MODERATE RISK HAZARDS

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SECTION 3H

DROUGHT

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Section 3H - DROUGHT

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HAZARD IDENTIFICATION

Drought is different from many of the other natural hazards in that it is not a distinct event, and usually has a slow onset. Drought can severely impact a region both environmentally and economically. A drought's effects impact various sectors in different manners and with varying intensity. Adequate water is the most critical issue; agricultural, manufacturing, tourism and commercial and domestic uses, all require a constant, reliable supply of water. As the population in the area continues to grow, so will the demand for water.

Drought is a complex issue involving many factors, with differing conditions and drivers throughout the state making this more of a regional focus. Drought can be defined regionally based on its effects:

- Meteorological - This type of drought is usually defined by a period of below average water supply.
- Agricultural - This type of drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- Hydrological - A hydrological drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as stream flow, snowpack, and as lake, reservoir and groundwater levels.
- Socioeconomic: A socioeconomic drought occurs when the results of drought impacts the health, well-being, and the quality of life, or when a drought starts to have an adverse economic impact on a region.

The drought issue is further compounded by water-rights specific to any state or region. Water is a commodity possessed under a variety of legal doctrines. In addition, the prioritization of water rights between farming and federally protected fish habitats in the state is also at issue.

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HAZARD PROFILE

The 1987-92 Drought[1]

This section focuses on conditions experienced during the most recent drought, the six-year event from 1987 to 1992. A few examples from the 1976-77 drought are also mentioned, but detailed discussion of this earlier event is minimized because conditions have changed greatly since then. Impacts experienced during the 1976-77 drought when 47 of the State's 58 counties declared local emergencies served as a wake-up call to water managers statewide, spurring implementation of many improvements to water supply reliability.

Water Supplies and Water Project Operations

The 1987-92 drought was notable for its six-year duration and the statewide nature of its impacts. Because of California's size, droughts may or may not occur simultaneously throughout the entire state. The jet stream's position during the winter storm season is an important determinant of regional precipitation amounts. California, spanning more than nine degrees of latitude (a north-to-south extent equaled or exceeded only by Alaska and Texas), seldom experiences uniform levels of wetness or dryness, as illustrated in Figure 10. Historical values for the Sacramento River and San Joaquin River indices shown in the previous chapter also demonstrate this point. As defined by these indices, the Sacramento River system experienced two dry years and four critically dry years during the drought; the San Joaquin River system experienced six critically dry years.

Defining drought conditions in urbanized coastal Southern California is complicated. Historically, imports (from Northern California, from the eastern Sierra, and from the Colorado River) have provided about 65 percent of the region's water supply. Hydrologic conditions in the Colorado River Basin may vary greatly from those being experienced in California; the extensive storage in the river basin further acts as a buffer to short-term hydrologic changes. Colorado River unimpaired flow at the gaging station used for interstate compact administration was below the long-term historical average during the 1987-92 drought, but the immediately prior multi-year wet period had filled system reservoirs.

When the SWP sharply curtailed deliveries in 1991, MWD (the most junior of California's

[1]Source: DWR Drought Report, July 2000

major Colorado River water users) was able to maintain a full Colorado River Aqueduct due to availability of surplus river water.

Water users served by most of the State's larger suppliers did not begin to experience shortages until the third or fourth years of the drought. Reservoir storage provided a buffer against drought impacts during the initial years of the drought. The CVP and SWP met delivery requests during the first four years of the drought, but were then forced by declining reservoir storage to cut back deliveries substantially. (Cachuma Reservoir storage is also shown to provide an example of drought impacts to a Southern California reservoir not connected to imported water supplies.) In 1991, the SWP terminated deliveries to agricultural contractors and provided only 30 percent of requested urban deliveries. The CVP, with its larger storage capacity, reduced agricultural deliveries by 75 percent and urban deliveries by 25 percent in 1991.

By the third year of the drought, overall statewide reservoir storage was about 40 percent of average. Statewide reservoir storage did not return to average conditions until 1994, thanks to an unusually wet 1993. Some examples of surface water supply impacts included:

- Among large urban agencies' water development projects, the City and County of San Francisco's system experienced the greatest supply impacts, having only about 25 percent of total storage capacity in 1991. The City and County constructed two turnoutsone 75 cubic feet per second and the other 25 cfson the California Aqueduct to obtain access to supplies from water transfers.

- Lake Tahoe, the principal storage facility for the U.S. Bureau of Reclamation's Newlands Project in Nevada, not only fell below its natural rim but also reached a record low of more than a foot below the rim. Storage on the Truckee River system, all dedicated to Nevada uses, reached a low of ten percent of total capacity in 1991.
- The creek providing water for Markleeville, the county seat of Alpine County, dried up. A pipeline was constructed to a new water source. This example is typical of impacts faced by small rural water systems with marginal water supplies.

- As described later in this chapter, the drought spurred many water agencies to begin planning for new facilities to improve water supply reliability. Only two new water management facilities of regional scope were put into service during the drought.

- In Northern California, the Department's North Bay Aqueduct pipeline was completed in 1988, replacing previously constructed interim facilities. The NBA was used to convey SWP water and water transfers to Napa Valley communities experiencing

significant shortages of local surface supplies. In the San Joaquin Valley, initial operational testing was being conducted for the Kern Water Bank, a project originally developed by the Department for SWP supply augmentation and subsequently turned over to local agencies to implement. In a 1990 test program, the Department banked about 100 thousand acre-feet of SWP water in what was then known as the Semitropic local element of the KWB. Semitropic Water Storage District returned, through exchange, about half the stored water in 1992.

- Delta regulatory constraints affecting CVP and SWP operations during the drought were based on SWRCB Decision 1485. (D -1485 requirements took effect in 1978, immediately following the 1976-77 drought.) Other operational constraints included temperature standards established by SWRCB through Orders WR 90-5 and 91-01 for portions of the Sacramento and Trinity Rivers. On the Sacramento River below Keswick Dam, these orders included a daily average water temperature objective of 56° F during critical periods when high temperatures could be detrimental to survival of salmon eggs and a pre-emergent fry.

- Groundwater extraction increased substantially during the drought. The total number of well driller reports filed with the Department was in the range of 25,000 reports per year for several years, up from fewer than 15,000 reports per year prior to the drought. The majority of the new wells drilled were for individual domestic supply. Water levels and the amounts of groundwater in storage declined substantially in some areas. As indicated earlier, groundwater extractions were estimated to exceed groundwater recharges by 11 maf in the San Joaquin Valley during the first five years of the drought. Precise surveys of the California Aqueduct identified an increase in subsidence along the aqueduct alignment in the San Joaquin Valley, in response to increased groundwater extractions.

Examples of impacts to groundwater supply included:

- Numerous private domestic wells went dry, as did wells supplying small systems in rural areas. Homeowners with private wells were forced to drill new wells or deepen existing ones. Groundwater users most at risk were typically those relying on extractions from small coastal basins with limited recharge, or on low-yield fractured rock formations such as those in the Sierra Nevada foothills. Dry wells at a number of small water systems in rural areas of the Sierra Nevada foothills resulted in the need to haul water. The counties affected included Butte, Amador, Mariposa, and Tuolumne.

- Water levels in Salinas Valley aquifers declined, and increased seawater intrusion was noted. San Antonio and Nacimiento Reservoirs, used by Monterey County Water

Resources Agency for groundwater recharge, were only at six percent of capacity in 1991. The valley's extensive agricultural production relies almost entirely on groundwater. (A new water recycling project providing supplemental irrigation supply, in the Castroville area, did not become operational until after the drought ended.)

- Some communities in the Central Coast area rely on small groundwater basins formed by coastal terrace deposits, with recharges to these basins being limited largely to direct precipitation over the basin. These communities typically experienced shortages throughout the drought, and instituted rationing in response. Santa Barbara experienced the largest water supply reductions of any of California's larger municipalities; its limited groundwater and local surface water supplies were unable to support area residents' needs. As described later in this chapter, the city was forced to adopt several emergency measures including a 14-month ban on lawn watering.

- Groundwater supplies ranged from none to minimal for the small North Coast communities that frequently experience water supply problems. In Mendocino, for example, supplies are provided by individual private wells. It has been estimated that ten percent of the town's wells go dry every year, an amount that increases to 40 percent during droughts. Other communities with problems included Weaverville and Fort Bragg (building moratoria/connection bans), Klamath (connected to a private well), and Willits (hauled water, installed temporary pipelines). Wells or springs serving several small water systems in the Russian River corridor went dry; water haulage was necessary.

Actions Taken by Water Agencies to Respond to Drought

Department of Water Resources

The Department devoted substantial resources to drought-related information collection and dissemination, including staffing a Drought Center to serve as a central point of contact for information and emergency assistance requests.

The Department also chaired the interagency Drought Action Team established by Governor's Executive Order No. W-3-91.
The Division of Flood Management compiled and disseminated climatology, hydrology, and water storage data.

Staffs in District offices were tasked with performing anecdotal surveys of local water agency conditions, and with providing increased local assistance support in water conservation and other programs. Information collected by the Department was provided

to the media, to the general public, and to the Legislature. Numerous status reports and other drought-related information were published; examples are listed in the references at the end of this report.

In addition to routine SWP operations, the Department conducted several trial programs to improve SWP water supply reliability. The demonstration groundwater storage program with SWSD was one example. In 1989, a weather modification project using aerial cloud seeding was operated in the Feather River watershed. The Department additionally began a demonstration weather modification program using ground-based propane generators in the Middle Fork Feather River watershed in 1991. The program was terminated after three years when initial results indicated that a redesign was necessary, by which time the drought had ended.

The Department used the California Aqueduct to wheel water for other agencies' drought-related water transfers, and also for the drought water bank. The bank, the most ambitious of the Department's drought response activities, is described in detail below. The Department developed the bank in response to the Governor's 1991 Executive Order. The bank operated three times during 1991 and 1992, then again in 1994, a critically dry year.

The Department purchased water under 351 short-term agreements in 1991. About 50 percent of the water came from land fallowing, and about 30 percent from groundwater substitution.

The remainder of the water came from reservoir storage. In 1992, about 80 percent of bank purchases came from groundwater substitution and 20 percent from reservoir storage. No land fallowing contracts were executed in 1992. While land fallowing was a major feature of the 1992 bank, it is also the water source that has the greatest potential for generating third party impacts. The costs to the seller of participating in land fallowing are higher, and it was determined that water purchased from other sources could be less expensive. Finally, demands in the 1992 and 1994 banks were much less than those in 1991, and a judgement was made that land fallowing was not needed to meet critical water needs.

The 1991 and 1992 banks were able to acquire sufficient water to meet critical needs of all participants. The highest priority critical needs were basic domestic use, health and safety, and fire protection.

Agricultural critical needs allocations were based on supplies for permanent plantings such as orchards and vineyards. DFG, in a program operated in parallel to the drought water bank, used emergency drought relief funding appropriated during the Legislature's 1991-92

extraordinary session to purchase almost 75 taf for fish and wildlife purposes. Most of the water was used for wetlands at wildlife refuges.

Water users and residents in regions of bank sales expressed concerns about third-party impacts of the fallowing and groundwater substitution associated with the 1991 and 1992 banks. Some private groundwater users in Butte County not participating in the bank filed claims against the Department alleging impacts to their wells. The Department conducted extensive groundwater monitoring programs in areas of the groundwater substitution purchases, including installing extensometers to measure subsidence. The Department paid Yolo and Butte Counties amounts equivalent to two percent of the value of the groundwater substitution contracts in their counties, to fund preparation of county water plans or to update existing plans. The Department also funded external reviews of 1991 and 1992 Bank operation, which included economic evaluation of third-party impacts (see references in Appendix).

In 1993, the Department completed a programmatic environmental impact report covering operation of potential drought water banks over the next 5 to 10 years. A bank would be implemented as needed on an annual basis upon an executive order of the Governor, a decision by the Secretary for Resources, or a finding by the Department's Director that drought or other unanticipated conditions would significantly curtail waters supplies. The bank would continue to operate until water supplies returned to noncritical levels.

The Department opened another drought water bank in 1994, together with a short-term water purchase program for SWP contractors. The Department began organizing a 1995 bank in September 1994, anticipating another dry year.

By mid-November, water agencies had signed contracts with the Department to purchase water from the bank for critical needs. The bank acquired options to purchase 29 taf of water from five willing sellers. The options were subsequently not exercised due to wet conditions in 1995.

Other Water Agencies

The majority of the State's urban water retailers and water wholesalers implemented demand reduction techniques either voluntary or mandatory at some point during the drought. Demand reduction programs were typically accomplished through extensive customer education and outreach programs. Mandatory rationing levels reached as high as 50 percent in some hard-hit communities.
Small communities in isolated areas lacking back-up water sources and the ability to interconnect with other water agencies typically had no recourse other than demand

reduction or water haulage. Customers of agricultural water agencies reduced planted acreage to match water supplies expected to be available. Table 3 shows contingency measures implemented by some of California's larger urban agencies in 1991, the driest year of the drought. That year's relatively cool summer helped urban water users meet rationing goals by lessening landscape water use needs.

Examples of other actions taken by water agencies are briefly summarized below.

- Increased groundwater extraction was a common response action. Agencies drilled new wells, deepened existing ones, or expanded distribution systems to serve groundwater to lands previously supplied only from surface water. Some agricultural water agencies worked with their customers to develop delivery schedules that stretched agencies' stored surface water by making growers responsible for meeting part of crop water needs through private groundwater extraction. Groundwater, either directly or through substitution, was the source of supply in many transfers.

- Water systems of all sizes constructed interconnections with neighboring agencies, to facilitate water transfers and exchanges. The City and County of San Francisco turnouts on the California Aqueduct are an example of interconnections made solely for the purpose of water transfers.

- Some agencies constructed temporary or emergency pipelines to a back-up supply when their primary source of supply became inadequate. Multi-agency water transfers and exchanges used to make a temporary SWP water supply available to southern Santa Barbara County, for example, entailed construction of a 16-inch pipeline between Ventura and Oxnard. The City of Willits used pipe supplied by the Office of Emergency Services to make a temporary connection to an alternate water supply.

- The drought increased interest in water recycling projects, especially in Southern California. Planning began for a number of new projects. After the drought ended, however, studies of many smaller projects (and of projects not eligible for federal cost-sharing) were deferred. Projects most likely to remain active were typically those driven by wastewater disposal requirements, and those eligible for federal cost-sharing.

- Coastal communities' interest in seawater desalting likewise increased. The drought served as a catalyst for initiating research studies, bench scale tests, and demonstration projects, primarily in Southern California. Most of these efforts terminated with the end of the drought, because seawater desalting remains noncompetitive with other water supply augmentation options. The City of Santa Barbara did contract for installation of a modular, portable seawater desalting plant, in

response to its severe reductions in local water supplies. The plant, rated at a production capacity of 7.5 AF/year, operated only during 1991. The plant was subsequently mothballed; later, part of its equipment was sold. During the time of its brief operation, it was the State's largest seawater desalting plant designed for providing municipal water supply.

- In a general sense, the drought encouraged water agencies to review the reliability of their water supplies and to initiate planning programs addressing identified needs for improvement. Examples of agencies performing extensive reviews of supply reliability in response to the drought included MWD, SDCWA, East Bay Municipal Utility District, and Alameda County Water District.

- The water transfers listed as contingency measures in Table 3 were short-term transfers. Short-term transfers, including those for the Department's drought water bank, were widely implemented during the drought. It is difficult to accurately quantify the amount of short-term transfers implemented during the drought, because many transfers involved pre-1914 water rights not subject to SWRCB jurisdiction.

  Some short-term "transfers" were not actually transfers from the standpoint of water rights administration, as in the case of transfers of contractual allocations among CVP contractors.

- Long-term water transfers are usually considered to be part of improving water agencies' overall supply reliability, not as drought response actions.

  A water agency could execute a long-term agreement for transfers only in dry/drought years, or one which would entail exchanging wet year supplies for dry year supplies over the agreement's duration. Some agreements of this nature were executed subsequent to the drought's end.

- The drought encouraged water and power agencies to implement weather modification (cloud seeding) programs, most located in Coast Range and Sierra Nevada watersheds. The number of operating programs increased from perhaps a dozen prior to the drought to 20 during the drought.

  However, the absence of cloud masses suitable for seeding is a limiting factor on the potential for water supply augmentation during droughts.

Drought Impacts to Water Agencies

Discussion of drought impacts to the environment and at the water user or economic sector level is beyond the scope of this report; information on this subject can be found in the references provided in the Appendix.

The fundamental drought impact to water agencies was a reduction in available water supplies. Examples of further drought impacts to water agencies are briefly summarized below :

- Declining revenues and increasing operational costs were problems faced by most water agencies. Revenues declined as customers responded to calls for voluntary or mandatory reductions in water use. Costs increased, as agencies reacted to shortages by purchasing water, deepening wells, or implementing water education and conservation campaigns. Water agencies thus increased their rates to recover costs, sending a mixed message to the public use less water, pay more.

- Agricultural water agencies were especially affected by drought-related financial problems. Estimated statewide drought-idled acreage was on the order of 500,000 acres, about five percent of 1988-level harvested acreage. With reduced revenues, water agencies were hard-pressed to cover fixed costs.

  Financial problems experienced by Kern County Water Agency's member districts, together with concerns about SWP water allocation rules, were an impetus for subsequent negotiation of the Monterey Amendments between the Department and the SWP contractors.

- Some agencies not experiencing drought-induced water quantity problems nevertheless experienced water quality problems most typically, agencies relying on groundwater. Increased extractions resulted in lowered water tables and resultant contaminant migration toward production wells. The City of Fresno, for example, took at least 34 of its municipal wells out of service as a result of increased concentrations of pesticides, solvents, and salts. Most municipalities relying on small coastal groundwater basins observed increased amounts of seawater intrusion.

- Saltier water was also a concern for in-Delta diverters. The Department installed temporary barriers at two South Delta locations Middle River and Old River near the Delta-Mendota Canal intake to improve water levels/water quality/circulation for agricultural diverters. Contra Costa Water District relied largely on CVP supplies during

the drought, because water quality at its Rock Slough intake was poor. (As part of Los Vaqueros project construction, CCWD subsequently constructed a new intake farther upstream on Old River, to lessen salinity intrusion impacts.)

- Some Southern California water agencies experienced increased salt concentrations as a result of receiving a higher percentage of Colorado River water in their MWD supplies. The total dissolved solids content of MWD's Colorado River supplies is typically on the order of 700 milligrams per liter. MWD attempts to provide a 50/50 blend of SWP and Colorado River water to its member agencies, to the extent practical. Reduced SWP supplies during the latter part of the drought limited MWD's blending capability, and MWD lacked facilities to deliver a 50/50 blend throughout all of its service area. SDCWA was probably the most affected member agency. Imported MWD water provides 70 to 95 percent of SDCWA's service area supply; SDCWA received essentially 100 percent Colorado River water during 1991-92. Construction of Diamond Valley Reservoir and completion of the Inland Feeder will facilitate better regional distribution of SWP water for blending.

Drought-Related Legislation

Public and media interest in droughts fosters heightened awareness of water supply reliability issues in the Legislature. More than 50 drought-related legislative proposals were introduced during the severe, but brief 1976-77 drought. About one-third of these eventually became law. Similar activity on drought-related legislative proposals was observed during the 1987-92 drought.

Selected chaptered drought or water supply reliability bills from the 1987-92 drought are summarized below, followed by a summary of the proposed State Drought Emergency Relief and Assistance Act of 1991. The Legislature took action on the provisions contained in this proposal during an extraordinary session held in 1991-92.

Chaptered Drought or Water Supply Reliability Legislation

- Various technical and clarifying changes were made to Water Code provisions governing temporary and long-term water transfers.

- The use of potable water for specified non-potable purposes was declared to be a waste or unreasonable use of water if suitable, cost-effective reclaimed water supplies were available. Several measures expanding the types of applicable non-potable

purposes were enacted.

- Leases of water for up to five years, with specified limitations, were exempted from SWRCB jurisdiction over water transfers. (Chapter 847-91)

- Groundwater substitution transfers were explicitly authorized; related findings were made. (Chapter 779-92)

- The Water Conservation in Landscaping Act directed the Department to draft and adopt a model water efficient landscape ordinance by July 1992. Local agencies not adopting their own ordinances by January 1993 were required to begin enforcement of the model ordinance as of that date. (Chapter 1145-90)

- The Agricultural Water Suppliers Efficient Management Practices Act required the Department to establish an advisory committee to review efficient agricultural water management practices, and to offer assistance to agricultural water suppliers seeking improved efficiencies. (Chapter 739-90)

- The Water Recycling Act of 1991 set a statewide goal of recycling 700 AF/year by 2000 and 1 MAF/year by 2010. (Chapter 187-91)

- The Agricultural Water Conservation and Management Act of 1992 authorized agricultural water suppliers to institute water conservation or efficient water management programs. (Chapter 184-91)

- The Department was required to develop standards for installation of gray water systems in residential buildings. (Chapter 226-92)

- Effective January 1992, water purveyors were required to meter new connections. (Chapter 407-91)

- Caltrans was required to implement drought-resistant freeway landscaping, and to allow local agencies to place recycled water pipelines in highway rights-of-way. Another measure urged the Department of General Services to use drought resistant plants in new landscaping.

- The Urban Water Management and Planning Act, in effect since 1983, was amended in multiple sessions. Amendments in 1991 required water suppliers to estimate available water supplies at the end of one, two, and three years, and to develop contingency plans for shortages of up to 50 percent.

- The Department and the Department of Fish and Game were directed to submit various reports to the Legislature describing water supply availability and drought-related water needs for fish and wildlife.

The Drought and Emergency Management Actions

As the 1987-92 drought entered its fifth year, carry-over storage in the State's major reservoirs had been depleted and water agencies throughout California were facing the prospect of major reductions in supplies.

The Governor signed an executive order in February 1991, creating a Drought Action Team and directing the team to coordinate a response to water supply conditions. The team was headed by the Director of DWR; its membership included representatives from nine other State agencies, with invited participation from additional State and federal agencies. Among other things, the team was charged with advising the Governor on "determining whether and when to proclaim a state of emergency due to drought conditions".

Prior to formation of the Drought Action Team, the Governor had declared a state of emergency in the City and County of Santa Barbara in 1990, at the request of both jurisdictions. By early 1991, ten counties had declared local drought emergencies.

By the end of 1991, 23 counties had declared local drought emergencies.

Ultimately, no statewide declaration of emergency was made for the 1987-92 drought, although a declaration would almost certainly have been made but for the "March Miracle" rains in 1991.

Had such a declaration been made, the Governor would have had broad powers to take emergency response actions, as summarized below. Prior to the "March Miracle," for example, plans were being made to require that all communities develop strategies to respond to a worst case scenario of a 50 percent reduction in their normal water supplies.

Water Conservation in Landscaping Act

The Model Water Efficient Landscape Ordinance was added to Title 23 of the California Code of Regulations in response to requirements of the 1990 Water Conservation in Landscaping Act. Local agencies not adopting their own ordinances by January 1993 were required to begin enforcement of the model ordinance as of that date.

The model ordinance applied to all new and rehabilitated landscaping (more than 2,500 square feet in size) for public agency projects and private development projects that require a local agency permit. The purpose of the ordinance was to promote water efficient landscape design, installation, and maintenance. The ordinance's general approach was to use 0.8 ET0 as a water use goal for new and renovated landscapes. (ET0 is a reference evapotranspiration, established according to specific criteria.)

To date, there has been no statewide-level review of how cities and counties are implementing this requirement; hence, its water savings potential remains to be quantified. Estimating urban landscaping water use is difficult due to lack of data.

Only a handful of water districts in California has actual data on the extent of irrigated acreage (residential lots plus large turf areas, such as parks, cemeteries, and golf courses) in their service areas, and data are nonexistent at a statewide level.

Emergency Services Act

The Emergency Services Act (Government Code Section 8550 et seq.) authorizes the Governor to proclaim a state of emergency where he or she finds that conditions of disaster or extreme perils exist, caused by conditions such as flood, fire, storm, epidemic, riot, drought, earthquake, or volcanic eruption. These conditions of emergency must be beyond the control, or likely control, of the services, personnel, equipment and facilities of any single city or county. The emergency must also require the combined forces of a mutual aid region to combat.

Generally, the act is triggered by a local emergency proclamation and a request to the Governor to proclaim an emergency.

The Governor may also proclaim an emergency without such a local request, if he finds that a state of emergency exists, and local authority is inadequate to cope with the emergency. The Governor must proclaim the termination of the state of emergency at the earliest possible date that conditions warrant. Drought differs from other emergencies in that it occurs over a period of time, instead of being a sudden occurrence like fire, flood, or earthquake. Accordingly, its burdens on cities and counties are likely to be cumulative, rather than sudden and overwhelming. To invoke the extraordinary remedies of the Emergency Services Act, conditions of a disaster or extreme peril to the safety of persons and property should exist, and not be a matter of speculation. The act permits the Governor to assign a State agency any emergency response activity related to the powers and duties of that agency. This assignment may be accomplished by executive order without the need of the Governor having to proclaim a state of emergency.

Public agencies often have specific powers in their enabling acts to adopt water rationing and other demand reduction measures. Municipal water districts, for example, have specific authority to adopt a drought ordinance restricting use of water, including the authority to restrict use of water for any purpose other than household use. During a local emergency, cities and counties may promulgate orders and regulations necessary for the protection of life and property, and they have the authority to provide mutual aid to any affected area. Where a county has declared an emergency, it is not necessary for cities affected by emergency conditions within the county to make an independent declaration of local emergency.

Water Code Sections 350-358 authorizes public and private water purveyors to declare a water shortage emergency and to adopt regulations and restrictions to conserve water. The governing body of a purveyor may declare a water shortage emergency whenever it determines that consumers' requirements cannot be satisfied without depleting the water supply to the extent that there would be insufficient water for human consumption, sanitation, and fire protection. The governing body may adopt regulations and restrictions on water delivery and use to conserve water for the greatest public benefit, with particular regard to domestic use, sanitation, and fire protection. The regulations may provide for connection moratoria. DHS has the authority to impose terms and conditions on permits for public drinking water systems to assure that sufficient water is available. This includes the authority to require an agency to continue its moratorium on new connections adopted pursuant to Water Code Section 350 et seq.

Article X, Section 2 of the California Constitution prohibits waste or unreasonable use or unreasonable method of use or diversion of water.

Court decisions interpreting the Constitution have stressed that a use reasonable in times of plenty may be unreasonable in time of shortage, and reasonable use must be determined in the light of statewide conservation considerations. Water Code Section 275 directs the Department and the SWRCB to take appropriate actions before courts, administrative agencies, and legislative bodies to prevent waste or misuse of water.

Probability of Future Events

The probability of future drought events is shown in Section 2, figure 2-4 on page 2-17.

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VULNERABILITY ASSESSMENT

Overview

Unlike some potential hazards, the probability that Los Angeles will experience drought conditions in the future is virtually 100%. The only unknowns are exactly when, how severe, and the duration of drought conditions. Also, unlike other potential hazards, drought does not directly cause personal injury, death, or damage to facilities and infrastructure. Nonetheless severe drought could result in substantial monetary loss, and could exacerbate the effects of other natural hazards.

Severe drought could result in the following adverse effects:

- Substantial economic loss to agriculture and related industries.
- Loss of natural vegetation, potentially exacerbating the adverse effects of brush fires and floods.
- Economic loss to commercial and residential property owners from landscape damage due to water shortages or rationing.
- Water agencies also experience reduced revenue when water usage declines due to use restrictions on water
- Water supply agencies could experience increased cost of operations and/or increased treatment costs as less desirable sources of water supply are tapped.

Potential Losses to Agriculture and Related Industries

According to the 2002 U.S. Census of Agriculture, Los Angeles County is home to more than fifteen hundred farms. The market value of Los Angeles County farm products in 2002 was in excess of $281 million. While few commercial farms are located within the City limits, the City is home to significant numbers of workers in agricultural industries. In addition, agricultural production in the surrounding area, as well as related industries, generates retail and wholesale sales in the City.

Severe or sustained drought not only causes direct damage to crops, a secondary result is increased susceptibility insect damage and disease.

Loss of Natural Vegetation

A substantial portion of the land area within the City of Los Angeles is composed of

undeveloped hillsides and mountainous areas covered with natural vegetation. Loss of natural vegetation as a direct result of drought, or from secondary causes such as disease and insect damage increases the potential severity of other hazards, particularly flood, landslide/mudslide, and brushfire. The specific vulnerabilities associated with these hazards are discussed in sections 3D, 3N, and 3C respectively.

An additional consequence of natural vegetation loss is loss of natural habitats for indigenous species of fauna.

Damage to Residential and Commercial Landscape

Public education efforts conducted by the City's Department of Water and Power has resulted in increased awareness among property owners of the importance of low-water maintenance landscaping. In addition, commercial and government landscaping increasingly relies on reclaimed water. However, most landscapes (including lawns) within the City remains water intensive.

The resulting economic loss is difficult to measure because costs would be distributed among an extremely large number of residential and commercial property owners. However, an extreme drought event could result in losses of hundreds of millions of dollars.

Increased Costs to Water Supply Agencies

The high potential for drought increases to cost of water acquisition, storage, transportation and treatment for water supply agencies. Between 1991 and 2001, for example, Southern California water agencies invested more than $261 million in conservation, recycling, and groundwater clean-up programs. According to the Metropolitan Water District, during the same time period more than three million water-conserving showerheads and almost two million ultra-low flow toilets were installed in Southern California at a cost of $106 million.

Identifying Assets

Drought conditions do not pose a direct threat to facilities or physical infrastructures.

Estimating Potential Losses

Drought would not result in any direct loss or damage to Critical Response Facilities, Critical Infrastructure, or Critical Operating Facilities.

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Analysis of Future Development

Within the City development patterns have little effect on vulnerability to drought hazards. However, the overall rate of development, to the extent that overall water usage is affected can increase or decrease susceptibility to drought hazards