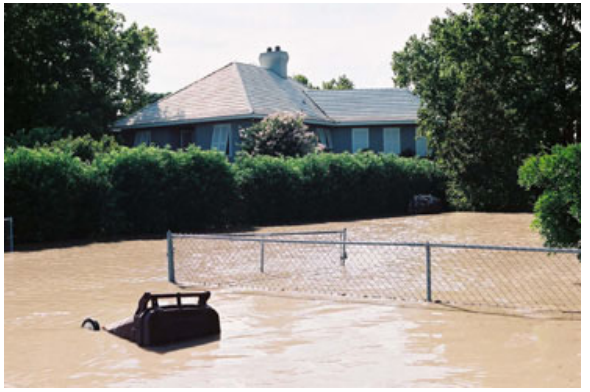
6 | Flooding Hazards

6.1 | Overview

Characteristics Flooding is the inundation of normally dry land as a result of a rise in the level of surface waters or the rapid accumulation of storm-water runoff; it becomes a hazard when the flow of water has the potential to damage property and threaten human life or health. Flood risks are greatest, and flood hazards most severe, in winter, when water bodies are usually full and soils saturated. Flooding is primarily a natural process and, therefore, difficult to prevent. However, land-use and development decisions have a significant effect on the frequency and severity of floods; in general, urbanization increases the risk of flooding by increasing stormwater runoff and, to a lesser extent, erosion. Flooding can take many forms—river floods, storm-related flash floods and coastal floods, for example—and be caused by many reasons, including heavy rains, melting snow, inadequate drainage systems, hurricanes, and failed dams and levees.



Relationship to other hazards While flooding is most often caused by excess runoff from heavy rainfall or snowmelt, it can also result from the interaction with other natural hazards:

- Earthquakes can create floods indirectly by generating tsunamis and seiches; damaging flood-control equipment; and causing dams, levees and channel banks to fail.
- Landslides—themselves often triggered by earthquakes—can block water courses, resulting in upstream flooding. Also, large masses of earth that break loose and slide into a reservoir can cause catastrophic flooding by making the reservoir overflow.
- Subsidence—tectonic-related or caused by the pumping of groundwater, oil or gas—increases the risk of flooding by lowering ground levels.
- Fires strip away vegetation, which makes hillsides contribute to flooding by reducing their ability to absorb water.

Specific flood hazards As suggested above, flooding can occur for many reasons. The safety element examines flooding hazards resulting from the following five causes (with a brief description of each):

- Excessive stormwater runoff from heavy rain. When rainfall exceeds the absorption rate of the soil or the water-storage capacity of the watershed, the excess rainfall flows downstream. This is the flood hazard with the greatest potential to affect Oakland. While it is impossible to prevent excess stormwater runoff, proper engineering and land-use planning can be used to minimize the potential adverse effects on areas subject to flooding and reduce off-site flooding and erosion.
- Tsunamis. Often incorrectly referred to as tidal waves, tsunamis are waves caused by an underwater earthquake, landslide or volcanic eruption. Because San Francisco Bay is a mostly enclosed body of water, severe damage from tsunamis in Oakland is unlikely. However, this hazard needs to be considered not only to meet state mandates but also because of the potential for wave damage along the waterfront.
- Seiches. A poorly understood phenomenon, seiches (pronounced "SIGH-chaise") are waves in an enclosed or semi-enclosed body of water such as a lake, reservoir or harbor. (They are analogous to the sloshing of water in a bucket when shaken.) Seiches are usually caused by unusual tides, winds or currents but could also be triggered by earthquake-induced ground motion. Seiche waves, while rare, can have devastating effects on nearby people and property. The occurrence of devastating seiches in Oakland is highly unlikely but, again, needs to be considered.
- Failure of dams and other water-holding structures. This is an unlikely hazard but needs to be considered due to the potential for large-scale damage. Dam failures are one of the greatest natural threats to life and property because of the large volumes of water, numbers of people and area of land typically involved.

- Rise in sea level. While there is continuing debate over global warming, many people believe that it is causing an accelerated rise in sea levels. Such a phenomenon would lead to flooding in coastal communities worldwide, including Oakland.

Oakland's storm-drainage system In undeveloped areas, water drains through natural swales, ditches and streams. As land is developed, this system is usually replaced with underground stormwater drains and earthen or concrete-lined ditches. In Oakland, stormwater runoff is collected through a combination of creeks and other natural watercourses (especially in the hills), and human-built drainage structures (see Figure 6.1). The creeks generally flow in a roughly parallel, southwesterly direction from their headwaters in the Oakland/Berkeley hills, following steep natural channels segmented by many short culverts until they reach flatter, more-developed areas. From there, most creeks flow through underground culverts until their point of discharge. The major surface drainage-ways in Oakland follow the channels of the following creeks (from north to south): Temescal, Glen Echo, Trestle Glen, Sausal, Peralta, Courtland, Seminary, Lion, Arroyo Viejo, Elmhurst, Stonehurst and San Leandro. Runoff from Temescal Creek drains through Emeryville, directly into San Francisco Bay, while runoff from the other creeks drains first into the Oakland Estuary; runoff from Glen Echo and Trestle Glen creeks drains into Lake Merritt before entering the Oakland Estuary.

6.2 | INSTITUTIONAL FRAMEWORK

National Flood Insurance Program (NFIP) The NFIP is a program administered by the Federal Emergency Management Agency (FEMA) that provides federally backed flood insurance to homeowners, renters and business owners in certain communities. The insurance is available for properties in communities that have chosen to implement zoning and building measures to reduce damages from future floods. FEMA's "flood-insurance rate maps" (FIRM's), delineating a community's flood plains, form the basis for the regulation of development in flood plains and the rating of flood-insurance policies. Oakland, like most cities and counties in California, participates in the NFIP. To remain in the program, the city, among other measures, requires that all new construction and major improvements to existing structures proposed within flood plains be built at or above flood-elevation levels.

State regulations for the supervision of dams and reservoirs are found in sections 6000-6501 of the California Water Code.

State's Division of Safety of Dams (DSOD) The mission of the DSOD, a unit of the state's Department of Water Resources (DWR), is to prevent the loss of life and destruction of property resulting from the failure of a dam or reservoir. As part of its charge, the DSOD inspects sizable non-federal dams and reservoirs in the state annually to ensure that they are operating adequately. Corrective action is required of dams found to be deficient. The division also reviews and considers for approval plans and specifications for the construction of new dams and for the enlargement, alteration, repair or removal of existing dams.

The Dam Safety Act is found in section 8589.5 of the California Government Code.

Emergency procedures cover areas to be evacuated, evacuation routes and traffic control, shelters, transportation for people with special needs, security of the area, assignment of responsibilities, and resources needed.

State's Dam Safety Act This state law requires owners of dams to prepare maps showing the approximate extent of inundation in the event of a dam failure. Based upon a review of these inundation maps, the state's Office of Emergency Services (OES) designates those areas where death or personal injury would result from the partial or total failure of a dam. Under the law, affected cities and counties are required to adopt emergency procedures for the evacuation and control of populated areas located below dams. Also, sellers of real-estate property known to be located in an area of potential inundation from dam failure must disclose this information to potential buyers. Inundation maps are kept on file with OES and DWR.

The California Environmental Quality Act is found in sections 21000-21178 of the California Public Resources Code.

California Environmental Quality Act (CEQA) The state's CEQA guidelines propose a wide range of environmental impacts that public agencies should consider in their evaluation of development proposals. Considerations related to flooding hazards include the potential for a project to:

- substantially alter the existing drainage pattern of the project site or area, or substantially increase the rate or amount of surface runoff, resulting in flooding on- or off-site;
- create or contribute runoff water in excess of the capacity of existing or planned stormwater drainage systems;
- place housing, or structures which would impede or redirect flood flows, within a designated 100-year flood-hazard area;
- expose people to a significant risk of injury or death, or structures to a significant risk of damage or loss, from flooding (including as a result of dam failure); and
- expose people or property to inundation by seiche, tsunami or mudflow.

Alameda County Flood Control and Water Conservation District (ACFCWCD) The district, a unit of the Alameda County Public Works Agency, is

responsible for the construction, operation and maintenance of the major storm-drainage facilities throughout Alameda County. The ACFCWCD is divided into ten flood-control zones, each covering a different drainage basin; Zone 12—created as a result of the October 1962 floods—provides flood protection to the cities of Oakland and Emeryville. To reduce the risk of flooding, the district designs and builds structures to meet the existing and projected need for flood control. In Oakland, such projects have included the channelization of large portions of the city's main creeks, and construction of the Lake Merritt pump station, which regulates the water level in the lake. In coordination with the federal government, the ACFCWCD also maps flood plains in the cities and unincorporated areas of the county.

Stormwater Quality Management Plan (SQMP) The 1987 amendments to the federal Clean Water Act require that cities reduce discharges from municipal storm drains by obtaining permits under the National Pollutant Discharge Elimination System (NPDES). To meet this requirement, 17 local agencies, including Oakland and the other 13 cities in Alameda County, formed the Alameda Countywide Clean Water Program and have obtained joint NPDES permit coverage since 1991. Compliance with the permit hinges on implementation by each member agency of performance standards for stormwater pollution control measures outlined in the SQMP. Performance standards related to flood control in the SQMP for the 2001-2008 period include the cleaning, as necessary, of storm drainage facilities and requiring development projects to implement effective erosion and sediment-control measures.

Alameda Countywide Clean Water Program

Oakland Public Works Agency (PWA) The PWA has several responsibilities related to flood control, primarily the construction and maintenance of the local storm-drain system. Whereas the ACFCWCD builds, operates and maintains the major trunk lines and flood-control facilities along the city's creeks, the PWA is responsible for the public storm drains that ultimately feed into the county's system. The PWA also regularly cleans and clears obstructions from storm drains and creeks to ensure the free flow of water; through its "maintain-a-drain" campaign, encourages city residents and businesses to keep neighborhood storm drains free of debris; and, in conjunction with the Oakland Fire Department, distributes sandbags during the rainy season to mitigate flooding. Finally, PWA is developing a master plan to address the city's storm-drainage infrastructure needs in a comprehensive manner. The master plan will identify deficiencies in the storm-drainage system and develop prioritized recommendations for rehabilitating the system in order to reduce localized flooding; it will also provide data that will allow Oakland to address development impacts on the storm-drain system.

The creek protection, storm water management and discharge control ordinance is found in chapter 13.16 of the Oakland municipal code; the erosion and sedimentation ordinance is found in section 15.04.780; and flood-related regulations pertaining to land subdivisions are found in sections 16.20.010 and 16.24.070.

Local regulations Oakland's creek protection, storm water management and discharge control ordinance contains several provisions to reduce flooding risks. Requirements include that natural waterways be kept free of obstacles and that hydrology reports be obtained for development proposals within a creek floodway or riparian corridor, or near the top of a creek bank. In addition, the erosion and sedimentation ordinance prohibits the issuance of grading permits for sites located in a designated flood-hazard area unless the grading plan provides for measures to mitigate the projected flood hazard. Finally, the city has enacted provisions pertaining to land subdivisions requiring that subdivisions be designed to minimize flood damage; that streets and lots be laid out to provide for approved drainage facilities; that street grading and improvements include catch basins, pipes, culverts and storm drains; that public utilities be constructed to minimize or eliminate flood damage; that water-supply systems be designed to minimize or eliminate infiltration of floodwaters into the systems; and that tentative parcel maps contain provisions for drainage and flood control.

6.3 | ANALYSIS

Storm-induced flooding The most common flood hazards in Oakland are all associated with excess stormwater runoff from heavy rain: the overtopping of stream banks, the failure of stormdrains, and the erosion of creek banks from high-velocity water flows. Oakland experienced its worst-ever flooding conditions during the storm of October 12 and 13, 1962. Runoff from the storm caused extensive property damage throughout cities in the East Bay. Following this storm, and at the request of the Oakland city Council, the ACFCWCD created Flood Control Zone 12 to construct needed flood-control and storm-drainage facilities, and to provide ongoing flood protection to the cities of Oakland and Emeryville. In the 1960s and 1970s, the ACFCWCD increased, at great expense, the carrying capacity of Oakland's drainage system by widening, deepening, straightening and lining in concrete more than a dozen creeks, streams and channels, including Lake Merritt's tidal channel. Thanks to these infrastructure projects, creek-related flood hazards have been dramatically reduced

throughout the city . Similarly, Lake Merritt was a major source of flooding until the construction of the flood-control pump station under 7th Street in 1967.

To assess and manage risks consistently across the country, FEMA adopted the "100-year flood" as the standard basis for flood-hazard evaluation (to determine flood-insurance requirements), with the "500-year flood" indicating additional areas of flood risk in a community. A 100-year flood is an event of a magnitude that, on average, is expected to be equaled or exceeded once during any 100-year period—that is, a one in one hundred, or one percent, chance. Similarly, a 500-year flood is an event of a magnitude that, on average, is expected to be equaled or exceeded once during any 500-year period—that is, a one in five hundred, or 0.2 percent, chance. It should be noted that the 100-year and 500-year flood plains are theoretical constructs, since in many cases there is insufficient historical flood data to judge flood frequency accurately.

FEMA's flood-insurance rate map for Oakland assigned the "Zone C" designation to the vast majority of the city. This is FEMA's designation carrying the lowest flood potential or hazard, and represents "areas of minimal flooding." Several areas covering a small but not insignificant portion of the city were assigned the "Zone B" designation, generally representing areas between the limits of the 100-year and 500-year flood plains (see Figure 6.1). As the 100-year and 500-year terms imply, the probability of severe flooding in these areas is highly unlikely, though it is higher than in "C" zones. Zone B areas are primarily found in the flat, industrial parts of East Oakland, generally east of Fruitvale Avenue; they include the area from 34th Avenue to Hegenberger Road on the bay side of the BART alignment; the area south of Arroyo Viejo Creek below MacArthur Boulevard; the area east of Sausal Creek below MacArthur; and land along Temescal Creek west of Highway 24.

Finally, a very few areas, covering only a small fraction of the city, were assigned the "Zone A" designation, representing "special flood hazard areas" that would be inundated by a 100-year flood. These areas are almost entirely within, or immediately adjacent to, creek channels, specifically those of Temescal, Glen Echo, Trestle Glen, Sausal, Peralta, Arroyo Viejo and San Leandro creeks. In most "A" zones, the 100-year flood would be contained within the existing channels or underground culverts; in the rest, 100-year floods would generally result in shallow flooding in the form of sheet-flow, with very few locations experiencing flooding depths in excess of one foot. In flood-prone areas, ACFCWCD continues to pursue priority projects to improve flood protection. One of the agency's projects currently underway is enlargement of the

underground storm drains along Lakeshore Avenue between Lake Merritt and Prince Street.

Much of the city's storm-drainage system was built in the 1930s and has reached or passed its serviceable life span. Moreover, most parts of the system were not designed to accommodate the level of development that has taken place since. Meanwhile, parts of Oakland, including significant portions of North and East Oakland, have no storm-drainage system, and instead rely on local streets to carry stormwater runoff. As a result, localized flooding—observable as sheet-flow in the streets, primarily in the flatter areas of the city close to the shoreline—occurs following large storms. As mentioned earlier, the city is developing a storm-drainage master plan with the goal of reducing localized flooding. As part of the master plan, the city is surveying every inlet and manhole structure in Oakland, and identifying historic storm-related problem areas. A computerized hydraulic model based on this inventory database will be used to simulate storm events, assess the capacity of the storm-drainage system and identify its deficiencies. Scheduled for completion in early 2004, the master plan will recommend a prioritized capital-improvement program for the short-to-medium term, and a maintenance program for the long term. Full implementation of the master plan will require significant funding and, most likely, a dedicated funding source.

Of all flood hazards discussed in the safety element, excess storm-water runoff has the greatest potential to affect Oakland. Nevertheless, Oakland is not a particularly flood-prone community. The city has neither the large rivers nor open coastline that can result in devastating storm-induced flooding. As mentioned above, recurring flooding is usually confined to small areas of the city. In addition, it can be expected to occur generally as shallow, sheet-flow flooding only, and as such would not present a direct threat to life or cause significant damage to structures.

Tsunamis Tsunamis are not an uncommon occurrence on the California coast. In 1964, a tsunami associated with an Alaskan earthquake caused eight deaths and $11 million in damage at Crescent city (Del Norte County). In the 100 years between 1868 and 1968, 19 tsunamis were recorded at the Golden Gate tide gauge, with a maximum wave height of 7.4 feet. Most often, tsunamis are generated by large offshore earthquakes in the Pacific Ocean, producing waves that reach the California coast many hours after the earthquake. Tsunamis can also be generated by local earthquakes, in which case the first waves could reach shore mere minutes after the ground stops shaking, giving authorities no time to issue a warning. The West Coast and Alaska

Tsunami Warning Center in Palmer, Alaska, operated by the National Weather Service, is responsible for issuing warnings about potential tsunamis along the West Coast of the United States. Warning times vary depending on the distance to the causative earthquake. For most tsunamis approaching the coast, several hours are available to evacuate residents and undertake other emergency preparations.

The scarcity of data makes it difficult to estimate the tsunami hazard in Oakland. However, past tsunamis have resulted in little damage around San Francisco Bay. The hazard in the bay is much smaller than along the Pacific Coast, as the bay is an enclosed body of water. (Available data indicate that tsunami wave heights diminish to about half from the Golden Gate to the Richmond shoreline.) Also, locally generated tsunamis, for which there would be little warning time, are much less likely than distant-source tsunamis: there are no geologic structures offshore of central California capable of producing tsunamis; also, large tsunamis appear to be the result of vertical displacement of the sea floor, whereas faulting movements in the Bay Area are mainly in a horizontal direction. (Records at the time of the San Francisco earthquake of 1906 showed the height of the wave measured at Fort Point as no more than six inches.)

Flooding from tsunamis would affect low-lying areas along San Francisco Bay and the Oakland Estuary, especially filled areas that are only a few feet above sea level. The areas of Oakland that would most likely be inundated by a tsunami having a wave height of 20 feet are shown on figure 6.1, as determined by the U.S. Geological Survey; such a tsunami is estimated to arrive at the Golden Gate once every 200 years. Areas that could be flooded with several feet of water include the Bay Bridge landing, the outer and middle harbor of the Port of Oakland's seaport, the San Leandro Bay shoreline (including Martin Luther King, Jr. Regional Shoreline) and the Oakland International Airport's shoreline. Areas along the inner harbor, Brooklyn Basin and the tidal channel would be sheltered by the island of Alameda. The likelihood of large-scale devastation in Oakland resulting from tsunamis appears to be small, especially as there would usually be ample time to evacuate residents at risk.

Seiches There is no data on the local occurrence or impact of seiches, as none has ever been recorded in the Bay Area. Given the absence of local data—and that seiches are, in general, poorly understood—an accurate assessment of the hazard posed by seiches is difficult. Damage from a seiche would depend primarily on the size, depth, elevation, proximity to development and, if human-made, structural condition of the body of water in which the seiche occurs. Outside the Bay Area, earthquake-generated

seiches have on occasion damaged dams and water-storage tanks. In addition, isolated damage to adjacent and down-slope structures has been observed from seiches occurring in swimming pools and in small, shallow lakes and ponds.

In Oakland, the only threat of large-scale damage from seiches appears to come from downstream flooding that would be caused by large volumes of water overtopping a dam or reservoir, a hazard that is examined in the following section. (Lake Merritt, with depths greater than two or three feet only near its center, is likely too shallow to be able to generate devastating seiches.) The likelihood of large-scale devastation in Oakland resulting from seiches appears to be minuscule.

Dam failure According to inundation maps developed by dam owners to fulfill requirements of the Dam Safety Act, there are 13 active dams, reservoirs and clearwells that, in case of failure, would cause flooding in Oakland. (Additionally, there are small ponds and water tanks scattered throughout the city, the failure of which could result in the sudden release of a sizable volume of water. Failure of such a facility in the Oakland hills could cause isolated damage to structures downhill.) These 13 facilities, listed by owning entity, are:

- Central, Claremont, Dingee, Dunsmuir, Estates and 39th Avenue reservoirs, the dams at Lake Chabot and at Upper San Leandro reservoir, and the Upper San Leandro filtration plant no. 1 and no. 2 clearwells (owned by the East Bay Municipal Utility District, or EBMUD). As part of its seismic improvement program, EBMUD will have upgraded and strengthened all its reservoirs by 2005. Upgrade measures include the addition of seismic anchors and the installation of pre-stressed wire around tanks. EBMUD has also identified reservoirs at risk due to landslides and incorporated landslide-mitigation improvements at these sites. EBMUD also has a dam safety program, carried out in cooperation with the DSOD, to confirm that its facilities are safe for continued operation.
- Lake Temescal dam (owned by the East Bay Regional Park District). This dam was last inspected by the state's Division of Safety of Dams in July 2002. At the time, it presented no issues necessitating corrective action and was "judged satisfactory for continued operation."
- Lower Edwards and Upper Edwards reservoirs (owned by the Mountain View Cemetery Association). These reservoirs were removed from the jurisdiction of the Division of Safety of Dams in 1983 because their capacity does not reach regulatory thresholds.

As shown on Figure 6.1, most of these facilities are located in North and East Oakland, within a half mile south and west of I-580 and State Highway 13. The map also shows the potential inundation areas for each facility. This information, based on inundation maps prepared by dam owners, represents the best estimate of where water would flow in case of total failure of a dam with a full reservoir; generally, flood waters would follow existing stream beds or drainage courses. Flooding from dam failure, while unlikely, could have catastrophic impacts on portions of North and East Oakland. The dam and reservoir failures resulting in the largest flooded areas in Oakland would be those of Central reservoir and of Lake Chabot, Lake Temescal and Upper San Leandro reservoir dams. Of particular concerns are the Lake Temescal dam, since it straddles the main trace of the Hayward fault, and the Lake Chabot dam, which is located only one-quarter mile east of the fault. In the event of dam failure, Lake Temescal's waters would follow the Temescal stream course, inundating an area one block wide north of Highway 24 to College Avenue that would then broaden to several blocks wide west of College. Failure of the Lake Chabot dam (and of the Upper San Leandro reservoir dam) would inundate much of the Brookfield Village district and the industrial areas near the airport (as well as a large portion of San Leandro). The risk posed by dam failures is mitigated by the regulatory safeguards in place and should be weighed not only against the extremely rare occurrence of dam failure in the United States but also against the significant benefits provided by water-storage facilities.

Sea-level rise Studies indicate that sea levels are rising around the world due to the "greenhouse effect," or the long-term global warming of the earth's surface from heat trapped in the atmosphere by greenhouse gases. Global warming is raising sea levels by melting some of the earth's glaciers and polar ice caps, and by causing the thermal expansion of ocean water. Sea-level rise can be expected to result in the tidal flooding of low-lying property, damage to coastal roads and other infrastructure, erosion of beaches, loss of coastal wetlands, and the contamination of drinking water from saltwater intrusion, among other effects.

A 1987 study by the San Francisco Bay Conservation and Development Commission estimates that water levels in San Francisco Bay will increase by 4-5 inches by the year 2037, and by 1-5 feet by 2100, depending on the acceleration of this phenomenon. Based on those estimates, it can be assumed that bay water levels at Oakland will rise by approximately one foot over the next 50 years—an adequate time horizon for purposes of the safety element since few structures exceed such a life-span. Only very-low-lying areas would be flooded by such a rise in water levels; in Oakland, such areas are found

south of the High Street Bridge, along the San Leandro Bay shoreline, and include, most notably, the EBRPD's Martin Luther King, Jr. Regional Shoreline. Because the rise in bay water levels will occur gradually and very slowly, it will not threaten human lives and will allow far-sighted owners of shoreline property to take necessary protective action.

6.4 | POLICY STATEMENTS

POLICY FL-1 Enforce and update local ordinances, and comply with regional orders, that would reduce the risk of storm-induced flooding.

- ACTION FL-1.1: Amend, as necessary, the city's regulations concerning new construction and major improvements to existing structures within flood zones in order to maintain compliance with federal requirements and, thus, remain a participant in the National Federal Insurance Program.

  ▶ **CEDA BUILDING SERVICES DIVISION**

- ACTION FL-1.2: Continue to require that subdivisions be designed to minimize flood damage by, among other things, having lots and rights-of-way be laid out for the provision of approved sewer and drainage facilities, providing on-site detention facilities whenever practicable and having utility facilities be constructed in ways that reduce or eliminate flood damage.

  ▶ **CEDA BUILDING SERVICES DIVISION**

- ACTION FL-1.3: Comply with all applicable performance standards pursuant to the 2003 Alameda countywide National Pollutant Discharge Elimination System municipal stormwater permit that seek to manage increases in stormwater run-off flows from new-development and redevelopment construction projects.

  ▶ **PWA ENVIRONMENTAL SERVICES DIVISION**

- ACTION FL-1.4: Continue to enforce the grading, erosion and sedimentation ordinance by prohibiting the discharge of concentrated stormwater flows by other than approved methods.

  ▶ **CEDA BUILDING SERVICES DIVISION**
  ▶ **PWA ENGINEERING DESIGN DIVISION**

- ACTION FL-1.5: Continue to enforce provisions under the creek protection, storm water management and discharge control ordinance designed to keep watercourses free of obstructions and protect drainage facilities.

  ▶ **PWA ENVIRONMENTAL SERVICES DIVISION**

POLICY FL-2 Continue or strengthen city programs that seek to minimize the storm-induced flooding hazard.

- ACTION FL-2.1: Continue to repair and make structural improvements to storm drains to enable them to perform to their design capacity in handling water flows.

  ▶ **PWA ENGINEERING DESIGN DIVISION**

- ACTION FL-2.2: Continue maintenance efforts to keep storm drains and creeks free of obstructions—while retaining vegetation in the channel, as appropriate—to allow for the free flow of water.

  ▶ **PWA SEWER AND STORM DRAIN MAINTENANCE DIVISION**

- ACTION FL-2.3: Continue the "Maintain-a-Drain Campaign," which encourages residents and businesses to keep storm drains in their neighborhood free of debris.

  ▶ **PWA SEWER AND STORM DRAIN MAINTENANCE DIVISION**

- ACTION FL-2.4: Continue to provide sandbags and plastic sheeting to residents and businesses in anticipation of rainstorms, and to deliver those materials to the disabled and elderly upon request.

  ▶ **PWA SEWER AND STORM DRAIN MAINTENANCE DIVISION**

POLICY FL-3 Seek the cooperation and assistance of other government agencies in managing the risk of storm-induced flooding.

- ACTION FL-3.1: Upon completion of new flood-control projects, request that FEMA revise its flood-insurance rate map of the city to reflect flood risks accurately.

  ▶ **CEDA BUILDING SERVICES DIVISION**

- ACTION FL-3.2: To reduce the cost of flood insurance to property owners, work to qualify for the highest-feasible rating under the Community Rating System of the National Federal Insurance Program.

  ▶ **CEDA BUILDING SERVICES DIVISION**

- ACTION FL-3.3: Meet annually with the Alameda County Flood Control and Water Conservation District to establish jointly the district's capital improvement program for most effectively reducing the remaining threat of storm-induced flooding.

  ▶ **PWA ENGINEERING DESIGN DIVISION**

- ACTION FL-3.4: Encourage the ACFCWCD to continue maintaining adequately those watercourses, storm drains and other flood-control facilities for which it has legal responsibility.

  ▶ **PWA SEWER AND STORM DRAIN MAINTENANCE DIVISION**

- ACTION FL-3.5: Refer development proposals adjacent to floodways and floodplains to the ACFCWCD for its review and comment.

  ▶ **CEDA BUILDING SERVICES DIVISION**

POLICY FL-4 Minimize further the relatively low risks from non-storm-related forms of flooding.

- ACTION FL-4.1: Request from the state Division of Safety of Dams a timeline for the maintenance inspection of all operating dams in the city.

  ▶ **OFD OFFICE OF EMERGENCY SERVICES**

- ACTION FL-4.2: Review for adequacy, and update if necessary, procedures adopted by the city pursuant to the Dam Safety Act for the emergency evacuation of areas located below major water-storage facilities.

  ▶ **OFD OFFICE OF EMERGENCY SERVICES**

- ACTION FL-4.3: Inform shoreline-property owners of the possible long-term economic threat posed by rising sea levels.

  ▶ **CEDA BUILDING SERVICES DIVISION**

- ACTION FL-4.4: Stay informed of emerging scientific information on the subject of rising sea levels, especially on actions that local jurisdictions can take to prevent or mitigate this hazard.

▶ **CEDA BUILDING SERVICES DIVISION**

6.5 | RESOURCES

Agencies consulted

- Federal Emergency Management Agency (www.fema.gov)
- California Division of Safety of Dams (damsafety.water.ca.gov)
- S.F. Bay Conservation and Development Commission (www.bcdc.ca.gov)
- Alameda County Flood Control and Water Conservation District (www.co.alameda.ca.us/pwa/flood.shtml)
- Alameda Countywide Clean Water Program (www.cleanwaterprogram.com)
- Oakland Public Works Agency (www.oaklandpw.com)

Documents consulted

- "Maps Showing Areas of Potential Inundation by Tsunamis in the San Francisco Bay Region, California;" United States Geological Survey, 1972.
- "Stormwater Quality Management Plan, July 2001-June 2008;" Alameda Countywide Clean Water Program, 2003 (www.cleanwaterprogram.com/ACCWP_SWQMP_all.pdf).
- "Sea Level Rise: Predictions and Implications for San Francisco Bay;" San Francisco Bay Conservation and Development Commission, revised 1988.

Other resources

- FEMA's National Flood Insurance Program (www.fema.gov/fima/nfip)

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