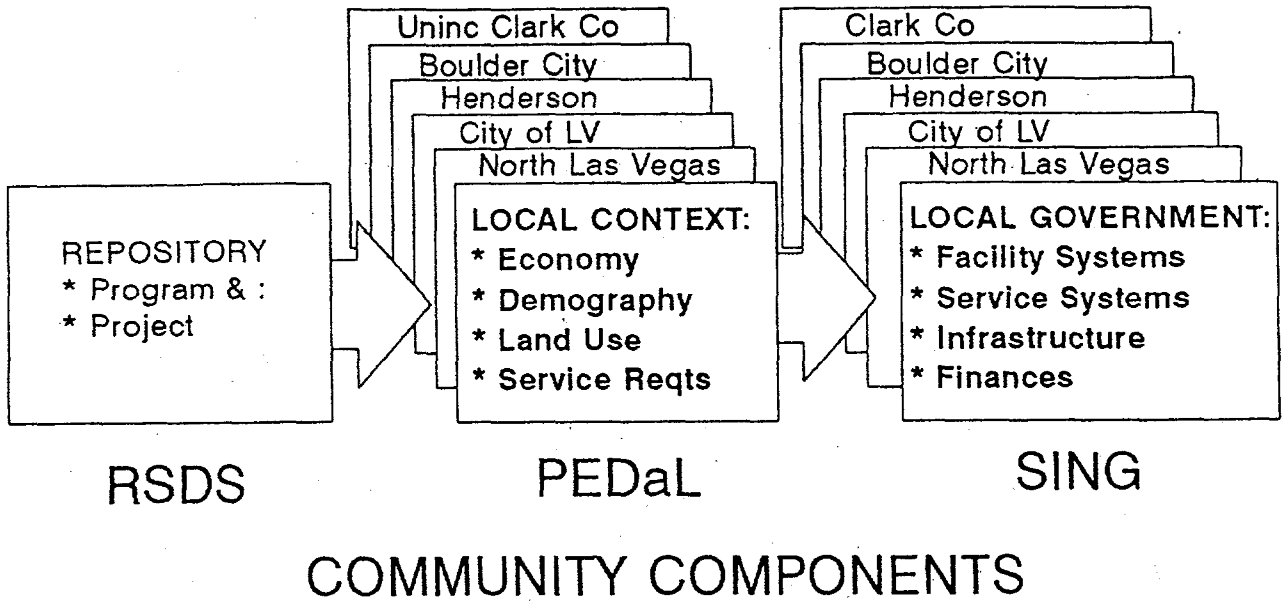
[4] Direct services, direct service support, administrative/management.

Figure 2-1 (Section 2.2)
Integrated E-D/Fiscal Monitoring/Assessment Systems



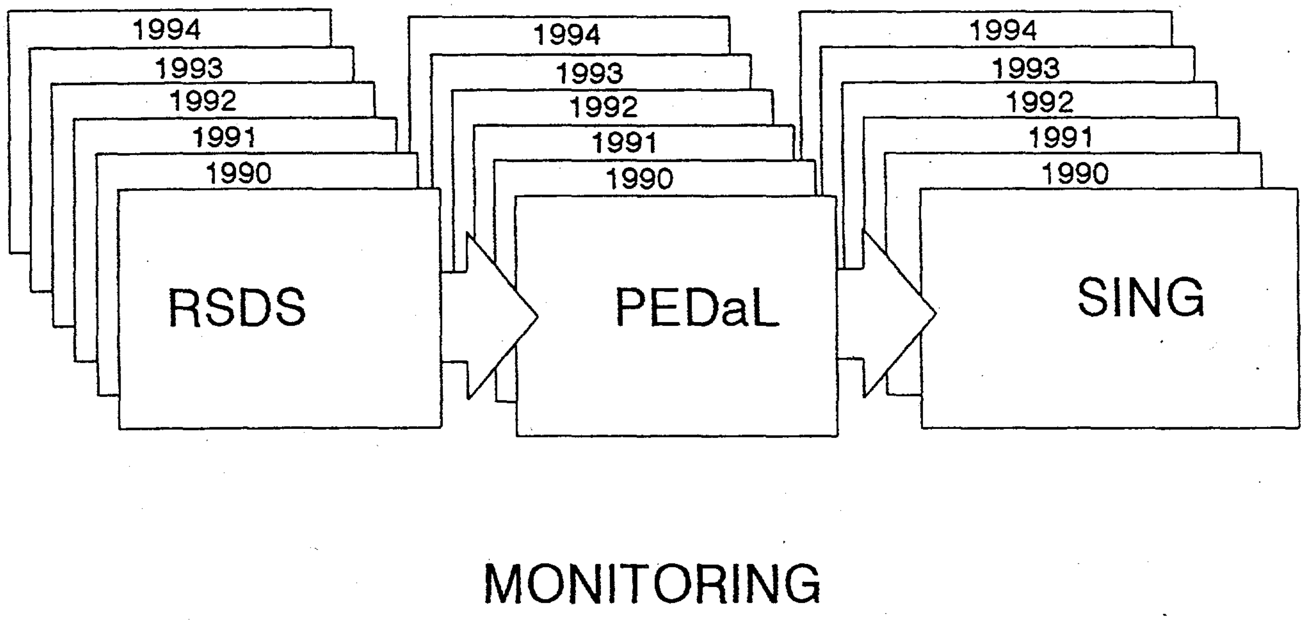


Figure 2-2 (Section 2.2)
Integrated Socioeconomic Assessment

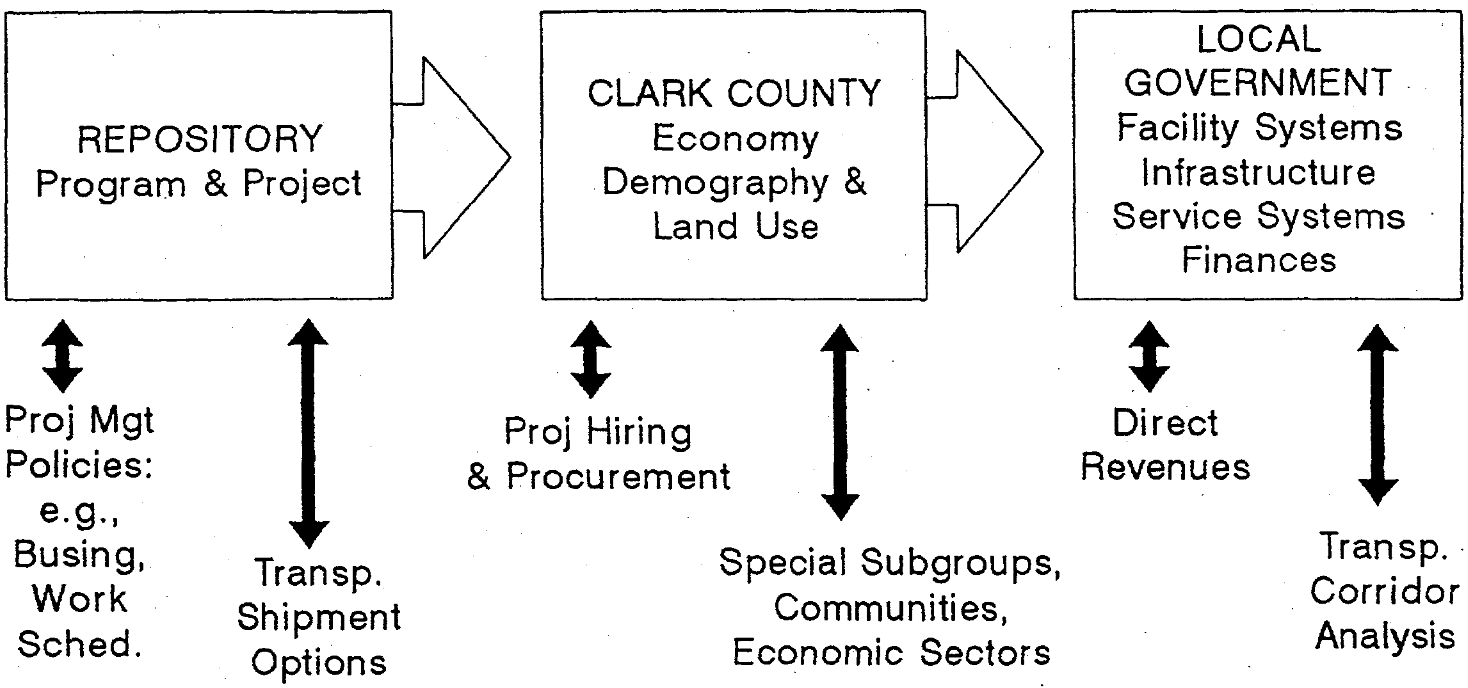


Figure 2-3a (Section 2.3.1)
Clark County Share of Regional Population: 1910-1990
(Southwest U.S.: California, Arizona, Nevada)

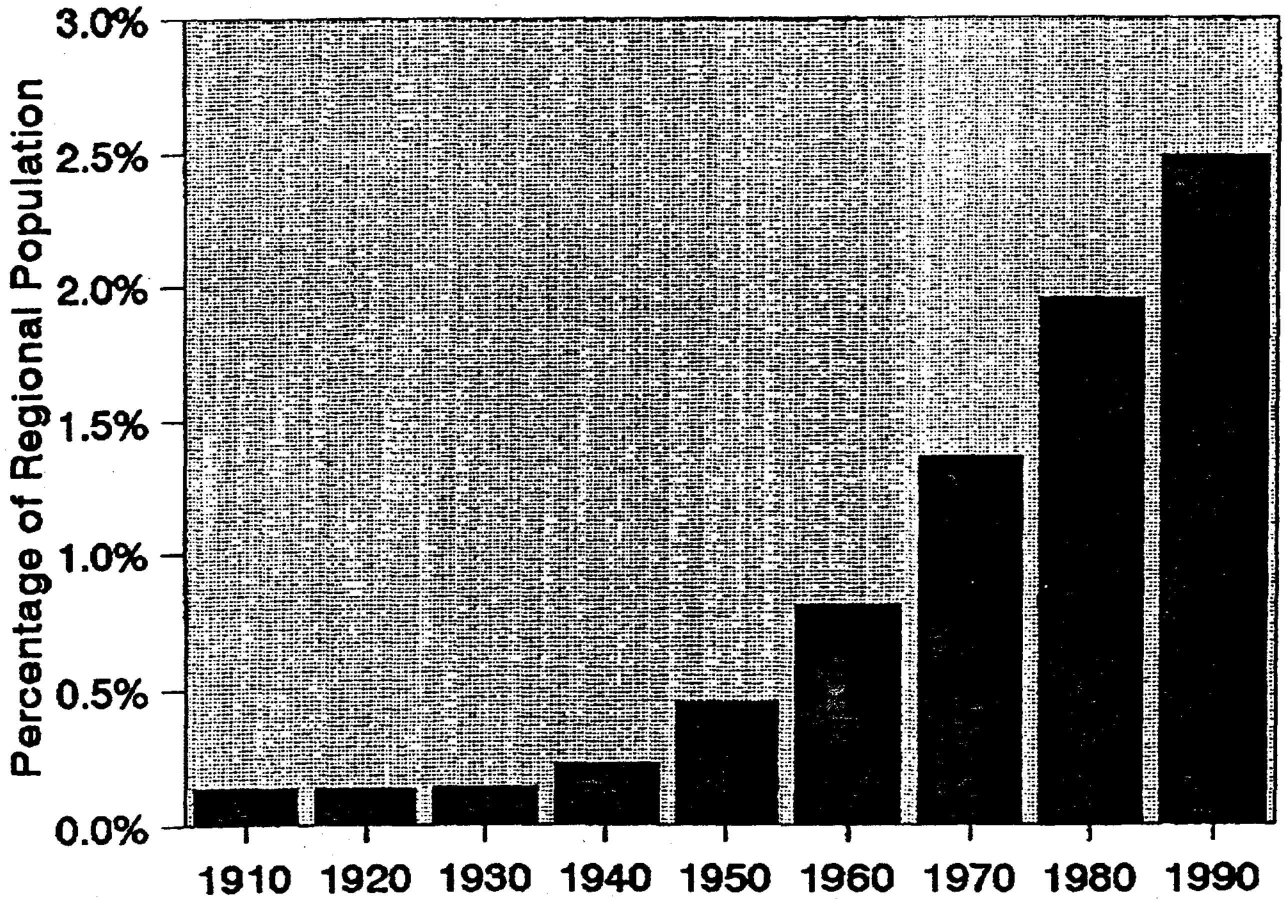


Figure 2-3b (Section 2.3.1)
Clark County Share of Regional Growth: 1910-1990
(Southwest U.S.: California, Arizona, Nevada)

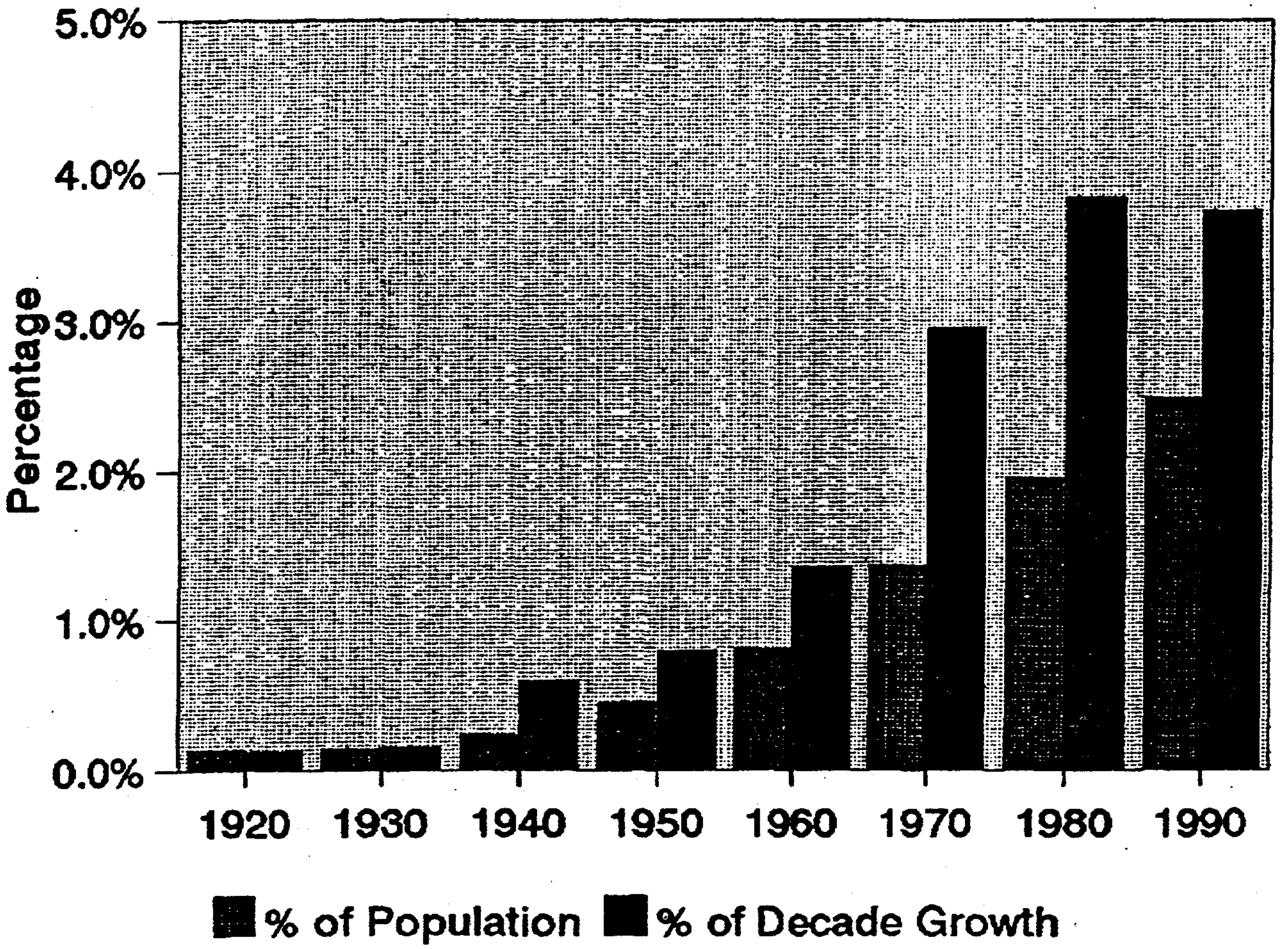


Figure 2-4a (Section 2.3.2)
If Clark County Were a Fortune 500 Company: Revenues

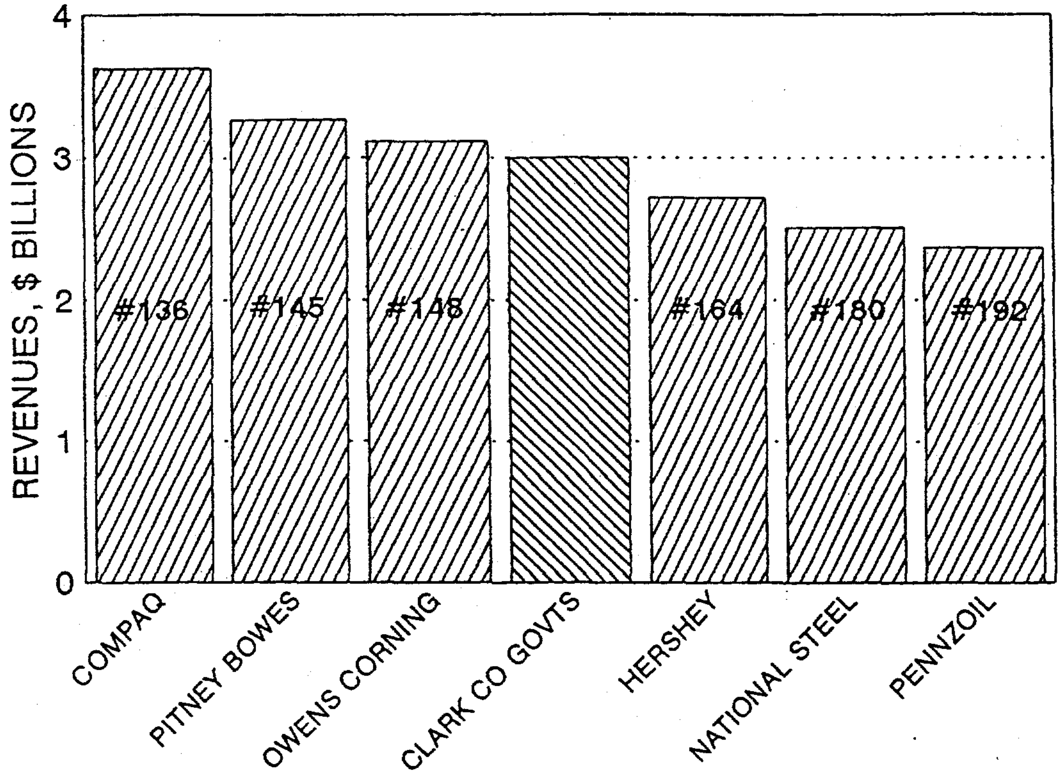


Figure 2-4b (Section 2.3.2)
If Clark County Were a Fortune 500 Company: Assets

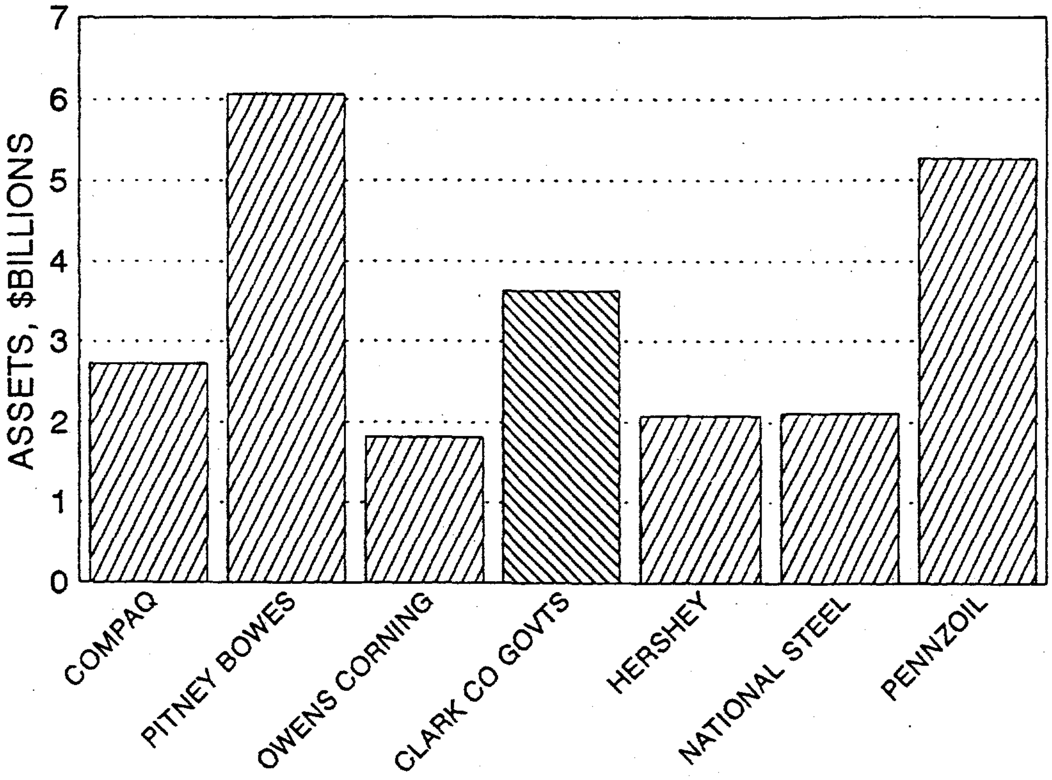


Figure 2-5a (Section 2.3.2)
Clark County and Las Vegas CCD: 1990

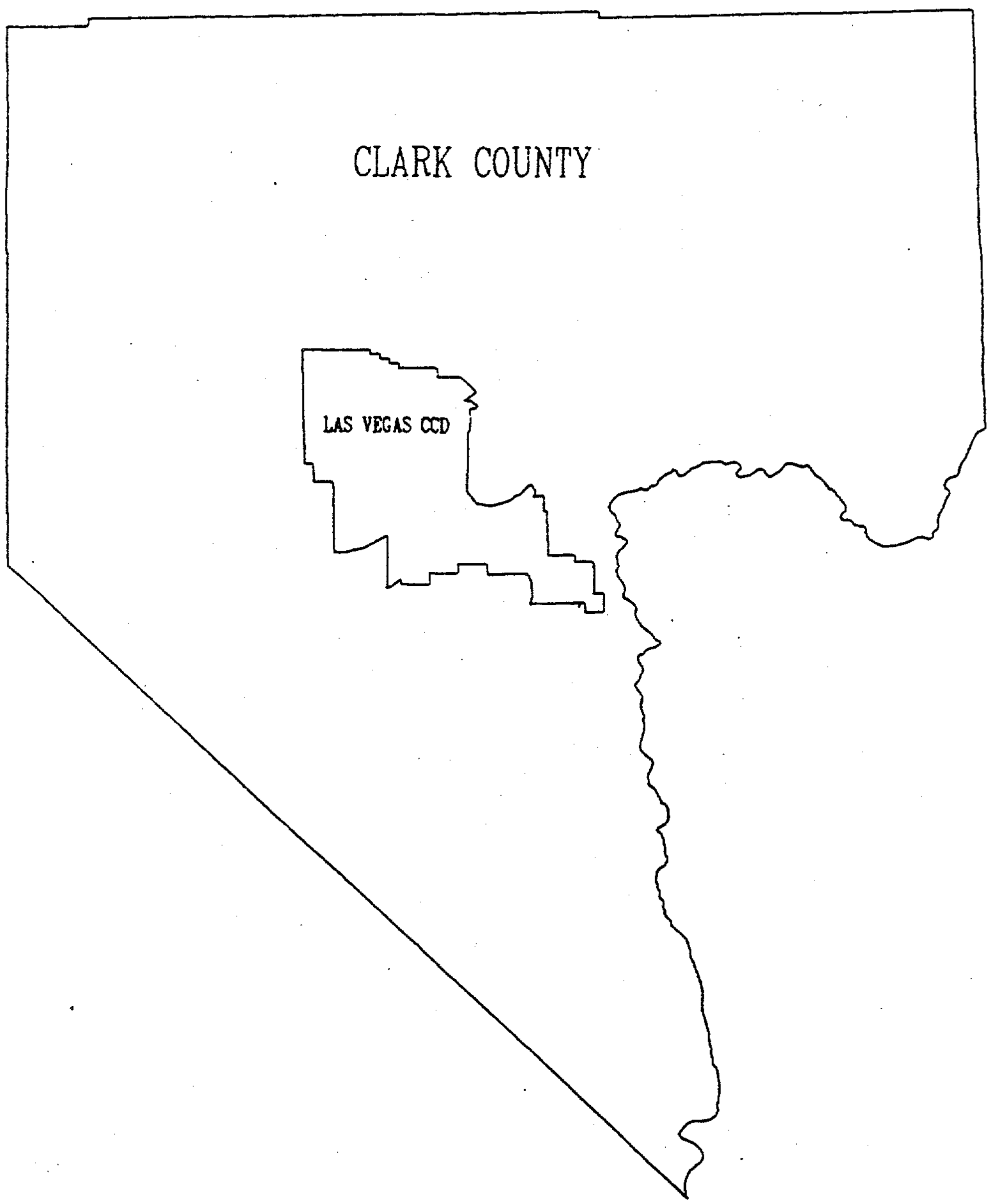


Figure 2-5b (Section 2.3.2)
Distribution of 1980-1990 Population Growth: Las Vegas CCD

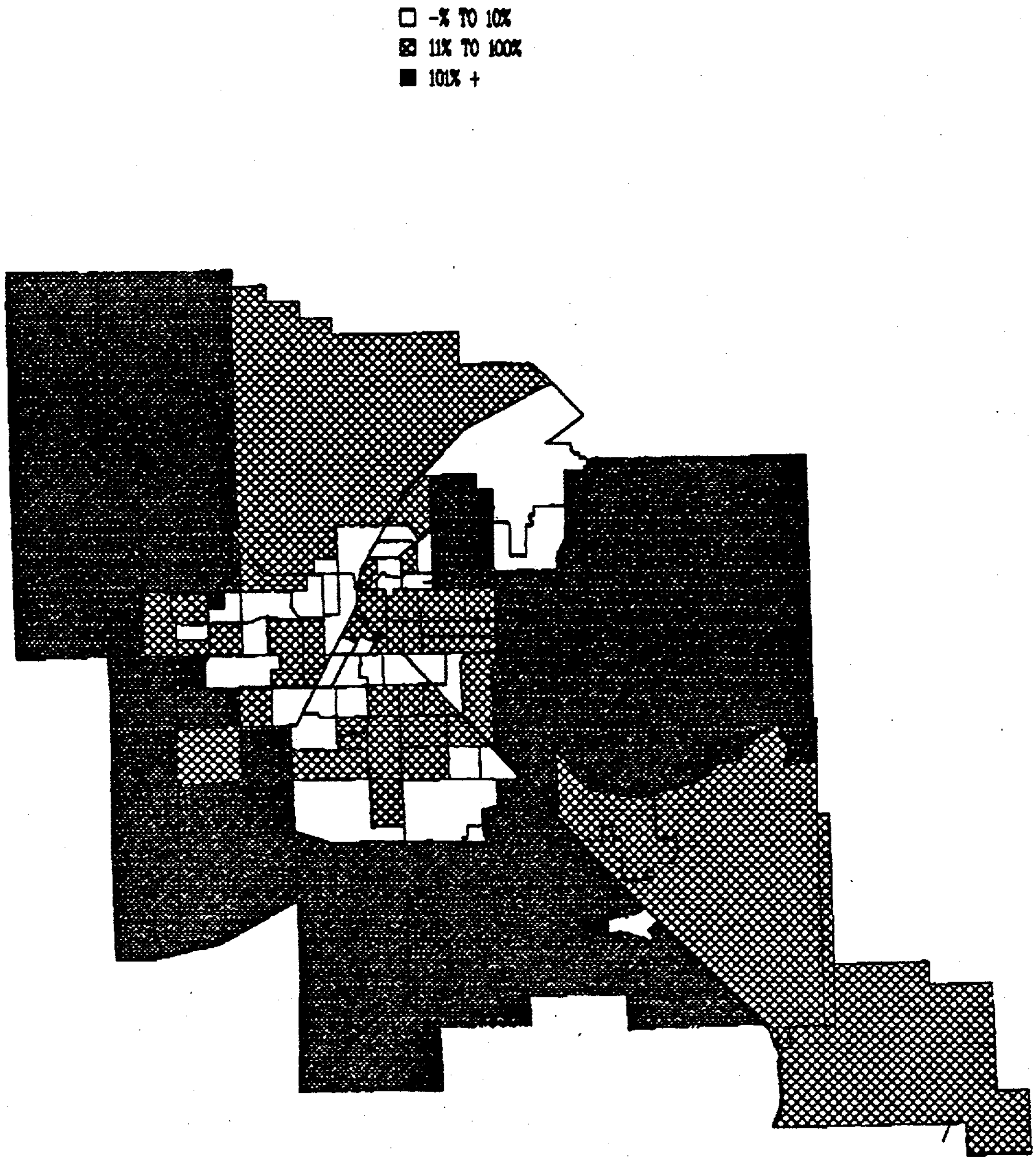


Figure 2-5c (Section 2.3.2)
Distribution of Population Density: 1990
Las Vegas CCD

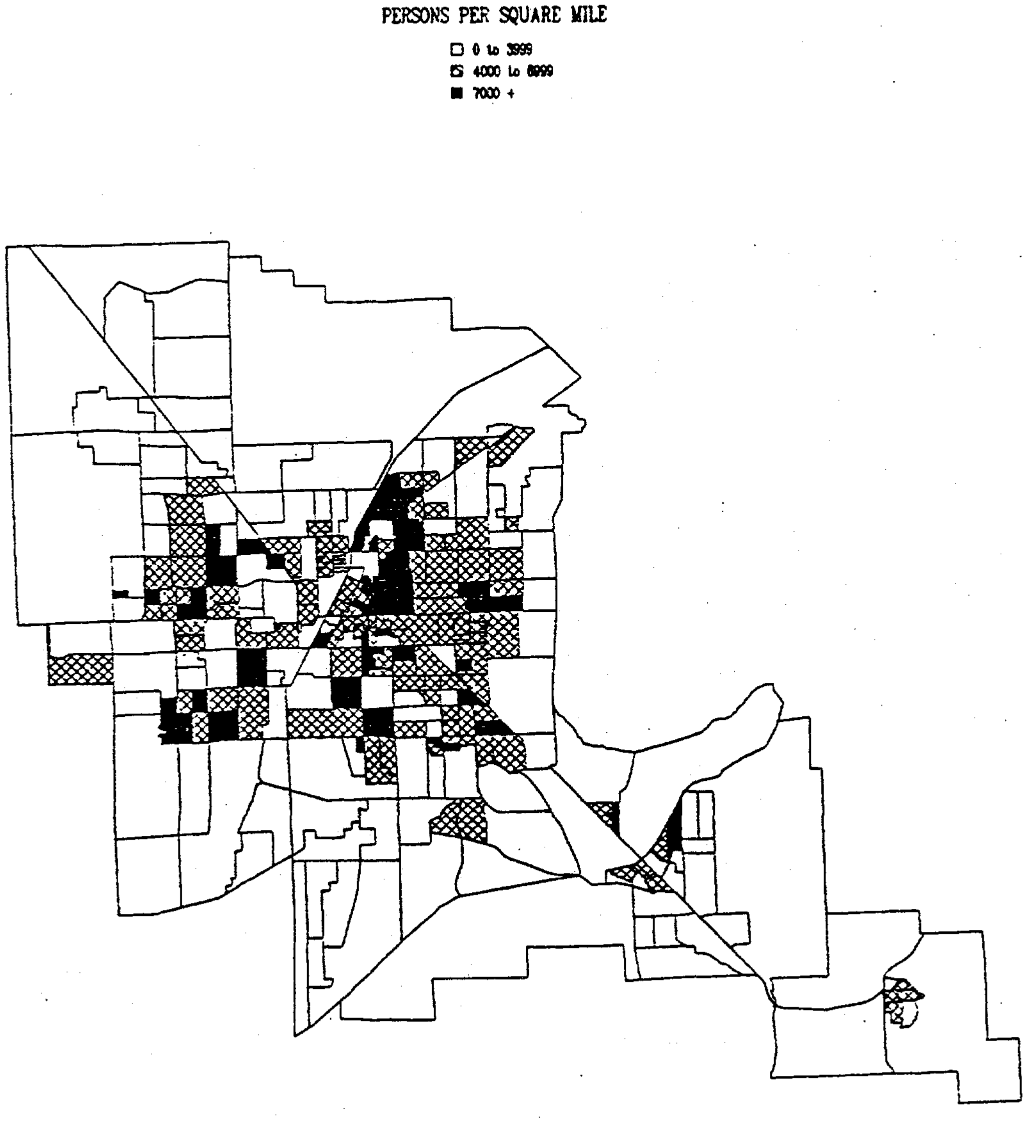
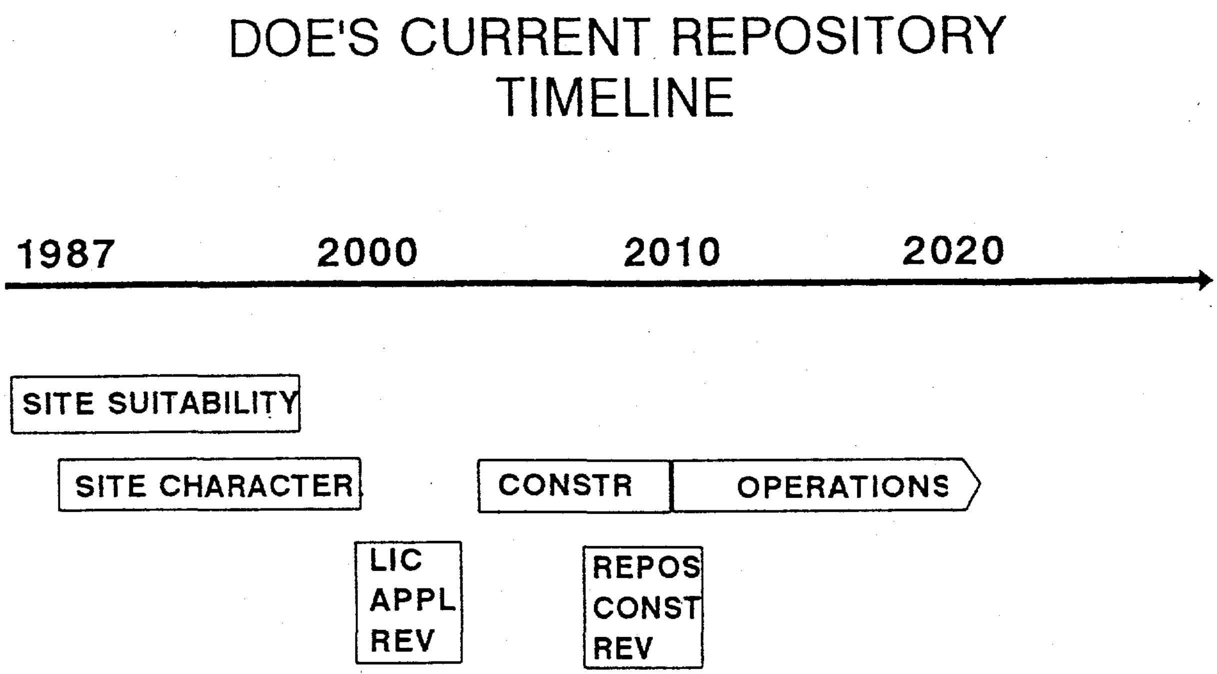


Figure 2-6 (Section 2.3.4)
Repository Program Timeline



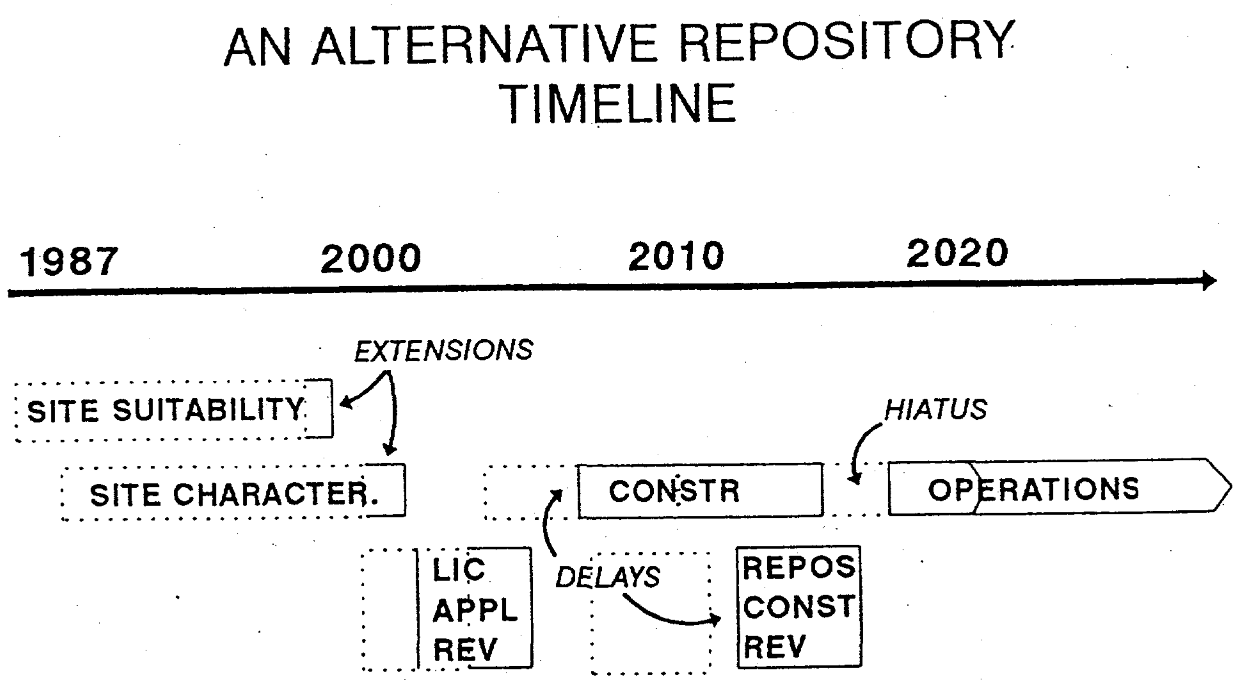


Figure 2-7 (Section 2.3.5)
Dimensions of Uncertainty: USDOE/OCRWM Waste Management System

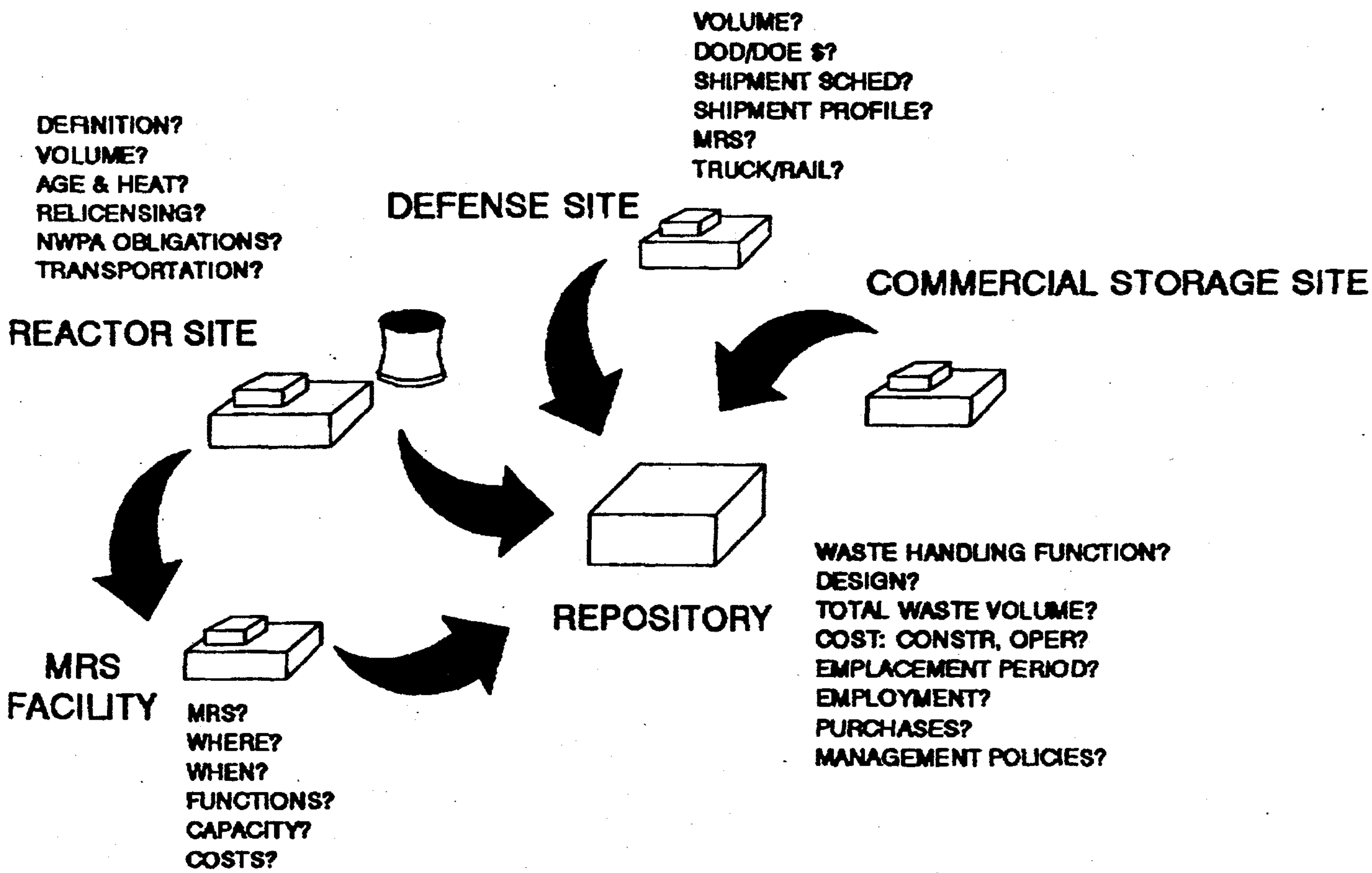


Figure 2-8a (Section 2.4.1)
Integrated Monitoring/Assessment Systems:
Repository Program & Project

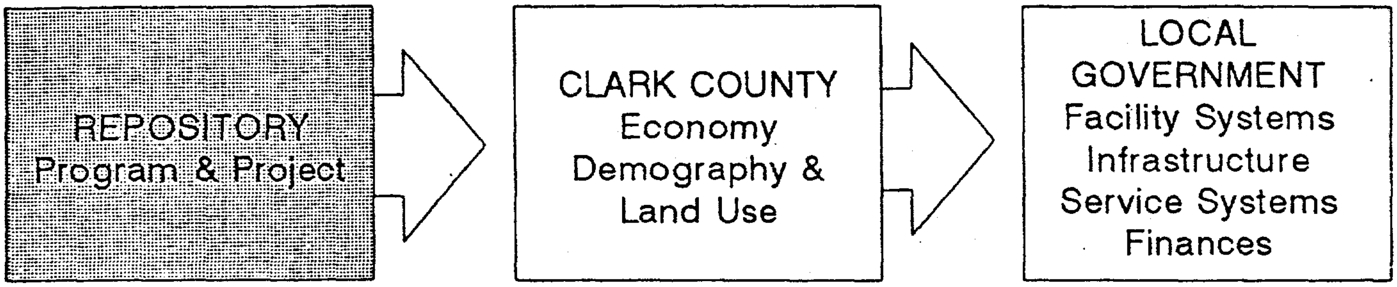


Figure 2-8b (Section 2.4.1)
The National Repository Program & Local Project:
"Standard" & "Special Effects"

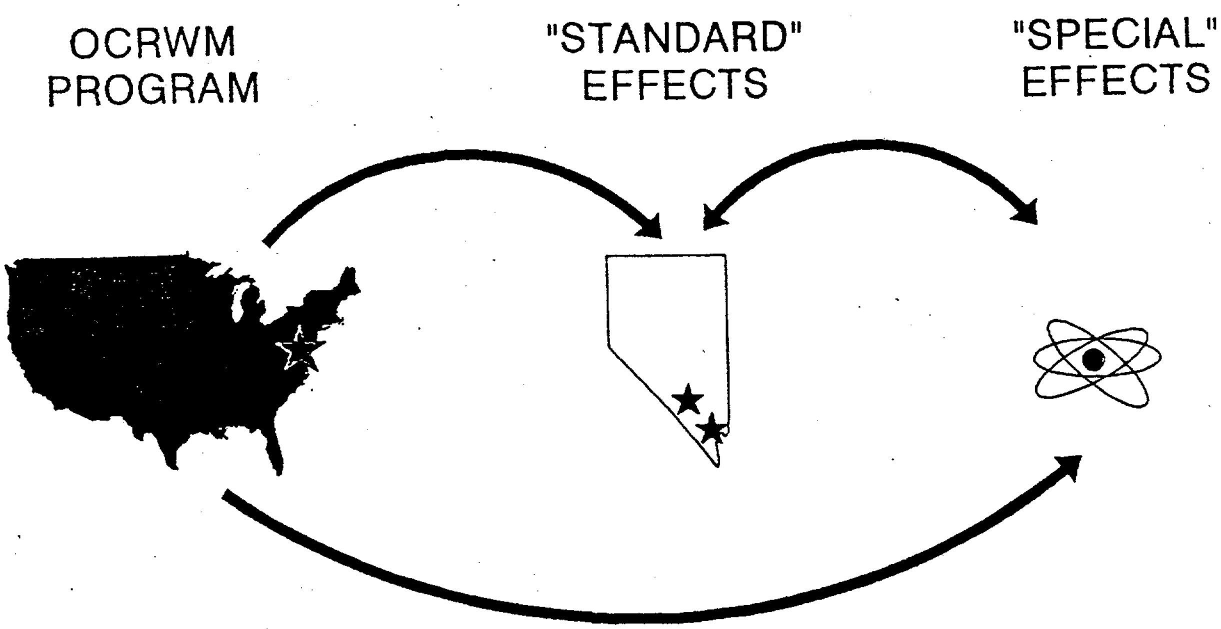


Figure 2-9 (Section 2.4.2)
Integrated Monitoring/Assessment Systems:
Local Economy, Demography, & Land Use

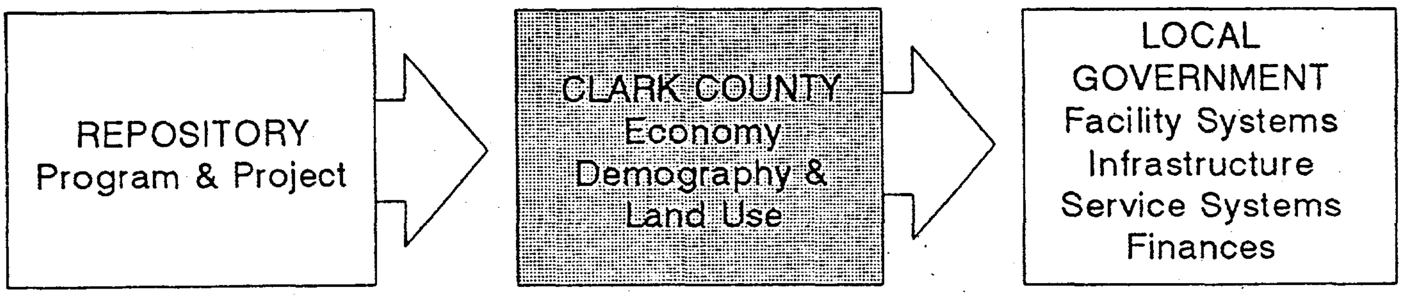


Figure 2-10a (Section 2.4.2)
Linking E-D & Land Use Terms of Reference

	ECONOMY	DEMOGRAPHY
RESIDENTIAL LAND USE	HOME OCCUPATION EMPLOYMENT	RESIDENT POPULATION
NON-RESIDENTIAL LAND USE	WORKPLACE EMPLOYMENT ——— VISITOR POPULATION	GROUP QUARTERS POPULATION

Figure 2-10b (Section 2.4.2)
Linking E-D & Land: The PEDaL Process

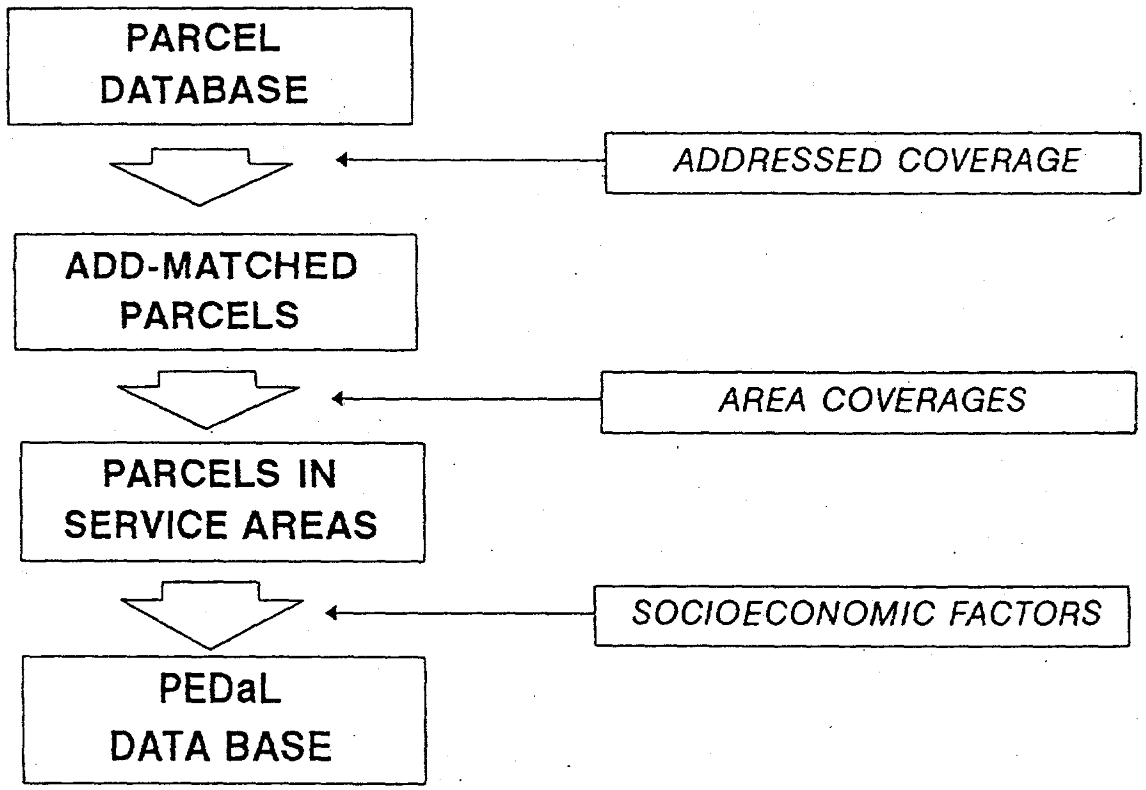
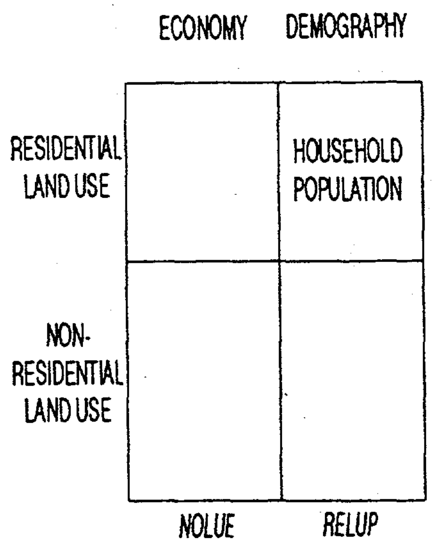


**Figure 2-10c (Section 2.4.2)
Linking E-D/Land & Service Requirements:
Household Population**



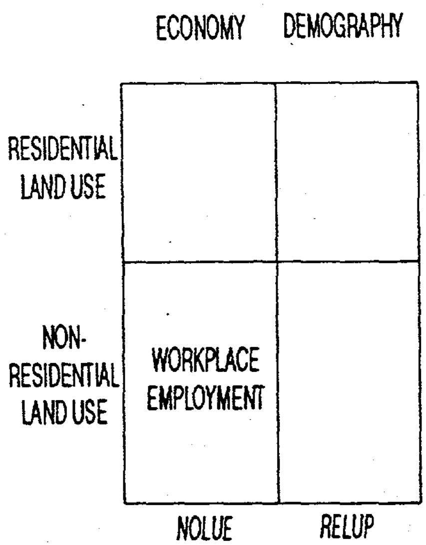
E-D CHARACTERISTICS

* Avg Hshld Size
* Hshld Type
* Age Distribution
* Hshld Labor Force
* Hshld Income
* Vehicle Ownership
* Hsng Vacancy

SERVICE REQUIREMENTS

* Trip Generation
* Sewer Flow
* Water Reqts
* School Enrollment
* Recr Potential
* Crime Potent.
* Fire Svc Reqts.

Figure 2-10d (Section 2.4.2)
Linking E-D/Land & Service Requirements:
Workplace Employment



E-D CHARACTERISTICS

* Jobs by LU Categ
* Jobs
* Earnings
* Building Space
* Building Vacancy
* Taxable Sales

SERVICE REQUIREMENTS

* Trip Generation
* Sewer Flow
* Water Reqts
* Police Protection
* Fire Svc Reqts.

Figure 2-11
Alternative Intercensal Population Estimates:
City of Henderson: 1980-1988

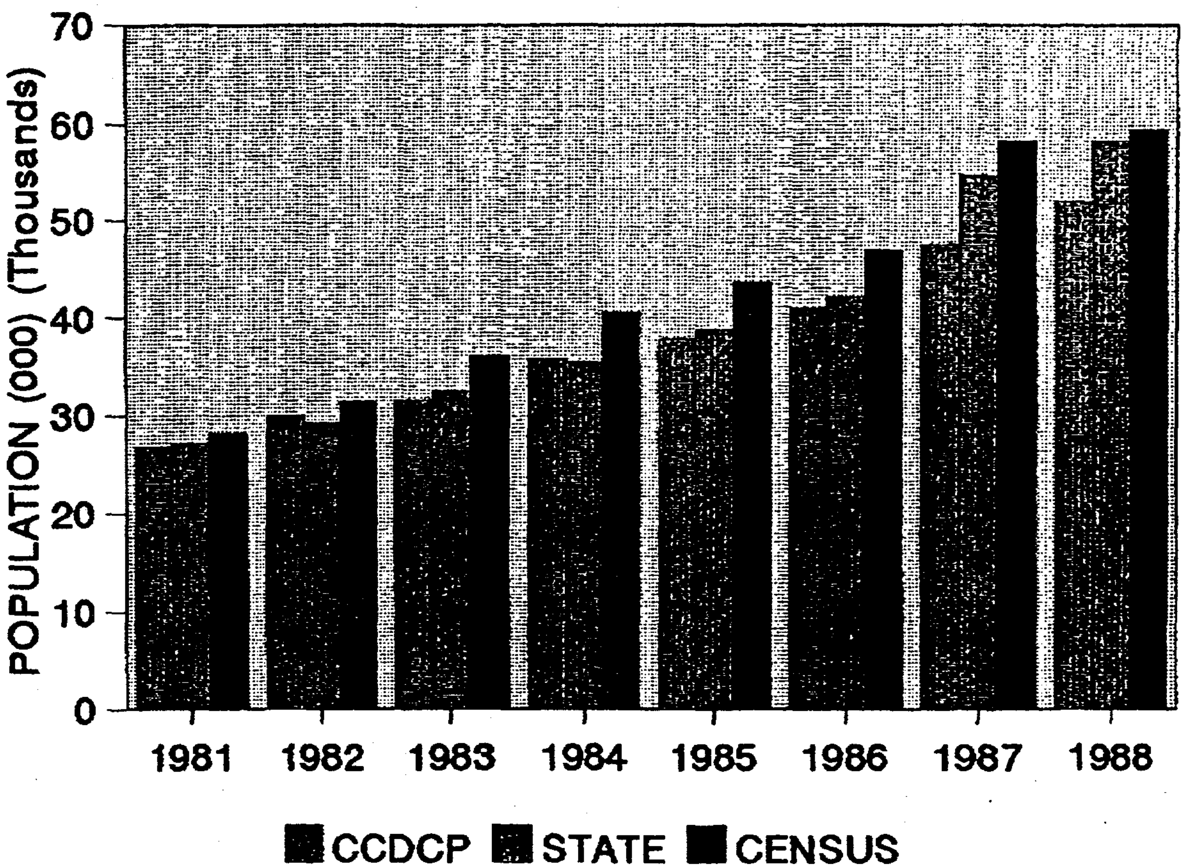


Figure 2-12a
Local Service Area Geographies:
Traffic Analysis Zones (NLV)

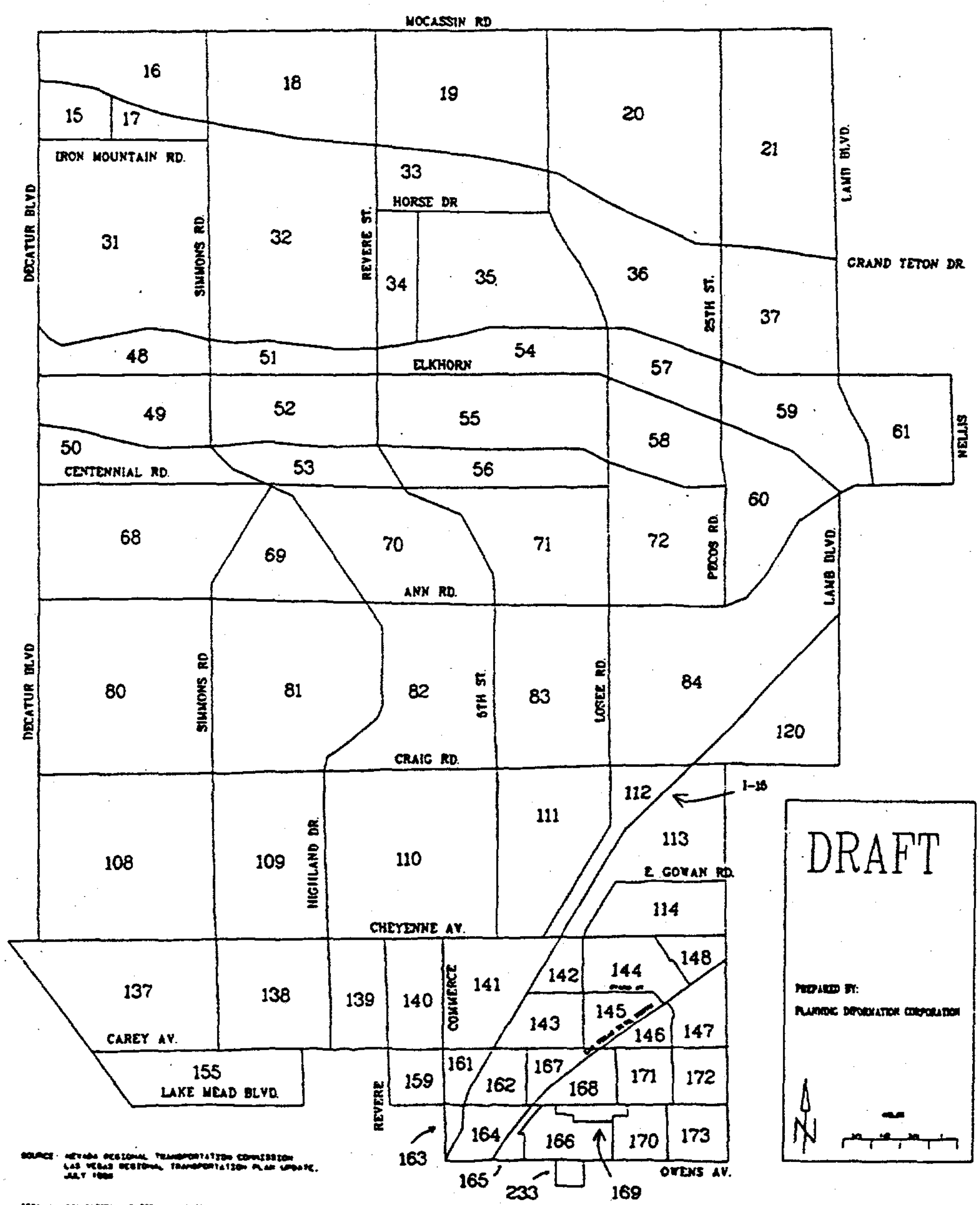


Figure 2-12b
Local Service Area Geographies:
Police Neighborhoods (NLV)

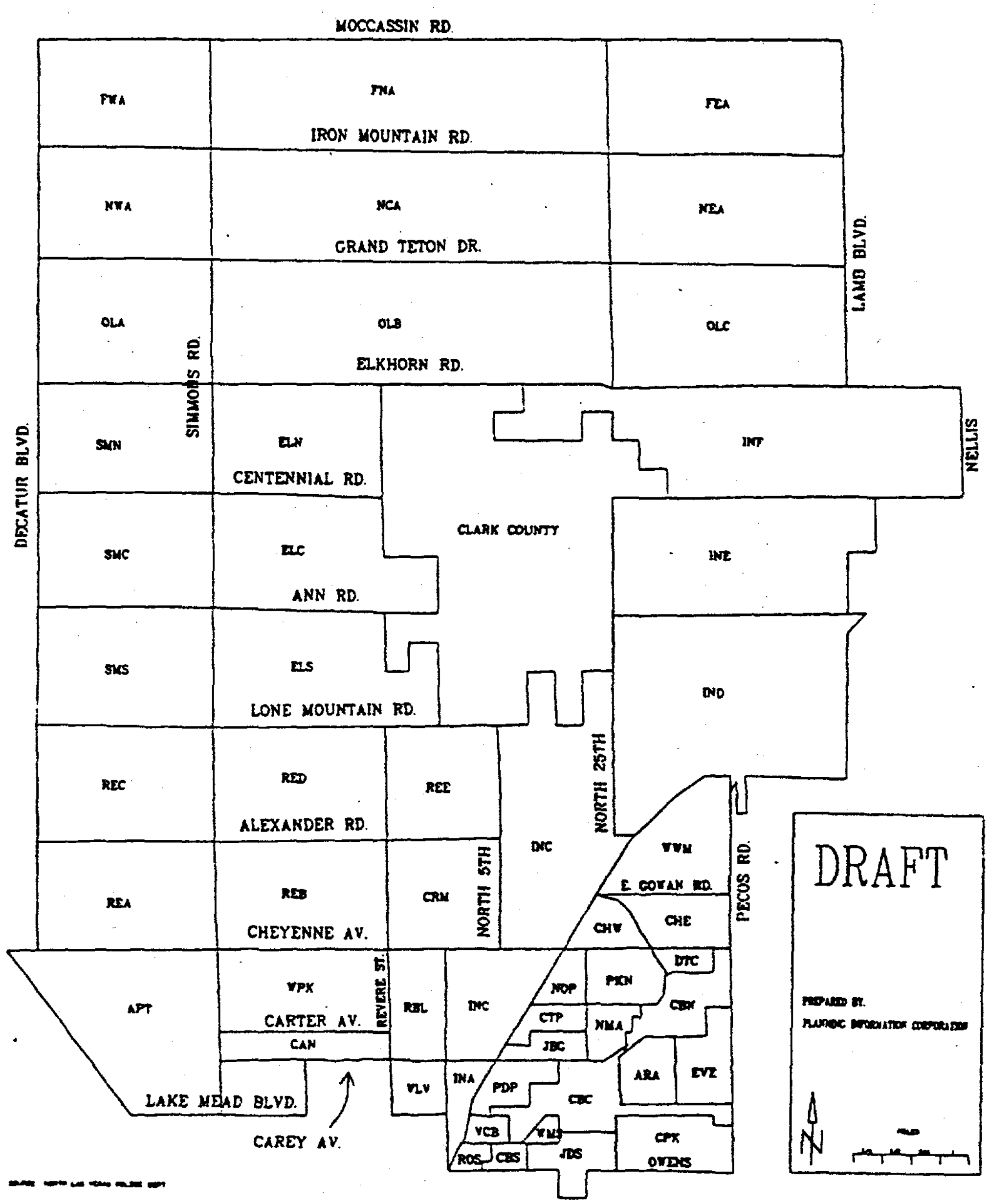


Figure 2-12c
Local Service Area Geographies:
Zip Code Areas (NLV)

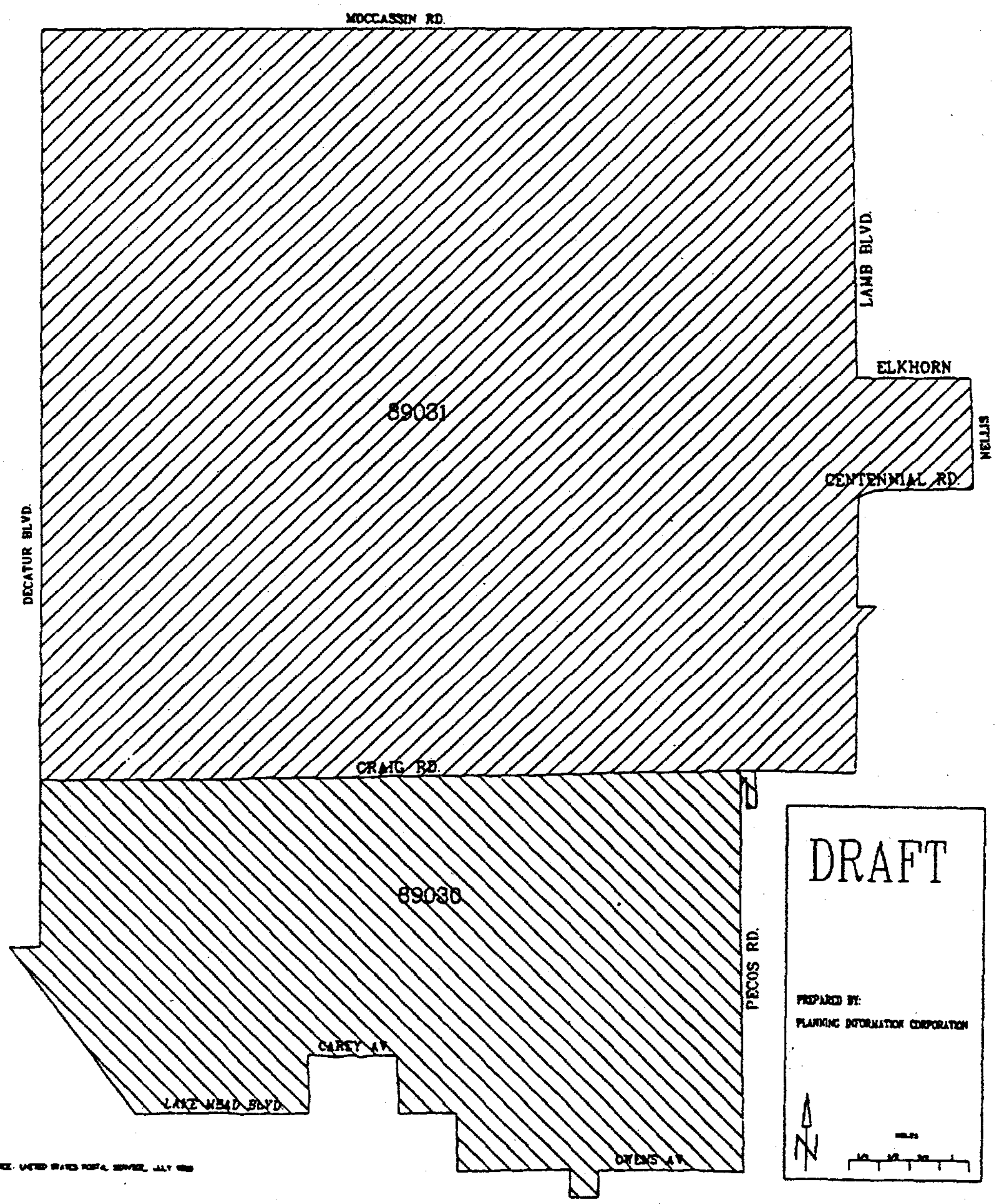


Figure 2-12d
Local Service Area Geographies:
Master Plan Areas (NLV)

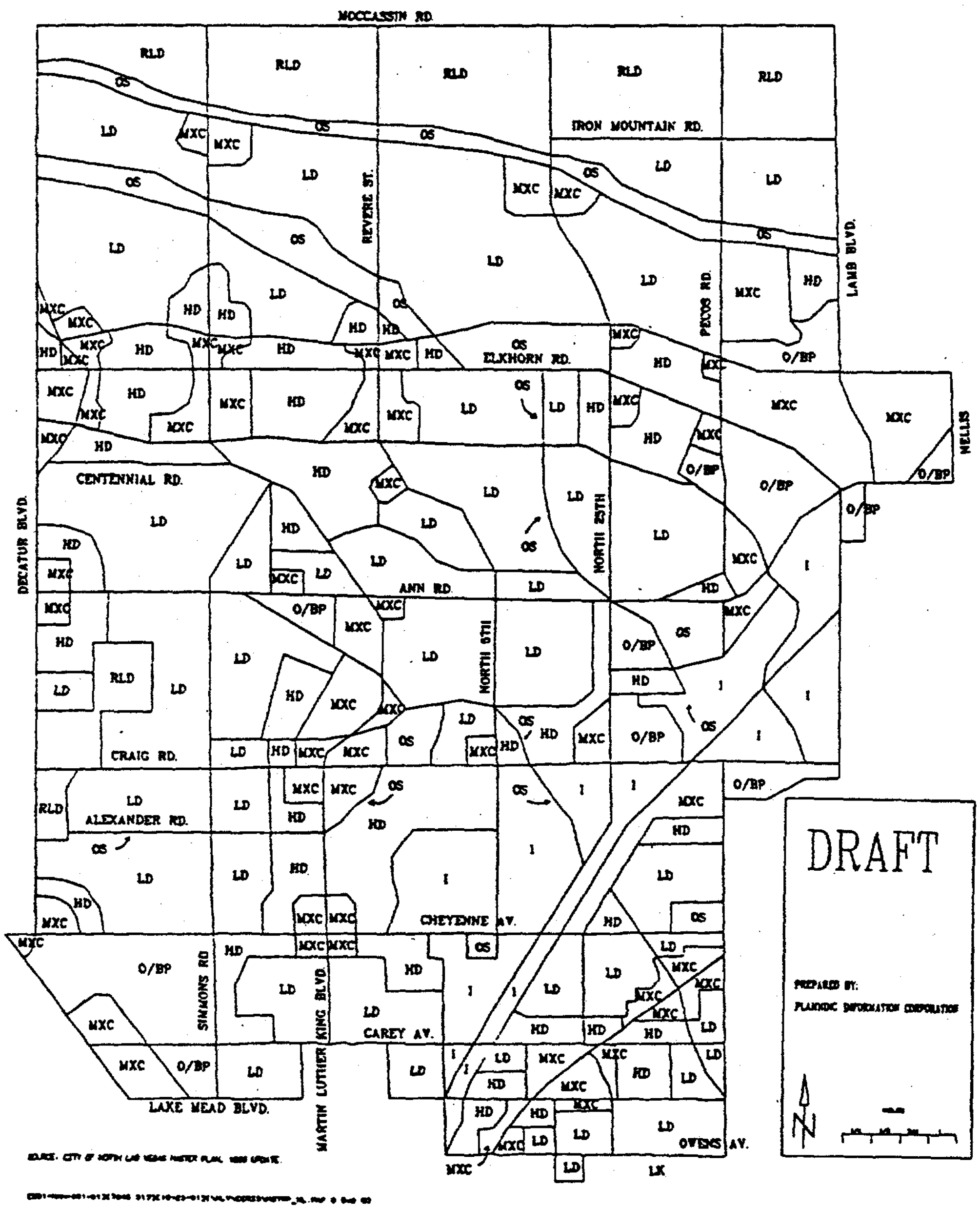


Figure 2-12e
Local Service Area Geographies:
Fire Response Areas (NLV: Hypothetical)

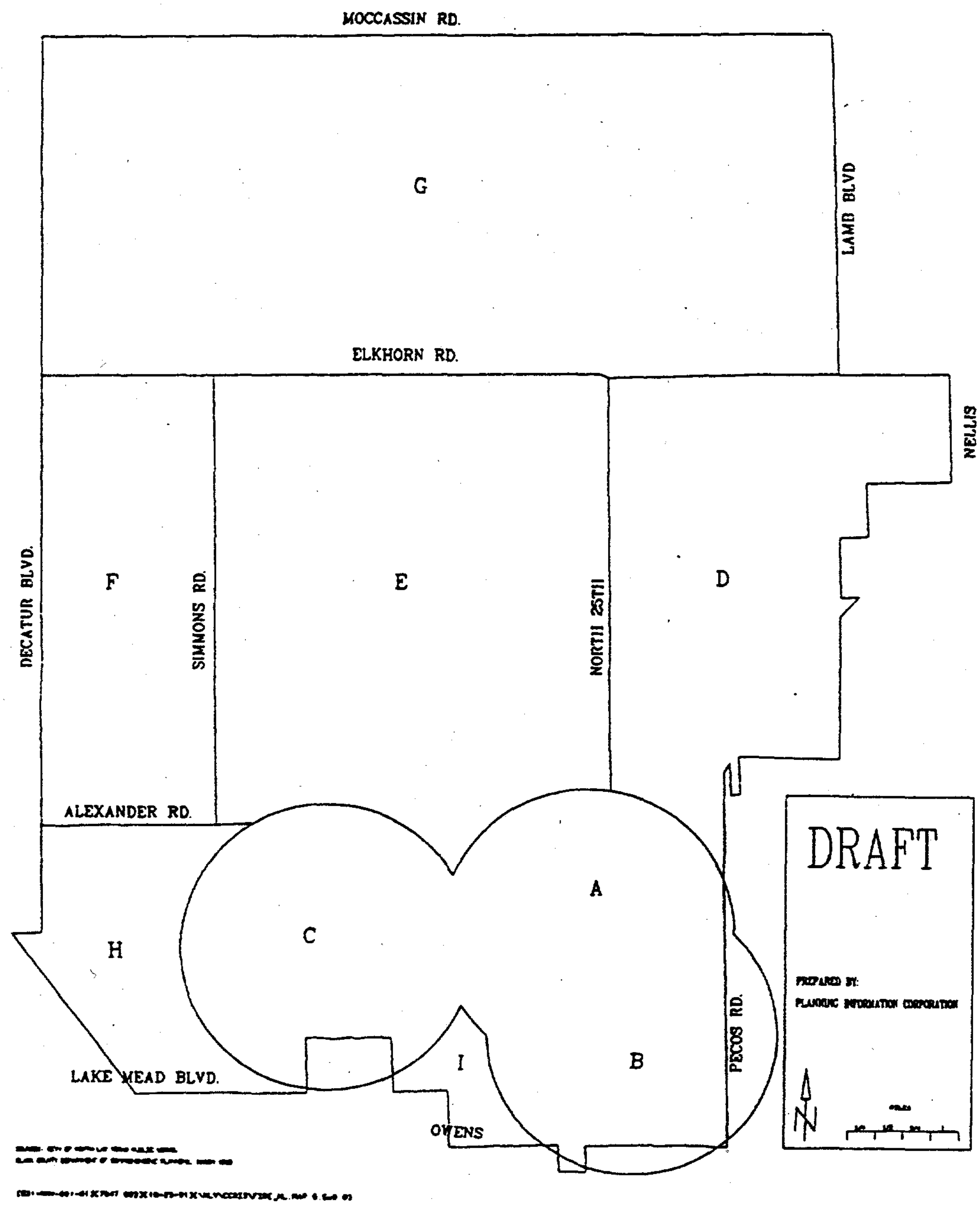


Figure 2-13a
Integrated Socioeconomic Monitoring/Assessment:
Government Systems & Finances

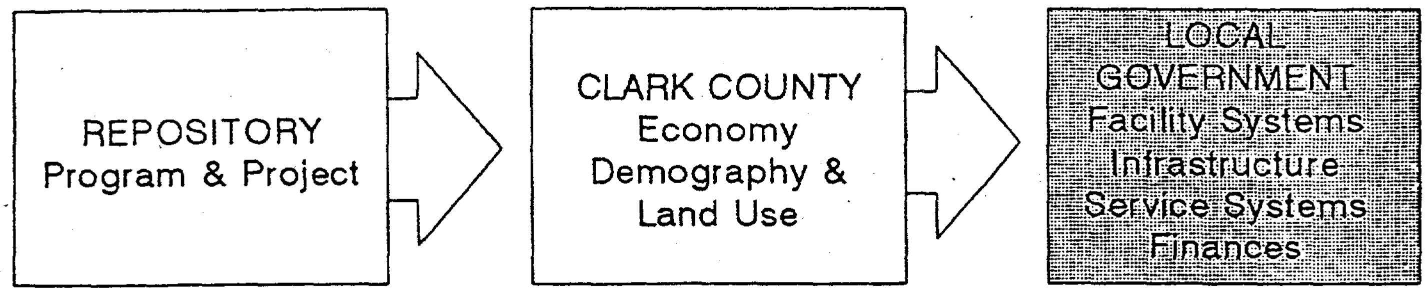


Figure 2-13b
Systems Information for Governments:
The SING Process

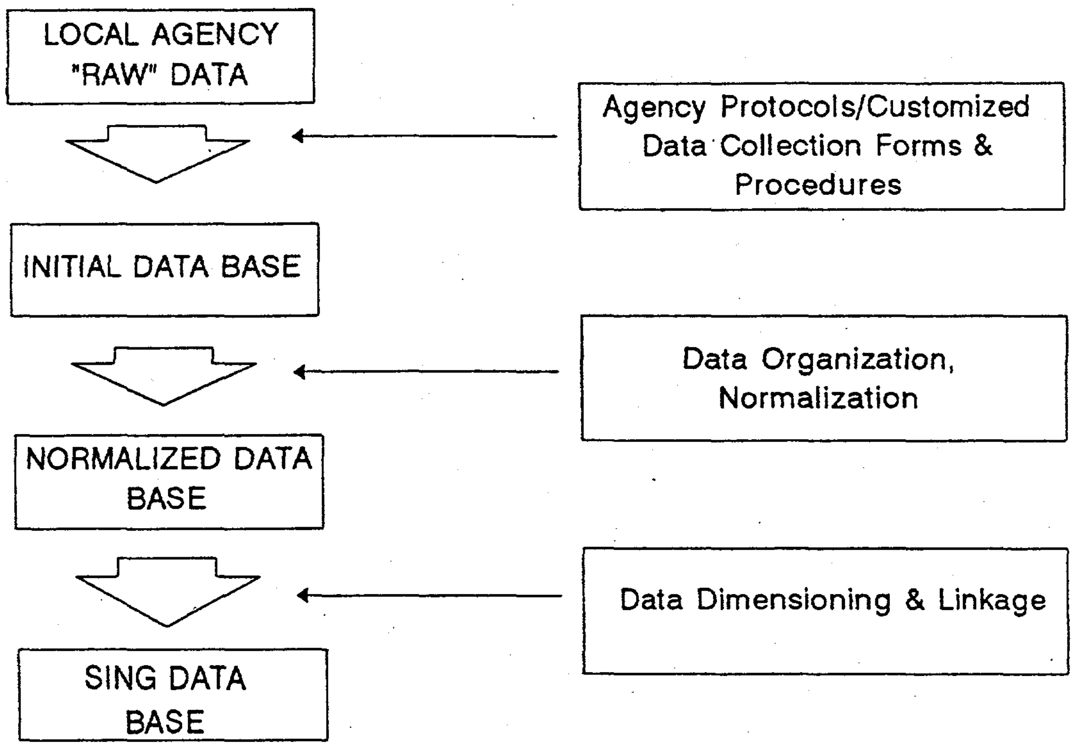


Figure 2-13c
Systems Information for Governments: SING
Data Dimensioning: Functions

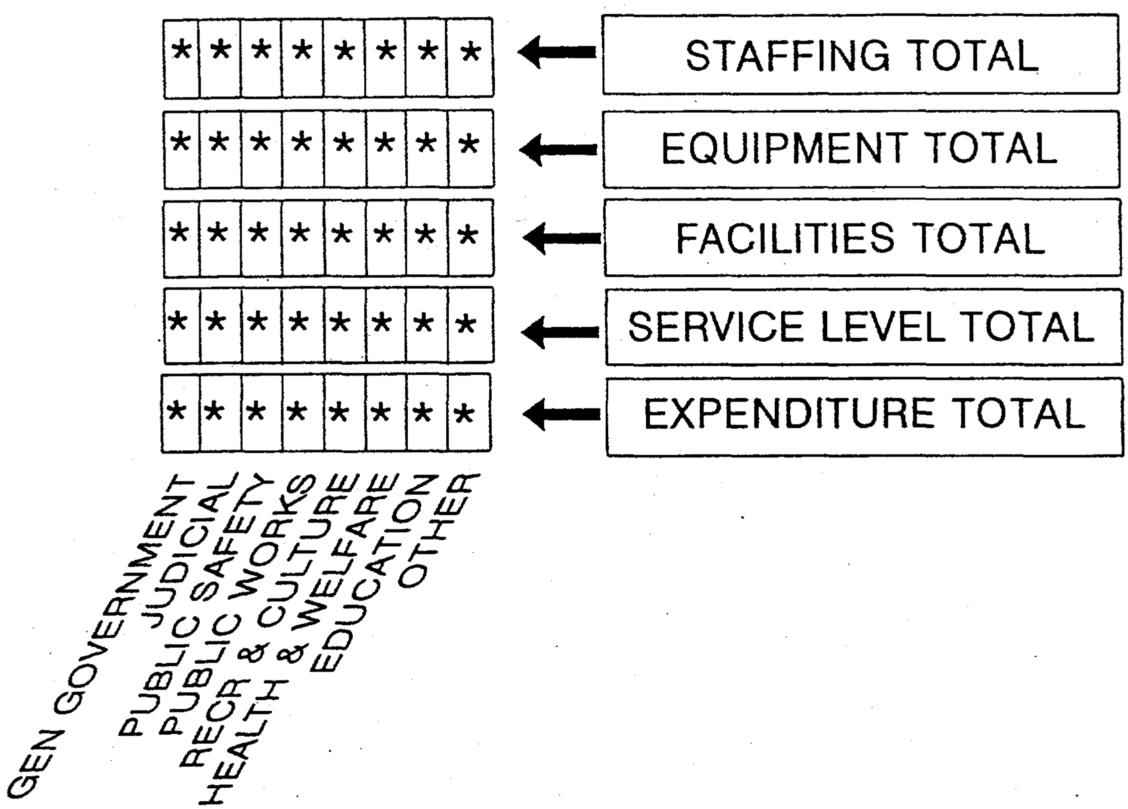


Figure 2-13d
Systems Information for Governments: SING
Data Dimensioning: Service Character

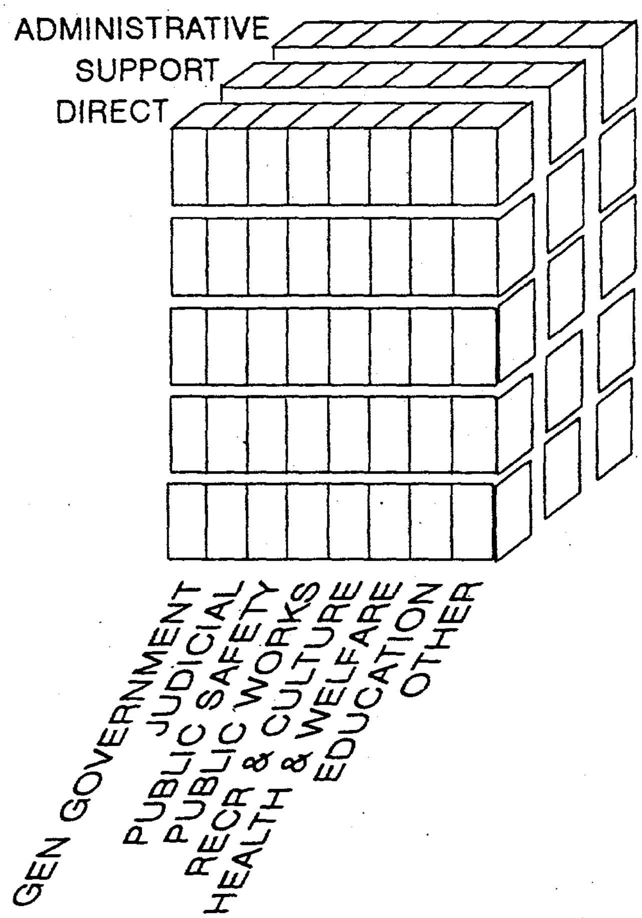


Figure 2-13e
Systems Information for Governments: SING
Data Dimensioning: Geography

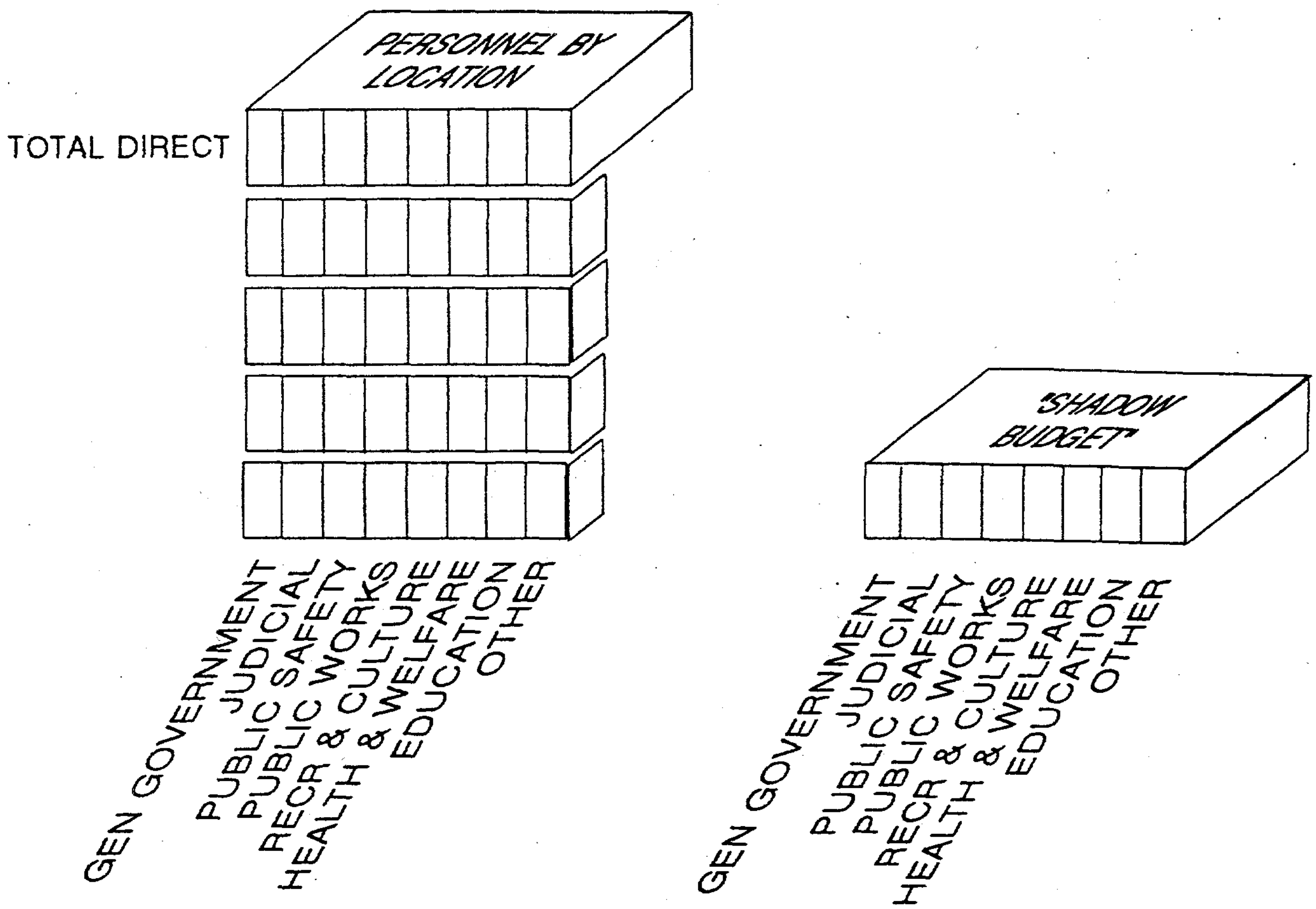


Figure 2-14 (Section 2.5)
Systems Development Task Outline:
Economic, Demographic, Land Use, Government Systems, and Finance Components

1. MONITORING
- *1.1 COUNTY-LEVEL ECONOMIC-DEMOGRAPHIC CHARACTERISTICS*
  - *1.1.1 Update BEA/ESD Employment & Income Data and Analysis*
  - *1.1.2 Update Other County-Level Data Resources and Systems*
  - *1.1.3 Analyze Key Components of the Clark County Economy*
  - *1.1.4 Systems Transfer Process*
- *1.2 SUBCOUNTY E-D/LAND USE: PEDaL*
  - *1.2.1 Extend PEDaL-90 to the Entire County*
  - *1.2.2 "Populate" PEDaL-91*
  - *1.2.3 "Populate" a Previous-Year PEDaL: e.g., 1985*
  - *1.2.4 Assemble Additional 1990 Census Data*
  - *1.2.5 Assemble Additional 1980 Data Corresponding to 1.2.4*
  - *1.2.6 Phased Transfer with Designated Agencies and Entities*
- *1.3 GOVERNMENT SYSTEMS AND FINANCES: SING*
  - *1.3.1 Incorporate "Remaining" 1990 Data*
  - *1.3.2 Develop Service Levels Monitoring Capability*
  - *1.3.3 Update SING-91*
  - *1.3.4 Phased Transfer with Designated Agencies and Entities*
- *1.4 REPOSITORY PROGRAM AND PROJECT*
  - *1.4.1 Develop Repository Program and Project Definitions and Links*
  - *1.4.2 Trace Total Program Expenditures to Nevada*
  - *1.4.3 Identify Labor Costs Associated With 1.4.2*
  - *1.4.4 Identify Employment and Employment Characteristics*
  - *1.4.5 Identify Relevant Characteristics of Non-Labor Expenses*
  - *1.4.6 Project Management Policies*
  - *1.4.7 Database and Database Access for the Above Information*
  - *1.4.8 Phased Transfer Process*

2. PROJECTION/ASSESSMENT SYSTEMS
- *Systems Design Criteria*
- *Major Systems Components*
- *2.1 COUNTY-LEVEL ECONOMY AND DEMOGRAPHY*
  - *2.1.1 Evaluate Long-Term Regional Trajectories*
  - *2.1.2 Evaluate REMI as a Clark NWD Systems "Motivator"*
  - *2.1.3 "Exercise" REMI as Currently Calibrated*
  - *2.1.4 Recalibrate REMI re Unique Aspects of Local Economy*
  - *2.1.5 Recalibrate REMI re NV-Clark Government Finance*
  - *2.1.6 Develop REMI-PEDaL Linkages*
- *2.2 SUBCOUNTY E-D/LAND USE PROJECTION/ASSESSMENT*
  - *2.2.1 Analyze the PEDaL Database and Change*
  - *2.2.2 Model Current Development Patterns and Practices*
  - *2.2.3 Apply "Current Patterns" Model to County-Level Economic Futures*
  - *2.2.4 Devise Alternatives to the "Current Patterns" Model*
  - *2.2.5 Apply "Alternative Patterns" Model to County Economic Futures*
  - *2.2.6 Package the Subcounty Allocation System for Local Agencies*
  - *2.2.7 Phased Transfer with Designated Agencies and Entities*

Figure 2-14 cont. (Section 2.5)
Systems Development Task Outline:
Economic, Demographic, Land Use, Government Systems and Finance Components

2.3 GOVERNMENT SYSTEMS AND FINANCES
Expenditures
2.3.1 Develop Automatic Current Service Measures (and Definitions)
2.3.2 Identify Alternative Levels of Service (and Definitions)
2.3.3 Develop Current and Alternative Service Selection Functions
2.3.4 Apply Current and Alternative Service Levels re Measure Systems Deficiencies/Capacities and Associated Costs
2.3.5 Package the Above for Local Officials in Clark County Agencies
2.3.6 Phased Transfer to Designated Entities and Agencies Revenues
2.3.7 Model the Current Nevada State Local Revenue Structure
2.3.8 Apply Model to State-County Economic Futures
2.3.9 Package the NV-Clark State-Local Revenue Model
2.3.10 Phased Transfer with Designated Agencies and Entities
2.4 REPOSITORY SCENARIO SYSTEM
2.4.1 Identify RSDS Links to UNLV TRC and Other Scenario Investigtn
2.4.2 Contributions to RSDS Database Update
2.4.3 Contributions to Repository Monitoring - RSDS Links
2.4.4 Contributions to RSDS Computerization and Package
2.4.5 Phased Transfer Process

Task 1 MONITORING

- *Economic and Demographic Characteristics*
- *Residential and Nonresidential Land Use*
- *Government Facility and Service Systems*
- *Government Finances*

It is critical that the monitoring systems developed in FY 1991 be maintained, updated, refined, and transferred. Each of these activities requires ongoing efforts in the Clark County socioeconomic program. Experience in the nuclear waste assessment program and elsewhere suggests that if the data and database are not updated and refined, loss of both the data and database system are likely -- the phrase is "use it or lose it." If forced to choose, we would therefore place a priority on the maintenance and development of monitoring systems developed in Fy 1991 over the development of projection/assessment systems. Here are some of the topics and tasks.

Task 1.1 COUNTY-LEVEL ECONOMIC-DEMOGRAPHIC CHARACTERISTICS

Compared to Tasks 1.2-4 following, we consider monitoring economic and demographic characteristics at the county level a lower priority because (a) the focus of the Clark County nuclear waste assessment is on distributional issues, and (b) most of this data is assembled from existing secondary sources; we don't lose it if we skip a year. On the other hand, some of this information provides inputs for other parts of the integrated system, and the update process is relatively quick and painless.

Task 1.1.1 Update BEA/ESD Employment and Income Data and Analysis

Arrangements for two-digit data without suppression.
Could include other regions: e.g., California, Nevada, U.S.
Efficient data assembly and analysis process.
Inputs for monitoring systems Task 1.2.2.

Task 1.1.2 Update Other County-Level Data Resources and Systems:

- *Vital statistics*
- *Population estimates*
- *Visitor-gaming (regarding LVCVA and NV Gaming Commission)*
- *DOE/NVOO regarding NTS*
- *Nellis*

Data assembly/update is efficiently accomplished.
Data systems require refinement.
Input for monitoring systems Task 1.2.2.

Task 1.1.3 Analyze Key Components of the Clark County Economy:

- *Visitor-Gaming*
- *NTS*
- *Nellis AFB*
- *Retirement migration*

Revisit studies from NWPO Phase III (1988).
Link findings to Clark NWD socioeconomic systems.
Input for assessment systems Task 2.1.3.

Task 1.1.4 Systems Transfer Process

The process includes:

- *Collaboration during systems development*
- *Current database transfer*
- *Conversion for access in various user computer environments*
- *Training regarding database access*
- *Training regarding database maintenance and update*
- *Training regarding applications in integrated system*

Low transfer priority (compared to 1.2 and 1.3).

Task 1.2 SUBCOUNTY E-D/LAND USE: PEDaL

A powerful and innovative system for monitoring subcounty economic, demographic, and land use characteristics on an integrated and geographically disaggregated basis was developed in 1991, and was "populated" with 1990 data for NLV only. The system is called PEDaL: Population, Economy, Demography, and Land Use. The extension, update, and development of this system is a high priority because (a) it is critical for the assessment of distributional impacts in the urbanized LVV as well as rural Clark, and (b) it has many applications in addition to nuclear waste assessment; it develops and maintains the necessary local constituency for a long-term monitoring and assessment effort. We could skip a year without loss of data, but this would stall the systems development and transfer process.

Task 1.2.1 Extend PEDaL-90 to the Entire County

- *City of Las Vegas*
- *Henderson*
- *Boulder City*
- *Unincorporated LVV*
- *Rural Clark County, including*
  Indian Springs
  Goodsprings
  Moapa-Overton

The work tasks include:

(a) Assessor file conversion (completed).

(b) Address matching systems check.

(c) Assemble relevant coverages (via GISMO, ESRI, local agencies).

(d) Consider local zoning data (status and form varies).

(e) Calibrate regarding 1990 census (regarding resident population and land use).

(f) Calibrate regarding 1990 BEA/ESD (regarding jobs and nonresident land use).

(g) Enhance infrastructure information not included in SING.

(h) Review and adjust regarding vacancy, FAR, employment density, residents in nonresident land uses, home occupation employment in residential land uses, etc.

(i) Apply RELUP, NOLUE, DCAP models; these use control totals to generate factors which permit aggregation of integrated economic, demographic, land use, and service requirements information for multiple service area geographies..

(j) Assemble database (appending, access scripts, etc.).

(k) Package database (menus, download, run-time, etc.).

(l) ArcView linkage.

Input for monitoring systems Task 1.3.5., and for assessment systems Task 2.2.1.

Task 1.2.2 "Populate" PEDaL-91

All of the above tasks apply, though we gain numerous efficiencies in database update versus initial database population. On the other hand, new resources potentially available in 1992 suggest further systems development.

- *To apply appraisal file data (building space, parking, etc.) which may be available in 1992*
- *To apply ARC/INFO DIME (scheduled for March), if not included in PEDaL-90*
- *To develop year-to-year data analysis and access procedures*
- *To develop further ArcView linkage.*

Input for assessment systems Task 2.2.1., if we base initial model calibration on 1-year change.

Input for ongoing monitoring in Task 1.3.5.

Task 1.2.3 "Populate" a Previous-Year PEDaL: e.g., 1985

Since the assessor's office retains an end-of-the year file, it is possible to construct a PEDaL database for previous years, making possible an analysis of change over multi-year periods -- e.g., 1985-90, 1984-91. Such information may be a more reliable basis for calibrating a subcounty projection/assessment system than a 1-year 1990-91 trend. The work effort for previous years involves the same list of tasks described in 1.2.1, with efficiencies in the execution of most tasks, but with the possibility of problems due to changes in format and coding.

Input for assessment systems Task 2.2.1, if we base initial model calibration on a 5-6 year rather than a 1-2 year change.

Task 1.2.4 Assemble Additional 1990 Census Data

ACCEN is a system developed in 1991 to access 1980 and 1990 census data, perform simple calculations on that data (absolute change, percent change, percent distribution, etc.) and to visually display the results using emerging thematic mapping capabilities. (PIC is an active "beta" test site for the PC version of ArcView.) The development of ACCEN was motivated by internal needs in calibrating the PEDaL and SING systems. However, with some additional efforts at the "top end," it can be made available to local users as part of the systems transfer process.

- *Receive and convert census flat files*
- *Select information for access via Paradox ACCEN*
- *Identify and script census data analysis routines*
- *Develop ArcView linkages*
- *Package and transfer*

A series of files with information relevant to the Clark socioeconomic assessment program will become available in FY 1992. Each can be developed for access via ACCEN.

Task 1.2.5 Assemble Additional 1980 Data Corresponding to 1.2.4

We have 1980 STF1AB and have incorporated selected portions in ACCEN. Use of census data in trend analysis will require further systematic use of 1980 data in conjunction with 1990 comparables.

Task 1.2.6 Phased Transfer to Designated Agencies and Entities

"Systems transfer" has become a more prominent goal of the Clark NWD program as it has become apparent that the program might produce systems worthy of transfer. Thus, progress in systems development has required concomitant development in systems transfer concepts, and in this the E-D/Fiscal components in general (and perhaps the PEDaL component for E-D/Land Use monitoring in particular) has served as "spearhead" for other components of the Clark NWD socioeconomic program. Several things have become apparent about "systems transfer":

(a) *First, even for "completed systems," transfer is a process, not an isolated event. This is true even for "off-the-shelf" "shrink-wrapped" systems such as WordPerfect or Lotus; it applies to a greater extent by an order of magnitude to custom-tailored socioeconomic systems for local communities.*

(b) *Second, all systems created in the Clark NWD program are very much "in development" -- regarding procedures for update, adaption to changing information resources, adaptions for user needs, and linkage to other components. Thus, "systems transfer" in FY 1992 does not involve "completed systems" but to systems which are (and should be) very much "in development"; this further increases the process component of "systems transfer".*

(c) *Third, transfer requires appropriate resources both for the "transferor" and the "transferee." For the transferor, "appropriate resources" means funding for collaboration, conversion, training, systems documentation. For the transferee, "appropriate resources" means sufficient time by staff with appropriate backgrounds and appropriate authority in their local government organizations.*

Phased transfer can involve individuals, groups, and/or agencies, and can include:

- *Collaboration and presentation during systems development*
- *Presentation at policy (non-technical) levels*
- *Conversion of data and data access systems for various user computer environments*
- *Training regarding database access*
- *Training regarding database maintenance and update*
- *Training regarding applications in integrated system*

All of the above should be coordinated initiatives between systems developers and systems users.

Task 1.3 GOVERNMENT SYSTEMS AND FINANCES: SING

Clark County government involves several general governments, each with multiple agencies in a distinctive local government organization. It includes several special districts with distinctive missions, service areas, and management information systems. It involves quite distinctive urban and rural service functions. And, all components in *all areas have felt the stress of sustained and at times explosive growth, during which the area has emerged as a metropolitan area with its distinctive manifestations of the problems (air pollution, traffic congestion, crime, social service needs) facing metropolitan areas across the country.*

The Clark NWD socioeconomic program needs to monitor government systems in their functional and geographic diversity, drawing on existing information resources[5] but assembling these in a way that allows:

- *Reporting to entities in their terms of reference.*
- *Reporting in terms of consistent functional terms of reference.*
- *Reporting for multiple relevant service area geographies.*
- *Analysis linkages between service type, service area, service "population" or "drivers," service activity measures, the staff equipment and facilities which provide the service, service costs, and service-specific revenues.*
- *Efficient annual updating.*

The system developed to meet these challenging objectives is called SING: Systems INformation for Governments. In 1991 SING was "populated" with 1990 data for all general-purpose governments in Clark County (Clark County, Las Vegas, Henderson, N. Las Vegas, Boulder City, Mesquite), plus less comprehensive information for the Metro Police Department, the School District, the Clark Sanitation District, the Las Vegas Valley Water District, the Regional Transportation Commission, emergency management functions, etc.

In FY 1991 all of the information collection for general governments, much of the information collection for special districts and special functions, all of the information processing, and all of the systems design and development was conducted by PIC. The transfer and constituency-building process (collaboration with service providers during information collection, demonstration, and consultation during systems development) was also conducted by PIC. A modest portion of all relevant information collected for general governments and a more significant portion of that collected for special districts and functions remains to be incorporated into SING-90.

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5 *Clark NWD has no authority, even within Clark County government, to change agency information systems or formats.*

The extension, update, and development of SING is a high priority because: (a) it is critical for the assessment of fiscal impacts at the service area, jurisdiction, and areawide (e.g., LVV, Indian Springs) levels; (b) if not collected and processed, much of the information will be lost; and (c) the information has many applications in addition to nuclear waste assessment. To skip a year in the collection and processing of this data could, in our judgement, jeopardize the entire system -- requiring us to "start from scratch" once again at some future date in the Clark County nuclear waste assessment program. A "SING-NV" for state government agencies might appropriately be updated biannually, since the state budget is assembled biannually, but all local agencies operate on an annual budget cycle.

Task 1.3.1 Incorporate "Remaining" 1990 Data

As mentioned, a modest portion of general-purpose government data and a more significant portion of data collected for special districts and functions remains to be incorporated in SING-90. This involves some system design and development (to accommodate special information features), but mainly information processing, normalization, validation, etc.

The current SING-90 is reasonably complete (at least for general governments) for personnel, equipment, facilities, expenditures, and revenues. It is less comprehensive with regard to infrastructure (streets and roads; sewer plants and interceptor systems; water treatment, storage, and major transmission; etc.), and it is less comprehensive with regard to the revenue base and revenues generated than with revenues distributed and received. As for other categories, this information exists -- it does not have to be created from scratch. It does need to be received and incorporated into the SING and PEDaL systems as appropriate for projection/assessment applications -- (i.e., processed and normalized, reflecting a systems design, with systems development for access and linkage).

Input for Task 1.3.2, and Task 1.3.3

Task 1.3.2 Develop Service Levels Monitoring Capability: i.e., SING - PEDaL Linkages

The SING and PEDaL systems were developed independently in 1991, and have not been developed and linked to provide automated monitoring of services levels[6] -- a capability which in our view is necessary for defendable assessment of the distribution of fiscal impacts in urbanized areas. This requires:

- *A dimensioning of SING-90 by geographic service area as well as by function and jurisdiction (assumes developed SING-90 re 1.3.1 and extended PEDaL-90 re 1.2.1).*
- *Computer systems linkage between SING and PEDaL.*
- *Linkage specifications by function and/or service area, re projection/assessment, re local government management -- among entities and service providers.*
- *Linkage systems design and development.*
- *Linkage testing and application.*

Input for Task 2.3.1
Input for Task 2.3.2
Input for Task 2.3.3

Task 1.3.3 Update SING-91

Regarding information collection, update will have major efficiencies over 1990. We now know who has what and generally in what form. The information providers generally understand what is expected of them and their role in the process. Many have a notion of the potential value-added for them. Our judgement is that information collection for update requires about 1/4 of the time and energy for 1990 information collection. (This assumes no prolonged political process to "get in the door" with particular jurisdictions or entities -- which was also a factor in 1990).

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6 *"Service levels" is a short-hand term and includes types of facilities and services, service measures, factors of production (staff, equipment, facilities), unit facility, and service costs, etc.*

The involvement of the entities in 1990 information collection was limited to cooperation and coordination. More active involvement (e.g., temporary assignment of a management analyst in the city or county manager's or the service agency director's office) is welcome and encouraged but would not substantially change the update information collection effort.

Regarding information processing, update will have significant efficiencies over 1990. We now know what information goes where, and have trained personnel to accomplish the task reliably. Our judgement is that information processing for update requires about 1/2 of the time and energy for 1990 information processing.

The involvement of the entities in 1990 information processing was zero. More active involvement is welcomed and encouraged, but in 1991 this would be training for systems maintenance (part of the transfer process), with savings in information processing costs expected in FY 1993 rather than FY 1992.

Regarding systems design and development, update will focus on testing and refinement of menus and scripts developed in FY 1991 (and in Task 1.3.2 above). Thus update will have significant efficiencies over 1990. Our judgement is that systems design and development for update (including both FY 1991 and FY 1992 Task 1.3.2) requires about 1/4 of the time invested in 1990 systems design and development.

The involvement of the entities in 1990 systems design and development was zero. More active involvement in FY 1992 is encouraged, but the prerequisites for effective involvement are knowledge of the SING database (e.g., via involvement in information collection and processing), knowledge of database systems (particularly Paradox, as used in SING systems development), and full appreciation of the projection/assessment purposes of SING and SING-PEDaL. The most useful involvement in FY 1992 would be collaboration in systems refinement and testing by persons who expect to become systems users-managers.

Task 1.3.4 Phased Transfer to Designated Agencies and Entities

The discussion in Section 1.2.6 above also applies to phased transfer of the SING system. The distinction is that SING has potential constituencies in every agency of every government entity, and that collaboration-in-process involves more potential participants who will (should) have more specific input on the system's representation of activities of which they have ground-truth knowledge.

As for PEDaL, phased transfer of SING should include:

- *Collaboration and presentation during systems development*
- *Presentation at policy (non-technical) levels*
- *Conversion of data and data access systems for various user computer environments*
- *Training regarding database access*
- *Training regarding database maintenance and update*
- *Training regarding applications in integrated system*

Given resources allocated to phased transfer, the recommended priorities are:

- *SING-90 and SING-91*
- *PEDaL-90 (as extended in Task 1.2.1) and PEDaL-91*
- *SING-PEDaL linkage (probably FY 1993)*

Task 1.4 REPOSITORY PROGRAM AND PROJECT

The system for repository program and project monitoring is under development by DOE. Affected entities have an opportunity to provide input, but do not directly control the information resources, the collection procedures, the information systems design, or the DOE resources allocated to the generation of repository program and project monitoring. Affected entities have a mutual interest in persuading DOE to generate repository information useful in integrated socioeconomic assessment systems. This is clearly not occurring now.

Desirably, the information systems design should be a collaborative effort between DOE and affected entities; information collection would be performed by various agencies of DOE; this information would then be accessed for formulation by particular affected entities (as well as DOE) for particular socioeconomic, transportation, and other assessment purposes.

- *Information systems design involves engagement and interaction with various entities (not just YMPO) within DOE, a process which will be more efficient if authorized at the highest levels. The substance of the process, however, involves the development of a preliminary information system design,[7] the review of existing available information resources vis a vis their internal DOE*

[7] *E.g., that implied by RSDS (see Section 2.4).*

purpose as well as the preliminary information system design, engagement with DOE on this basis, conclusions,[8] and discussion, repeating the process. This is an involved and detailed process which is difficult to conduct on a committee basis but in which all affected entities have an interest.

- *Information collection in this case is performed by DOE and its agencies.*
- *Information assembly and access can be a database in which resources provided by DOE are tapped and formatted for general and specific entity uses.*

Repository monitoring is clearly part of the Clark NWP program concept, but to date the specific funding allocations have been in the transportation rather than the socioeconomic elements of the Clark NWD program. Repository monitoring is needed in all elements of the socioeconomic program. The requirements of the E-D/Fiscal components may provide a comprehensive "framework" within which the particular requirements related to emergency management and transportation can be located. This framework monitors:

- *Expenditures*
- *Employment, employment characteristics, and residency*
- *Labor costs: gross payroll and employer contributions*
- *Purchases, and purchase characteristics and distribution*
- *Project management policies*

It is not sufficient for the Clark NWD to rely on the transportation components of its program to generate repository information for socioeconomic assessment; the transportation components will not generate the information systems framework or the actual information needed for socioeconomic assessment. Regarding repository information systems design for E-D/Fiscal impact assessment (the more time-consuming aspect), Clark County has two options: (a) to engage actively in information systems on a cooperative basis with other affected entities or (b) to cooperate with other affected entities, remaining knowledgeable and "in the loop" but avoiding active engagement. Either approach could "work."

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[8] *Conclusions may include (a) discovery of additional DOE information or formatting capability, (b) modification of DOE proposed information collection or processing, and/or (c) modification of the preliminary information systems design.*

Task 1.4.1 Develop Repository Program and Project Definitions and Links

At present, DOE has not developed systematic links between the repository program as described in OCRWM Annual Reports and DOE/YMPO socioeconomic monitoring activities. These links can be forged through examination of WBS and B&R dictionaries and data.

Task 1.4.2 Trace Total Program Expenditures to Nevada

Develop the information systems and definitions to identify total "repository project" and/or Nevada expenses associated with the activities monitored in current DOE/YMPO quarterly (employment) data reports.

Task 1.4.3 Identify Labor Costs (Gross Payroll and Employer Contributions) Associated With 1.4.2

Develop the information systems and definitions to identify labor costs (gross payroll and employer contributions) associated with activities monitored in current DOE/YMPO quarterly (employment) data reports.

Task 1.4.4 Identify Employment and Employment Characteristics Associated With 1.4.3

Given the framework described above, develop the information systems and definitions to identify the associated employment and employment characteristics:

- *By organization, contractor*
- *By work site*
- *By place of residence (individual zip code areas)*
- *By "body" and FTE*
- *By hiring category*
- *By household characteristic*

Task 1.4.5 Identify Relevant Characteristics of Non-Labor Expenses

Given the framework described above, develop information systems and definitions to characterize non-labor program and project expenses:

- *Procurement vs other expenses*
- *Capital and other procurement expenses*
- *Categories of materials, equipment, supplies, and services, purchase*
- *Distribution of such purchases*

Task 1.4.6 Project Management Policies

- *Busing*
- *Work schedules*
- *On-site housing*
- *Subsidized services*
- *Per diem allowances*
- *Hiring policies*
- *Procurement policies*

Task 1.4.7 Database and Database Access for the Above Information

Assembly of a computerized database of the above information, useful for update, program oversight, and socioeconomic assessment. Regarding the latter, the repository monitoring information defines the "direct" E-D/Fiscal effects of the repository program and project in Nevada.

Task 1.4.8 Phased Transfer Process

Without an integrated database (we do have pieces), we are clearly not in a position to transfer now. As we develop an integrated database on the repository program and project (in socioeconomic terms), we can make this available to Clark NWD program participants. "Phased transfer" in this case would emphasize training for access (and eventually for applications); collaboration during systems development is less involved than for PEDaL and (particularly) SING.

Task 2 PROJECTION/ASSESSMENT SYSTEMS

- *Economic and Demographic Characteristics*
- *Residential and Nonresidential Land Use Implications*
- *Government Facility and Service Systems*
- *Government Finances*

Monitoring systems provide the data variables which may be incorporated in projection/assessment models, the actual data used in parameter calculations, and the data used in annual updates and in assessment system testing and refinement. Thus, a discussion of projection and assessment systems presumes the development, implementation, maintenance (and, desirably, transfer) of monitoring information systems -- topics considered in Section 1 above. This section considers a strategy for the development of projection/assessment systems for the Clark County Nuclear Waste Assessment Program in the economic, demographic, government systems, and fiscal areas.

It is important to note that these systems may be applied to estimate current or projected repository impacts. Used in combination with monitoring information on the direct effects of the repository program and project,[9] these systems can be applied to assess current impacts of the repository on the economy, demography, land development character, government systems, and finances of Clark County. In this application, projection/assessment systems are used in the attribution of current economic-demographic or fiscal control totals (established through monitoring) to the repository project, however defined and described in socioeconomic terms.

Used in combination with a scenario[10] for the repository program and project as it may unfold in the future, projection/assessment systems can be applied to assess the impacts of the repository in the context of a projected future for Clark County and its jurisdictional entities and sub-areas. In this application, the role of baseline projection/assessment systems is to describe "plausible," "instructive," or "useful" futures as contexts for the assessment of repository scenarios. Social science is not, perhaps may never be, and arguably should not be, developed to the point that it can be asked to provide "accurate" or "reliable" projections over the multiple decades involved in the repository program for systems as complex and open as the Las Vegas/Clark County metropolitan area.

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[9] *Whether direct repository effects are defined as standard or special effects.*

[10] *Described in socioeconomic terms, via RSDS (see Section 2.4).*

Systems Design Criteria

The criteria for projection/assessment systems have evolved over months of discussion involving the Clark County Nuclear Waste Division Project Team, the Steering Committee, and the Peer Review Committee. From this discussion, the following criteria emerge:

- *The systems should be capable of describing repository impacts in the specific Clark County socioeconomic context. The systems should reflect the unique characteristics of the Clark County economy, its demographic character, its local government organization and service systems, and its finances under Nevada law. Impacts should not be assessed in the abstract from the local context, or in reference to a generalized context description not recognizable by local officials and knowledgeable residents.*

- *The systems should describe key linkages within and among the major economic, demographic, government systems, and fiscal variables. Put another way, the systems should be able to trace estimated impacts within and among these variables. Such tracing, though a multi-step process, is a necessary condition for dependability. The assessment of impacts on the area economy, population in a particular jurisdiction, the requirements of a particular facility system, and the finances of a particular entity cannot be defendably conceived as separate and isolated exercises.*

- *The systems should be applicable at the jurisdictional and service area as well as the countywide level. That is, they should be capable of systematically considering the geographic distribution of repository impacts on particular service areas and jurisdictions as well as the urbanized area or Clark County as a whole. The system must be able to describe impacts at disaggregated service areas or at aggregated urbanized or metropolitan areas.*

- *The systems should be sustainable and transferable. While the volume of calculations and data points may be relatively large, the assessment and monitoring systems design should be straightforward and relevant to local service managers who are the ultimate systems constituents.*

Major Systems Components

The above criteria can best be met through a series of approximations extending over several years, with varying emphasis on design, implementation, testing/refinement, and transfer. The initial emphasis should be to design "working systems" for each major variable or dimension, then to develop linkages (including feedback loops) among the major systems, then to test and refine the system for application in various contexts, then to package the systems, and arrange for ongoing maintenance and transfer. This section describes some of the key steps in this process, without specific reference to the funding and priorities for the Clark County Nuclear Waste Program in FY 1992, FY 1993, or beyond. The major elements are:

(1) *A county-level economic-demographic projection/assessment system.*

(2) *A subcounty economic-demographic and land use projection/assessment system, linked to #1.*

(3) *A government systems (level of facilities and service) and expenditure (cost of facilities and service) projection/assessment system, linked to #2.*

(4) *A government revenues projection/assessment system, linked (given the Nevada state-local revenue structure) to economic-demographic projections at the state and county level, with distributions to local funds linked to subcounty economic and demographic projections (#2 above).*

(5) *Major feedback elements in the E-D/Fiscal system: e.g., the implications of revenue constraints for local government expenditures and service levels, the resolution of local government expenditures as described in detail by the government systems and expenditure system (#3) and in summary (and without reference to the types and levels of local services) in the county and subcounty E-D systems (#1 and 2).*

Task 2.1 COUNTY-LEVEL ECONOMY AND DEMOGRAPHY

Clark County is an emerging metropolitan economy, with increasingly complex internal dynamics and increasingly significant linkages with the metropolitan economies of the southwest U.S. (L.A., Phoenix, Salt Lake City) and the nation as a whole. The Las Vegas Valley serves increasingly as a commercial and professional service center for the southern Nevada region, a source of supplies and services for basic industry *(visitor-gaming, military, DOE) of the area, a destination resort and convention center for an increasingly differentiated[11] regional and national market, and a residential location for both military and nonmilitary retirees.*

Distributional effects are critical in the Clark County repository assessment system because system deficiencies are more credibly discussed at the sub-area (service area, transportation corridor, etc.) level, and because fiscal consequences are more credibly discussed with reference to the responsible local service providers rather than in generalized local spending terms. Therefore, the role of a county-level economic model is essentially to "motivate" the distributional components of the E-D/Fiscal projection/assessment system. Nevertheless, it is desirable that this motivation come from a county-level economic model which is capable of reflecting the internal and external dynamics of a rapidly evolving economy, and the major linkages between the economy and demography (e.g., migration, age, and sex distribution) of the area.

REMI is an economic-demographic projection system which meets the above criteria, and which, in addition, has been purchased and invested in by several Nevada nuclear waste program participants (DOE/YMPO, UNLV, NWPO, NVESD) for several years. Over the 4-year period 1988-1991, the total investment in REMI (capital and operating) by the above entities totals well over $500,000 and may approach $1 million. While neither REMI nor any other economic model fully reflects the unique aspects[12] of Clark County, REMI provides a sufficiently sophisticated framework within which these aspects can be reflected as they are developed through special investigation, as well as a technical team (among model developers and local users) capable of reflecting such refinements in subsequent versions of the REMI system.

Steps towards the development of REMI as a component of the Clark County repository projection/assessment system include the following:

Task 2.1.1 Evaluate Long-Term Regional Trajectories

Impact assessment requires the evaluation of project effects in a specific local context. Repository impact assessment requires the evaluation of repository program and project effects in an unusually long, even futuristic local context extending over several decades. Because it is so highly disaggregated (a strength in other contexts), REMI is at best an unwieldy tool for such long-term business forecasts or scenarios, which

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[11] L.A. and Phoenix, retirees and families, weekenders, vacationers, and junkets.

[12] The dominant visitor-gaming economic base, the significant roles of DOE and military activity, the increasing role of retirement migration, the evolving linkages with LA and Phoenix, etc.

require a focus on context conditions rather than on local (Clark County) economic interrelationships. Context conditions may include national or major region demographic or personal income, shifts in industrial policy and other "fundamentals" that set the framework for local (Clark County) economic futures.

The long-term economic context for repository assessment in Clark County needs to be evaluated and related to the more disaggregated forecasts produced by REMI for the Clark County economy. The evaluation can take a variety of approaches -- informed judgement, business forecast trends, the DRI model (designed more specifically for these purposes than REMI), and/or REMI. Whatever, the long-term economic parameters for local impact assessment of the long-term repository program and project need to be explicitly addressed.

Task 2.1.2 Evaluate REMI as a Clark NWD Systems Motivator

It is not necessary to possess REMI or to develop "hands-on" operations expertise with REMI in order to evaluate its role as a motivator of the distributional components of the Clark County projection/assessment system. Indeed, such activities can divert attention and resources from the development of linkages needed in the development of projection/assessment systems capable of assessing the distributional impacts of the repository program and project. An evaluation of an existing REMI run for Clark County can provide the basis for the application of REMI as a component of an integrated Clark County projection/assessment system. Tasks include:

- *Receive output from an instructive REMI run for Clark County, including output for state, regional, or national levels applicable to the county-level output.*

- *Review the output. How do recent trend estimates conform to monitoring data discussed in Section 1.1 above? How do key variables and relationships "track" into the projected future? How is current repository, NTS, Nellis, visitor-gaming, and warehouse-distribution activity reflected in the REMI run? How is the Clark County capture of regional or national activity reflected in input assumptions and output? How is local government activity reflected and is this consistent with monitoring information on government systems among Clark County entities?*

- *Based on the review, what are the key linkages between any REMI output and the distributional components of the Clark County projection/assessment system?*

Task 2.1.3 Exercise REMI as Currently Calibrated

In systems application, REMI will be applied to describe "useful" projected contexts within which to assess repository impacts. Looking forward to such applications, it is desirable to identify the criteria for such applications. Do they involve capture of national or region-specific activity, diversions of activity due to constraints in competing regions, continuity or discontinuity in regional capture trends, sector-specific or across-the-board assumptions?

The combinations and permutations of such assumptions are sufficiently numerous so that a sorting of relevant criteria is needed to clarify the basis for "expected" and "high" or "low" projections to be used in applications of the Clark County assessment system. An efficient way to identify such criteria is to devise a series of "exercises" for a version of REMI as currently calibrated. Based on a review of the results, criteria for applications of REMI to describe projected contexts for the assessment of repository impacts will be defined. Tasks include:

- *Identify combinations of assumptions for use in REMI runs to describe projected contexts for the assessment of repository impacts.*
- *Test the above combinations using a version of REMI as presently calibrated.*
- *Review the output from the above "exercises" of REMI, considering their utility in describing projected contexts for repository assessment.*
- *Revise the criteria and rerun the tests.*
- *Identify criteria for applications of REMI in the Clark County repository assessment program, and arrange for updated REMI runs based on these criteria as required in the Clark County assessment program.*

As this task relates to system application more directly than to system design and development, it may be appropriately deferred.

Task 2.1.4 Recalibrate REMI re Unique Aspects of Local Economy

While REMI makes effective use of secondary data to calibrate the model to reflect local circumstances, such procedures cannot fully reflect the special features of any metropolitan economy, particularly one with the unique character of Clark County/Las Vegas. Thus, the adequacy of the model's assessment of a cutback in military *activities at Nellis Air Force Base, or a test ban at NTS, or new gaming competition in Colorado, or increasing systems capacity constraints in southern California will always be somewhat at issue.*

Evaluation of such issues normally has two parts. The first is an evaluation of the direct effects involved -- an exercise which does not involve REMI at all, except to the extent that the findings must be expressed in "REMI terms." The second part of the evaluation considers REMI's estimate of the implications of the direct effects in the Clark County economy. For example, would cutbacks at Nellis result in out-migration or increased local retirement?

Such evaluations are the concern of those who use REMI on a continual basis for a variety of purposes not related to repository impact assessment. Nevertheless, if doubts about the application of REMI to the Clark County economy cloud applications of REMI for socioeconomic impact assessment, it may be desirable to conduct such evaluations in the Clark County assessment program. The steps for each such evaluation may include the following:

- *Assemble the requisite "direct effects" data*
- *Apply in REMI and evaluate results*
- *Revise the calibration of REMI (Clark County versions) to reflect the evaluation results*

Regarding the first of the above steps, one should note that the state's Yucca Mountain Socioeconomic Study included four such investigations in 1988:

- *The Las Vegas/Clark County visitor-gaming economy*
- *Retirement migration (military and civilian) in the Clark County economy*
- *NTS-related activity in southern Nevada*
- *Nellis AFB and related military activity*

A systematic update of these investigations would provide the basis for an examination of the specific ways in which REMI reflects unique components of the Clark County economy and the adequacy of REMI's representation of these components.

Task 2.1.5 Recalibrate REMI re NV-Clark Government Finance

Peer review has raised several issues regarding REMI's modeling and calibration of government finance -- the removal of disposable income through levies of federal, state, and local taxes, the return of governmental levies to the local economy through government expenditure, the time effects of capital expenditures focused in time and *paid for over time, and the implications for the multiplier effects of additional basic household income (received by repository workers) in the local economy. Personal income redistributed through local expenditures which draw on "own-source" revenues, or state expenditures in Clark County which are supported by taxes paid by Clark County residents, must not be double counted in estimating the local economic effects of additional "basic" local earnings and household income.*

Appropriate adjustments require: (1) a reliable data base of government finance information (provided by SING) needed to calibrate the necessary adjustments and (2) specific knowledge of how REMI reflects the effects of government finance -- i.e., the "levers" within REMI to make the appropriate adjustments. The specific appropriate adjustments need to be identified, calibrated and tested before REMI is used in publicly-evaluated repository assessments prepared by Clark NWD.

Task 2.1.6 Develop REMI-PEDaL Links

This step may be undertaken at any point that the Clark NWD has an in-house version of both REMI and the distributional components of the projection/assessment system (see Section 2.2 below). The step is necessary at the point that multiple runs of the integrated projection/ assessment system are contemplated.

Task 2.2 SUBCOUNTY PROJECTION/ASSESSMENT

The monitoring systems created for the Clark County repository program include a system (PEDaL) for monitoring the distribution of population, demographic characteristics, employment, land use characteristics, developed and undeveloped land, and numerous other features for multiple geographic sub-areas: school enrollment areas, sewer service areas, police precincts, fire response areas, zip code areas, transportation corridors, traffic analysis zones, etc. Repository monitoring systems (still under development by DOE) may provide direct employment residency information for zip code or "zip plus four" areas, as well as zip code data on the distribution of employment purchases. It is presumed that, while direct "special" effects of the repository could be significant in relation to Clark County as a whole, direct "standard" effects will be relatively small. In either case, but particularly in the standard effects case, the evaluation of repository impacts with reference to service areas with varying facility and service systems capacities and deficiencies is an important capability desired by the Clark County repository program.

One direction for developing such a capability is to purchase and calibrate a model system developed for the purpose of allocating population and employment within *metropolitan areas.*[13] *Another direction is to exploit the rich information resource of the PEDaL system to generate consistent distributions of future population, employment, and land use -- including those portions which can be independently estimated using repository monitoring data.*

Ultimately, Clark County may find that the two directions are complementary, not competing. Certainly the adaption of a model system such as DRAM/EMPAL would benefit greatly from the PEDaL system for monitoring economic, demographic, and land use characteristics. For the Clark County assessment program, however, the approaches are competing for the present. The purchase and calibration of a model system such as DRAM/EMPAL would absorb most of the funds allocated for the entire E-D/Fiscal area for FY 1992, would make effective use of only parts of the PEDaL information resource, would generate results only for combinations of traffic analysis zones (not for fire response areas, school enrollment areas, sewer service areas, specific TAZs, etc.), and would embroil the Clark County NWD in a model administration activity appropriately led by other county or regional agencies.

It is suggested that the Clark repository assessment program focus on the second option identified above -- certainly in FY 1992 and FY 1993. The following discussion assumes that the PEDaL monitoring system is extended to all areas of Clark County for at least two monitoring points in time (see Sections 1.2.1 and 1.2.2 above).

Task 2.2.1 Analyze the PEDaL Database and Change

The PEDaL database provides a remarkable resource for analyzing current land development patterns and trends -- factors which do not predict the future, but which do provide detailed inputs for forecasts of land development patterns consistent with projected economic-demographic futures.

In this task, we will:

- *Analyze the PEDaL database (two points in time).*
- *To identify (at the service-area level).*

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[13] *DRAM/EMPAL, developed by Steve Putnam at the University of Pennsylvania, is one of the reputable systems developed for this purpose.*

- *Changes in population, employment, and land development (residential, commercial, institutional, visitor-gaming, industrial-warehousing).*
- *Factors associated with these changes -- e.g., undeveloped land, existing development character, accessibility, systems availability/capacity, development value.*

The purpose is to develop a repeatable analysis system drawing on the PEDaL database, an analysis system designed to generate factors for estimating the distribution and character of growth and change at the sub-area level. This analysis can be repeated for any 2 years of PEDaL data, and could be applied to generate a "rolling recalibration" of the subcounty projection/assessment system based on experience, say, in the most recent 5-year period.

Task 2.2.2 Model Current Development Patterns and Practices

This procedure will not attempt to capture all of the dynamic interrelationships among locational decisions in metropolitan areas. It will attempt to establish a useful link between county-level projections (in population and employment terms) and the distribution of resident, visitor, and working population (in residential and nonresidential land uses) among sub-areas of Clark County. The procedure will reflect the available land for development, relevant constraints on the use of available land, as well as trends in residential and nonresidential land development and the role of key facility systems which enable urban land development.

Task 2.2.3 Apply "Current Patterns" Model to County-Level Economic Futures

Note that this application would assume current development patterns and practices, taking into account land availability, key service extensions, and (potentially) development "in the pipeline."[14]

Task 2.2.4 Devise Alternatives to the "Current Patterns" Model

Working with knowledgeable local officials, we will devise alternatives to the model calibration from Task 2.2.2 to reflect specified alternatives to current development patterns and practices -- alternatives intended perhaps to increase in-fill development, adjust

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[14] *This requires a link between PEDaL (an integrated monitoring of local economic, demographic, and land use characteristics) with local permit application systems (describing development "in the pipeline")--such as the computerized PAC system currently under development in NLV.*

core-fringe development emphases, limit total vehicle miles traveled, reduce government systems costs, increase water use efficiency, etc.

In characterizing the results of the Task 2.2.2 analysis as a "current patterns" model, we should point out that this is not a simple-minded description of current patterns and practices. A "current patterns" model may well reflect land capacity, local land development policy, environmental constraints on land development, the capacities of various infrastructure systems, trends in development types and use intensities, etc.

Task 2.2.5 Apply "Alternative Patterns" Model to County-Level Economic Futures

Task 2.2.6 Package the Subcounty Allocation System for Use by Local Agencies

This could involve packaging of the databases generated by the models (step 1) and/or packaging of the models themselves (step 2).

Task 2.2.7 Phased Transfer with Designated Agencies and Entities

Task 2.3 GOVERNMENT SYSTEMS AND FINANCES

Projection/assessment systems for government expenditures and revenues reflect the distinctions in the "drivers" of expenditures and revenues. As local government officials are acutely aware, the forces which drive expenditure needs are not necessarily matched with additional revenues.

Expenditures

This topic assumes the development of base case systems capable of monitoring current levels of service at the service area as well as the jurisdictional level -- i.e., a PEDaL-SING link for each Clark County entity. Current "levels of service" include distinctions regarding the types of service provided, the population sub-groups served, measures of service activity, staff equipment, and facility "factors" of service delivery and the unit (capital and operating) service costs. These distinctions are maintained for the various service-providing entities within Clark County.

Task 2.3.1 Develop Automatic Current Service Measures (and Definitions)

Present the results by local government function and by jurisdiction budget categories using tables, figures, and thematic maps as appropriate.

Task 2.3.2 Identify Alternative Levels of Service (and Definitions)

The alternatives may involve different types of service, different service populations, different levels of service activity, different service technology (factors of service delivery), and/or different unit service costs. Alternatives establish a point of reference for calculated gaps between current and alternative service levels. While rendered in management-relevant terms, the alternatives may be rendered in the general terms (e.g., park acreage per 1,000 residents) of national standards.

Task 2.3.3 Develop Current and Alternative Service Selection Functions

These are data management procedures which facilitate the user's choice of current or alternative levels of service (various dimensions) and phasing guidelines for the transition from current to selected alternative service levels.

Task 2.3.4 Apply Current and Alternative Service Levels; Measures of Systems Deficiencies/Capabilities and Associated Costs

Task 2.3.5 Package the Above for Use by Local Officials in Clark County Agencies

Task 2.3.6 Phased Transfer to Designated Entities and Agencies Revenues

Revenues

Revenues assessment involves linkages between the economy and the revenue base, the revenue base and the revenues generated (tax rates and fees), and between the revenues generated and those distributed to various state and local funds. Given the state-local revenue structure in the State of Nevada, local revenue projection/assessment systems require parallel procedures at the state and local level, since in many cases local revenue receipts are allocations from statewide revenue "pots."

Revenue forecasting capabilities in Nevada do not currently include a systematic linkage between the revenue base and the economy which generates that base; recent trends are used (with varying sophistication) to extrapolate expected future revenue resources. Thus, there is no system (at the state level or within localities which rely on state resources and state estimates of same) enabling policy makers to consider the revenue consequences of economic futures. A downturn in taxable sales in 1991 (associated with both the resident and the visitor component of taxable sales) resulted in an unanticipated $200+ million shortfall in sales tax revenues.

Task 2.3.7 Model the Current State-County Economic Futures

(The assessment formula may be a streamlined but generally accurate representation of the legislated formula.)

Task 2.3.8 Apply Model to State/County Economic Futures

Task 2.3.9 Package the NV-Clark State-Local Revenue Model

Task 2.3.10 Phased Transfer with Designated Agencies and Entities

Task 2.4 REPOSITORY SCENARIO SYSTEM

A repository scenario system has been developed by the State NWPO, with contributions for computerization by Nye County in FY 1991. The system is designed to generate "direct effects" inputs for socioeconomic analysis, taking into account the many uncertainties in the national repository program and the local repository project. A computerized scenario system is needed for any fully defendable assessment of socioeconomic impacts in Nevada. Computerization is necessary to effectively manage information regarding numerous program components, the long (annualized) time period for the project, the many uncertainties in the national program and local project -- linking those to numerous "direct effects" required in fully dimensioned socioeconomic assessment.

Clark County NWD has not contributed to the repository scenario system but has contracted with UNLV TRC for scenario design related to transportation issues. This work would not (and is not intended to) provide inputs for socioeconomic projection and assessment. Regarding the RSDS, it would appear that Clark NWD has several options: (a) contribute to RSDS development, incorporating links with the UNLV TRC product; (b) coordinate with RSDS developers regarding access to and use of RSDS; (c) develop a separate scenario system for use in the Clark County socioeconomic program -- a system drawing on the same repository information resources, considering many of the same dimensions of uncertainty and generating "direct effects" in many of the same terms. The justification for option "c" would be political, not programmatic. Assuming arrangements at the policy-level, the work tasks for options "a" or "b" might include:

Task 2.4.1 Identify RSDS Links to UNLV TRC and Other Scenario Investigations in the Clark NWD Program

Identify the ways in which Clark NWD investigations might elaborate RSDS intermediate and final outputs for Clark County. Develop the relevant database and systems linkages.

Task 2.4.2 Contributions to RSDS Database Update

The RSDS draws on numerous information resources which are periodically updated (and sometimes reformatted) by DOE. To reflect the most recently generated (and therefore in a sense the most credible) information, these resources need to be obtained and incorporated into the RSDS system and system documentation.

Task 2.4.3 Contributions to Repository Monitoring - RSDS Links

The information systems design for repository monitoring reflects the RSDS framework. Monitoring and scenario projection are linked. Revisions of the information systems design for repository monitoring could suggest modifications in RSDS. Information generated through repository monitoring should update and recalibrate RSDS.

Task 2.4.4 Contributions to RSDS Computerization and Package

We have a "moving target" to some extent, in which new data and review comments suggest refinements in the RSDS September 1991 computerization.

Task 2.4.5 Phased Transfer Process

Potentially applicable under either option "a" or "b."

3.0 EMERGENCY PLANNING AND MANAGEMENT

This section follows the organizational format developed for the Final Base Case Analysis for Emergency Planning and Management, with some exceptions as noted below. The component parts of this Systems Development Report for Emergency Planning and Management are as follows: (3.1) Introduction; (3.2) Emergency Services, Facilities, and Personnel by Agency; (3.3) Emergency Response Integration; (3.4) Emergency Warning, Evacuation, Sheltering, and Treatment Capabilities; (3.5) Emergency Services Environmental Attributes; and (3.6) Applications of GIS-Based Emergency Management Data: Critical Incident Data Management and Scenario Modeling.

It should be noted that this Systems Development Report describes data organization and application, but does not contain the data themselves. As noted below, a significant amount of data collection in the area of emergency planning and management has taken place since the production of the Final Base Case Analysis. For these reasons, the Draft Systems Development Report was accompanied by a separate volume titled "Final Base Case Analysis -- Emergency Management Section Update: Systems Development Report Data Supplement." This volume contained data referenced in this section and was current as of March 12, 1992. Subsequent to that date further data has been received, but the base case in general, and that data supplement in particular, has not been updated. These data are being incorporated into the system under design, however, and will be included in the next Emergency Management Base Case Update.

3.1 INTRODUCTION

This introductory section will discuss two topics. These are an overview of the systems development process for emergency planning and management and a review of data set construction efforts to date.

3.1.1 Overview of Emergency Planning and Management Systems Development

The emergency planning and management section of this Systems Development Report will follow the topical organization of the Final Base Case Report, with some important modifications, two of which are most significant. First, the data used for Systems Development is a subset of those data developed for the Final Base Case; the composition of this subset was be determined by the (a) the selection of key data to be monitored and tracked over time and (b) the selection of key data that will be incorporated into the GIS mapping effort to facilitate a multiplicity of applications for current data. In this way, the data developed for this project will be of optimal utility for planning purposes, projective purposes, and real-time emergency applications. Given the desirability for the geographic organization of data, data format attributes in the systems development report will differ from those presented in the base case. Second, a new section has been added that outlines the types of applications anticipated once a GIS-based data system is up and running.

Within this section of the Systems Development Report, an outline is presented of preliminary data sets that will be tracked over time. It is important to note that this section remains in a developmental stage, and that essential consultations with emergency services and GISMO personnel are ongoing as the data system itself continues to undergo development. These individuals will be critical in determining the applications that will ultimately derive from this work; those applications will in large part direct the data formulation effort. Further, work is continuing on the construction of ARC/INFO GIS emergency planning and management data sets within the study group. The efforts of the emergency planning and management group between the draft and final versions of this report have been largely directed toward the operationalization of the automated system, based upon input received from reviewers on the interim and draft versions of this document.

This emergency planning and management section also differs significantly from the economic-demographic/fiscal section that precedes it, for several reasons. First, the economic-demographic/fiscal data will, in large part, be a driver for projected changes in emergency planning and management needs over time. As populations grow and the nature of land use patterns change, new emergency planning and management needs arise. Second, economic-demographic/fiscal data are more amenable to formal modeling than are emergency services data. As a result, the systems design for emergencies services data is more qualitative in nature than for economic-demographic/fiscal data, although applications will be similarly quantitative for analytic purposes. Third, the applications and underlying data developed for emergencies services will be explicitly designed as tools for both planning/training and real-time applications during emergency service provision.

The emergency service, facilities, and personnel data that formed the foundation of the base case description of emergency planning and management have served as a central component of the systems development phase of this project. The central change between the two has been the geographic orientation of those data used for systems development. The types of data selected for inclusion in the systems development process are those data that will be monitored and tracked over time for use in the monitoring components of the study at a later date; they are also those data considered significant for formulations of impact assessments that will also occur later in the study process. Given that these are data that will be updated through continuing monitoring, this process will essentially provide a "rolling base case" that describes changes in current conditions in Clark County as they evolve. This allows for the development of trend analysis over time, and increases the reliability of future service needs projected for planning purposes as earlier analysis can be compared to actual conditions as they evolve. The geographic nature of the system under development also facilitates the examination of emergency service integrative capabilities, a key in successful areal emergency planning and management.[15]

When the emergency management data management system is fully operational, and kept updated with continuing data collection (and integrated with economic-demographic/fiscal and transportation data) it will be possible to hypothesize critical incidents at any location in Clark County and plan the response to that incident. For example, say a motor carrier transporting nuclear waste were involved in a collision at a (any) specified point in the county. When coverages are complete, it will be possible to immediately determine the answers to such questions as: what jurisdiction is the accident within; what are the closest emergency planning and management, law enforcement, fire, emergency medical, and public works services; with whom do these agencies have aid agreements; what are the communications capabilities of those responding to the scene[16]; what are response times of various responders; what are the capabilities of the responders; how many people live within any given proposed evacuation area; what are the sensitive facilities within the hazard area; where would evacuees be sheltered and what routes would be used to the shelters[17]; what are the closest medical facilities with radiological accident resources; and so on. Data reflecting existing service provision will be used to

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[15] In the Repository Related Plans phase of the research program, issues of command and control specifically with respect to the transportation of high level nuclear waste will be addressed. This information will then be incorporated into the data management system.

[16] In addition to the critical need for communication capability between responding agencies, there is also the difficulty of communication/information demand from the public and the media during a major incident. In many emergencies judged by the media to be a national or international "event" these demands can be paralyzing to top management if not efficiently addressed. Case studies presented in the Repository Related Plans report will document some of these difficulties and present "lessons learned" from these experiences. Floods of inquiries from the general public, as well as a significant increase in the level of use public telecommunications systems, can also result in communications difficulties of major dimensions and will be explored in the case studies. For example, in the recent (April-May, 1992) LA riots, the cellular phone system essentially went down. Many emergency response services have grown dependent to some extent on cellular phones; the potential for diminution of this service must be included in emergency plans.

[17] In the Repository Related Plans study phase, many additional elements related to potential victims of an accident will be evaluated, including relocation assistance, crisis counseling, continuing shelter and feeding, inquiries from relatives, the return to home or work place, jobs in the future, and notification of relatives living away from the area.

"benchmark" the system for existing service levels against which future conditions can be measured. Further, potential differential impact distribution can be assessed through geographic analysis -- where are resources "thin" along the likely transportation routes, areas of extended response time for primary and specialty response resources, etc.

Additionally, existing attributes that may contribute to critical incidents, or make emergency response to critical incidents problematic, will be mapped to facilitate response planning, For example, flash floods may precipitate a critical incident or make response to a related (or unrelated) simultaneously occurring critical incident problematic; these areas will thus be mapped to allow contingency planning. In other words, two kinds of data are needed to provide the type of response tools desired. The first is the type of data that has been collected and will be monitored on type and level of emergency service resources available, and these are considered in this section. The second type is "environmental" data, both of natural and human origin, that will influence various emergency resource applications, and those are considered in Section 3.5. Section 3.4 has been reorganized from the base case to provide for the geographic format of the developing system; some variables in have been moved forward to Section 3.2, while others have been moved from 3.3 into 3.4. Section 3.6 presents in outline form proposed applications once the data are converted to a GIS format.

3.1.2 Data Set Construction

Since the production of the "Final" Base Case Analysis (November 26, 1991), emergency planning, management, and response data collection has continued. This effort has primarily focussed on two areas. First, there were a number of recognized data gaps in the Final Base Case due to the unavailability or inaccessibility of some data. These areas were concentrated on and, while some data gaps remain, these are much smaller at present. Second, a concentrated effort was made to spatially reference existing data. In anticipation of GIS applications and systems development efforts, a significant amount of geographically or spatially referenced data was collected.

These efforts are reflected in the volume titled "Final Base Case Analysis -- Emergency Management Section Update: Systems Development Report Data Supplement" that accompanied the Draft Systems Development Report. This supplement fulfills the large majority of the data needs described in Sections 3.2, 3.3, and 3.4, below. Data needs outlined in Section 3.5 remain to be filled, and will be developed from a number of different sources, as noted in that section.

3.2 EMERGENCY SERVICES, FACILITIES, AND PERSONNEL BY AGENCY

In the Base Case, information on emergency services, facilities, and personnel was compiled by service provider. This information has been further developed to spatially reference data were possible. (Please see the Emergency Management Section Update: Systems Development Report Data Supplement for specific data.) For example, fire service personnel and equipment are referenced to particular fire stations to show the geographic distribution of resources. This will allow the development of analytic tools that, for example, show what resources can be brought to bear on an incident at a given site within a specific time frame, based on the distance between resource location and travel networks between resources and the incident itself. When converted to a GIS format, some data are represented as points on a map, such as a location of a particular fire apparatus, while other types of data are represented as polygons on a map, such as police beat areas. Still other types are represented as arcs, such as transportation routes, while some data will remain in tabular form but they will be associated with points, polygons, or arcs. The types of GIS format data to be assembled are noted in the following sections.

The types of geographic data to be tracked for systems development purposes in the area of services, facilities, and personnel (various types of emergency response resources) are as follows:

3.2.1 Emergency Operations Centers (by entity)

3.2.1.1 EOC Locations (point)

3.2.1.2 EOC Coverage Area (polygon)

3.2.1.2 EOC Communications Capabilities, By Location (tabular data)

3.2.2 Emergency Response Facilities (by entity and by service)

3.2.2.1 Location of Facility (point)

3.2.2.2 Facility Primary Response Area (polygon)

3.2.2.3 Response Time Zones, if appropriate (polygons)

3.2.2.4 Service Population (derived from demographic data)

3.2.2.5 Personnel Assigned to Facility (tabular data)

3.2.2.6 Major Equipment Assigned to Facility (tabular data)

3.2.2.7 General Services Provided by Facility (tabular data)

3.2.2.8 Specialized Services Provided by Facility (tabular data)

3.2.2.9 Communications Frequencies Used (tabular data)

3.2.3 Dispatch and Communications Centers

3.2.3.1 Dispatch/Communications Center Location (point)

3.2.3.2 Dispatch/Communications Center Coverage Area (polygon)

3.2.3.3 Repeater Sites (point)

3.2.3.4 Repeater Coverage Areas (polygon)

3.2.3.5 Communications Frequencies Used (tabular data)

3.2.4 Electronic Data Storage and Retrieval Systems

3.2.4.1 Electronic Data Storage and Retrieval Locations (point)

3.2.4.2 Electronic Data Storage and Retrieval Systems (tabular data)

3.2.5 Specialized Radiological Response Entities

3.2.5.1 Location of Radiological Response Entities (point)

3.2.5.2 Radiological Response Entity Coverage Areas (polygon)

3.2.5.3 Radiological Response Entity Capabilities (tabular data)

3.3 EMERGENCY RESPONSE INTEGRATION

As was the case with the Base Case, emphasis in systems development has been placed on ability of various agencies to integrate resources in the field during critical incidents. These data will allow analysis of the ease with which resources can be accessed and pooled, and the ability to function integrally in the field. (Again, specific data appear the Data Supplement volume of the Draft version of this report.)

The types of geographic data to be tracked for systems development purposes in the area of response integration (ways of integrating the various response resources) are as follows:

3.3.1 Jurisdictional Area Coverages

3.3.1.1 Jurisdiction by Service Entity (polygon)

3.3.1.2 Aid Agreements by Service

3.3.1.2.1 Automatic Aid Agreements (polygon)
3.3.1.2.2 Mutual Aid Agreements (polygon)
3.3.1.2.3 Interlocal Agreements (polygon)

3.3.2 Communications Linkages

3.3.2.1 Inter-Entity/Intra-Jurisdiction Direct Communications Capabilities (polygon)

3.3.2.2 Inter-Entity/Inter-Jurisdiction Direct Communications Capabilities (polygon)

3.3.3 Coordination Linkages

3.3.3.1 Interagency Training Links (polygon)

3.3.3.2 Interagency Command System Links (polygon)

3.3.4 Electronic Data Storage and Retrieval Links

3.3.4.1 Data Storage and Retrieval Links (polygon)

3.4 EMERGENCY WARNING, EVACUATION, SHELTERING, AND TREATMENT CAPABILITIES

The types of geographic data to be tracked for systems development purposes in the area of emergency warning, evacuation, sheltering, and treatment capabilities (i.e., ways of warning the public of impending harm, moving the public out of harm's way, sheltering the public out of harm's way, or treating the public if they came in harm's way) are as follows:

3.4.1 Warning Systems

3.4.1.1 Federal Communications and Warning Systems

3.4.1.1.1 Locations (point)
3.4.1.1.1 Coverage Areas (polygon)

3.4.1.2 Emergency Broadcast System

3.4.1.2.1 Locations (point)
3.4.1.2.2 Coverage Areas (polygon)

3.4.1.3 Audible Warning Systems

3.4.1.3.1 Siren Locations (point)
3.4.1.3.2 Siren Coverage Areas (polygon)

3.4.2 Evacuation and Relocation

3.4.2.1 Emergency Shelters

3.4.2.1.1 Shelter Locations (point)
3.4.2.1.2 Shelter Catchment Area (polygon)
3.4.2.1.3 Shelter Capacity (tabular data)

3.4.2.2 Evacuation Routes

3.4.2.2.1 Primary Evacuation Routes (arcs)
3.4.2.2.2 Secondary Evacuation Routes (arcs)

3.4.2.3 Sensitive Facilities

3.4.2.3.1 Hospitals (point)
3.4.2.3.2 Convalescent Facilities (point)
3.4.2.3.3 Daycare Centers (point)
3.4.2.3.4 Preschools (point)
3.4.2.3.5 Schools (point)
3.4.2.3.6 Other (point)

3.4.3 Emergency Medical Treatment Facilities

3.4.3.1 Facilities with Emergency Rooms

3.4.3.1.1 Facility Location (point)
3.4.3.1.2 Catchment Area (polygon)
3.4.3.1.3 Facility Capacity (tabular data)

3.4.3.2 Designated Trauma Centers

3.4.3.2.1 Facility Location (point)
3.4.3.2.2 Catchment Area (polygon)
3.4.3.2.3 Facility Capacity (tabular data)

3.4.3.3 Radiological Accident Treatment Facilities

3.4.3.3.1 Facility Location (point)
3.4.3.3.2 Catchment area (polygon)
3.4.3.3.3 Facility Capacity (tabular data)
3.4.3.3.4 Staffing (tabular data)
3.4.3.3.5 Staff Training Qualifications (tabular data)

3.4.3.4 Specialized Relief/Service Agencies

3.4.3.4.1 Relief Service Facility Locations (point)
3.4.3.4.2 Relief Service Facility Capabilities (tabular data)
3.4.3.4.3 Relief Service Coverage Areas (polygon)

3.5 EMERGENCY SERVICES ENVIRONMENTAL ATTRIBUTES

The types of geographic data to be tracked for systems development purposes in the area of environmental attributes (those aspects of the natural and human environment that are likely to precipitate or exacerbate critical incidents) are as follows:

3.5.1 Natural Hazards and Associated Histories, by Location

3.5.1.1 Storm Cell Paths (polygon)

3.5.1.2 Lightning Damage Areas (polygon)

3.5.1.3 Flood Areas

3.5.1.3.1 Flash Flood Areas (polygon)
3.5.1.3.2 Other Flood Areas (polygon)

3.5.1.4 Heavy Precipitation Areas

3.5.1.4.1 Average Rainfall Areas (polygon)
3.5.1.4.2 Average Snowfall Areas (polygon)

3.5.1.5 High Wind Areas

3.5.1.5.1 Prevailing Winds by Area (polygon)
3.5.1.5.2 Average and Peak Wind Speeds by Season (polygon)

3.5.1.6 Dust Storm Areas (polygon)

3.5.1.7 Landslide/Rockfall/Avalanche Areas (polygon)

3.5.1.7.1 Seasonal Variations (polygon)

3.5.1.8 Earthquake Fault Zone Areas (polygon)

3.5.1.8.1 Earthquake History (tabular data)

3.5.2 Technological Hazards and Associated Histories, by Location

3.5.2.1 Extremely Hazardous Materials

3.5.2.1.1 Extremely Hazardous Materials Manufacturing and Storage Sites (point)
3.5.2.1.2 Extremely Hazardous Materials Transportation Routes (arcs)
3.5.2.1.3 Hazardous Materials Storage Sites (point)

3.5.3 Lifeline Utilities

(Being developed by OEM/GISMO)

3.5.4 Demographic Coverages

(From eco-demo/fiscal data: population attributes from census data; land use categories)

3.5.5 Economic Coverages

(From eco-demo/fiscal data: types of businesses by location; zoning areas)

3.5.6 Transportation Coverages

(Being developed in conjunction with TRC: transportation volume; road and railway characteristics; airport characteristics; historical accident data; average speed and impedance data; etc.)

3.5.7 Topographic and Geographic Features

3.6 APPLICATIONS OF GIS-BASED EMERGENCY MANAGEMENT DATA: CRITICAL INCIDENT DATA MANAGEMENT AND SCENARIO MODELING

The ultimate goal of the system under development is to construct analytic tools that will allow Emergency Planning, Management, and Response data to be brought to bear on both planning/training and real-time critical incident problems. To this end, the following tools, utilizing the data outlined in Sections 3.2, 3.3, 3.4, and 3.5 above, are being developed in a ARC/INFO database GIS format. These efforts are being coordinated through the Clark County Office of Emergency Management and GISMO.

3.6.1 Critical Incident Modeling Capability

The goal of critical incident modeling is to be able, in a planning context, to specify a variety of incident parameters and attributes and then hypothesize incident resolution using actual data. This involves, for example, being able to specify a variety of incidents, such as a hazardous materials spill, and having the ability to vary the composition of the spill and the severity of the incident to analyze the ability of the response system to successfully resolve the incident.

3.6.1.1 Variable Parameter Modeling

3.6.1.2 Integration with Existing Critical Incident Modeling Tools (e.g. plume models)

3.6.2 Incident Response Modeling Capability

Once incidents can be hypothesized, the tools developed under this task will allow the questions of what resources can be brought to bear on the problem, in what time frame, with what capabilities? can be addressed. Further, questions of ease of on-scene communication may be addressed as well.

3.6.2.1 Response Times by Entity and Resource

3.6.2.2 Response Capabilities by Entity and Resource

3.6.2.3 On-Site Communications/Coordination Capabilities

3.6.3 Critical Incident Human Exposure Modeling

Another critical component of the critical incident management modeling is the ability to display data on public exposure to risk. For a toxic release, for example, what is the population in the area that is exposed, how many people would have to be evacuated if it comes to that, and what are some of the human factors that complicate exposure? are all questions that could be addressed under this task?

3.6.3.1 Exposed Population Modeling

3.6.3.2 Exposed Sensitive Facility Modeling

3.6.4 Evacuation and Sheltering Modeling

The next component of the critical incident modeling tasks addresses the questions of when people have to be moved out of harm's way, by what routes are they to be moved, where will they go, and how best should they be distributed between existing sheltering resources?

3.6.4.1 Evacuee Movement Modeling

3.6.4.2 Evacuee Sheltering Modeling

3.6.5 Accident Victim Transportation Modeling

This component allows modeling of the transportation and distribution of accident victims. That is, for those people who were not moved out of harm's way without sustaining injury, where will they be taken, and what are the resources and capacities of the various receiving medical facilities?

3.6.5.1 Trauma Victim Transportation Modeling

3.6.5.2 Hazmat Accident Victim Transportation Modeling

3.6.5.3 Radiological Accident Victim Transportation Modeling

3.6.6 Environmental Hazard Overlays

These are the modeling components that serve to create impedances to efficient response. These environmental attributes may be incident precipitants, or they may render incident response problematic. The data for these layers remain to be collected, for the most part.

3.6.6.1 Meteorological Hazard Modeling

3.6.6.2 Geological Hazard Modeling

3.6.6.3 Technological Hazard Modeling

To date (June, 1992), significant progress has been made on conversion of tabular and textual emergency management, planning, and response data to an ARC/INFO format, and applications design in the draft/demonstration stage. Systems design has been developed for more fully for some areas than others (notably 3.6.1 and 3.6.3) and demonstration applications have been given for various county and municipal agencies along with multi-agency committees. Output capability to 8.5" x 11" plotting is still under development, and precludes inclusion of maps in this document.

Capabilities have been developed for relocating points on maps, along with zoom, pan, and map scaling functions. Title II hazardous materials sites have been incorporated, and the capacity for buffering around points has been achieved. Hazmat site data has been read into the software, such that 1 and 10 minute post-spill areas are generated based on materials stored at particular sites. TIGER census and Clark County street centerline data have been incorporated, along with locations of preschools, schools, adult care facilities, health care facilities, and shelters. Emergency management resources have also been geocoded, and a demonstration of the emergency response functions has been developed. This demonstration allows for user-selected spill locations, user-selected plume and buffering dimensions, along with plume direction. Analysis then displays the population by census tract in the area, and tabulates the number of persons in the area as well as the number of families. Further, schools, police and fire stations, and health care facilities in the area are displayed, along with their attributes. Major and minor roads within the area for response planning as well.

4.0 SYSTEMS DEVELOPMENT FOR TRANSPORTATION MODELING AND MONITORING

This section of the Systems Development Report describes the transportation sub-system of the "master" system for modeling and monitoring conditions in Clark County. This transportation sub-system describes the design for connecting tools and data bases for transportation analysis and monitoring and the relationship of the master system to this particular sub-system. This design relies extensively on previous work in the Base Case Analysis (see IAI Nov. 1991) which describes the types of indicators of current transportation conditions within Clark County. Furthermore, this design is also structured by the input requirements for specific analytic tools such as TRANPLAN and RADTRAN which are part of the transportation sub-system. Additionally, implementation of this design will require ongoing assessment of the data bases that can be used to describe and analyze transportation conditions within the county which are not addressed by formal computer models. That is, information about infrastructure, the organizational context of the transportation system, and other topics described in this section will require further assessment of the characteristics of the data for monitoring and analyzing these issues. A major consideration in the inclusion of these data into the transportation sub-system is their amenability for use in a geographic information system (GIS). Indeed, this sub-system design is based upon the use of GIS coverages as the medium for integrating the diverse data that are described in the Base Case Analysis.

This section is organized to present the logic of the transportation sub-system for monitoring and modeling transportation conditions in Clark County. First, we review the variable categories for description of the county rail and highway base case conditions, then we present the tools for monitoring and modeling, including their data requirements and outputs. Finally, we discuss the connection of these tools into a modeling and monitoring system and the connection of this sub-system to the master system.

4.1 VARIABLE CATEGORIES FOR DESCRIPTION OF THE RAIL AND HIGHWAY ELEMENTS OF THE TRANSPORTATION NETWORK

The transportation component of the Base Case describes existing highway and rail conditions for selected elements of the Clark County transportation network. We present here a brief overview of those Base Case elements that conceivably could be included in a monitoring and modeling system. For each category described below, data or other information to describe the system have been characterized for use in monitoring and modeling by fourteen different variables:

a. rationale for existence

b. current use

c. variables and/or elements

d. frequency of collection and updating

e. size

f. method of storage and retrieval

g. quality assurance procedures

h. amenability to spatial analysis & use in GIS

i. source of data (agency, type)

j. method of data collection

k. portability/transferability

l. cost

m. degree of error and reliability

n. responsible agency/entity

This characterization of data bases is fundamental to systems development because it can be used to analyze the compatibility and consistency problems in the monitoring and modeling of transportation data for Clark County. That is, how or if these data bases or other information can be incorporated into a data system will depend upon the utility and structure of the information. We are currently in the process of ongoing evaluation of these data bases for inclusion within the modeling and monitoring system. This evaluation will continue as the process of implementing this system design proceeds. Attached as an appendix to this document is a characterization of these data sets that will be used as a basis for incorporating data bases into this sub-system.

4.1.1 Selected Highway Elements of the Clark County Transportation Network.

Certain portions of the Clark County highway network are characterized in the Base Case. These are indicated in the list below and depicted in Figures 4-1 and 4-2.

NDOT Route A: (US-93 - I-15 - Craig Road/Rancho Rd. or Spaghetti Bowl- US-95)

I-15 from California - US-95

I-15 from AZ - US-95

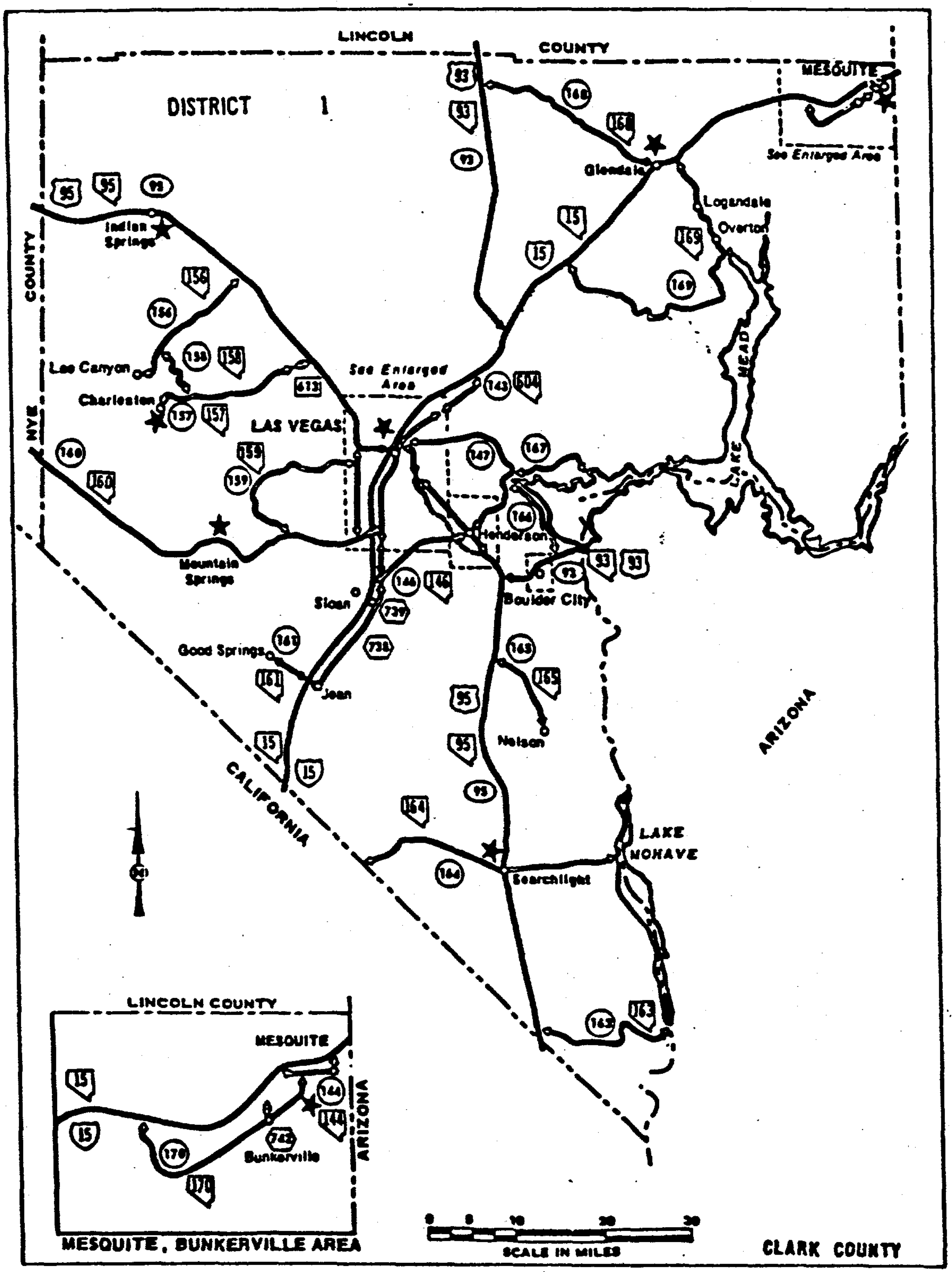
US-95 from Searchlight - Proposed Southern Beltway - I-15 - US-95

Proposed Western Beltway (to link I-15 and US-95)

Proposed Northern Beltway (to link US-93/I-15 and US-95)

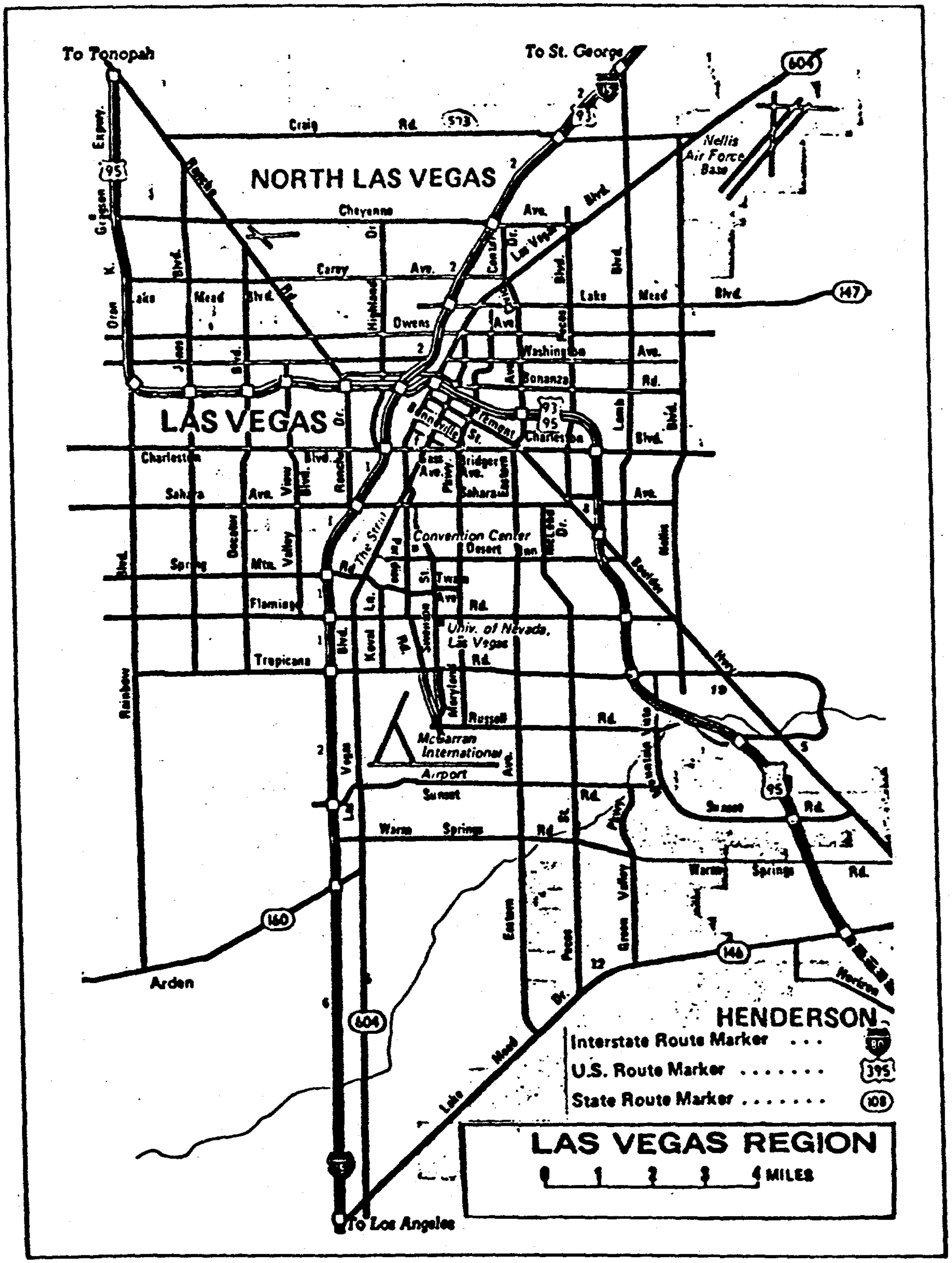
US-95 from I-40 to Searchlight - SR 164 - (via Nipton, I-15, California 127) - SR 373

Figure 4-1
Operational Stage Network in Clark County



Source: NDOT 1988

Figure 4-2
Operational Stage Network in Las Vegas



Source: NDOT

For the above routes, the Base Case describes the following categories of data:

Roadway Geometric Features: location of mileposts, location of intersections, number of lanes, segment lengths, lane widths, shoulder widths, bridge and tunnel clearances, intersection characteristics, median type, curvature and grade, and at-grade rail crossings.

Traffic Safety Features: location of signals and signs, signal operation/timing, posted speed limits, passing lanes, truck escape ramps, and guardrail/barrier type.

Pavement Features: surface type/structure, condition.

Structures: type, dimensions, structural condition, height/width/weight limits.

Use and Travel Related Characteristics: consists of volumes (average daily traffic and annual average daily traffic) demand patterns, travel times, vehicle type, and vehicle occupancy.

Maintenance Facilities and Activities: maintenance facility location, maintenance activities from facility by road type.

Safety Considerations: accidents and safety related characteristics, law enforcement and safety, and hazardous materials shipment.

Transit: data include service patterns, use (i.e. ridership), and costs, including are structure, training, employment, and operating expenses.

Environmental Context: aspects of environmental quality or environmental protection associated with the highway system.

4.1.2 Rail Elements of the Clark County Network

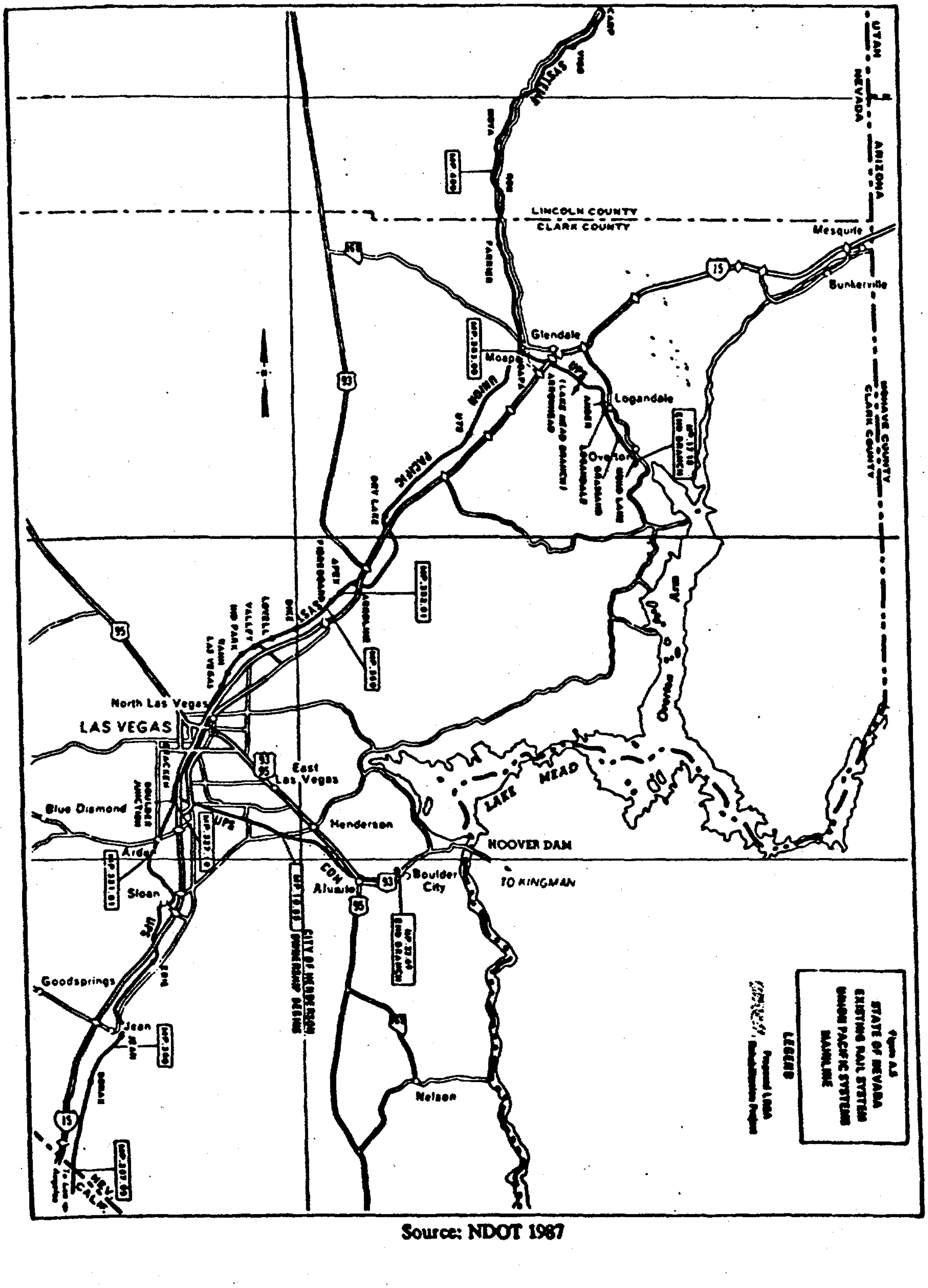
Clark County contains rail lines that are primarily owned and operated by Union Pacific, including 107.23 miles of mainline track in Clark County (from milepost 287.95 at the California border to milepost 395.18 at the Lincoln County border). In addition, Union Pacific also has 10.85 miles of track on the Boulder City branch line, 17.18 miles of track on the Lake Mead branch line, and 11.46 miles on the Nellis Air Force Base spur. The City of Henderson owns 11.84 miles of track connected to the Boulder City branch line. These tracks are characterized in Table 4-1 and depicted in Figure 4-3.

Table 4-1
Clark County Rail Routes

Track Description	Category	Length (miles)	FRA Classification
California border - Lincoln County border (UP MP 287.95 to MP 395.18)	Mainline	107.23	5
Boulder City line @ MP 327.43 (Boulder Junction to Henderson)	Branchline	10.85	2
Henderson to Boulder City	Branchline	11.84	1 and 2
Nellis AFB line	Spur	11.46	Unavailable
Moapa to Lake Mead (48.80 miles from Las Vegas)	Branchline	17.18	2

(NDOT 1988)

Figure 4-3
Southern Nevada Rail Routes



Source: NDOT 1987

The variable set for describing these rail routes is as follows:

Track Characteristics: This category includes information about rail weight, curvature and grade, locations of sidings, turnouts, bridges and tunnels, and length of segments. Other elements for which some data exist are: track classification, weight limits, design speed, locations of crossings, terminal facilities, and loading facilities, and rail-highway grade crossing locations.

Structures: This category includes information about bridges, culverts, and tunnels. Their characteristics include type, location, dimensions, and height/width/weight limits. Any limitations or restrictions on the structural capacity or the geometric constraints relevant to describing existing conditions are also addressed.

Use and Travel Related Characteristics: This category includes data regarding passenger usage, tonnage, type of commodities, frequency and schedule, and consist make-up (i.e., number and type of locomotives and rail cars also reflect internal business decisions which affect profit, and are subject to change based on economic conditions.)

Safety Considerations: This category includes information on characteristics of at-grade rail-roadway crossings, accident data, shipment of hazardous materials, environmental considerations, and others such as agency responsibilities, jurisdictions and policies.

Environmental Context: This category includes information about natural resources such as water bodies, aquifers, watersheds and snowsheds or wildlife habitats (big horn sheep, desert tortoise, elk, fish, mule, peregrine falcon, water fowl), or areas with endangered plant species.

For both the highway and rail elements of the Base Case, jurisdictional and regulatory information is also described. The purpose for monitoring these jurisdictional and regulatory issues is to identify gaps or areas of potential overlap that could result in impacts to the transportation system in Clark County. Systems development will allow for monitoring jurisdictional and regulatory changes over time. These regulatory and jurisdictional data will be incorporated into the data monitoring system as a "table" or matrix that codes the jurisdictional responsibilities for particular elements of the transportation network and also codes the categories of regulations that apply to these elements. The issues to be coded are as follows:

Jurisdictions: Transporting hazardous materials, including nuclear waste, is within federal, state, and local jurisdiction. These data refer to specific responsibilities of federal, state, and county agencies with regard to nuclear waste transportation and other relevant issues for impact assessment.

Regulations: The statutory authority and the regulations issued by or affecting federal, state, and county agencies is included in this category. Inspection of rights of way, vehicle inspection, regulation of hazardous materials/environmental protection, and liability/insurance are examples of responsibilities which are outlined for the state agencies by statute. These data refer to codes and laws which define the agency responsible for setting standards and enforcement.

4.2 OVERVIEW OF TOOLS FOR MODELING AND MONITORING HIGHWAY NETWORK CONDITIONS

Conducting an impact assessment requires tools that can take Base Case information and manipulate it for monitoring and modeling changing conditions. In this section we present an overview of selected tools, their input requirements, and the nature of their output. The structure of these tools dictates in part what can be monitored and modeled because of their input requirements. The focus here is on computerized modeling tools and a data system for monitoring. The modeling tools address only the highway element of the Clark County transportation network. The other tool is a data system for recording longitudinal data selected key variables that describe elements of the transportation network not addressed by the modeling tools. These longitudinal data can be examined for trends.

4.2.1 TRANPLAN: Modeling and Forecasting Changes in the Highway Network

Computerized transportation modeling and forecasting is exemplified in the use of packages such as PLANPAC, BACKPAC, UTEP (Hicks 1989), and TRANPLAN. The modeling of transportation highway conditions in Clark County will be accomplished by the use of TRANPLAN, which is currently used by a number of government agencies (e.g., the New York Department of Transportation, the California Department of Transportation) and it also has been used in transportation analysis by the Texas Transportation Institute (Chang et al. 1989). TRANPLAN has been selected by the Clark County Regional Transportation Commission (RTC) as the software it will use for planning and forecasting applications. This investment by RTC indicates that the Clark County Nuclear Waste Division should incorporate TRANPLAN into its "tool box" for transportation analysis so that compatibility exists with RTC data and applications.

Consequently, rather than evaluate TRANPLAN in relationship to other available tools, the focus of this discussion is the structure and application of the software for this project. Note that the intention here is not to describe the milieu of software operations, but rather to explain enough of its structure to understand how it is applied.

TRANPLAN Structure and its Forecasting Capabilities

TRANPLAN is a computerized modeling tool used widely by transportation analysts and planners.[18] TRANPLAN was developed by DeLuew, Cather and Company with the assistance of Mr. Raif Kulunk. The software was acquired by the Urban Analysis Group in 1990 where further improvements were made to the package. RTC, under contract to BRW Inc., has recently adapted TRANPLAN for Clark County purposes. After first describing the general structure of the TRANPLAN model, RTC adaptations of TRANPLAN will be briefly reviewed.

TRANPLAN Components

TRANPLAN is a batch file system that performs over forty different "functions." This system can be thought of as having three components: a control file component, a TPMENU component, and a Network Information System component for graphic display. This system can operate solely from a "control file" which links together batch files to perform a particular function. A TRANPLAN control file is generally structured to include the following: function name, files, headers, options, parameter, data, and close file. An example control file for building minimum time paths between points in the highway network follows:

[18] The following discussion of the details of TRANPLAN is based almost exclusively on the Users Manual, version 7.0, distributed by the Urban Analysis Group.

```
$BUILD TRANSIT PATHS (function name)
$FILES
        Input File = [filename]
$HEADER
        Build Transit Path
$OPTIONS
        Print paths
$PARAMETERS
        Network = Las Vegas
        Selected Zones = 1-2
        Wait Time Factors = (4,2.5)
        No Transfers = 1-3
$END TP FUNCTION
```

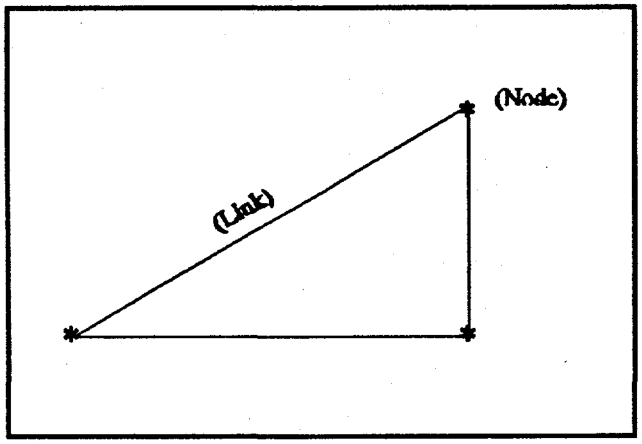
(The $ in each of the major lines of this control file is a programming convention.)

A more structured approach is offered by TPMENU which is a TRANPLAN component that provides a menu-driven interface that automates the control file process. TRANPLAN's graphic display component, termed the Network Information System (NIS), can be used to display and edit the highway network and also to display the output of different TRANPLAN functions. As yet, TRANPLAN does not have a direct link to a GIS, but Environmental Systems Research Institute (ESRI in Redlands, California) is currently developing such an interface. IAI staff are currently working on programming an interface in Arc Macro Language (AML). As system construction proceeds we will evaluate the utility of these alternate interfaces between the master system, TRANPLAN, and GIS display options.

Data Requirements and TRANPLAN Operation

TRANPLAN forecasting requires three types of information for its operation: socioeconomic data regarding land use which is used to estimate trip frequency and type; time, distance, and cost considerations (friction factors) that affect trip types; and a description of the highway network in terms of nodes and links. Nodes are physical locations -- often but not necessarily intersections -- within the highway network that are identified by a distinct number an by X and Y coordinates in state plane feet coordinates. Nodes connect links which are also identified by geographic coordinates. Link data describes an element of the transportation network in terms of its end nodes and attributes. Figure 4-4 below portrays node and link components of a highway network.

Figure 4.4
Highway Node and Link Components



TRANPLAN analyzes the types and frequency of trips along links and through nodes by a four element process. The foundation of this process is the use of Traffic Analysis Zones (TAZs) as a basic component of analysis. A TAZ is a geographical area that is usually delimited by links within the transportation network. Each TAZ is characterized by socioeconomic data regarding land use (e.g., population, dwelling types, etc.). This data is a basis for estimating the number of "trips" within a TAZ. Thus the first element of the analytic process is to determine "trip generation" by estimating the number of trips produced and attracted by the socioeconomic characteristics of land uses within a TAZ. The second element of the process is to determine travel between TAZs based on productions and attractions within each TAZ and interzonal impedances. This is done by determining "trip distribution." The third element of the process is assignment of "modal choice" to either passenger or transit vehicles. The final element in the process is "trip assignment" which apportions trips between TAZs according to travel time as a function of minimum paths between TAZs and volume-to-capacity ratios of these paths. Each individual element in this process is briefly developed later in this report.

The Gravity Model Basis of TRANPLAN

The operation of TRANPLAN is based upon a modified implementation of the classic physics gravity model. The basic idea of the physics gravity model is that the force of attraction between two objects is directly proportional to the mass of the objects and inversely proportional to the square of the distance between these masses. In this classic model, distance, mass, and a gravitational constant are resistance or impedance factors that affect the attractions between two objects. This notion of variable factors that affect the force of attraction between two objects is thus a fundamental idea that is used in

TRANPLAN, but it is modified in several ways. One of these modifications is the "separation" variable between the objects which in TRANPLAN can incorporate singularly or in combination time, distance, and a "cost" factor. A second modification of the model is replacing the square of the distance separating objects with "friction factors." Friction factors are indicated by a table that indicates willingness to travel by trip type between TAZs. An iteration process is used to match observed data with model calculations to calibrate the model. The final result of the Gravity Model function in TRANPLAN is a trip table file regarding productions and attractions between TAZs. The use of the this function will be briefly developed in the discussion below regarding trip distribution.

Link and Node Data

Within TRANPLAN, nodes, as previously noted, are indicated by number and geographical coordinates, but links care characterized by a wider range of attributes including distance, speed, capacity, number of lanes, and other such variables. These link attributes are the basic data that are used for various TRANPLAN analyses. Within the TRANPLAN NIS, data for any particular link can be displayed and modified. The attribute categories displayed in the NIS for a link are as follows:

"A"	= geographic coordinate at one end of link
"B"	= geographic coordinate at other end of link
Cost	= user-defined variable
Dist	= link distance
Speed1	= link speed for field one
Speed2	= link speed for a second speed field
User	= an alternate user-defined cost field
Assign	= the assignment group code, i.e., trip-type code
Dir C	= direction code for each link
LG1	= number of lanes
LG2	= intersection control
LG3	= jurisdictional control
CAPAC1	= link capacity in units of traffic
CAPAC2	= counted volume in each link
Volume	= the one-way volume for each link
V/C	= the volume-to-capacity ratio for each link
2-W VL	= the two-way volume for each link
V-C	= the volume and capacity difference for each link

TRANPLAN Analytic Process

After the node and link data are entered to build a highway network and before useful reports can be generated, there are four basic processes that are fundamental to operation of the TRANPLAN model: trip generation, trip distribution, modal spilt, and highway assignment.

Trip Generation

As noted above, trip generation is the process of identifying the trip productions and attractions within a TAZ. These are estimated by analysis of population, square footage of commercial businesses, employment, and other land use and socioeconomic data. Private residences are usually classified as trip producers. Commercial businesses, schools, and other entities are usually trip attractors. Socioeconomic data regarding TAZs are thus used to specify productions and attractions in vehicle trips per day. Origin and destination surveys can be used to supplement estimations of commercial vehicle trips per day within a TAZ.

Trip Distribution

The process of trip distribution produces a set of matrices of trips between TAZs by trip type. These matrices are constructed by the TRANPLAN gravity model function. This function takes the attractions and productions and friction factors between TAZs to distribute trips by type.

Modal Choice

The product of the process of modal choice is the apportionment of trips between alternate means of travel, typically private vehicle and public transit. In addition, this function is often used for assessment of occupancy rates by trip purpose. Modal choice is affected by trip purposes, production area characteristics, attraction area characteristics, and interzonal impedances. Modal choice can be calibrated with primary data regarding transit usage.

Highway Assignment

This process in TRANPLAN assigns traffic to specific highway routes between TAZs according to travel time variables and it results in the calculation of traffic volumes for links in the network. This process is as follows. Time paths are calculated between TAZs based on existing speed limits, and traffic is then assigned to the minimum time path. Volume-to-capacity (V/C) ratios (indicating congestion) are then computed as a basis to recalculate travel time based on congestion. This process undergoes a number of iterations until it matches some existing data regarding traffic volumes and travel times.

TRANPLAN Reporting

TRANPLAN has a wide range of reporting capabilities including at least 12 standard reporting modules: highway network, highway paths, highway load, highway network summary, highway incremental summary, complex weaves, transit load, matrix, matrix comparison, corridor volumes, network accessibility, and trip length frequency. The *TRANPLAN User's Manual* (Urban Analysis Group 1991) should be consulted for a detailed description of these reports, but in order to present a brief overview of the function of these reports, we will briefly summarize each below.

Highway Network reports delineate the link descriptions and node numbers within the highway network. All of the link attributes coded into the system can be reported as well as turn movements and prohibited turns. This report allows for selecting links by assignment group, link group, and for displaying all links within a particular "window" or group of windows. The output of this reporting module includes turn prohibitors, link descriptions, unused nodes, and node coordinates.

Highway Paths reports minimum impedance paths between points in the network. These paths can be calculated based on five different impedance factors: Time1, Time2, Cost, User, and Distance. Turn penalties and direction codes can also be included in these impedance calculations. There are two different types of usual reports from this reporting module. A nondestructive trace report portrays a path from a particular origin to a particular destination regardless of other paths traced. A destructive trace report portrays a path from a destination to an origin only until another path is encountered.

Highway Load reports on the volumes for particular elements of the network. There are three usual outputs available from this reporting module. The link volume report displays data by trip purpose for selected links. The turn volume report describes the volume of traffic at particular nodes in the network by trip purpose. The turning movements report can be used to portray turning movements from one node to another.

Highway Network Summary describes characteristics of links by link category. The following information is summarized for each link category: cost, distance, time, user, vehicle cost, vehicle distance, vehicle hours, vehicle user, capacity time, capacity distance, and the volume-to-capacity ratio. The standard output of this report is a table or set of tables with the associated link data.

Highway Incremental Summary reports on changes in time and speed changes for the each iteration of the process of loading information about link characteristics and volumes by purpose. The usual outputs of the report are: specific link history summaries, a distribution of time and speed changes by link, and a comparison of iterations with actual ground-count data.

Complex Weaves enables the analysis of selected portions of the highway network, often for purposes of assessing entry and exits from freeways. The function produces a table of "weave links" that are essentially matrices of origins and destinations for selected portions of the network.

Transit Load describes the assignment of passenger volumes for transit users. The usual reports produced from this module are: none-to-node volumes for particular transit lines, on and off volumes for particular lines, transit loading by links, transit summary by variables such as peak load, passenger trips, and passenger miles and hours.

Report Matrix allows for the selection of particular tables displaying information about impedances by trip purpose for a TAZ.

Matrix Comparison compares two trip matrices for volumes and impedances between zones, frequency of differences in zone to zone volumes, summary of impedance groups, and differences in productions and attractions between zones.

Corridor Volumes enables the analysis of one-way trips between TAZs. This function is often used for the analysis of transit data.

Network Accessibility reports for particular elements of the network the influence of time, cost, and distance factors on activity as defined as population or employment by trip frequency.

Trip Length Frequency displays trips lengths for a trip table by trip purposes and impedances.

These reports generate output files which can be imported directly into the NIS or else sent directly to a printer.

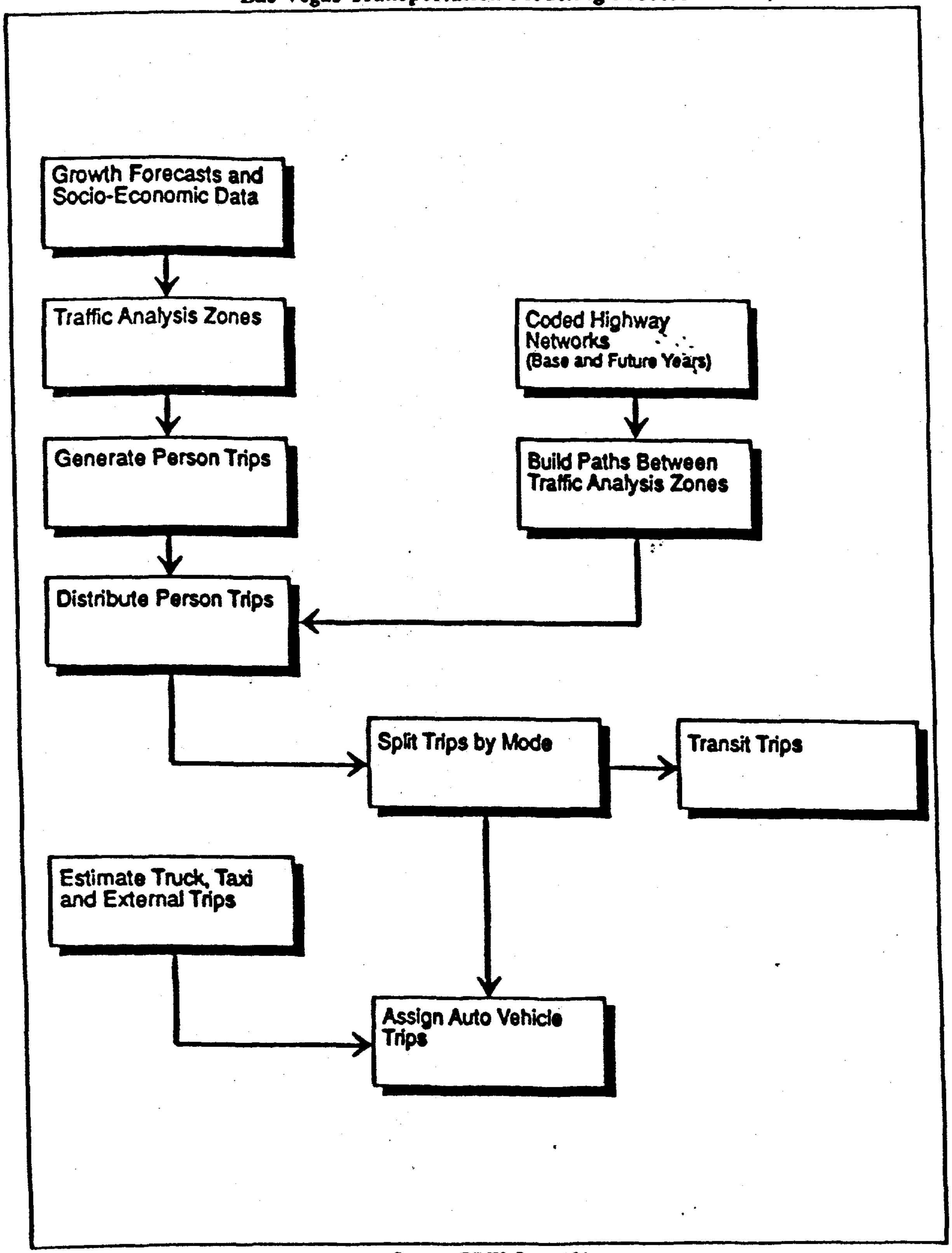
RTC Adaptations to TRANPLAN

The Regional Transportation Commission has adapted TRANPLAN for use as its planning and forecasting tool for the Las Vegas Valley. RTC's adaptation to the TRANPLAN model are expressed in two documents. The *1991 Planning Variables Report* (Coopers & Lybrand 1991) describes socioeconomic data used by TRANPLAN primarily for estimating trip generation within TAZs. The RTC report describes relevant socioeconomic data for 1990 and also forecasts these conditions for 2000 and for 2010. The use of these data for the execution of TRANPLAN is explained in the *Las Vegas Regional Transportation Plan Update* (BRW, Inc. 1991). Figure 4-5 depicts the TRANPLAN process as implemented by RTC.

Both the *1991 Planning Variables Report* and the *Las Vegas Regional Transportation Plan Update* should be consulted for the details of model adaptation. The intent here is to summarize some of the major points regarding the use of TRANPLAN to make clear its place in the overall system for monitoring and forecasting transportation conditions in Clark County.

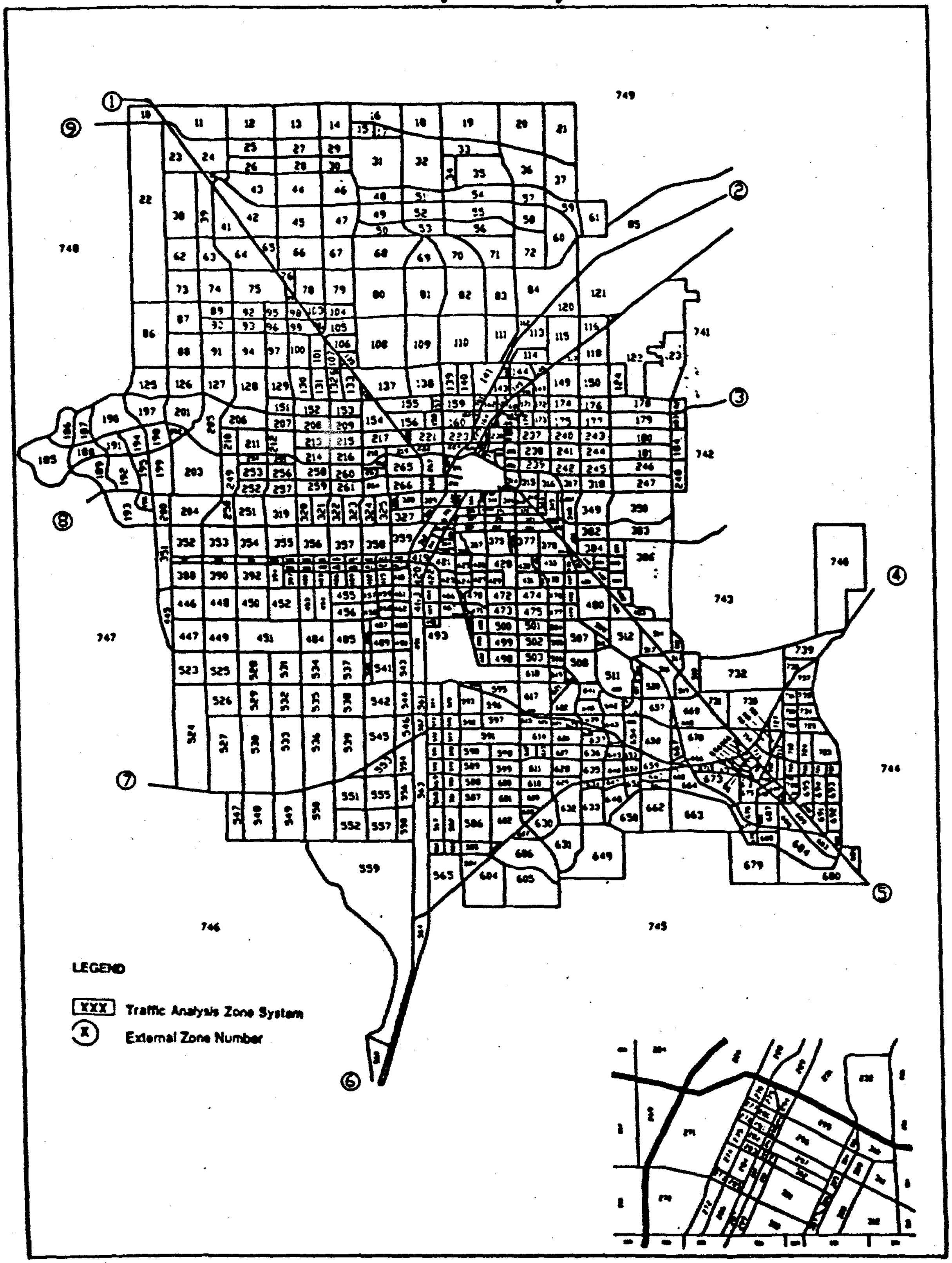
The RTC use of TRANPLAN revised the Nevada Department of Transportation's (NDOT's) 408 TAZs to 749 for the Las Vegas metropolitan area. These 749 TAZs (illustrated in Figure 4-6) were then organized into 18 "Development Districts" (listed in Table 4-2) as a means to more accurately estimate the process of intraurban growth within the Las Vegas metropolitan area.

Figure 4.5
Las Vegas Transportation Modeling Process



Source: BRW, Inc. 1991

Figure 4.6
Trafic Analysis Zone System



Source: BRW, Inc. 1991

Table 4-2
Employment by Land Use Projections
Clark County, Nevada 1990

Development District	Total Employment	Land Use				
		Hotel	Office	Industrial	Retail	Other*
1	3,553	0	0	2,995	150	408
2	25,205	85	242	4,133	4,242	16,504
3	17,790	1,899	573	3,021	9,031	3,266
4	7,848	300	8	3,512	2,545	1,483
5	13,623	358	0	10,270	2,040	955
6	4,793	577	0	41	2,982	1,193
7	5,470	0	290	299	3,517	1,364
8	59,915	19,251	17,942	2,654	6,937	13,131
9	38,648	4,145	983	2,437	19,439	11,644
10	22,699	9,610	121	1,280	2,295	9,394
11	7,117	0	0	1,103	3,236	2,779
12	16,552	1,812	2,395	7,677	3,079	1,588
13	881	0	97	463	90	231
14	58,307	6,342	8,721	11,421	21,035	10,788
15	64,227	48,264	967	1,497	8,099	5,399
16	24,184	0	6,934	3,526	6,727	6,998
17	4,589	0	638	11	3,151	789
18	0	0	0	0	0	0
TOTAL**	375,402	92,643	39,910	56,339	98,596	87,914

*Special Generators (Nellis AFB, McCarran Airport, UNLV) are included in "Other"
**Totals may not add due to rounding.
(Coopers & Lybrand 1991)

Growth projections within these Development Districts were estimated for the following variables:

- Total residential housing units
- Total occupied housing units
- Resident persons per occupied unit
- Total resident population
- Total employment
- Hotel/resort employment
- Office employment
- Industrial employment
- Retail employment
- Other non-retail employment

These projections were accomplished by a three step process: first, estimate population and employment by forecasting changes in residential and non-residential -- primarily commercial -- land use; second, develop functional relationships to predict the land use changes in each TAZ by using regression equations; and third, apply the functional relationships for land use changes to project socioeconomic conditions (Coopers & Lybrand 1991:6-8).

The existing and projected socioeconomic data are the foundation for the execution of TRANPLAN. The RTC implementation of TRANPLAN highway network, trip generation, trip distribution, and highway assignment functions is briefly reviewed below.

Highway Network

RTC codes five different types of link attributes in the highway network. An assignment group or functional classification is specified along with an estimated speed for each link type. These link types and speeds are as follows: external (99), local (20 mph), minor arterial (24 mph), major arterial (28 mph), ramp (30 mph), interstate (50 mph), freeway (50 mph), expressway (50 mph), collector (20 mph), or centroid collector -- a centroid in TRANPLAN is an actual or modeled link emanating from the center of a TAZ -- (15 mph). Additionally, three different link groups are specified: number of lanes, intersection control, and local jurisdiction (Clark County, City of Las Vegas, Henderson, North Las Vegas, and Other). These groups are used as part of the process for calculating link capacity which is accomplished by estimating vehicles per hour per lane in conjunction with a ratio of Green Time to Cycle Time. According to the *Las Vegas Regional Transportation Plan Update*, "A peak hour factor of 8 percent with 50/50 directional splits" (BRW, Inc. 1991:10) is also used in the capacity calculations. Directional codes and turn penalties are also part of the link attribute data.

Trip Generation

The process of trip generation uses socioeconomic data to estimate trip productions and attractions for each TAZ. Because the assumptions of this process are important for implementation of the TRANPLAN model, some of the details of the RTC trip generation process are summarized here.

The trip generation process describes person trips by trip type. Five different trip types are specified: home based work, home based school, home based shopping, home based other, and non-home based. External trips that start or end outside the TAZ are not part of the trip generation process nor are commercial truck and taxi trips. These are separately incorporated into the trip assignment process. The variables used to generate trips are as follows:

Household

population
household size
dwelling units
income class as defined as low ($18,400), medium ($28,500), high ($38,700).

Employment

hotel/casino
regional retail
community retail
other retail
other non-retail
office
industrial

School Enrollment

grades K-8
grades 9-12
grades 13+

Special Generators

Nellis Air Force Base
University of Nevada Las Vegas
McCarran International Airport

(BRW, Inc. 1991:16-17).

The trip distribution model was calibrated by RTC using a household survey that focused on collecting information about trip rates by household size and income. The survey resulted in data about origins, destinations, trip length, and travel time by trip purpose. The outcome of the calibration analysis produced the following information about household income effects on trip purposes:

Table 4-3
Percent of Total Trips by Purpose and Income Class

Income	Home to Work	Home to School	Home to Shopping	Home to Other	Non-Home Trips	Total
Low	27.1	6.2	19.0	24.8	22.9	100
Medium	29.7	9.0	18.0	22.0	21.3	100
High	31.6	12.0	17.6	19.5	19.3	100

(BRW, Inc. 1991:26)

Person-trip attractions were estimated using the following process. Dwelling, employment, and school enrollment data are multiplied by trip attraction rates by purpose which are derived from existing data sources. Then trip productions and attractions are balanced. The result of this process yields the following production-attraction table by trip purpose.

Table 4-4
Person-Trip Productions and Attractions
1990 Regional Daily Trips by Purpose

Trip Purpose	Productions and Attractions
Home-Based Work	627,220
Home-Based School	167,130
Home-Based Shopping	385,150
Home-Based Other	467,430
Non-Home Based	540,600
Total	2,187,530

(BRW, Inc. 1991:30)

Trip Distribution

The standard TRANPLAN gravity model function is used to distribute trips within the RTC implementation of this tool. In this gravity model function the number of trips (*t*) between any two zones is the equal to the following quotient:

$$t=\frac{p1\times a2\times ff}{\Sigma(a2\times ff)}$$

where

p1 is number of trips produced for a specific trip purpose for zone 1,
a2 is number of attractions for a specific trip purpose for zone 2, and
ff is friction factor for trips between the two specified zones.

This gravity model was matched with household survey data regarding actual trip length by trip purpose. The resulting production-attraction tables for the TAZ are then converted into an origin-destination format to portray direction of travel. This converted matrix and the original production-attraction matrix were then combined and then divided in half in order to match productions and attractions. The observed, i.e., household survey data, and TRANPLAN modeled data are compared in the following table:

Table 4-5
Percent Difference between Surveyed and Estimated Trip Length

Trip Purpose	Surveyed Trip Length	Gravity Model Trip Length	Percent Difference
Home-Based Work	13.2	13.24	+.35
Home-Based School	9.04	9.67	+6.97
Home-Based Shopping	8.16	8.07	+1.1
Home-Based Other	10.63	10.68	+.47
Non-Home Based	9.05	9.74	+7.62
Average	10.52	10.57	+.48

(BRW, Inc. 1991:35)

Modal Split

The modal choice function of TRANPLAN is used to generate matrices of the percentage of transit trips and vehicle occupancy rates by trip purpose for interzonal travel. The transit share matrices were developed by using Quick Response System, Version 2.1, a slightly-less sophisticated transportation modeling software package developed by Alan Horowitz in Madison, Wisconsin. Population data from the 114 metropolitan census tracts were used to estimate transit ridership and then the results of this analysis were redistributed to the 749 TAZs. Only resident trips -- as distinguished from non-resident trips -- were included in this analysis. Transit mode spilt (***ms***) is calculated by the following formula:

$$ms = \frac{1}{(1 + (I_t / i_a)^b)}$$

where

I_t is transit travel impedance,
I_a is auto travel impedance, and
b is a sensitivity exponent.

The percentage of transit mode share for 2010 was also estimated using the planned expansion of the transit network for the Las Vegas Valley.

The estimation of vehicle occupancy rates by trip purpose using the modal choice function of TRANPLAN was formulated by using data from the 1990 household survey. These data were also the basis for estimating 2010 occupancy rates based on future plans for ridesharing and transportation demand. The estimations by trip purpose for 1990 and for 2010 are depicted in the table below:

Table 4-6
Vehicle Occupancy Rates

Trip Purpose	1990	2010
Home-Based Work	1.12	1.30
Home-Based School	1.50	1.50
Home-Based Shopping	1.42	1.42
Home-Based Other	1.47	1.55
Non-Home Based	1.30	1.42
Average	1.32	1.42

(BRW, Inc. 1991:45)

Based on the analysis of transit and vehicle occupancy data, the modal spilt process will permit the generation of trip tables. These trip tables incorporate taxi and commercial truck trips based on NDOT estimates. The RTC analysis resulted in the 1990 modal spilt by trip type displayed in Table 4-7.

Table 4-7
1990 Modal Split by Trip Type

Trip Type	Number of Trips
Home Based Transit Trips	13,100
Home Based Work	595,300
Home Based School	113,650
Home Based Shop	285,500
Home Based Other	335,250
Non-Home Based Other	442,050
Taxi/Rental Car	76,900
Truck	142,400
External	93,900
Total Vehicle Trips	2,084,950

(BRW, Inc. 1991:47)

Highway Assignment

The RTC uses a standard TRANPLAN function -- Highway Equilibrium Load -- for the loading of vehicle trips onto highway links. This is an iterative function which assigns traffic based on travel time and impedance factors until "equilibrium" is attained. Equilibrium is understood to exist when a trip over an alternate path does not increase the time of all network trips. Turn prohibitors and turn penalties are included in this process. The RTC highway assignments in vehicle miles traveled (VMT) and by vehicle hours traveled (VHT) are compared for link types in the table below.

Table 4-8
Vehicle Miles and Hours Traveled by Link Type

Link Type	VMT	VHT
External	47,391	478
Minor Arterial	2,268,562	82,263
Major Arterial	3,952,568	141,636
Ramp	199,664	13,454
Interstate	1,458,247	28,002
Freeway	1,669,269	32,297
Expressway	123,010	2,418
Collector	840,588	33,966
Centroid Collector	1,155,269	76,760
TOTALS	11,714,568	411,274

(BRW, Inc. 1991:50)

4.2.2 Monitoring Base Case Indicators not Addressed by TRANPLAN

TRANPLAN is a powerful modeling tool for modeling and forecasting the movement of traffic through a highway network. It may also be especially useful for analysis of how traffic movement in one part of the network affect traffic in other parts. This type of analysis may be especially useful for modeling the effects highway shipments of nuclear wastes over selected routes in the system. However, TRANPLAN does not necessarily incorporate other variables that may be desirable for forecasting and monitoring purposes. Table 4-9 indicates the overlap between TRANPLAN and Base Case variables.

Table 4-9
TRANPLAN and Base Case Variables

Feature Type	Base Case Variable	TRANPLAN Variable
Roadway Geometric Features	location of mileposts	
	location of intersections	X
	number of lanes	X

Table 4-9
TRANPLAN and Base Case Variables

Feature Type	Base Case Variable	TRANPLAN Variable
	segment lengths	X
	lane widths	X
	shoulder widths	
	bridge and tunnel clearances	
	intersection characteristics	
	median type	
	curvature and grade	
	at-grade rail crossings	
Traffic Safety Features	location of signals and signs	
	signal operation/timing	
	posted speed limits	X
	passing lanes	
	truck escape ramps	
	guardrail/barrier type	
Pavement Features	surface type	
	structure	
	condition	
Structures	type	
	dimensions	
	structural condition	
	height/width/weight limits	
Use and Travel Related Characteristics	average daily traffic	X
	annual average daily traffic	X
	demand patterns	X
	travel times	X

Table 4-9
TRANPLAN and Base Case Variables

Feature Type	Base Case Variable	TRANPLAN Variable
	vehicle type	X
	vehicle occupancy	X
Maintenance Facilities and Activities	maintenance facility location	
	maintenance activities from facility by road type	
Safety Considerations	accidents and safety related characteristics	
	law enforcement and safety	
	hazardous materials shipment	
Transit	service patterns	X
	ridership	
	costs	
	structure	
	training	
	employment	
	operating expenses	
Environmental Context	emissions	
	environmentally sensitive areas	

Since not all the variables that may be useful for monitoring and forecasting are not included in TRANPLAN, we will specify the structure for a data base that will address these other variables. These variables can be grouped into the following categories: Pavement Characteristics, Roadway Structures and Markers, Traffic Movement, Accident and Safety, and Maintenance. However, one of the principal concerns is the accuracy of data maintained both within an agency and between agencies. Other important concerns include possible differences in the level of detail, basic scale, referencing system, and format used to collect and maintain data. Not all data required for impact analyses may be amenable to being processed in a GIS environment, and coverages may not exist for some of these data.

4.2.3 RADTRAN Modeling

RADTRAN 4 is a computerized modeling tool that is used for risk assessment in the transport of radioactive materials. RADTRAN is currently maintained by Sandia Laboratories in New Mexico and is available to users through the online system TRANSNET. The program incorporates assessments by the categories listed in Table 4-10. For systems development in Clark County, RADTRAN may be a useful tool for forecasting exposure levels and possible health effects from both highway and rail modes of radioactive materials transport.

Table 4-10
RADTRAN Assessment Categories

Number	Name	Characterization
1	TRUCK	Long Haul Vehicle
2	RAIL	Commercial Train
3	BARGE	Inland Vessel
4	SHIP	Open Sea Vessel
5	CARGO AIR	Cargo Aircraft
6	PASS AIR	Passenger Aircraft
7	P-VAN	Passenger Van
8	CVAN-T	Commercial Van
9	CVAN-R	Commercial Van
10	CVAN-CA	Commercial Van

RADTRAN requires an input file to be executed by the program. The input file contains user-specified information about the isotopes being transported, the shipment modes, population density (urban, rural, and suburban zones), link characteristics, and an array of other data. An input file for a normal truck transport of radioactive material would have the following structure:

1. Fraction of travel in rural population zone
2. Fraction of travel in suburban population zone
3. Fraction of travel in urban population zone
4. Velocity in rural zone (km/hr)
5. Velocity in suburban zone (km/hr)
6. Velocity in urban zone (km/hr)
7. Number of crew on a shipment
8. Average distance from source to shipment crew (m)
9. Number of handlings per shipment
10. Stop time for shipment (hr/km)
11. Minimum stop time per trip (hr)
12 Zero stop time per trip (hr, rail only)
13. Minimum rail classifications/inspections
14. Persons exposed while stopped
15. Avg. exposure distance while stopped (m)
16. Storage time per shipment (hr)
17. Persons exposed during storage
18. Avg. exposure distance during storage (m)
19. Persons per vehicle on transport link
20. Fraction of urban travel during rush hour
21. Fraction of urban travel o city streets
22. Fraction of rural/suburban travel on freeways
23. Vehicles per hour, rural zones (one-way)
24. Vehicles per hour, suburban zones
25. Vehicles per hour, urban zones

RADTRAN can produce reports that specify radioactivity dose by population density (in person-rems) and in effective dose equivalents. These can then be related to health and other effects of exposures. For example, a RADTRAN execution of an input file that specifies incident-free rail transport of vitrified waste has the following output:

INCIDENT-FREE SUMMARY

INCIDENT-FREE POPULATION EXPOSURE IN PERSON-REM

	PASSENGER	CREW	HANDLERS	OFF LINK	ON LINK	STOPS	STORAGE	TOTALS
LINK 1	0.00E+00	7.58E-03	0.00E+00	4.07E-03	2.02E-04	4.08E-03	0.00E+00	1.59E-02
TOTALS:	0.00E+00	7.58E-03	0.00E+00	4.07E-03	2.02E-04	4.08E-03	0.00E+00	1.59E-02

MAXIMUM INDIVIDUAL IN-TRANSIT DOSE

LINK 1 2.86E-05 REM

EXPECTED VALUES OF POPULATION RISK IN LATENT CANCER FATALITIES

MATL	GROUND	INHALED	RESUSPD	CLOUDSH	INGESTION	TOTAL
C14ORG	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR90	0.00E+00	6.43E-04	2.83E-03	0.00E+00	0.00E+00	3.48E-03
TC99	0.00E+00	2.09E-10	9.54E-10	3.14E-16	0.00E+00	1.16E-09
I129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS137	6.58E-03	9.64E-06	4.25E-05	0.00E+00	0.00E+00	6.63E-03
SM151	3.85E-09	3.46E-07	1.56E-06	2.10E-14	0.00E+00	1.91E-06
NP237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PU239	6.06E-09	7.98E-05	3.64E-04	4.21E-14	0.00E+00	4.44E-04
PU241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AM241	3.30E-06	1.51E-03	6.88E-03	1.35E-10	0.00E+00	8.39E-03
TOTALS:	6.58E-03	2.24E-03	1.01E-02	1.35E-10	0.00E+00	1.89E-02

MAXIMUM INDIVIDUAL IN-TRANSIT DOSE

LINK 1 2.86E-05 REM

EXPECTED VALUES OF POPULATION RISK IN GENETIC EFFECTS

MATL	GROUND	INHALED	RESUSPD	CLOUDSH	INGESTION	TOTAL
C14ORG	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR90	0.00E+00	3.43E-07	1.51E-06	0.00E+00	0.00E+00	1.85E-06
TC99	0.00E+00	1.31E-11	5.98E-11	4.45E-16	0.00E+00	7.29E-11
I129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS137	9.32E-03	4.89E-06	2.16E-05	0.00E+00	0.00E+00	9.43E-03
SM151	5.45E-09	2.91E-12	1.31E-11	2.97E-14	0.00E+00	5.47E-09
NP237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PU239	8.59E-09	5.45E-06	2.49E-05	5.97E-14	0.00E+00	3.04E-05
PU241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AM241	4.67E-06	1.36E-04	6.21E-04	1.91E-10	0.00E+00	7.62E-04
TOTALS:	9.32E-03	1.47E-04	6.69E-04	1.91E-10	0.00E+00	1.01E-02

EXPECTED RISK VALUES - OTHER

LINK	ECON $$	EARLY FATALITY	EARLY MORBIDITY
1	0.00E+00	0.00E+00	3.31E-04
TOTAL	0.00E+00	0.00E+00	3.31E-04

* *Note that ingestion risk is a societal risk; the user may wish to treat this value separately.*

RADTRAN is a potentially useful tool for estimating the effects of the transport of radiological materials for various travel modes. It may be very useful if it can be linked with the TRANPLAN user defined cost inputs for particular links in conjunction with RADTRAN risk estimations.

4.3 MONITORING RAIL ELEMENTS OF THE TRANSPORTATION NETWORK

4.3.1 Data for Modeling and Monitoring Rail Transport

The Base Case for rail conditions in the Clark County transportation network described data in the following categories:

Infrastructure Characteristics

- Track characteristics and classification
- Rail weights and limits
- Curvature and grade
- Design speed
- Location of sidings, spurs, and turnouts
- Location of at grade rail-highway crossings
- Location of bridges
- Location of tunnels
- Location of terminal loading facilities
- Length of segments
- Number of tracks
- Structures

Use and Travel Related Characteristics

- Passenger Usage
- Tonnage
- Types of Commodities
- Frequency/schedule by direction
- Consist/makeup

Safety Considerations

- At grade highway-rail crossings
- Accident data
- Safety programs
- location of hazardous areas
- hazardous materials shipment

Jurisdictions and Regulations

Rates
Track inspection
Vehicle inspection
Regulation of hazardous materials and environmental protection
Liability and insurance

Environmental Context

Ecologically sensitive areas
Locations with hazardous products or processes
Noise pollution
Air quality
Run-off, drainage, watersheds, and snowsheds

Most of the data for description of the Base Case was derived from the private publications of the Union Pacific railway, primarily the *Condensed Track Profile.*

4.3.2 Tools for Modeling and Monitoring Rail Transport

Available tools for forecasting rail conditions are models such as INTERLINE which is a national rail routing system. These kinds of routing models may not be the most useful for forecasting rail transport until more specific information exists about USDOE modal mix and routing, especially since routing choices may involve building new rail spurs. Consequently, at this point in time modeling and monitoring of rail conditions in the County is best accomplished by the application of rail data to a GIS. Much of the most useful data for modeling and monitoring rail conditions is well-suited to a GIS compatible data base. Consequently, we will use a GIS compatible data based monitoring system that relies upon analysis of trends in variable changes to predict future conditions. However, it should be emphasized that data regarding the rail system in the county belongs to private entities and this may affect the availability of data. Consequently, those variables selected for monitoring will be those that are both desirable and available.

Selection and monitoring of key indicators of rail conditions will be accomplished within the same categories that are used for monitoring highway data: track characteristics, route structures and markers, traffic movement, accident and safety, and maintenance. Again, the emphasis in selection of variables is upon those that can be geocoded.

4.4 AGENCY, JURISDICTIONAL AND REGULATORY INFORMATION

The organizational context of the transportation system (agencies, jurisdictions, and regulations) may change in response to future circumstances or mandated changes may affect the operation of the transportation network. Monitoring this organizational context will thus be an important element of the transportation forecasting and monitoring system. This organizational context can be thought of as a matrix in which the relevant monitoring agencies are one dimension and jurisdictional and regulatory issues that are controlled by each agency are the other dimension. Table 4-11, presented below, is an example of the matrix which can be used to indicate the particular agencies, their jurisdictional responsibilities and regulatory obligations. It can be expanded, contracted, or updated to indicate changes in the organizational context of the transportation system, and a history file can be created which indicates patterns of change.

Table 4-11
Organizational Context of the Transportation System
Federal, State and Local Jurisdictions

Agency	National Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority	Regulations Issued by or Affecting Agency
Department of Energy (USDOE), Office of Civilian Radioactive Waste Management (OCRWM)	Take title to spent fuel, provide casks, arrange shipping, collect disposal fees, regulate USDOE transportation contractors, assist state and local governments in transportation emergencies, provide emergency response training, involve states, tribes, local governments, and public in planning for transportation.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. PL 93-438. Energy Reorganization Act of 1974, 42 USC, 5801 et seq. Price-Anderson Act of 1957. 42 USC, 2010, 2012, 2014, 2039, 2232, 2239 (1976). Atomic Energy Act of 1954, as amended, 42 USC 2021 (1976).	DOE Order 54801.1. Re: Rad. waste shipping for defense, national security. DOE Orders: 5500.2. (8/81) 5500.4 (8/81), 5530.1 (1/83) re: emergency response. 44 CFR 351. USDOE assistance to states in emergency preparation, management. 49 CFR 171. USDOE notified of rad. accident
Nuclear Regulatory Commission (NRC)	Establish shipping cask requirements, license casks, establish lifting and tie-down standards for packages, establish safeguards to prevent sabotage, approve routes, require pre-notification of states.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. PL 93-438. Energy Reorganization Act of 1974, 42 USC, 5801 et seq. Price-Anderson Act of 1957, as amended. 42 USC, 2010, 2012, 2014, 2039, 2232, 2239 (1976). Atomic Energy Act of 1954, as amended, 42 USC 2021 (1976).	10 CFR - Parts: Shipping - 30, 40, 70 Transporting - 30, 40, 51, 70 State Programs - 30, 40, 50 Notification - 73 Reporting - 71 Monitoring - 73 Public Information - 9 Training - 1 (44 CFR, Response Plan. 351) Emergency Response - 50 Accident Notification - 50 Liability, Financial Response - 140 Inspection/Monitoring - 19, 30 Compliance - 71 Safeguards - 560
Environmental Protection Agency (EPA)	Promulgate applicable standards for protecting the public from radioactive material in repositories; review of Draft EIS, DEIS, regulations and requirements, SCP.	PL-425. Nuclear Waste Project Act of 1982, as amended, 1987. Clean Water Act, as amended, 1977, 33 USC, 1251 et seq. Presidential Reorganization Plan No. 3 of 1970. National Environmental Policy Act of 1969, 42 USC, 4231 et seq (1976) and 4371 et seq (1976). Resource Conservation and Recovery Act of 1976, USC 6901 et seq.	40 CFR - Parts: Shipping - 122, 190 Transporting - 122, 190 State Permits - 123 Public Information - 190 Compliance - 190 Rad Exposure Standards - 191 Training/Response Planning 44 CFR 351 Noise Emission Standards, Rail - 201

Agency	National Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority	Regulations Issued by or Affecting Agency
Department of Transportation (USDOT)	Regulate shipping requirements, documentation, handling, radiation levels allowed; establish routing requirements; provide training.	PL 97-425. Nuclear Waste Policy Act, as amended, 1987. Hazardous Materials Uniform Safety Act of 1990. National Highway Traffic Safety Amendments of 1985. Hazardous Materials Transportation Act of 1974, 49 USC, 1801 et seq (1976). PL 89-670. Department of Transportation Act of 1966, 41 usc, 1651 et seq (1976). Federal Railroad Safety Act of 1966, 41 USC, 43]. et seq. Interstate Commerce Act of 1887, as amended, 49 USC, 11502(a) (1976) Re: USDOT Agreement States.	HM-164 (49 CFR, 177.825) Routing, training, preferred routes, preemption of local regulations. DOT Orders 1900.7C Emergency response Crisis Action Plan 1950.1A. 49 CFR - Parts: Shipping - 171. Transporting 171. Cooperative Agreements with states (motor carriers) - 388. Packaging Design - 173, 178, 179, Chapter IV (Coast Guard). Material Characterization - 172 (RSPA). Labeling/Placarding - 172. Handling, Loading, Disposal - 172. 174 - (Rail); 175 - (Air); 176 - (Water); 177 - (Highway). Contamination - 174, 175, 176, 177. Notification - 175. Records - 172. Monitoring - 171, 177. Information to Accompany Shipments - 172 Accident Notification - 171 Routing - 177 (HM-164) Preparation - 177, Section E Inspection, Monitoring - 174, 175, 176, 180 Track Maintenance Standards - 213 Standards and inspection procedures for freight cars and locomotives - 215, 229, 230 through 232 Permits - 1023 Cooperation with states re: Enforcement, investigation, inspection - 1022 Training/Response Planning 44 CFR 351

Agency	National Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority	Regulations Issued by or Affecting Agency
Federal Emergency Management Agency (FEMA) Radiological Preparedness Coordinating Committee Committee includes: Dept. of Defense (DOD), Dept. of Health and Human Services (DHHS), Dept. of Agriculture (USDA) Dept. of Commerce, under FRERP or FRMAP.	Assist federal, state agencies in developing emergency response plans, coordinate federal agencies' emergency response, training for emergency responders.	PL 97-425. Nuclear Waste Policy Act of 1982, as amended, 1987. Presidential Reorganization Plan No. 1 of 1978, Executive Order 12241, 9/80.	44 CFR - Parts: Contamination. Chapter 1 Emergency Response Roles, 200. Federal Rad. Emergency Disposal (FRERP) 9/84 351. FEMA REP - 5. Guidelines for development of state and local radiological emergency response plans and preparedness for transportation accidents, Revised 1989 (FRMAP). Training and response planning, 14 CFR 300.
Council on Environmental Quality (CEQ)	Declaration of national policy to promote efforts to prevent or eliminate damage to the environment.	National Environmental Policy Act of 1969, 42 USC, 4231 et seq (1976) and 4371 et seq (1976).	40 CFR 1502 Environmental Impact Statement Re: Transportation. 49 CFR 1515, Freedom of Information Procedure.
Department of the Interior (DOI) - Bureau of Indian Affairs (BIA) - Bureau of Land Management (BLM)	Establish rights-of-way through Indian and public lands.	PL 97-425. Nuclear Waste Policy Act, as amended, 1987. Federal Land Policy and Management Act of 1976 43 USC, 1701 et sep (1976). Indian Affairs Bureau Authorization Act of 1921, as amended, 25 USC, 21 (1976).	43 CFR, Chapter 11 Transportation through public lands. 25 CFR, Chapter 1 Rights-of-way for highways and railroads through Indian lands.

Agency	State Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority
Agency for Nuclear Projects/Nuclear Waste Project Office	Within oversight and monitoring role, conduct or coordinate all state activities re HLW transport to a repository; maintain liaison with USDOE, WIEB, local governments, tribes; provide information to public, executive and legislative commissions and committees.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. NRS 459.0093 to 459.0098
Nevada Commission on Nuclear Projects	Advise and make recommendations to governor and legislature on state policy concerning disposal of radioactive waste.	NRS 459.0091
Nevada Legislative Committee on High Level Radioactive Waste	Study and evaluate information and policies regarding HLW repository; any potentially adverse effects of construction and operation of repository; and any other policies relating to disposal of high level radioactive waste, recommend appropriate legislation to legislature and commission.	NRS 459.0085
Division of Environmental Protection, Nevada Department of Conservation and National Resources	Provide hazardous waste management from generation to disposal, including transportation, handling, safety.	NRS 232, 136, 444.774, 444.776, 444.778, 444.748, 444.752, 444.762, 449. Resources and Recovery Act of 1976. 40 CFR 271.6, 261, 262, 263, 264, 270, 271, 124.

Agency	State Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority
Agency for Nuclear Projects/Nuclear Waste Project Office	Within oversight and monitoring role, conduct or coordinate all state activities re HLW transport to a repository; maintain liaison with USDOE, WIEB, local governments, tribes; provide information to public, executive and legislative commissions and committees.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. NRS 459.0093 to 459.0098
Public Service Commission of Nevada	Supervise and regulate operation and maintenance of public utilities, including hazardous materials transportation by rail. Specific Responsibilities: Approve rate schedules for railroads; Receive motor carrier accident reports; Inspect motor carrier vehicles; order repairs; Weigh commercial motor vehicles; Issue certificates for intrastate common carriers; Determine levels of liability and necessary insurance or bonds to which motor carriers are subject.	NRS 233B.0613, 703.150 and 380, 704.020, 704.050, .060, .070, .120, 704.210, .300. NRS 705.020, NRS 706.441, 706.173., .246, .251, .256, .256, .386. Nevada Administrative Code (NAC) 706.191, .192, .193. 42 USC 2210, Price - Anderson Act (covers certain damage claims from transportation accident). PL 96-296, Motor Carrier Act (minimum levels of liability for radioactive materials carriers).

Agency	State Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority
Agency for Nuclear Projects/Nuclear Waste Project Office	Within oversight and monitoring role, conduct or coordinate all state activities re HLW transport to a repository; maintain liaison with USDOE, WIEB, local governments, tribes; provide information to public, executive and legislative commissions and committees.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. NRS 459.0093 to 459.0096
Nevada Department of Transportation Nevada Transportation Board	**Planning Division** Develop and coordinate balanced state transportation policy; Coordinate local plans for transportation facilities and services; enter into cooperative agreements with counties for road improvement; Provide approval and guidance for route selection. Specific Responsibilities: **Department:** Maintain general highway plan, collect info relative to mileage, traffic, character and condition of highways; Prepare highway planning surveys, maps and studies of traffic; *Develop plan for routing shipments of highway-route-controlled quantities* (1113HRCQ) *of nuclear material and* HLW; Develop and carry out state plan for service by rail; Conduct motor vehicle inspections; Issue permits for over-dimensional or overweight vehicles. **Board:** Designate alternative routes for HLW transportation.	NRS 408.125, .141, .190, .275, .283; NRS 459.125; NRS 484.695, .737, .7631, .779, NRS 705.421.
Nevada Highway Patrol, Department of Motor Vehicles and Public Safety	Enforce regulations and provisions of State Environmental Commission, NRS and USDOT. Specific Responsibilities: Issue permits to transport hazardous materials; Inspect motor vehicles which transport hazardous materials; Investigate accidents; Receive notification of HRCQ and radioactive waste shipments; Initial response for hazardous materials accidents; Handle emergency response and safety measures until responsible parties arrive; Maintain repository for information concerning hazardous materials in Nevada; Receive and maintain reports for accidents or incidents involving hazardous materials.	NRS 444.470, 459.250, .705 .715, .720 and .730, 481.027(1), NRS 481.180, NRS 484.755, NRS 706.171, 706.231, 706.441. Executive Order - Emergency Management Administration Order No. 10.

Agency	State Jurisdictional Responsibilities Related to Nuclear Waste Transportation	Statutory Authority
Agency for Nuclear Projects/Nuclear Waste Project Office	Within oversight and monitoring role, conduct or coordinate all state activities re HLW transport to a repository; maintain liaison with USDOE, WIEB, local governments, tribes; provide information to public, executive and legislative commissions and committees.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987. NRS 459.0093 to 459.0098
Radiological Health Section, Health Division, Department of Human Resources	Regulate low level waste site. Specific Responsibilities: Receive notification of radioactive materials/waste shipments. Issue license for use of low-level waste site	NRS 459.030, .120., .221
Nevada Division of Emergency Management, Department of the Military	Coordinate emergency services, including hazards analysis, mitigation, planning, preparation, response, recovery.	NRS 414
State Fire Marshal	Establish training program for response to hazardous materials spills.	NRS 477.050

Agency	Local Jurisdictional Transportation Planning Responsibilities Related to Nuclear Waste Transportation	Statutory Authority
Board of County Commissioners of Clark County	Develop policy and review county activities regarding Yucca Mountain repository.	NRS 459.713.
Steering Committee, Clark County Nuclear Waste Repository Division	Advise NWD and Commission on nuclear waste repository matters; review and monitor NWRD program.	Commission action.
Clark County Nuclear Waste Repository Division, Dept. of Comprehensive Planning	Within oversight and monitoring role, conduct or coordinate all county activities re HLW transport to a repository; maintain liaison with USDOE, WIEB, local governments; provide information to public, county commission.	PL-425. Nuclear Waste Policy Act of 1982, as amended, 1987.
Regional Transportation Commission of Clark County	Fund and evaluate projects to improve transportation facilities within Clark County. *Responsible for all federal (and other) transportation planning grants to the County, including coordination of transportation systems.*	NRS 373.030. Clark County Code Chapter 4.04 Metropolitan Planning Organization (MPO). Governor's Designation

Note: Table adapted from Final Base Case, pg 509

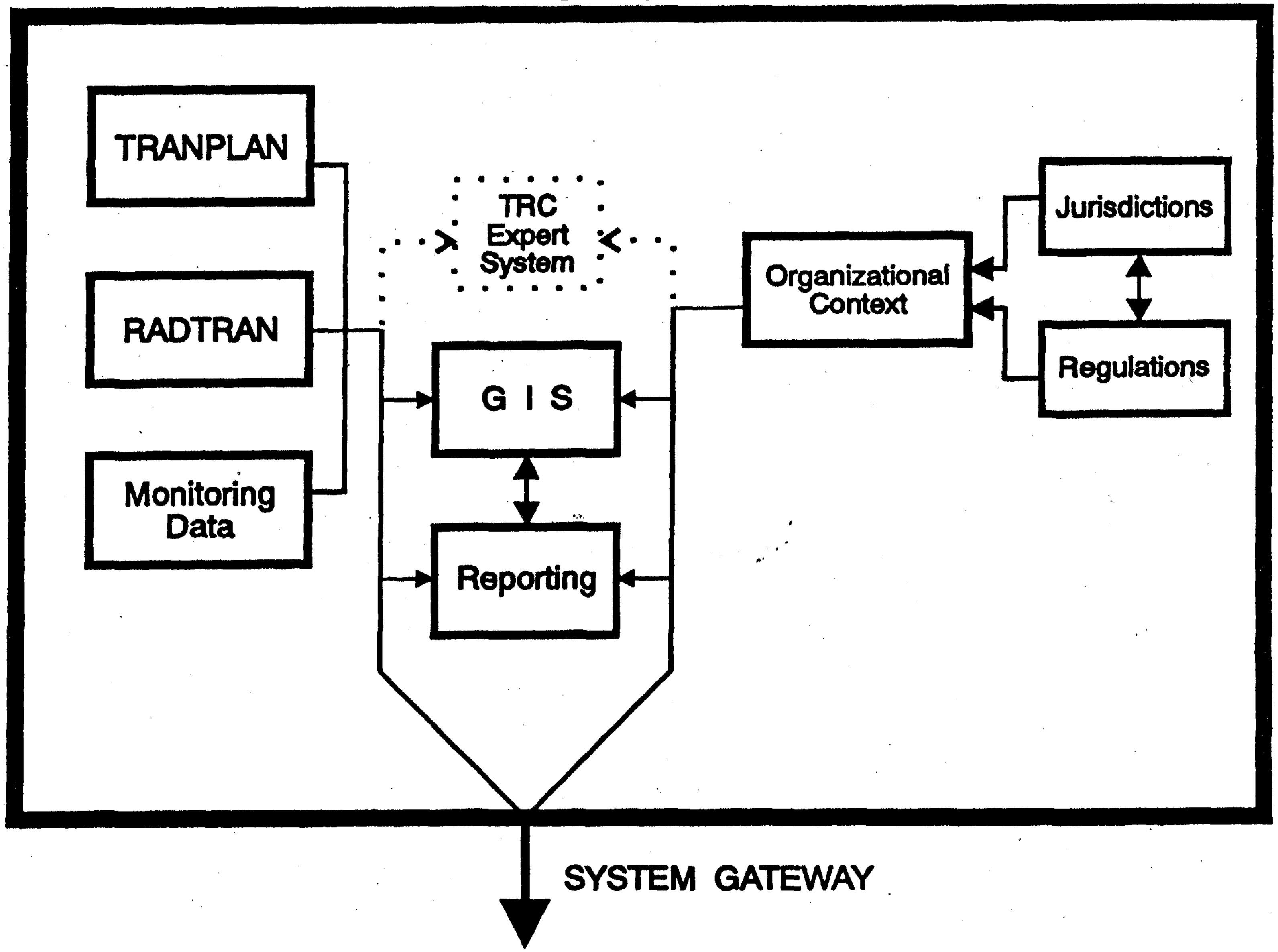
4.5 INTEGRATING THE TOOLS INTO A MODELING AND MONITORING SYSTEM

TRANPLAN, RADTRAN, and the data monitoring system (DMS) will be integrated into a modeling and forecasting system that incorporates monitoring the organizational context of the transportation network for assessing transportation conditions in Clark County. This system will be constructed by connecting the tools, integrating data into a GIS, and establishing a gateway. These steps are briefly described below.

4.5.1 Connect the Tools into a System

TRANPLAN, RADTRAN, the DMS, and the organizational context monitoring will be integrated into a transportation modeling and monitoring system. Figure 4-7 illustrates the overall systems structure. Where appropriate, the outputs and inputs of these tools will be linked. For example, link volumes obtained as outputs from TRANPLAN could form a part of the input data for RADTRAN. All potential linkages have not yet been identified.

Figure 4.7
Integrated System Tools



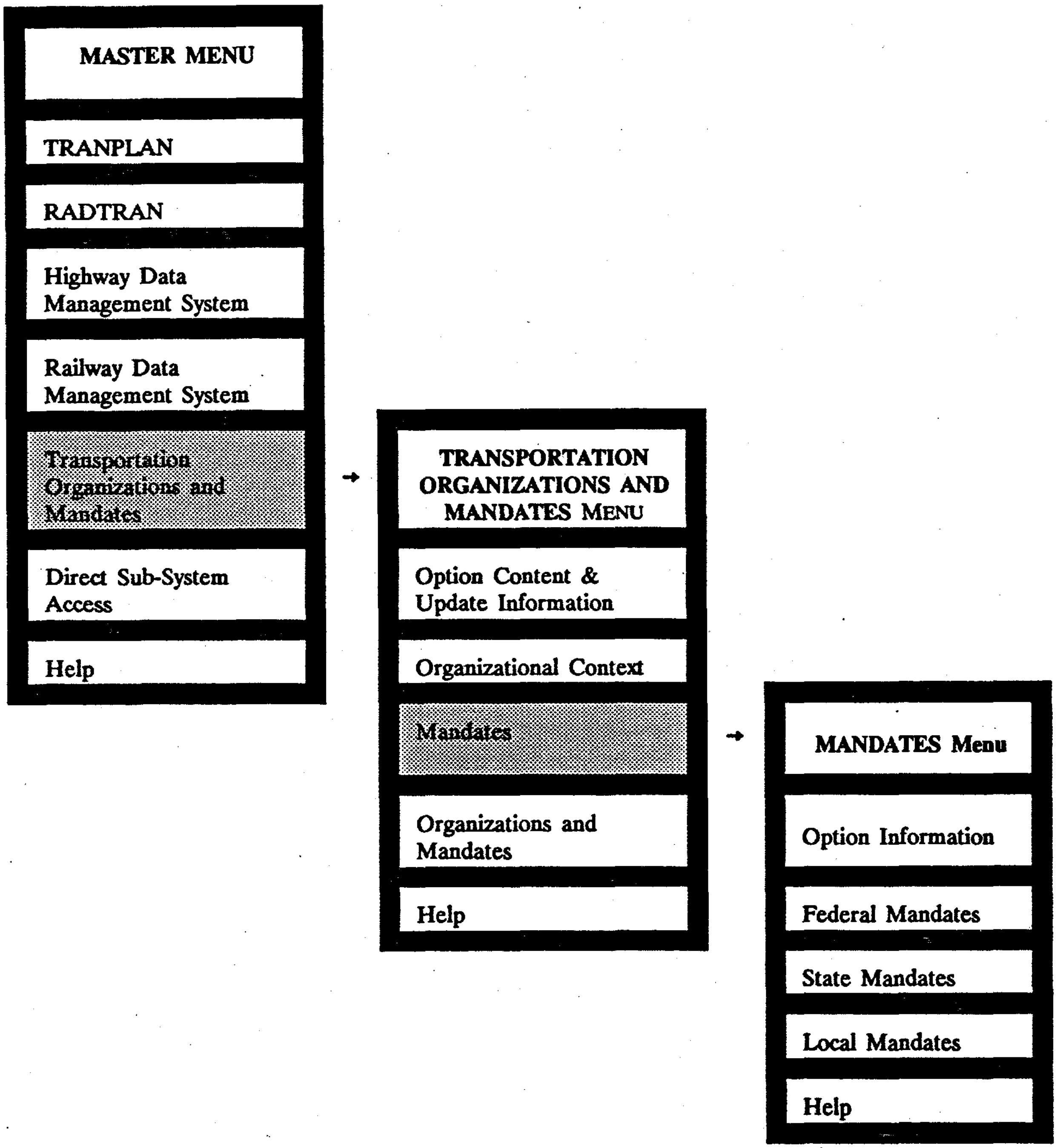
4.5.2 GIS Integration

A transportation network is well-suited to geocoding and incorporation into a geographic information system. However, at least two factors can limit the use of a GIS to integrate data: one, not all transportation data may be amenable to geocoding; and two, for those data that are amenable, not all may exist in GIS coverages. Consequently, where it is feasible and possible we will use geocoded data associated with each of these tools. Furthermore, the powerful graphical display capabilities of a GIS will be used to better convey the results of transportation analyses using TRANPLAN, RADTRAN, the DMS, and the organizational context monitoring. This may require the ability to exchange data between these models and the GIS system. As this system is constructed, an important task for the IAI programming staff will be developing linkages between the models for data exchange and integration.

4.5.3 Establish a Gateway between Transportation and the Master System

There needs to be a gateway between the master system and the transportation tools for modeling and monitoring. The function of the gateway will be to interface between the different tools within the transportation sub-system and the master system. This gateway will be a user-friendly, menu-driven interface which will present options for using the tools and data bases within the transportation sub-system. A sample menu for this gateway is presented in Figure 4-8. Selection of a particular option will then allow the user to complete an analysis within the sub-system and export that analysis to the master system where it can be combined with additional data. This interface will be a customized product constructed by IAI GIS programming staff and it will have an option for Direct System Access of sub-options within the menu system. This Direct System Access option is intended to be a short-cut method for users familiar with the sub-system tools and menus. The general structure of these menus is outlined below, but the actual construction of the interface will be accomplished in close consultation with Clark County Nuclear Waste Division staff. This consultation will ensure that the interface meets the needs of Clark County staff to access all desired tools in the transportation sub-system.

Figure 4-8
Sample Menus for Gateway



5.0 SOCIOCULTURAL SYSTEMS DEVELOPMENT

The sociocultural group is presently at the Draft Base Case phase of the study process. It is anticipated that this group will be in phase with the remainder of the study process within the next fiscal year.

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TRANSPORTATION APPENDIX

Data Characterization Summary for Clark County's Transportation System

Abbreviations and Acronyms

AAT	Average Daily Traffic
AAT	Average Annual Daily Traffic
CDA	Clark County Department of Aviation
CDPW	Clark County Department of Public Works
CFR	Code of Federal Regulations
EMS	Emergency Medical Service
EOB	Equal Opportunity Board
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FRA	Federal Railroad Administration
GIS	Geographic Information System
GISMO	Clark County Geographic Information System Management Office
GRNDB	Geographic Road Network Database (used by NDOT)
HEN	City of Henderson
ICC	Interstate Commerce Commission
LAS	City of Las Vegas
LVTS	Las Vegas Transit System
NDOT	Nevada Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NRS	Nevada Revised Statutes
NVL	City of North Las Vegas
PSC	Public Service Commission
RIM	Relational Information Management system
RTC	Regional Transportation Commission of Clark County
TRANPLAN	Transportation Planning Model
TRC	UNLV Transportation Research Center
UNLV	University of Nevada Las Vegas
USDOT	U.S. Department of Transportation
USGS	United States Geological Survey

Data Characterization Summary

Much of the information used to characterize transportation data is found in existing documents. For example, descriptions of the highway and transit portions of the Clark County transportation system can be found in reports prepared by or for the Regional Transportation Commission (RTC). A key document is the "Inventory and Analysis Report" portion of the *Las Vegas Regional Transportation Plan Update* prepared by BRW and dated August 27, 1990. Other portions of the plan, including forecasts, alternatives evaluations, policy analysis, and implementation plans are in preparation. The "Inventory and Analysis Report" relies upon a large number of previous studies conducted by numerous organizations. These studies include the following:

1. *Policies and Procedures, 1988 Edition* (RTC) which presents "guidelines for the fair administration of the Regional Transportation Fund and projects under the jurisdiction of the Regional Transportation Commission."
2. *City of Las Vegas Capital Improvements Projects List* (City of Las Vegas, 1990) which lists ongoing, committed, and proposed street and highway capital improvement projects for 1990-1991 through 1999-2000.
3. *Planning and Program Development* (NDOT Traffic Section, 1989) which gives 1988 Annual Daily Traffic (ADT) at 35 statewide, year-around automatic traffic recorder (ATR) sites; 1988 Annual Daily Averages, or counts taken by portable machines on a seasonal basis; and 1988 vehicle classification counts.
4. *City of Henderson department of Public Works Capital Improvement Projects* (June 1989)
5. *City of North Las Vegas Five-Year Capital Improvements Plan* (October 1989)
6. *Activity Report Fiscal Years 1987-89* (RTC)
7. *Overall Work Program, Fiscal Year 1991* (RTC)
8. *Transportation Improvement Program, Fiscal Years 1991-1993* (RTC) which contains prioritized short-range programs, including major projects to be initiated between July 1, 1990 and June 30, 1991.
9. *Clark County Nevada Road Report, 1990* (Clark County Dept of Public Works) which lists projects which took place in 1989
10. *Proposed Fiscal Year 1990-91 Work Program* (NDOT) which describes and lists funding sources for projects to be undertaken statewide by NDOT during FY 1990-91.
11. *Las Vegas Valley Corridor Study Phase II—Maryland Parkway* (RTC, 1985) which identifies and prioritizes corridor Transportation Systems Management (TSM) problems along Maryland Parkway.
12. *Decatur Corridor Study* (RTC, 1987) which identifies improvements that can reduce congestion or enhance the safety of travel along Decatur.
13. *Preliminary Report Pertaining to a Beltway for the Las Vegas Valley* (RTC and NDOT, 1988), which was stimulated by increasing congestion on arterials as well as the possibility that DOE could transport nuclear waste through Clark County.
14. *Draft Final Report—Immediate Action Program, Resort Corridor Program* (Peat, Marwick, Main and Company, March 1990) which identified ways to reduce traffic congestion and improve traffic flow in the Resort Corridor.
15. *Las Vegas Boulevard Corridor Study* (RTC, 1989) which recommended low cost, short-term improvements.

16. *Nevada Dept of Transportation Highway System Plan, Short-Range Long-Range* (NDOT) which is the basis for generating the Department's Annual Work Plan.
17. *Las Vegas Downtown Traffic Circulation Study* (BRW, Inc. 1990) which addresses regional access and circulation for the downtown.
18. *State Highway I-15 Widening Study-Las Vegas Boulevard to US 95* (Louis Berger & Assoc., 1988) which describes preliminary design alternatives.
19. *Sahara Avenue and I-15 Interchange Study* (Louis Berger & Assoc., 1989) includes preliminary designs, cost estimates, and economic analyses.
20. *Tropicana Avenue and I-15 Interchange Study* (Louis Berger & Assoc, 1989) includes preliminary designs, cost estimates, and economic analyses.
21. *I-15 and US 95 Expressway Spaghetti Bowl Interchange Final Report* (Louis Berger & Assoc., 1989) describes and evaluates alternatives.
22. *Regional Transportation Plan* (author unknown, 1980)
23. *1982 Goods Movement Study, Technical Report* (RTC)
24. *Downtown Las Vegas Parking Study, Technical Memorandum No. 1: Parking Demand Analysis Needs/Assessment* (Parsons, Brinckerhoff, Quade & Douglas, 1989)

Data presented in the "Inventory and Analysis Report" include maps depicting the Regional Roadway Functional Classifications, Average Daily Traffic Volumes on major roadways (from NDOT and counts taken for the Downtown Circulation Study and Resort Corridor Study), vehicle miles of travel, auto occupancy, automobile operating costs, auto accident costs (based on NDOT transportation accident reports), roadway link level of service (based on NDOT counts), intersection level of service (using data from the corridor studies, Downtown Circulation Study, and the City of North Las Vegas), a screenline analysis (cumulative traffic volume and capacity analyses across a series of parallel highways), accident rates and frequencies (from NDOT Urban Highway Accident Location Listing), and levels of air pollutants.

The Regional Transportation Commission, the Nevada Department of Transportation (NDOT), and the other authors listed above are not alone in producing reports, maps, and data regarding transportation system elements. The Environmental Protection Agency (EPA), the Federal Railroad Administration (FRA), the Public Service Commission (PSC) and several other agencies are also sources of such information. In the table that follows, fourteen different variables are used in a summary characterization of selected data sets. This is a basis for incorporating data bases into the transportation component of the modeling and monitoring system.

Transportation Appendix
Data Characterization Summary for Clark County's Transportation System

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
DESCRIPTION OF THE CLARK COUNTY TRANSPORTATION SYSTEM														
Geographical and Logical Boundaries of the System (Jurisdiction)														
Element Boundaries														
	required for planning, design, construction, operation and maintenance of facilities; also may affect responsibility for emergency preparedness.	management purposes	location of jurisdictional boundary	varies by jurisdiction; boundaries change with annexations	not applicable	traditionally stored as hard copy maps and reports; NDOT uses GRNDB	not known	appropriate and useful to store this information in a GIS format	NDOT, LAS, NLV, HEN, CDPW, CDA, RTC	maps of jurisdictional boundaries	transferable	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW, CDA, RTC
Highways and Road Elements Definition														
Functional Classification of Facility (road segment)														
	facilitates the systematic development of highways and logical assignment of responsibilities among different jurisdictions	management and operations purposes; also used to allocate funds and to prioritize for planning purposes	functional class of facility	information is fairly consistent over time, except when reclassified; frequency not known	not applicable	hard copy maps and reports; NDOT also uses AutoCAD and TRANPLAN database	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	developed from construction and maintenance records and field surveys	transferable	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW, GISMO
Administrative Classification of Facility														
	to identify agency responsible for administering the facility and for interagency coordination for planning, design, and operations of highway facilities.	management and operations maintenance, liability, and enforcement purposes.	Administrative class of facility	Information is fairly consistent over time, except when reclassified. Frequency not known.	not applicable	Hard copy maps and reports.	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	developed from maps of the highway network.	transferable	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW, GISMO
Geographic Location of Highways & Roads														
	necessary to precisely identify the alignment of facilities.	panning and operations, environmental studies, and socioeconomic studies	primary variable is location.	varies by agency	not applicable	Hard copy maps and reports, GRNDB, and aerial photos.	not obtained	appropriate and useful	NDOT, LAS, NLV HEN, USGS, CDPW	Obtained from planning and alignment maps, geodetic surveys, and aerial photography.	transferable	not obtained	not obtained	NDOT, LAS, NLV, HEN
Rail Element Definition														
Geographic Location of Track (lines)														
	necessary to precisely identify the alignment of the rail network.	planning and operations, environmental studies, and socioeconomic studies	primary variable is location; operating carrier/carries with trackage rights are also considered	not obtained	not applicable	Hard copy maps and reports, GRNDB, and aerial photos.	not obtained	appropriate and useful.	Union Pacific, NDOT, USGS	Obtained from planning and alignment maps, geodetic surveys, and aerial photography.	transferable	not obtained	not obtained	Union Pacific, NDOT

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Air Element Definition														
Geographic Location and Description of Facility														
	mapping, planning, and to aid pilots	necessary for precise identification (location) and airport information for airport users	airport reference points for location; FAA data on open, public airport, associated terminal control facilities, traffic control centers, and radio aids; facility category; runway length and orientation; services and carriers; basic navigation aids	varies by agency, geographic data is fairly consistent; FAA updates and publishes airport information every eight weeks	11 airports in Clark County	maps, reports	not obtained	appropriate and useful	NOAA Airport Facility Directory, NDOT and the Nevada component of the National Airport System Plan, and airport operating agencies	maps, plans, descriptive reports	transferable	not obtained	not obtained	NDOT, airport operators
Operating Agency														
	to aid pilots and planners	used by pilots and carriers	numerous design, navigation, and communication features that pertain to safe operation of aircraft from an airport	every 8 weeks for NOAA documents	all airports open to the public are included	books, maps, reports	not known, but the smaller and less used the airport, the more unreliable the data may be	appropriate and amenable	NOAA, NDOT, airport operators	plans, drawings, and documents related to each airport	easily transported	FAA documents can be purchased for about $10.00	not known for all data; sectional maps may not be current for small air strips, and some private airstrips may have been abandoned	FAA provides to NOAA
Modal Mix of Elements in the Operation of the System/Network														
	important of network/system planning; relates to other elements such as emergency preparedness	planners can employ this data	vehicle mix by type, in-state v. out-of-state vehicles, transit usage	varies by element	not applicable	reports, e.g., NDOT Annual Traffic Reports, Nevada Rail Plan, RTC Transit Plans	not obtained	some transferability	NDOT, RTC, Rail Agencies, Las Vegas Convention & Visitors Authority	gathered from reports	some transferability	not obtained	not obtained	NDOT, RTC
HIGHWAY AND ROADS BASE CASE DESCRIPTION														
Infrastructure Characteristics														
Geometric Features														
	necessary for input for calculation of operating conditions such as level of service, delays, and safety	consultants for traffic impact analyses and design of upgrades, city, county, and state agencies for intersection control (signal timing, implementation of traffic control devices, turning movement prohibitions)	linear location of mileposts, geographic locations of major features, number of lanes, segment lengths, lane widths, bridge and tunnel clearances, intersection locations and characteristics, median type, curvature and grade, at-rail crossings	varies by agency	not applicable	hard copy maps and reports, GRNDB, computer file, video log, maps, GIS coverages, aerial photography, TRANPLAN network	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	NDOT Accident database, Cumulative Milepost Listing, Road Alignment listing, and field survey records, video logs	can be obtained as necessary	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Traffic Safety Features														
	to analyze traffic safety and legal issues	consultants for traffic impact analyses and design of upgrades, city, county, and state agencies for intersection control (signal timing, implementation of traffic control devices, turning movement prohibitions)	location of signals and signs; signal operation, timing, and coordination; posted speed limits; sight distances; passing lanes; truck escape ramps; barrier type	varies by jurisdiction	not applicable	maps, reports, TRANPLAN network data, DBASE files, photolog inventory, NDOT's Accident Database, GRNDB	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	field surveys, installation records, video logs	may be obtained as required	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW
Pavement														
	needed to assess maintenance requirements and safety	government agencies responsible for maintenance of facilities and safety analysis	surface type and structure, condition	varies by agency	not applicable	NDOT's Accident Database, Logs of Federal Aid and State Aid Highway Systems, and GRNDB	not obtained	appropriate and useful	NDOT, LAS, NLV HEN, CDPW	pavement design documents for facility and field surveys	may be obtained as necessary	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW
Structures (bridges, tunnels, culverts)														
	for maintenance/reconstruction and safety	maintenance and planning divisions of public works departments and NDOT	type; dimensions; structural condition; height, width, and weight limits	varies by agency	not applicable	NDOT's Cumulative Milepost Listing (for type and dimension data)	not obtained	appropriate and useful	NDOT	design drawings/records, field inspections	may be obtained as necessary	not obtained	not obtained	NDOT
Use and Travel Related Characteristics														
Volumes (link and intersection)														
	required for planning, operations, and maintenance activities.	used by state and local government agencies' transportation divisions	ADT, AADT, peak hour volumes, peak hour factors, seasonal variation, hourly distribution, turning movements	varies by agency (e.g., some, such as NDOT's permanent traffic recording stations, is gathered hourly, while others are obtained as needed)	not applicable	hard copy maps, reports, computer database, DBASE	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	automated and manual counting procedures	may be obtained as needed	not obtained	not obtained	NDOT, LAS, NLV, HEN, CDPW
Demand Patterns														
	required for planning and operations activities	used by state and local government agencies' transportation divisions	volumes by trip purpose, trip interchange volumes/OD volumes	varies by agency, primarily on an as-needed basis	not applicable	hard copy, Lotus spreadsheets, reports	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, CDPW	field surveys, interviews, mail surveys	may be obtained as needed	not obtained	not obtained	NDOT, RTC
Travel Times														
	to measure the performance of roadways	planning, design, and maintenance	link speeds/travel time peak-hour, door-to-door travel times peak-hour, level of service, delay along major streets	varies by agency	not applicable	maps, AutoCAd, TRANPLAN, reports	not obtained	appropriate and useful	NDOT, CDPW, RTC	contracted field studies	may be obtained as needed; transferable	not obtained (these field studies may be expensive)	not obtained	NDOT, LAS, NLV, HEN, CDPW, RTC
Vehicle Type and Vehicle Occupancy														
	indicate use of transportation facility, vehicle mix affects operations on the facility	planning purposes, quality control, and demand management programs	category of vehicle, persons per vehicle	not obtained	not applicable	reports	not obtained	appropriate and useful	NDOT, CDPW	monitoring sessions at specific locations		not obtained	not obtained	NDOT, CDPW

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Maintenance Facilities and Activities														
Facilities by Road Type and Maintenance Costs														
	essential to facilitate efficient and safe operations of vehicles on the facilities	planning, design, and scheduling maintenance activities	maintenance facility location, maintenance activities from facility, pavement and structures maintenance costs, user costs	varies by agency; periodic	not applicable	reports, inventories	not obtained	appropriate and useful	NDOT, LAS, NLV, HEN, RTC, CDPW	inventories of the responsible agencies, maps	transferable	available	not obtained	NDOT, CDPW, RTC, LAS, NLV, HEN
Safety Considerations and Emergency Response Capabilities														
Accidents and Safety Related Characteristics														
	necessary to identify hazardous locations and elements, conduct engineering studies, establish project priorities, and improve safety	to define high-accident locations, make before-and-after studies, justify actions on traffic control devices, evaluate geometric designs, justify improvement expenditures, change regulations and zoning, identify needs	accident location, times of occurrence, vehicle type, accident type, damage, accident rates/frequencies	collected continuously and recorded at NDOT	Thirty-two megabytes of ASCII informatio n for 195,000 reported state accidents from 1984 to 1989	NDOT has reports, maps, collision diagrams, and computer database. TRC uses a relational database (RIM). NDOT has reports, maps and collision diagrams	not obtained	appropriate and useful	NDOT, Metro Police, FEMA, Div. of Emergency Mgt., Office of Emergency preparedness, Disaster Emergency Service, Fire Dept., Test Site, Mercy Ambulance (EMS)	accident reports, printouts, collision diagrams	may be obtained as required	available at no cost to TRC	not obtained	NDOT
Law Enforcement and Safety														
	closely related to concerns of public safety; aids in identifying areas of need	law enforcement and emergency response	vehicle inspection, weighing, traffic laws	incidents continuously recorded	not obtained	reports, diagrams, specific laws and codes	not obtained	appropriate an useful	NV Legislative Counsel Bureau, UNLV Library, TRC	18 CFR, 49 CFR; NRS 408 459, 481, 706; CC Code Ch. 15,	not known	not obtained	not obtained	NDOT, Police
Hazardous Materials Shipment														
	economic analysis, design purposes, also may be useful for emergency preparedness	not clear from NDOT reports	commodity, points of origin/destination, routes travelled in the state	appears to be a one-time effort reported April 1991	10,109 trucks in 1989 and 1990	not mentioned, but probably on tape	not mentioned in report	appropriate and useful if future collection is slated	NDOT reports: Average Daily Tons of all Commodities and Hazardous Materials Moved by Truck in Nevada	interview of truck drivers at 45 sites statewide; 49 CFR; NRS 459	transferable point data for interview locations and data to characterize route segments	not obtained	details not presented in report	NDOT
Transit														
	viewed as a means of relieving congestion and improving air quality; potential means for commuting workers	planning purposes (e.g., to expand fixed-route service in the Las Vegas area); elderly are major users of the system	service, routes, frequency, hours of operation, use (ridership), costs	varies by operator; data must be collected to meet UMTA's section 15 reporting requirements	not applicable	hard copy records, maps, and planning documents	not obtained	appropriate and useful	RTC, Las Vegas Transit Service, PSC, NV Taxi Cab Authority	transit operators, survey research	not known	not obtained	some sampling error in surveys	Las Vegas Transit Service, Economic Opportunity Board, Las Vegas Trolley Service, PSC, RTC, and for-profit providers

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Responsibilities, Jurisdictions, and Policies														
	to identify roles and responsibilities of agencies which have authority in specific jurisdictions and which may adjust workloads with changing needs	compliance to codes and laws by agencies subject to and setting standards	regulation and inspection of rights of way, vehicle inspection, environmental protection, liability/insurance	not obtained	not applicable	written regulations, summary reports	not obtained	not appropriate (except jurisdiction boundaries)	USDOT, RTC, NDOT, Division of Emergency Management, Nevada Highway Patrol, PSC, Road Districts, Local Powers	agencies and regulations: NRS 408, 259, 459, 481, 484, 706; 49 CFR, 40 CFR	jurisdictional information may be transferable	not obtained	not obtained	federal, state, and county government agencies
Environmental Context of Highway System														
Ecologically Sensitive Areas														
	necessary for impact assessment to provide for the management and protection of wildlife and natural resources such as wetlands, parks and forests	maintaining and operating these areas	waterbodies, national forests, wildlife management areas, hunting and fishing areas, areas with endangered plant species, desert tortoise habitats, wildlife habitats (bighorn sheep, elk, mule, peregrine falcon, antelope, fish, waterfowl)	varies by agency	not applicable	hard copy maps and reports, and wildlife habitat boundaries are stored in GIS coverages at TRC	not obtained	appropriate and useful	Nevada Department of Wildlife, US Forest Service, Nevada Department of Conservation and Natural Resources	not known	may be obtained as required	not obtained	not obtained	Nevada Department of Wildlife, Nevada Department of Conservation and Natural Resources
Other Environmental Concerns														
	actually a compilation of data sets concerning aspect of environmental quality associated to the highway system; relevant in assessing the impact of highway incidents	for consideration by planners, engineers, and public service agencies in regards to highway construction, alteration, and use.	locations with hazardous products/processes linked by highway; noise pollution; air pollution; run-off, drainage, watersheds, and snowsheds	varies by agency (e.g., EPA updates annually, health district monitors continuously)	not known	print out, CD ROM, maps, reports	not obtained	appropriate and useful	PSC, EPA, NDOT, Dept. Public Safety, CC Health District (Air Pollution Control Division), Water District, Regional Flood Control District, Nevada Dept. of Industrial Relations	monitoring stations, Highway Patrol and Metro shipment notifications, reporting facilities	transferable, some may be obtained	not obtained	not obtained	PSC, EPA, NDOT, Dept. Public Safety, CC Health District, Water District, Regional Flood Control District
RAIL ELEMENT OF THE BASE CASE														
Infrastructure Characteristics														
Track Characteristics														
	necessary to have accurate information for safe operations of trains and for track maintenance, reflect carrier investment and operations decisions (profit maximization v. safety)	management and operational purposes by railroad companies; PSC of Nevada infrastructure inspectors and monitors may use	track class; rail weight; curvature and grade; weight limits; design speed; location of sidings, crossings, turnouts, bridges, tunnels, terminal facilities, loading facilities, and rail-highway crossings; length of segments; number of tracks	not obtained	Union Pacific has about 213 miles of mainline track in southern Nevada	reports (Condensed Track Profile) and alignments is available as a GIS coverage	not obtained	appropriate and useful	Union Pacific	not obtained	transferable	not obtained	not obtained	Union Pacific, NDOT

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Structures														
	necessary for safe operations of trains and for maintenance	operational purposes by the railroad company	type, location, dimensions, materials, age, structural condition, height, width, and weight limits	not obtained	Union Pacific has over 300 bridges and culverts and about 15 tunnels in southern Nevada	reports (Condensed Track Profile)	not known	appropriate and useful	Union Pacific	not obtained	transferable	not obtained	not obtained	Union Pacific
Use and Travel Related Characteristics														
	reflective of existing network capabilities and possible potential needs	used in evaluating rail operation	passenger usage, tonnage, type of commodities, frequency by direction, consist make-up, district boundaries	not obtained	not known	reports (Condensed Track Profile)	not obtained	appropriate and useful	Union Pacific	scheduling, planning documents	transferable (district boundaries)	not obtained	not obtained	Union Pacific
Safety Considerations and Emergency Response Capabilities														
Railroad/Highway Grade Crossings														
	important for planning, management, and providing emergency response	carriers, emergency responders	crossing location, number of tracks, signal devices	by incident; Surface Rating Reviews of At-grade crossings are performed every two years	not known	reports, internal railroad data	not obtained	appropriate and useful (historic data could identify potentially hazardous locations)	Union Pacific, NDOT, FRA	accident and incident reports	transferable	not obtained	not obtained	Union Pacific, NDOT
Accident Data (location and damage)														
	monitoring of rail system safety, identification of safety program needs and successes, and for reporting, as required, to the Federal Railroad Administration (FRA)	preparation of statistics and reports, research, and identification of needs	elements pertinent to train/highway grade crossing accidents (derailments & collisions), inspection frequency and procedures, and locations of hazardous areas	frequency determined by event, threshold criteria for reporting is met	national in scope and immense	FRA data tapes, computer listings, and reports requested through the Pubic Service Commission	some interpretation may be required on the part of reporter, thus may be subject to error	due to lack of specifics regarding variables, amenability has not be ascertained	reports submitted by the railroad to FRA	observations, interviews, and measures by a railroad employees (reporter)	some portability and transferability (data tapes, computer listings, and reports)	not known	submission is at the discretion of the railroad, & accidents that do not involve death, injury, substantial property damage, or emergency services may go unreported	Railroads, FRA

Data Set	Rational for Existence	Current Use	Variables/Elements	Frequency of Collection	Size	Method of Storage	Quality Assurance Procedures	Amenability to GIS	Source (Agency)	Method of Collection	Portability/ Transferability	Cost	Degree of Error	Responsible Agency
Hazardous Materials Shipment														
	needed for business purposes such as billing, tracking and locating shipments, making up trains, car allocation, etc. The Interstate Commerce Commission (ICC) has requirements regarding the generation of waybills and bills of lading, data for monitoring carrier activity	economic analyses of the transportation sector as well as commerce. Carriers use the data internally for marketing and sales studies and business planning	carloads by category (type & amount), origin and destination by state, and through shipments	annually	75 to 100 categories	ICC samples are on tape which are expanded by NDOT, then reported (hard copy)	ICC data involve an expansion of a 10% waybill sample; quality of input data is not known	origins and destinations may be resolvable only to a state level, or perhaps northern versus southern state breakdown	the carrier forwards data to the ICC	not known	short report for PSC is transferable	not obtained	the expansion of the 10% ICC data will produce error of varying degree	ICC, NDOT, the PSC, and carriers
Agency Responsibilities, Jurisdictions, and Policies														
	necessary to maintain safety and business operations	railroad operations	regulation (rates, hazardous materials, and environmental protection), track inspection, vehicle inspection, and liability/insurance	not known	not applicable	regulation, summary reports	not obtained	not appropriate (except for jurisdictions)	FRA, PSC Nevada, NDOT	NRS 704, 705; reports	jurisdiction boundaries	not obtained	not obtained	FRA, NDOT, PSC of Nevada, carriers
Environmental Context of the Rail System														
	necessary to provide for the management and protection of wildlife and natural resources such as wetlands, parks and forests, and other aspects of environmental quality	maintaining and operating environmentally sensitive areas and planning for potential affects to ecology (such as that which might be created by noise pollution or spills)	ecologically sensitive areas (waterbodies, national forests, wildlife management areas, hunting and fishing areas, areas with endangered plant species, desert tortoise habitats, wildlife habitats); locations with hazardous products/processes; noise pollution; air quality; run-off and drainage, watersheds, snowsheds	varies by agency (e.g., EPA updates annually, health district monitors continuously)	not applicable	hard copy maps and reports, printouts, CD ROM, and wildlife habitat boundaries are stored in GIS coverages at TRC;	not obtained	appropriate and useful	Nevada Department of Wildlife, US Forest Service, Nevada Department of Conservation and Natural Resources, PSC, EPA, NDOT, Dept. Public Safety, CC Health District (Air Pollution Control Division), Water District, Regional Flood Control District, Nevada Dept. of Industrial Relations	monitoring stations, Highway Patrol and Metro shipment notifications, reporting facilities	transferable, some may be obtained as required	not obtained	not obtained	Nevada Department of Wildlife, Nevada Department of Conservation and Natural Resources, PSC, EPA, NDOT, Dept. Public Safety, CC Health District, Water District, Regional Flood Control District