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1. **INTRODUCTION**

The Maricopa County Department of Emergency Management recently received funds from the Federal Emergency Management Agency (FEMA) to develop an emergency mass evacuation strategy plan for Maricopa County. This project, jointly administered by the Maricopa County Department of Emergency Management and the Maricopa County Department of Transportation, engaged representatives from police, fire, public health, transportation, emergency management, and research organizations in the following tasks:

- Survey of existing operations plans (both locally and nationally);
- Identification of traffic related considerations essential to development of the evacuation strategies;
- Identification of agency roles and responsibilities;
- Development of emergency evacuation strategies; and
- Development of an emergency evacuation plan template to guide emergency responders and transportation.

The project resulted in:

- An emergency evacuation plan template that is transferable between local transportation and emergency management agencies;
- An approach that relies on existing data (or data that is practical to obtain);
- Outreach and facilitation that engages participating agencies.

1.1 **Background**

The Maricopa County Department of Emergency Management is responsible for the Emergency Operations Plan for Maricopa County. The Plan outlines a wide variety of operational strategies that guide response to emergencies and disasters within Maricopa County. Current events have generated the need for many new strategies and plans to be added to the County’s existing Emergency Operations Plans — one of these new strategies is an emergency mass evacuation strategy plan.

Emergency mass evacuation planning was the focus of the AZTech™ Mass Evacuation Workshop held on March 18, 2002. A key need and action item identified during the workshop was to develop a comprehensive, multi-agency emergency mass evacuation strategy plan for the County. Participants suggested that the plan should lead to intergovernmental agreements, incorporate existing local and regional plans, and result in better cooperation through mutual aid relationships.

1.2 **Problem Statement and Project Purpose**

The evacuation elements of existing Emergency Operations Plans focus on relatively contained evacuations. An emergency mass evacuation strategy plan is needed to guide response to a major, wide-area emergency that impacts a large geographic or heavily populated area.

Emergency mass evacuation is unique from “special event crowd control” in that evacuation-precipitating events and incidents are typically life threatening, occur unpredictably, and may encompass several jurisdictions requiring the coordinated efforts of multiple agencies. For the
purposes of this project, it is assumed that an evacuation would be required within a relatively short time-frame, and require the populace to be evacuated for a distance of five to seven miles from the location of the incident.

2. **EXISTING CONDITIONS**

The first stage of the project was to conduct an inventory of existing conditions, which included a review of local emergency operations plans, documentation of resources that local agencies would be able to provide in event of an evacuation, and a review of evacuation plans developed by other cities throughout the United States.

2.1 **Summary of Evacuation Elements of Local Emergency Operations Plans**

Existing emergency operations plans were gathered from local agencies and reviewed for evacuation elements. **Table 1** lists the evacuation related sections that were collected from emergency response plans of local and state agencies. Details of each document are contained in Technical Memorandum No. 1.

<table>
<thead>
<tr>
<th>Local Agency</th>
<th>Existing Documentation Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maricopa County</td>
<td>Maricopa County Department of Emergency Management, Emergency Operations Plan, Appendix 8 – Evacuation</td>
</tr>
<tr>
<td></td>
<td>Emergency Civil Preparedness Information</td>
</tr>
<tr>
<td>City of Mesa</td>
<td>Mesa, Arizona Emergency Operations Plan Annex F – Evacuation</td>
</tr>
<tr>
<td>City of Phoenix</td>
<td>Phoenix, Arizona Major Emergency Response and Recovery Plan Annex G – Evacuation</td>
</tr>
<tr>
<td></td>
<td>Phoenix Fire Department, Phoenix Regional Standard Operating Procedures: Evacuation Sector</td>
</tr>
<tr>
<td>City of Scottsdale</td>
<td>Scottsdale, Arizona Major Emergency Operations Plan Annex F – Evacuation</td>
</tr>
<tr>
<td>City of Tempe</td>
<td>Tempe Fire Dept. Policies and Procedures Section 207.14 Evacuation</td>
</tr>
</tbody>
</table>
2.2 Characteristics of Mass Evacuation Plans from other Large Metropolitan Areas

Emergency operations plans were gathered from several large metropolitan areas and reviewed for evacuation elements. These include Seattle, Los Angeles, Chicago, and Cleveland as illustrated in Table 2.

Table 2 – National Survey of Evacuation Plans

<table>
<thead>
<tr>
<th>Area</th>
<th>Existing Documentation Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle, Washington</td>
<td>Volume 1, Seattle Disaster Readiness &amp; Response Plan BASIC PLAN</td>
</tr>
<tr>
<td>Columbia County, Georgia</td>
<td>Emergency Evacuation Plan for Dam Failure and Flooding: Savannah River Dams</td>
</tr>
<tr>
<td>Los Angeles, California</td>
<td>Emergency Operations Master Plan and Procedures</td>
</tr>
<tr>
<td></td>
<td>Los Angeles City Fire Department, Evacuation Guidelines</td>
</tr>
<tr>
<td>Cuyahoga County, Ohio</td>
<td>Evacuation Plan, City of Cleveland, Ohio</td>
</tr>
<tr>
<td>Wilmington, North Carolina</td>
<td>I-40 Evacuation Plan, Reversal of I-40 from Wilmington to I-95</td>
</tr>
</tbody>
</table>

Lastly, available evacuation planning documentation was reviewed to identify essential components of an evacuation plan. Common to several of the emergency evacuation planning guidelines were:

- Provision and framework for inter-agency coordination;
- Inter-jurisdictionally coordinated dissemination of timely and accurate evacuation travel information, including traffic conditions, evacuation routes, and information about services along evacuation routes and at destination shelters;
- Plan for collection of data such as traffic volumes and speeds, occupancy, and traveler behavior;
- Coordination of evacuation routes across jurisdictional boundaries;
- Recommendations to formulate strategies to reduce transportation demand (e.g. evacuating in shifts, utilizing mass transit);
- Management of available capacity on evacuation routes;
  - Termination of work zones where possible
  - Improved efficiency in detecting, responding to, and clearing incidents on evacuation routes
- Framework for information sharing that provides updated information to all affected jurisdictions on evacuation plans and status;
- Framework for regional coordination of resources; and
- Forecasting of resource requirements and locating the necessary resources.
2.3 Available Physical and First Response Resources

In the event of a mass evacuation scenario, many agencies within multiple jurisdictions will be called upon to assist and offer resources. It is important to know what types of resources are available and which agencies can provide them. Table 3 provides a high-level summary of the resources available to local agencies. Table 3 is based on the minutes of the Mass Evacuation Planning Workshop held in March, 2002.

Table 3 – Available Physical First Response Resources

<table>
<thead>
<tr>
<th>Functional Group</th>
<th>Available Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Transportation (ADOT)</td>
<td>Freeway Management System, (CCTV, VMS), 511</td>
</tr>
<tr>
<td></td>
<td>Highway Condition Reporting System (HCRS)</td>
</tr>
<tr>
<td></td>
<td>ALERT, Freeway Service Patrol</td>
</tr>
<tr>
<td></td>
<td>Communications, paging ability, two-way radios</td>
</tr>
<tr>
<td></td>
<td>Large trucks, vans</td>
</tr>
<tr>
<td>County Transportation (MCDOT)</td>
<td>Traffic control/barricades</td>
</tr>
<tr>
<td></td>
<td>Variable Message Signs</td>
</tr>
<tr>
<td></td>
<td>Traffic Signal Control</td>
</tr>
<tr>
<td>City Transportation (Mesa, Chandler, Scottsdale, Peoria, Phoenix, Gilbert, Tempe, Glendale)</td>
<td>Transit buses, trucks, loaders, etc.</td>
</tr>
<tr>
<td></td>
<td>Potential backup TOC/EOC, communication systems</td>
</tr>
<tr>
<td></td>
<td>Traffic signal control</td>
</tr>
<tr>
<td></td>
<td>Variable Message Signs</td>
</tr>
<tr>
<td></td>
<td>Road maintenance (sand, cones, signs)</td>
</tr>
<tr>
<td>Transit (Valley Metro, Phoenix Transit)</td>
<td>Over 600 Buses</td>
</tr>
<tr>
<td>Sky Harbor Airport</td>
<td>Radio system</td>
</tr>
<tr>
<td></td>
<td>Buses</td>
</tr>
<tr>
<td></td>
<td>Barricades</td>
</tr>
<tr>
<td>Emergency Management (Maricopa County EM, State EM, Red Cross)</td>
<td>Emergency notification dial-up systems (CENS)</td>
</tr>
<tr>
<td></td>
<td>Emergency Alert System</td>
</tr>
<tr>
<td></td>
<td>Media Alert</td>
</tr>
<tr>
<td>Police Agencies</td>
<td>Air support (fixed wing, rotary)</td>
</tr>
<tr>
<td></td>
<td>Statewide – 15 officer response teams</td>
</tr>
<tr>
<td>Fire Agencies</td>
<td>Manpower (2/3 of workforce available for recall)</td>
</tr>
<tr>
<td></td>
<td>Technical Rescue Teams/Urban Search and Rescue</td>
</tr>
<tr>
<td></td>
<td>Metro Medical Response Systems</td>
</tr>
<tr>
<td></td>
<td>Disaster Mortuary</td>
</tr>
<tr>
<td></td>
<td>Disaster Medical Assistance Team</td>
</tr>
<tr>
<td>Salt River Project</td>
<td>Power systems</td>
</tr>
<tr>
<td></td>
<td>Radio System</td>
</tr>
<tr>
<td></td>
<td>Helicopter aerial views</td>
</tr>
<tr>
<td></td>
<td>Satellite phone</td>
</tr>
</tbody>
</table>
2.4 Inventory and Summary of Existing Evacuation Models

Lastly, the inventory included a summary of modeling software that can be applied to an evacuation scenario analysis.

Numerous emergency and traffic modeling software applications are available for use before and during an evacuation scenario. Development of many of these programs stems from three distinct origins — evacuation planning for terrorism or war, evacuation planning for hurricanes, and models developed for everyday traffic simulation. The reviewed models are listed below, and the characteristics are summarized in Table 4:

- Advanced Landside Performance Simulation (ALPS2000)
- Consequences Assessment Tool Set (CATS)
- Dynamic Evacuation Simulation System (DYNEV)
- Evacuation Traffic Information System (ETIS)
- Hurricane Evacuation Program (HURREVAC)
- Oak Ridge Evacuation Modeling System (OREMS)
- Traffic Estimation and Prediction System (TrEPS)
- Transportation Analysis Simulation System (TRANSIMS)
- TSIS/CORSIM
- VISSIM

<table>
<thead>
<tr>
<th></th>
<th>Provides Impact Area Estimations</th>
<th>Provides Detailed Analysis of Traffic Operations</th>
<th>Evaluates Potential Evacuation Corridors (Planning)</th>
<th>For use during Real-Time Evacuations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alps2000</td>
<td></td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>CATS</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DYNEV</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>ETIS</td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>HURREVAC</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OREMS</td>
<td></td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>TrEPS</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSIMS</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSIS/CORSIM</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>VISSIM</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.5 Inventory Summary

The inventory of existing conditions included a review of local emergency operations plans, review of resources that local agencies would be able to provide in event of an evacuation, and a review of evacuation plans developed by other cities throughout the United States.

The review yielded few comprehensive large-scale mass evacuation plans developed both locally nationally. However, essential elements of an emergency mass evacuation plan were identified from the reviewed plans and documents.

The inventory documented the types of resources and equipment that would be available in event of a mass evacuation scenario.

Finally, the inventory identified a number of simulation models that may be applied to develop and evaluate an evacuation plan. The desired scope and complexity of the simulation exercise will determine which model is most suitable for use in a particular application.
3. **Traffic Analysis**

At the second stage of the project, a high-level traffic analysis of two evacuation planning areas was performed. The purpose of the traffic analysis was to:

- Outline data that should be collected as part of a comprehensive evacuation plan, including socioeconomic data and roadway characteristics;
- Describe the considerations essential to the selection of evacuation routes;
- Describe the procedure for determining the number of vehicles that can be accommodated on an evacuation route; and
- Provide a method to determine the minimum time that will be required to evacuate a specified area.

3.1 **Inventory and Existing Traffic Data**

An emergency evacuation scenario will overload the existing roadways with vehicles. To hypothetically illustrate the traffic conditions on the roadway network during an evacuation, two areas were identified for analysis: a 5-mile radius surrounding the Loop 101 & Loop 202 Interchange in the East Valley and a 5-mile radius surrounding the Loop 101 & Bell Road Interchange in the West Valley. Each of these areas includes multiple jurisdictions, significant residential populations, and sizable employment and entertainment centers.

The first step of the analysis was to inventory the evacuation areas, including population, roadways and number of lanes, and other characteristics that may impact an evacuation. Much of this inventory data was obtained from the Maricopa Association of Governments and from aerial maps. **Table 5** contains a portion of the inventory data collected for each evacuation area.

<table>
<thead>
<tr>
<th>Table 5 –Evacuation Planning Area Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area 1 – East Valley</strong></td>
</tr>
<tr>
<td>Jurisdictions</td>
</tr>
<tr>
<td>- Arizona State University</td>
</tr>
<tr>
<td>- Gilbert</td>
</tr>
<tr>
<td>- Mesa</td>
</tr>
<tr>
<td>- Phoenix</td>
</tr>
<tr>
<td>- Salt River Pima-Maricopa Indian Community</td>
</tr>
<tr>
<td>- Scottsdale</td>
</tr>
<tr>
<td>- Tempe</td>
</tr>
<tr>
<td>Residential Population</td>
</tr>
<tr>
<td>Employment Population</td>
</tr>
<tr>
<td>Total Population</td>
</tr>
<tr>
<td>810,132</td>
</tr>
<tr>
<td>Transportation Network Characteristics</td>
</tr>
<tr>
<td>- Numerous freeways, including Loop 202, Loop 101, US 60</td>
</tr>
<tr>
<td>- Mature arterial network, some discontinuity of arterials over Salt River</td>
</tr>
</tbody>
</table>
3.2 Evacuation Route Alternatives

The location of an incident becomes the epicenter of the evacuation area, and all traffic is directed outbound from that point, using as many pre-designated routes as possible. Important roadway characteristics and considerations that should be considered when selecting an evacuation route are:

- Shortest paths to the designated destination area(s)
- Grade-separated, controlled access facilities
- Maximum number of lanes that provide continuous flow through the evacuation area
- Roadways that are not expected to become disabled while the evacuation is in progress
- Existing signal control and signal coordinated corridors
- Availability of real-time traffic flow and route condition information to emergency managers and the public (e.g., from closed-circuit television cameras, traffic detectors)
- Availability of infrastructure to disseminate real-time conditions and messages to the traveling public (e.g., 511, variable message signs)
- Minimal number of potentially hazardous points and bottlenecks on evacuation routes, i.e. bridges, tunnels, at-grade wash/stream crossings
- Maximum existing capacity
- Additional capacity can be added on a temporary basis

3.3 Roadway Capacity

Roadway capacity represents the maximum number of vehicles that can reasonably be accommodated on an evacuation route, measured in vehicles per hour. Roadway capacity can be highly variable, and is affected by number of lanes, speed, construction activity, crashes, and objects in the roadway, to name a few. Different classes of roadways have different capacities. Freeways have a much higher capacity than an urban arterial, for example.

Table 6 illustrates the approximate capacity of various types of roadways, based on Highway Capacity Manual guidelines.

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>Urban Freeways</th>
<th>Multilane Highways (50 mph speed limit)</th>
<th>Urban Streets (3 signals per mile, 40 mph speed limit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>890 vph</td>
</tr>
<tr>
<td>2</td>
<td>4,560 vph</td>
<td>-</td>
<td>1,780 vph</td>
</tr>
<tr>
<td>3</td>
<td>6,930 vph</td>
<td>3,430 vph</td>
<td>2,670 vph</td>
</tr>
<tr>
<td>4</td>
<td>9,360 vph</td>
<td>5,140 vph</td>
<td>3,560 vph</td>
</tr>
<tr>
<td>5</td>
<td>11,850 vph</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Approximate roadway capacities were determined for each potential evacuation route in the east valley and west valley evacuation areas. Subsequently, the capacity of each route was summed to calculate the total available roadway capacity for each evacuation area.
A key variable affecting roadway capacity is the number of traffic signals on a given roadway, and the percent of traffic signal green-time allocated in that direction. Because vehicles can only pass through the intersection when the traffic signal is green, the capacity of the roadway is reduced proportional to the percent of time that the traffic signal is green for the given direction. If, during an evacuation scenario, all of the green-time is allocated to an outbound direction with little or no green time allocated to the side-streets, the capacity of the evacuation route in the outbound direction will increase proportionally. Table 7, column 1 illustrates the total capacity of each evacuation area under congested conditions and assuming that no modifications are made to traffic signals. Table 7, column 2, illustrates the capacity of the evacuation areas when the traffic signal timing strategy is implemented.

### Table 7 – Evacuation Areas Total Roadway Capacity

<table>
<thead>
<tr>
<th>Evacuation Area</th>
<th>Total area capacity*, no signal-timing modifications</th>
<th>Total area capacity*, signal-timing modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Valley</td>
<td>139,320 vph</td>
<td>192,850 vph</td>
</tr>
<tr>
<td>West Valley</td>
<td>51,480 vph</td>
<td>87,900 vph</td>
</tr>
</tbody>
</table>

* Summation of the capacity of individual routes within evacuation areas

#### 3.4 Minimum Evacuation Times

The final step of the traffic analysis was to determine the minimum evacuation time for each evacuation area. Dividing the number of vehicles in the evacuation area by the total roadway capacity yields a high-level approximation of the minimum evacuation time of the area, as demonstrated below.

\[
MinT = \frac{Pop}{Occ \times RCap}
\]

Where:

- \(MinT\) = Minimum evacuation time, in hours
- \(Pop\) = Population of evacuation area, in persons
- \(Occ\) = Average vehicle occupancy, in persons per vehicle
- \(RCap\) = Roadway capacity in vehicles per hour

Utilizing the population data collected for each evacuation area and assuming average vehicle occupancy of 1.5 persons per vehicle, the minimum time to evacuate each area was calculated.

Recall that the east valley evacuation area total population is nearly double the population of the west valley evacuation area. However, as demonstrated in Figure 1 and Figure 2, the minimum evacuation time of the west valley evacuation area (approximately 8 hours) is nearly twice the minimum time required to evacuate the east valley area (approximately 4 hours) due to the limited freeway system available in the west valley evacuation area.

The impacts of various operational strategies on the minimum evacuation time were investigated. An additional travel lane on arterials (e.g. reverse center-lane, shoulder use) reduced the
evacuation time by 30 minutes in the east valley evacuation area and by nearly 2 hours in the west valley evacuation area. The evacuation time in the east valley evacuation area is more sensitive to freeway-oriented strategies, while the evacuation time in the west valley evacuation area is more responsive to arterial-oriented strategies. Increasing the vehicle occupancy (e.g. mandatory carpooling) had a pronounced benefit in both evacuation areas.

Figure 1 – Potential Impact of Strategies on West Valley Evacuation Time

Figure 2 – Potential Impact of Strategies on East Valley Evacuation Time
3.5 Contraflow Operations Alternatives

Contraflow operations are the conversion of inbound traffic lanes to outbound only, so that all lanes are used for outbound traffic. Arterial and freeway contraflow operations can potentially double the number of available outbound traffic lanes during an evacuation scenario. Freeways lend themselves to more effective contraflow operations than do arterials because of their configuration as unsignalized, divided, access-controlled corridors.

A key element of a contraflow plan is to identify the appropriate inception and termination points for the corridor. Congestion at these points can severely reduce the overall effectiveness of the plan. Due to the high cost of materials and manpower required to deploy contraflow operations, it is important that inception and termination points be designed appropriately to accommodate the traffic loading and unloading from the contraflow route. Design aspects that have been deployed along evacuation routes throughout the country include:

- “Evacuation Route” signing;
- Median-crossovers;
- Exit-ramps designed specifically for contraflow operations; and
- Access control gates (railroad crossing barriers).

Examples of contraflow operations implementation alternatives are shown in Figure 3a and Figure 3b.

3.6 Work Zone Removal Alternatives

Removal of work zones, where possible, during an evacuation scenario is critical to maximizing the vehicle flow on an evacuation route. Agencies commonly require, through contract language, contractors to provide the same number of travel lanes during construction that were available prior to the beginning of construction. In addition, jurisdictions should have the ability to require a contractor to remove work zones during an emergency scenario, where feasible. During an evacuation scenario, the Arizona DPS and local police should make it a high priority to enforce and assist in the removal of work zones.

3.7 Traffic Analysis Summary

A high-level traffic analysis was performed to hypothetically illustrate the traffic conditions during an evacuation scenario.

The traffic analysis demonstrated that a mass evacuation scenario will overload the existing roadways with vehicles. The traffic analysis demonstrated the impact of freeway access on minimum evacuation time, with the west valley evacuation area requiring twice as much time to evacuate as the east valley evacuation area. However, as demonstrated by the traffic analysis, various operational strategies can be implemented to significantly reduce the minimum evacuation time.
Figure 3a – Contraflow Operations Alternatives
Figure 3b – Contraflow Operations Alternatives

The end treatment to terminate contraflow operations can be spread over multiple interchanges, dropping one lane of traffic at each interchange, to alleviate queuing on arterials and on the freeway.
4. **EMERGENCY EVACUATION GOALS, OBJECTIVES, AND AGENCY ROLES**

The third step of the project was to establish baseline goals, objectives, and elements of an evacuation plan; in other words, what local agencies envision the plan will accomplish and what specifically will be contained within the evacuation plan template.

### 4.1 Goals and Objectives

An All-Agency Workshop held on February 13, 2004 was attended by nearly 60 representatives of police, fire, traffic operations, and transit. The objectives of the workshop were to identify the goals and objectives of a mass evacuation plan and the roles and responsibilities of agencies in planning for and implementing a mass evacuation plan for Maricopa County. Input received at the workshop was used to develop the evacuation strategies, as demonstrated in **Figure 4**.

![Figure 4 – Evacuation Strategy Development](image)

The proposed goals of an emergency mass evacuation plan were presented at the February 2004 All-Agency Meeting. These include:

- Develop a pre-agreed plan of response for evacuation scenarios;
- Identify needed intergovernmental and mutual aid agreements;
- Develop a template that is transferable between local transportation and emergency management agencies;
- Create an approach that relies on existing data; and
- Provide specific evacuation strategies that will guide development of agency-specific plans.

At the workshop, the group suggested additional goals of the mass evacuation plan, which include:

- Provide strategies for emergency evacuation (where evacuation may be required in very few hours, in contrast to hurricane evacuation plans where responders have days to implement the evacuation);
- Provide a concise supplement to existing emergency operations plans; and
- Focus on how emergency management and transportation disciplines can work together to develop an evacuation strategy plan.
4.2 Framework for Agency Coordination

An evacuation effort will be a sub-element of the larger disaster and incident response effort. The entire disaster response will be organized using the principles of the Incident Command System (ICS) as described in the National Incident Management System.

The Incident Command System (ICS) is a management system designed to enable effective incident management by integrating facilities, equipment, personnel, procedures, and communication within a common organizational structure (NIMS, page 7). ICS defines operating characteristics, interactive management components, and the structure of incident response organizations through the life cycle of the incident (NIMS, page 3). The United States Department of Homeland Security has recently approved the National Incident Management System (NIMS), which mandates the ICS as the standard for emergency response.

Since 2001, there is an increasing awareness in the transportation community of the content of this framework. The incident command structure is shown in Figure 5. The first responder to the scene of an incident initiates this structure. It is important to recognize that the incident command structure allows for flexibility as the nature of the incident evolves and changes. For example, if an incident is primarily rescue or fire oriented, fire department personnel may serve as the incident commander. As the nature of the incident changes and the emphasis becomes more on law enforcement or traffic control, the incident command may shift to police department personnel.

The incident command structure normally utilized within the Phoenix metropolitan area is Unified Command. Unified Command is an important element in incident management, particularly when multiple agencies are involved. Unified Command provides guidelines to enable agencies with different geographic, legal, and functional responsibilities to coordinate, plan, and interact effectively. As a team effort, Unified Command overcomes much of the inefficiency and duplication of effort that can occur when multiple agencies from different jurisdictional authority or functional responsibility operate without a common framework. All agencies responsible for any aspect of the incident contribute to the process of developing incident strategies and making optimum use of resources.

Through Unified Command, multiple agencies develop unified objectives and strategies for the incident — this is accomplished without any loss of authority, responsibility or accountability. Unified Command typically works best when participating agencies of the Unified Command collocate at the Incident Command Post.
4.3 Agency Roles and Responsibilities

Essential to a regional, large-scale mass evacuation is the delineation and understanding of roles and responsibilities. During an evacuation scenario, jurisdictions will fall into one of four roles:

- **Lead Jurisdiction**: The jurisdiction/municipality that orders the evacuation will typically be designated as the lead agency;
- **Affected Jurisdiction**: The reason/cause of evacuation is not within this jurisdiction, but portions of the jurisdiction are within the required evacuation area;
- **Neighboring Jurisdiction**: Jurisdiction is not included in the evacuation area. Jurisdiction will play a supporting role to lead and neighboring jurisdictions;
- **County/State and Federal**: County, State, and Federal Agencies will play a support role to the lead and neighboring jurisdiction. Inasmuch as the County is responsible for unincorporated areas, County agencies may assume a dual role of the lead or neighboring jurisdiction. Likewise, if the evacuation impacts multiple states, the State may play a lead role in the evacuation.

Primary roles and responsibilities of lead, affected, neighboring, and county/state/federal agencies during an evacuation scenario are outlined in Table 8.
### Table 8 – Roles and Responsibilities of Agencies

<table>
<thead>
<tr>
<th>Agency</th>
<th>Primary Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lead Jurisdiction</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Emergency Management          | • Coordinate resources (human, technical, equipment, facility, materials, and supplies) of agencies to support evacuation needs  
                                • Maintain expenditure records to facilitate reimbursement  
                                • Identify and contact other response agencies that will support evacuation  
                                • Coordinate dissemination of information to the media via the Public Information Officer, and in coordination with Joint Emergency New Center (JENC), and provide timely and accurate updates to media  
                                • Conduct high-level analysis of evacuation area, determine number of evacuees within jurisdiction |
| Public Safety                 | • Establish Incident Command/Unified Command/Area Command as appropriate  
                                • Direct, conduct, and monitor evacuation process  
                                • Provide protection and security of evacuation area  
                                • Direct traffic control (with support from Public Works/Transportation) |
| Public Works and Transportation| • Support traveler information dissemination, utilizing information obtained from vehicle detection systems, and CCTV surveillance system, and provide information to lead and affected jurisdictions emergency management personnel  
                                • Support public safety traffic management and control efforts, and implement modifications to signal system as requested  
                                • Provide road conditions information available from traffic signal systems, vehicle detection systems, and CCTV surveillance system to lead and affected agency emergency management personnel  
                                • Evaluate evacuation route alternatives, determine feasibility of using each evacuation route, and implement appropriate evacuation traffic control measures |
| Fire Department               | • Establish Incident Command/Unified Command/Area Command as appropriate  
                                • Perform rescue and life safety operations when required  
                                • Support public safety in executing evacuation |
| **Affected Jurisdiction**      |                                                                                                                                                                                                     |
| Emergency Management          | • Coordinate with lead jurisdiction through Incident Command/Unified Command/Area Command systems  
                                • Provide resources (human, technical, equipment, facility, materials) to support evacuation needs of lead and affected agencies  
                                • Maintain expenditure records to facilitate reimbursement |
Table 8 – Roles and Responsibilities of Agencies (continued)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Primary Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected Jurisdiction (continued)</td>
<td></td>
</tr>
</tbody>
</table>
| Public Works and Transportation         | • Support traveler information dissemination, in coordination with lead agency  
• Support public safety traffic management and control efforts, implement modifications to signal system as requested in coordination with lead agency  
• Provide road conditions information available from traffic signal systems, vehicle detection systems, and CCTV surveillance system to lead and affected agency emergency management personnel  
• Coordinate selection of evacuation routes with lead agency, and implement appropriate evacuation traffic control measures |
| Public Safety                           | • Direct, conduct and monitor evacuation process within jurisdiction  
• Protection and security of evacuation area  
• Direction traffic Control within jurisdiction (with support from Public Works/Transportation) |
| Fire Department                         | • Perform rescue and life safety operations when required  
• Support public safety in executing evacuation |
| Neighboring Jurisdiction                |                                                                                                                                                                                                                                      |
| Emergency Management                    | • Provide resources (human, technical, equipment, facility, materials) to support evacuation needs of lead and affected agencies |
| Public Works and Transportation         |                                                                                                                                                                                                                                      |
| Public Safety                           |                                                                                                                                                                                                                                      |
| Fire Department                         |                                                                                                                                                                                                                                      |
| County, State and Federal Agencies      |                                                                                                                                                                                                                                      |
| County Emergency Management (MCDEM)     | • Coordinate the resources (human, technical, equipment, facility, materials) to support evacuation needs of lead and affected agencies  
• Maintain expenditure records to facilitate reimbursement |
| State Emergency Management (ADEM)       | • Provide resources (human, technical, equipment, facility, materials) to support evacuation needs of lead and affected agencies  
• Maintain expenditure records to facilitate reimbursement  
• Coordinate inter-state and federal resources  
• May provide lead role during multi-state evacuation, or evacuees are evacuated to other states |
| County Public Works and Transportation  | • For evacuation areas within unincorporated areas of Maricopa County, MCDOT will assume the roles and responsibilities of a lead or affected agency public works/transportation.  
• When the evacuation area does not contain unincorporated portions of the County, MCDOT will serve as a neighboring agency  
• Provide traffic control assistance (e.g. REACT)  
• Ensure that road condition information is accurate and updated in Road Condition Reporting System (RCRS) |
<table>
<thead>
<tr>
<th>Agency</th>
<th>Primary Roles and Responsibilities</th>
</tr>
</thead>
</table>
| State Public Works and Transportation (ADOT) | • Support traveler information dissemination, utilizing information obtained from traffic signal systems, vehicle detection systems, and CCTV surveillance system  
• Support public safety traffic management and control efforts, implement modifications to signal system on highways and at interchanges as requested  
• Provide road conditions information available from traffic signal systems, vehicle detection systems, and CCTV surveillance system to lead and affected agency emergency management personnel |
| County Public Safety (MCSO) | • Primary responsibility for evacuation in unincorporated areas  
• For evacuation areas within unincorporated areas of Maricopa County, MCSO will assume the roles and responsibilities of a lead or affected agency.  
• When the evacuation area does not contain unincorporated portions of the county, MCSO will serve as a neighboring agency |
| State Public Safety (DPS) | • Primary responsibility for evacuation on state highways and freeways  
• Provides support to local agencies in implementing evacuation plans |
| Media | • Provide evacuation information to the evacuees as received from Public Information Officer. |
| Transit (Valley Metro) | • Coordinate/manage and provide transit resources  
• Coordinate with lead EOC through Transit Control Center  
• Identify and free up local assets (vans, dial-a-ride) to support evacuation  
• Utilize transit vehicles as mobile shelters for emergency personnel  
• Establish park-and-ride assembly points |
| American Red Cross | • Coordinate with lead jurisdiction Emergency Operations Center  
• Anticipate shelter needs, and provide reception and shelter locations to lead agency emergency management personnel  
• Manage long-term donations  
• Coordinate social services  
• Establish responder support (rest stations, food, water, etc.)  
• Facilitate contact centers for information  
• Coordinate with Salvation Army  
• Coordinate with Humane Society  
• Community Emergency Response Team (CERT) |
4.4 Emergency Evacuation Goals, Objectives, and Agency Roles Summary

Baseline goals, objectives, and elements of an evacuation plan were established. These goals and objectives guided the further development of the Emergency Evacuation Strategy Plan, outlining the elements of the evacuation plan and desired outcomes of the Evacuation Strategy Plan. Established goals include:

- Develop a pre-agreed plan of response for evacuation scenarios;
- Identify needed intergovernmental and mutual aid agreements;
- Develop a template that is transferable between local transportation and emergency management agencies;
- Create an approach that relies on existing data;
- Provide specific evacuation strategies that will guide development of agency-specific plans;
- Provide a concise supplement to existing emergency operations plans; and
- Focus on how emergency management and transportation disciplines can work together to develop an evacuation strategy plan.

An evacuation scenario will require coordination of multiple agencies and jurisdictions at all levels of government, including local, county, state, and federal. Agencies can be categorized, depending upon their role in an evacuation scenario, as lead agency, affected, neighboring, or other (county, state, federal) agency. The Incident Command System, and in particular the Unified Command System will serve to efficiently coordinate the efforts of these multiple agencies with their diverse jurisdictional and functional responsibilities.
5. EMERGENCY EVACUATION STRATEGIES

The typical emergency management sequence consists of two separate processes — planning and implementation. As applied to evacuation, the evacuation response process consists of Planning for Evacuation, and Implement Evacuation. As illustrated in Figure 6, Planning for Evacuation consists of five sequential steps (NIMS, page 98):

- **Step A:** Understanding the Situation — establishes the context and base assumptions of the evacuation scenario
- **Step B:** Objectives of Evacuation - establishes parameters of evacuation — time to begin and finish the evacuation is an example
- **Step C:** Develop Plans – specific plans and approaches to meet the objectives
- **Step D:** Disseminate the Plan – to the relevant parties, including emergency responders, media, and the public
- **Step E:** Evaluate and Update – as conditions change, the plan is revised as necessary

5.1 Emergency Evacuation Plan Template

The five-step evacuation response process was followed to develop an emergency evacuation plan template. The template consists of a series of worksheets — each worksheet addresses a step of the evacuation planning process that prompts the evacuation planner to consider particular items as the evacuation plans are developed, as illustrated in Figure 7. A critical element of the evacuation plan is to determine particular strategies, traffic control and public notification are two examples, that should be implemented to improve the evacuation process. As such, a set of strategies was developed, and a short description of each is included as an appendix to the evacuation plan template. As the evacuation planner determines is appropriate, he/she may select a strategy from the appendix and incorporate the strategy into his/her plan. Strategies are discussed further in Section 5.2.

---

**Figure 6 – Evacuation Planning Process**
(Adapted from United States Federal Response Plan, January 2003)
5.2 Emergency Evacuation Strategies

As exemplified in the traffic analysis, an evacuation scenario requires the proactive management of the roadway network in order to move thousands of individuals and vehicles in minimal time. The management of the roadway network can be approached from two avenues — management of roadway capacity and management of demand.

Capacity relates to the ‘supply’ of the roadway network in terms of its ability to accommodate vehicles. The supply of a roadway is typically measured in vehicles per hour. Factors that affect capacity include the number of traffic lanes, number of traffic signals, and the presence of obstructions such as work zones.

Demand is the number of vehicles in a given time period that desire access to the limited number of traffic lanes, as explained in Table 9. Demand-influencing factors include population, vehicle occupancy, and schedule of evacuation. Specific capacity and demand management are addressed in Sections 5.2.1 and 5.2.2.

Table 9 – Approaches to Evacuation Management

<table>
<thead>
<tr>
<th>Management Approach</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (Supply) Management</td>
<td>Managing (increasing) the maximum number of vehicles that a roadway can accommodate during a specified time period</td>
<td>Increase the number of lanes available by converting a center turn lane to a travel lane</td>
</tr>
<tr>
<td>Demand Management</td>
<td>Managing (decreasing) the number of vehicles that are allowed to use the roadway during a specified time period</td>
<td>Reduce the number of vehicles on the roadway network by encouraging people to carpool</td>
</tr>
</tbody>
</table>
5.2.1 Strategies to Increase/Maintain Roadway Capacity

1. Emergency Traffic Signal Timing Plans

Emergency traffic signal timing plans that are optimized to maximize traffic flow in the primary outbound direction significantly increase the capacity of the evacuation route for traffic exiting the evacuation area. Allocating “green-time” primarily to the outbound flow of traffic increases the number of vehicles that are able to pass through the intersection and exit the evacuation area. As an example, a normal-conditions traffic signal timing plan on a major arterial may allocate 60% of the available “green-time” to the east/west direction, and 40% of the available “green-time” to the north/south direction. In contrast, an emergency traffic signal timing plan would allocate 90% to 100% of the available green-time to the outbound direction, significantly increasing the number of vehicles that are able to pass through the intersection in that direction.

Emergency traffic signal timing plans may be implemented from the Traffic Management Center if the traffic signals are ‘interconnected’ by fiber-optic cable or copper wire. Otherwise, implementation requires a technician to make a field-visit to the traffic signal.

2. Minimize Traffic-Crossing Conflicts at Intersections

Conflicts at intersections such as merging or crossing points require vehicles to stop or slow-down, thus reducing the capacity of the evacuation routes. Minimizing or reducing the need of vehicles to come to a full stop at critical intersections along the corridor will improve the capacity of the evacuation route.

Minimizing conflict points is most effectively done by channeling vehicle flow. As demonstrated in Figure 8, conflict points may be significantly reduced by blocking two or more entrances to the intersection, and channelizing traffic flow.

![Figure 8 - Evacuation Routing Plans for a Four-Leg, Single Lane Approach Intersection with Various Crossing and Merging Conflicts](source: T.J. Cova, J.P. Johnson, Transportation Research Part A 37 (2003), pp 579-604)
3. **Monitor Conditions on Evacuation Routes Utilizing CCTV Surveillance Cameras**

Intelligent Transportation Systems (ITS) are a key component of capacity-enhancing strategies. Intelligent Transportation Systems are a broad range of technologically based tools that enable transportation and emergency managers to monitor traffic conditions, respond to capacity-reducing events (e.g. crashes, stalled-vehicles), and inform motorists of conditions on routes so that they may select the best route.

CCTV cameras, positioned on the valley’s freeway and arterial roadways, transmit images to the ADOT Traffic Operations Center and to local traffic management centers. Using these cameras, emergency and transportation managers can quickly detect, verify, and respond to incidents and reduce the impact of an accident on traffic flow. As an example, if a stalled vehicle is blocking a freeway lane, the transportation manager can dispatch a tow-truck to remove the vehicle prior to a police officer arriving at the scene. If a particular route becomes overly congested as viewed through a CCTV camera, transportation managers can begin to advise the public (see Strategy #4) to use an alternate route.

Each emergency operations center should establish communications with the ADOT Traffic Operations Center and with their respective local traffic management center so that CCTV images are accessible to emergency management staff during an evacuation scenario.

4. **Utilize Variable Message Signs to Provide Traveler Information During An Evacuation**

Variable message signs are a primary means for disseminating real-time evacuation information. Information concerning routes, shelters, and/or upcoming detours may be displayed on variable message signs. The frequencies of radio stations broadcasting evacuation information can also be displayed. Within the Phoenix metropolitan area, over 50 variable message signs are located on freeways at intermediate locations between freeway entrances, in advance of freeway-to-freeway interchanges, and at approximately two-mile spacing.

On arterials, signs are typically placed in advance of major arterials where decisions may likely occur. Messages can be posted by operators at the ADOT Traffic Operations Center.

5. **Maximize Utilization of High-Occupancy Vehicle Lanes During an Evacuation**

During an evacuation scenario, normal high-occupancy vehicle (HOV) restrictions should be enforced, encouraging travelers to car pool. Transit and emergency vehicles will also utilize the HOV lanes.

6. **Stage Service Vehicles and Tow Trucks to Remove Disabled Vehicles from Evacuation Routes**

Stalled vehicles and other vehicular incidents may cause additional congestion on evacuation routes, especially if they occur at bottleneck locations. During an evacuation, tow trucks should be strategically positioned along evacuation routes to help clear incidents quickly so that any available capacity can be restored.

7. **Establish On-Street Parking Restrictions**

Elimination of on-street parking along an arterial evacuation route may provide an additional travel lane and thus increase the capacity of the evacuation route. This is only effective if the additional lane is available for the length of the evacuation route until motorists have exited the evacuation area, as the overall capacity of the evacuation route is...
limited by the capacity of any bottleneck areas. Inventory of evacuation routes, including the suitability of shoulder use, should be conducted during a pre-planning evacuation exercise. During an evacuation, it may be necessary to utilize tow trucks to remove vehicles that are not moved by vehicle owners.

8. **Establish Restrictions for Oversize Vehicles**

Restriction of oversize vehicles on evacuation routes, or into and out of the evacuation area, can prevent disabled over-size vehicles from blocking the evacuation route. Oversize and overweight vehicles and cargo can decrease the capacity and safety along evacuation routes.

9. **Review and Terminate Work Zones**

All efforts should be made to review and terminate work zone closures where possible along the evacuation routes to maximize capacity of these routes. Work zones can cause significant delays, and pose significant risk to evacuees. The ADOT Highway and Condition Reporting System (HCRS) can be utilized to identify work zones on both freeway and arterial evacuation routes. The work zone information is entered by operators at the ADOT Traffic Operations Center, as well as personnel at many of the local jurisdictions throughout Maricopa County. The region should continue to emphasize to local agencies the importance of maintaining the currency of the data. The HCRS can be accessed at www.az511.com.

10. **Implement Freeway Contraflow Operations**

Contraflow operations are the reversal of in-bound traffic to out-bound traffic, effect doubling the number of lanes available for out-bound use during an evacuation scenario. Contraflow operations on freeway corridors can greatly increase the traffic throughput during evacuation scenarios. Freeways lend themselves to more effective contraflow operations than arterials because of their configuration as unsignalized, divided, access-controlled corridors. Implementation of contraflow operations is very labor-intensive, as it requires barricades to prevent traffic from entering the corridor in the opposing direction.

11. **Implement Arterial Contraflow/Reverse Lane Operations**

Two options are available to increase the capacity of an arterial roadway for an evacuation scenario: reversible lanes and contraflow operations.

Roadways with a continuous two-way left turn lane, without any medians, are suitable for lane reversal of the center lane. Implementation of a reversible lane is less labor-intensive than implementation of contraflow operations. Contraflow operations are the reversal of all inbound lanes to be used for outbound evacuees. This requires extensive traffic control at each of the corridor intersections, as well as along the corridor. It is recommended that contraflow operations along an arterial corridor be considered as a last option, as it may not be feasible to deploy the equipment quickly enough to be effective.

5.2.2 **Strategies to Decrease Vehicle Demand**

Realistically speaking, the roadway network will be overwhelmed during an evacuation scenario. Strategies to reduce the number of vehicles on the roadway network must be considered, two of which are outlined below.
12. **Provide Evacuation Information**

Providing accurate and timely information to evacuees and motorists during an evacuation is the most critical element of an effective evacuation plan. Pre-departure evacuation information can be provided to evacuees utilizing the 511 telephone system, internet, email, broadcast radio, and the Community Emergency Notification System (CENS). En-route travel information may be provided utilizing the 511 telephone system, broadcast radio, and variable message signs.

Disseminated information should advise motorists of routes to take, route conditions, and departure times. The Community Emergency Notification System is particularly useful because information can be focused to a specific geographic area. A CENS message may instruct one geographic area to utilize a particular evacuation route, and another geographic area to utilize an alternative route, thus distributing the vehicle demand.

13. **Implement Phased Evacuation**

Evacuation of residents can be implemented as a series of successive, geographically smaller evacuations. Phasing spreads the vehicle demand over time, thereby reducing vehicle demand on the roadway network at any time.

Evacuation phasing may be based on voluntary, recommended, and/or mandatory evacuation orders. Commencing an evacuation with either a recommended or voluntary evacuation order will result in the distribution of vehicle demand over time, mitigating the ‘peak hour’ conditions on the roadway network. Response to a voluntary, recommended, or mandatory evacuation order is highly dependent upon the public perception, including perceived danger and concern over personal property.

### 5.3 Long-Term Planning and Preparedness Strategies

Emergency mass evacuation is a multi-disciplinary effort that demands coordination between multiple agencies, departments, and jurisdictions. Moreover, the short response time that will be required to implement an evacuation allows little time for detailed planning and analysis. Advance preparation is essential. Recommended preparation activities include:

- Training and Exercises
- Mutual Aid Coordination Agreements
- Advance Data Collection
- Weekly Input and ‘Push’ of Information to Emergency Managers
- Establish Evacuation Response Coordinating Team
- Continued deployment of infrastructure to support evacuation
- Develop jurisdictional-specific evacuation plans

**Training and Exercises**

Training is necessary to adequately prepare personnel and volunteers in the event of a mass evacuation. Table-top exercises should be regularly conducted to improve inter-jurisdictional coordination and to pinpoint strengths and weaknesses of evacuation response. Participants, particularly those who are not normally exposed to incident response (transportation personnel) should be trained in the Incident Command System (ICS).
Mutual Aid and Coordination Agreements

Mutual aid agreements are the means by which one jurisdiction provides resources, support, and services assistance to another jurisdiction. As agencies develop evacuation plans, they should ensure that they are party to a mutual aid agreement with each of the jurisdictions from they expect to receive or to provide resources during an incident. This should include all neighboring or nearby jurisdictions (NIMS, page 39).

Agencies should ensure that mutual aid agreements exist for critical resources such as traffic barricades, heavy equipment (e.g. front-loaders), and personnel resources. Specifically, agencies should:

- Ensure that mutual-aid agreements are in place for traffic control equipment and other required resources;
- Establish provisions for rapid addition of operations personnel;
- Establish legal requirements for cross-agency/cross-jurisdiction use of resources prior to an evacuation; and
- Develop coordination agreements to establish a chain of command and lists of resources.

At a minimum mutual aid agreements should contain the following elements (NIMS, page 39):

- Roles and Responsibilities of key parties;
- Procedures for requesting and providing assistance;
- Notification procedures;
- Procedures and rules for payment, reimbursement, and allocation of costs;

**Advance Data Collection**

Advance data collection is a critical element of a comprehensive evacuation plan. In the event of an emergency evacuation, current data and information are required to support planning evacuation strategies. Information that could be collected and analyzed in advance and included on maps, charts, databases, or lists includes:

- Jurisdictional boundaries
- Population
- Transportation infrastructure
- Roadway characteristics
- Geographic features
- Other large organizations’ facilities
- Traffic control devices

These data elements are best organized and managed with a Geographic Information System (GIS). A GIS is an information management system that can collect, store, retrieve, query, analyze, and map data in support of the decision-making process. GIS provides an efficient and effective means to access and maintain large amounts of information in a format that is easily accessed, analyzed, and presented.

GIS allows emergency managers quick access to critical information, facilitating the near real-time development of evacuation plans. GIS can be used to help reach a decision about evacuation routes based on population density, roadway characteristics, and shelter locations. Because GIS outputs can be produced quickly, even on a field-based laptop computer, multiple scenarios can...
be evaluated efficiently and effectively. Complementing and perhaps integrated with a GIS are modeling and simulation tools to assist in the development (in near real-time) of evacuation plans.

The region should continue to enhance Geographic Information Systems to provide real-time access, even in the field, by emergency responders to essential data such as population, roadway characteristics, and infrastructure.

**Weekly Input and ‘Push’ of Information to Emergency Managers**

Dynamic data such as construction work zones on evacuation routes must be regularly updated and maintained. During an evacuation scenario, emergency managers need accurate reports on the current conditions of evacuation routes. The Arizona Department of Transportation Highway Condition and Reporting System (HCRS) provides the foundation for regional coordination of work zones, closures, and restrictions on arterials and freeways. Local agencies are encouraged to update the HCRS on a weekly basis. The system should be enhanced to include a ‘push’ of restriction information, via email, to subscribers and in particular to emergency management personnel. The HCRS data should be integrated with the GIS, providing a one-stop source of crucial information.

**Evacuation Response Coordinating Team**

Agencies should consider establishing a region Evacuation Response Coordinating Team. The Team may be comprised of operational-level public works, transportation, and emergency management officials from multiple jurisdictions who are trained to provide specialized evacuation planning assistance to local agencies during an evacuation scenario. The Team should be familiar with evacuation strategies and the resources required to execute an evacuation.

The Team would be a modular component of the Incident Command System, and activated as a branch of the ICS when necessary. Upon activation, the Team becomes an integral element of the local/county/state coordination effort.

**Deploy Infrastructure to Support Evacuation**

Finally, the region should continue to deploy the infrastructure necessary to support evacuation. Specifically, data communication links should be established between Emergency Operations Centers and Traffic Management Centers. Emergency Operations Centers should be equipped to serve as contingency traffic operations centers, including the ability to control ITS devices and traffic signals.

Intelligent Transportation Systems will play a crucial evacuation support role. The region should continue to support the deployment of ITS on valley freeways and arterials. Cameras, variable message signs, and interconnected traffic signals not only will help to alleviate everyday traffic congestion, but will significantly enhance the response capability during an evacuation scenario.

**Develop Agency-Specific Evacuation Plans**

The Evacuation Plan Template should be applied and modified to fit the needs of the individual agencies, and incorporated as an Annex to the agency’s Major Emergency Response Plan.

Agencies throughout the region should utilize the evacuation template to develop evacuation plans specific to their jurisdiction. For example, the City of Phoenix may consider developing an evacuation plan for downtown Phoenix. The Evacuation Plan Template would serve as the foundation of the plan. Simulation and detailed traffic analysis should be included.
The evacuation plans, and overall evacuation planning efforts of the agencies should be reviewed and updated on an annual basis. The review may be incorporated into the Major Emergency Response Plan annual review. An individual should be designated to be responsible for the plan review, maintenance, and updating.

5.4 Future Regional Evacuation Planning Efforts

The Emergency Evacuation Strategy Plan is the first step of the region’s evacuation planning process. Throughout the Strategy Plan development, stakeholders identified other planning needs that were beyond the scope of the current effort. Future phases should focus on:

- **Evacuation terminus locations.** Large numbers of vehicles will need accommodation at terminus locations. Planning of parking and management strategies for the thousands of vehicles should begin.
- **Reentry into evacuation area.** Smooth and coordinated reentry into the evacuation area should be included in future planning efforts.
- **Decision support system.** A base assumption of the Strategy Plan is that the decision to evacuate has already been made. Stakeholders understand the gravity of an evacuation order, and that evacuation is a last resort option. However, a defined process for making such a monumental decision has not been developed. A decision-support model to assist agency personnel and public officials to make such a decision should be developed. The model may incorporate transportation, social, health, safety, and economic impacts of an evacuation to provide a breadth of information to decision-makers to facilitate the decision process.
- **Public education and media participation.** A comprehensive strategy to educate and prepare the public for an evacuation scenario should be developed. Individuals, prepared with 72-hour emergency kits will ease the burden of the Red Cross. The education campaign could also emphasize the importance of car-pooling, and inform citizens of where to obtain timely information in event of a mass evacuation.
- **Shelter Identification.** A large-scale mass evacuation will require the accommodation of thousands of individuals, likely overburdening the currently designated shelter facilities. A detailed analysis of existing shelter facilities should be conducted.

5.5 Evacuation Strategies Summary

An Emergency Evacuation Plan Template was developed. The Template consists of a series worksheets — each worksheet addresses a step of the evacuation planning process and guides the evacuation planner to consider particular items. The Evacuation Plan Template contains summaries, referred to as Emergency Evacuation Strategy Sheets, of several of these operational strategies. Emergency Evacuation Strategy Sheets were developed to address capacity and demand management strategies.

An effective emergency evacuation plan requires advance preparation. Recommended preparation activities include:

- Training and Exercises
- Mutual Aid Coordination Agreements
- Advance Data Collection
- Weekly Input and ‘Push’ of Information to Emergency Managers
- Establishment of an Evacuation Response Coordinating Team
- Continued deployment of infrastructure to support evacuation
- Development of jurisdictional-specific evacuation plans
REFERENCES