Fish

Remarkably, rainbow trout (*Oncorhynchus mykiss*), the non-anadromous form of steelhead trout, have been seen in Sausal Creek and lower Palo Seco and Shephard Creeks (FOSC 2009). The majority of recorded observations are of adults. Three Sausal Creek sites were sampled for fish in July 1981. No fish were collected (Leidy 1984). In 1998 an electro-fishing survey of Cobbledick and Shephard Creeks along Scout Road and of Sausal Creek from the Montclair Golf Course to Canon Avenue was done (Hagan and Demgen 1998). No fish were found. The 1998 report concluded that the culvert under Highway 13 was a passage barrier. A survey of Palo Seco Creek during this study found four trout and concluded that the culvert under the Montclair Golf Course is a major migration barrier (Hagan and Demgen 1998). Another electrofishing survey including Sausal Creek in Dimond Canyon up to its confluence with Palo Seco Creek and in Shephard Creek along Scout Road found no fish (Lowe 2000). In 2001, the California Department of Fish and Game conducted a partial survey of Sausal Creek but ended the survey due to "low potential to restore salmonids" (Cleugh 2002).

Adult fish have been seen in a number of locations (FOSC 2009) by a variety of observers, including Palo Seco Creek and Sausal Creek from the Leimert Bridge down to the Barry Place/Hickory Street area just upstream of the 27th Street crossing (FOSC 2009, CEMAR). In February 2008, 11 trout were found dead from paint thinner being washed into the storm drain and creek (FOSC 2000). Only one of these observations was of juvenile trout in Palo Seco Creek. Rainbow trout in Sausal Creek and its tributaries are at great risk from one pollution event or large scouring flood event. Additionally, high water refuge areas in Sausal Creek are probably provided by the few undercut banks, failing drop structures, and concrete aprons.

Birds

Bird monitoring throughout the watershed has been on-going since 1998 with many sites surveyed. This effort created inconsistent data in frequency of visits and numbers, but documents presence/absence of species. The survey work was unsustainable and a reduced effort was begun in 2002 with eight sites visited throughout the watershed, focusing on the El Centro restoration. Data are collected quarterly using a circular plot method in which all birds seen or heard around a point are recorded during ten minutes. The data average 25 records per site, but have only been roughly analyzed. It is stored in the database Ebird at the Cornell University under Mark Rauzon. Preliminary analysis shows neo-tropical birds started breeding in the restoration sites in 2005, after the complete restoration of 2001/2002 matured. Wilson's Warblers began using the El Centro Area in 2005 and the Meander Area of alders in 2007. In 2009, Black-headed Grosbeaks were recorded on survey in the Meander Site, after the trees matured to a 25-30 foot height. Warbling Vireos and Pacific-slope Flycatchers have been present throughout this period of restoration in the over story and are increasing. Song Sparrows and Spotted Towhees also benefit from the creation of native low bushy cover. Fish-eating birds such as Belted Kingfisher and Great Blue Heron are recorded in the El Centro restoration area now seeking to eat trout. Red-shouldered Hawks and Red-tailed Hawks are seen hunting here (FOSC 2009).

EVALUATION OF WATERSHED EROSION SITES

A focused evaluation of several types of erosion sites was carried out in the Sausal Creek watershed. In general, the process of urbanization generates two phases of erosion. During the short-term development stage, grading and ground disturbance increases erosion. Once paved, the increased

stormwater volumes and large numbers of storm drain pipes produce long-term erosion of the unpaved areas of the watershed: natural slopes and unlined creek channels. Outlets of the stormdrain system were assessed for erosion. In urban areas with impervious surfaces even small amounts of rainfall produce runoff which is often conducted through pipes to outlet in natural channels. The concentrated flow at the storm drain outlets are a consistent source of potential erosion depending on the conditions at the pipe outlet.

As part of this plan, the City of Oakland GIS layer of storm drain pipes was used to assign letter/number identities to all of the storm drain outlets in the watershed (Figure 77). These outlets were then evaluated to create a list of priority outlets for field inspection. Priorities included outlets along major open channels, large pipe outlets, outlets in extremely steep areas, and outlets of storm drains which drain a large land area. The primary purpose of the field inspection was to identify major erosion problems associated with concentrated flow at outlets of storm drains. A number of features of each outlet was recorded—size and shape of pipe, pipe material, conditions of outlet, whether the culvert was plugged and, if so, by what percentage; whether the outlet was undercut and the number of feet of undercut, the material in the impact zone of outlet, the drop height from the outlet to the impact zone, the condition of the impact zone, the condition of the channel, whether a gully was present at the outlet and, if so, the length and depth of the gully; comments on the site, and a photograph.

The results were mapped with categories for the amount of erosion at the outlet: extreme, significant, or little to no erosion. The Sausal Creek watershed was separated into six sections in order to display the storm drain outlets and erosion along with natural creeks and roads (Figure 78). In total, there are 306 outlets included in Oakland's storm drain GIS layer (Figures 79-84). Not surprisingly, most of the erosion at the storm drain outlets occurs in the upper watershed and along Dimond Canyon. In these areas, most of the storm drains are set at a steep gradient or are set flat and drop storm water onto the slope or a creek bank. Erosion from concentrated flow sources is continuous, occurring with each runoff event until a repair project is done or until the erosion undercuts the pipe or causes significant slope erosion or failure. Table 48 lists the level of erosion of the outlets that were assessed.

Many of the storm drains on these maps have been in place since the development of the area. Figure 85 depicts typical erosion at a storm drain outlet which has no rock dissipater to break up the energy of the concentrated flow. One of the effects of storm water runoff, observed as part of the storm drain outlet assessment, was erosion of ephemeral and main stem creek channels. Figures 86-89 show some of this channel erosion and the effect of undercutting house and deck foundations on piers. Even one of the newest developments in the watershed, the Chabot Space and Science Center, has caused significant erosion to surrounding lands from its storm water outlets. This facility has large parking lots, roofs, and other paved areas which drain to a few outlets. There is significant erosion at these storm drain outlets and further downstream in the creek channels. The affected creeks are all on public property.

The erosion of creek channels is a cumulative effect of increases in impervious surfaces in the creek's drainage area and the proliferation of piped and concentrated runoff. As undeveloped parcels are built out in the upper Sausal Creek watershed, a number of factors affecting erosion are changed. These include: the area of impervious surfaces increases in the watershed of each ephemeral creek, and the volume and timing of storm water reaching the creek during a rainfall event will also increase. These changes become apparent during a large storm or wet winter when the most erosion occurs in the ephemeral creeks. The Castle Drive erosion site (Figures 95-98) in Joaquin Miller Park appears to have been caused by a storm drain outlet at the ridge top which releases storm water into the park.

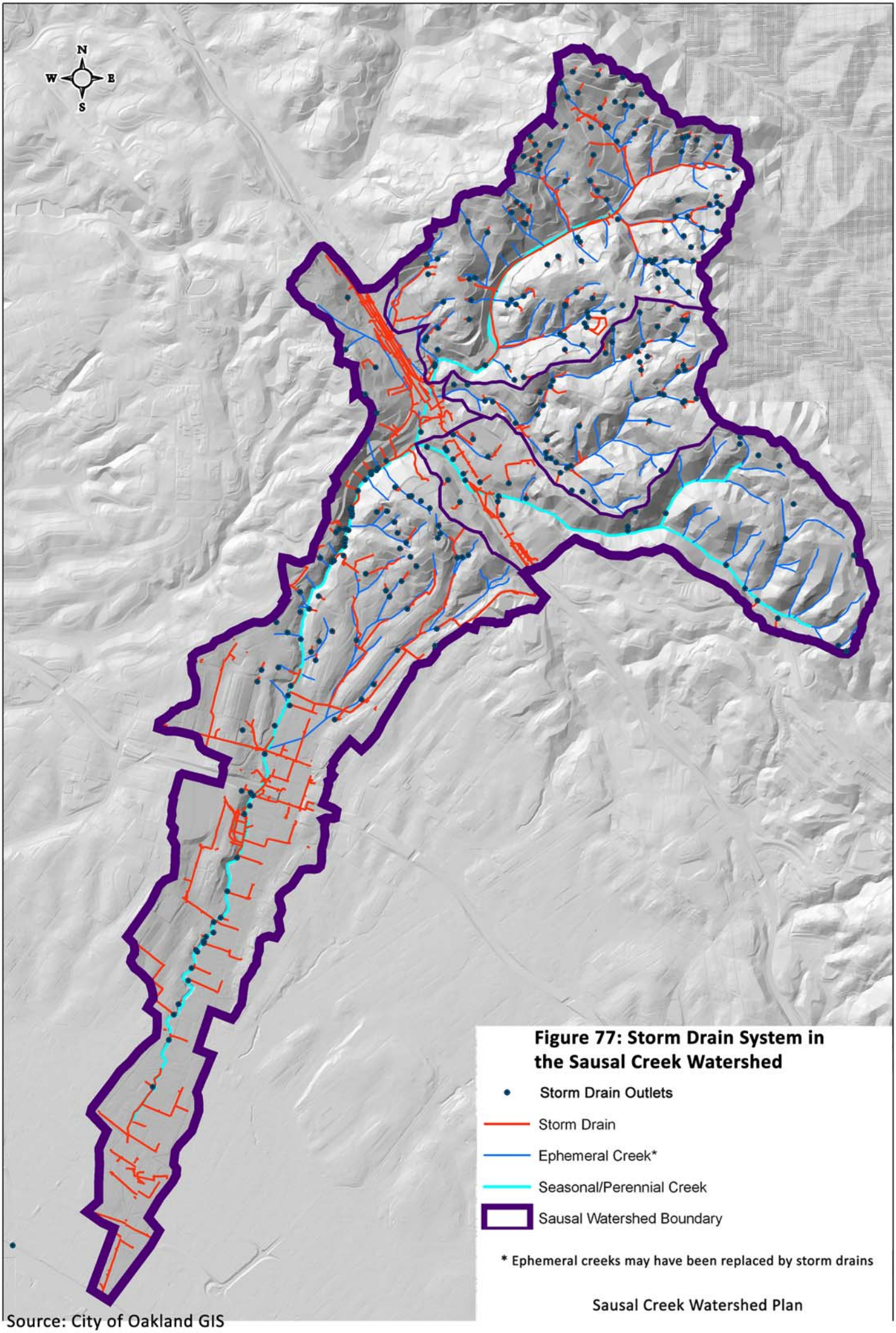
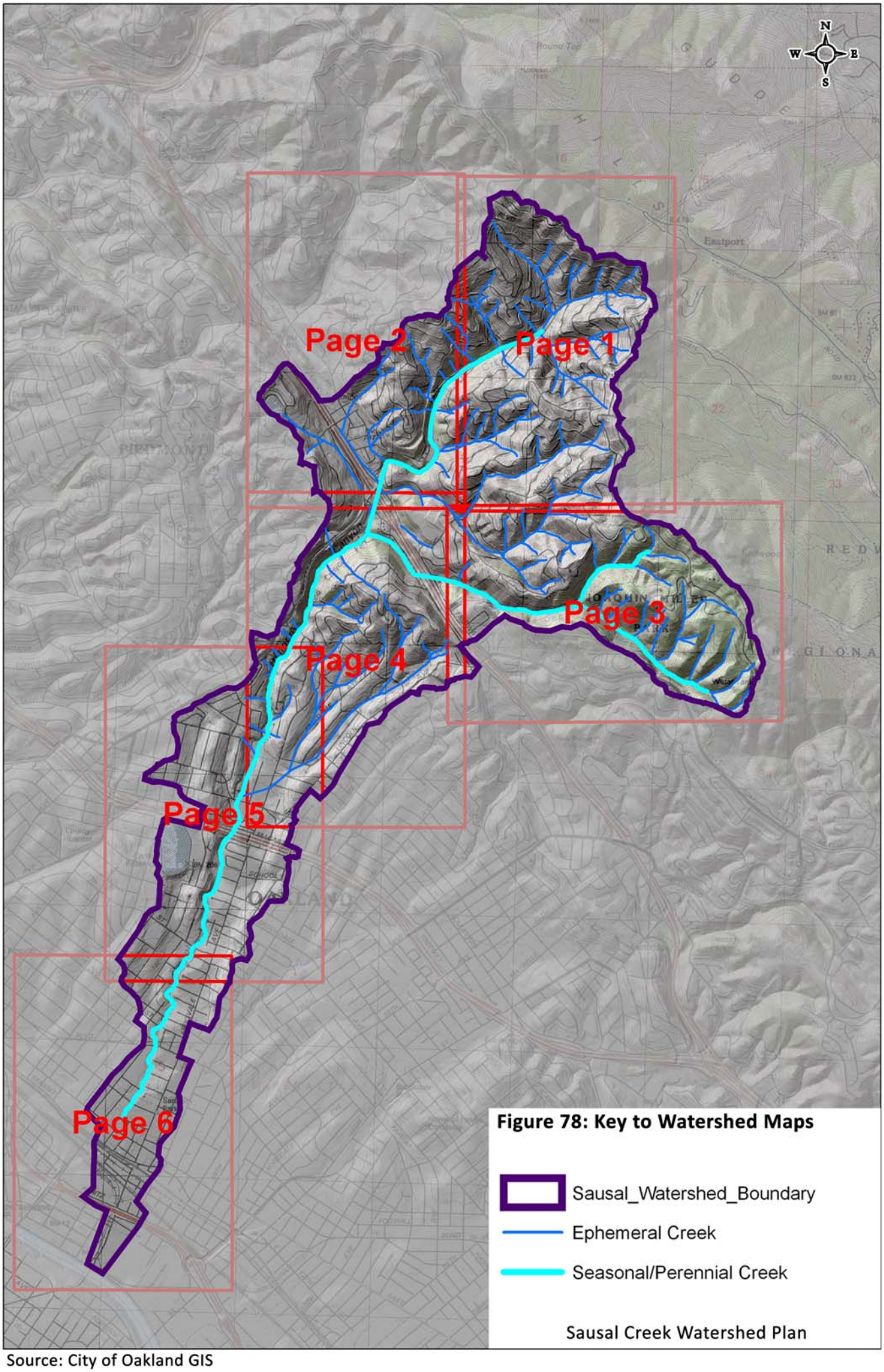


Figure 77: Storm Drain System in the Sausal Creek Watershed

Source: City of Oakland GIS



Source: City of Oakland GIS

Figure 79: Storm Drain Map 1

Storm Drain Outlet

- Not assessed
- Little or No Erosion at Outlet
- Erosion at Outlet
- Extreme Erosion at Outlet

- Storm Drain
- Ephemeral Creeks*
- Seasonal/Perennial Creek
- Sausal Watershed Boundary

* Creek may have been replaced by storm drain

Sausal Creek Watershed Plan

Source: City of Oakland GIS

Figure 80: Storm Drain Map 2

Storm Drain Outlet

- Not assessed
- Little or No Erosion at Outlet
- Erosion at Outlet
- Extreme Erosion at Outlet

- Storm Drain
- Ephemeral Creeks*
- Seasonal/Perennial Creek
- Sausal Watershed Boundary

* Creek may have been replaced by storm drain

Sausal Creek Watershed Plan

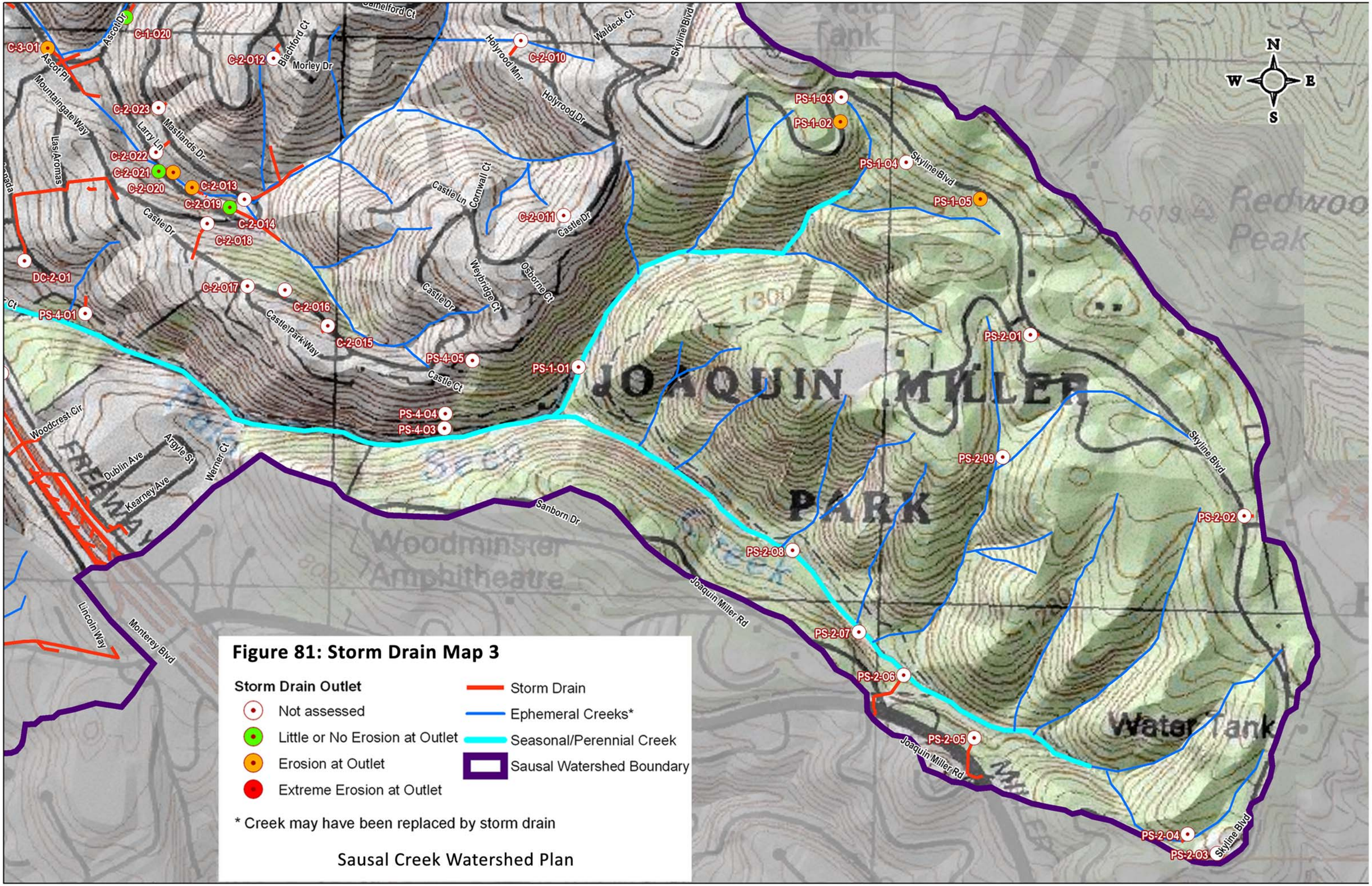


Figure 81: Storm Drain Map 3

Storm Drain Outlet

- Not assessed
- Little or No Erosion at Outlet
- Erosion at Outlet
- Extreme Erosion at Outlet

- Storm Drain
- Ephemeral Creeks*
- Seasonal/Perennial Creek
- Sausal Watershed Boundary

* Creek may have been replaced by storm drain

Sausal Creek Watershed Plan

Source: City of Oakland GIS

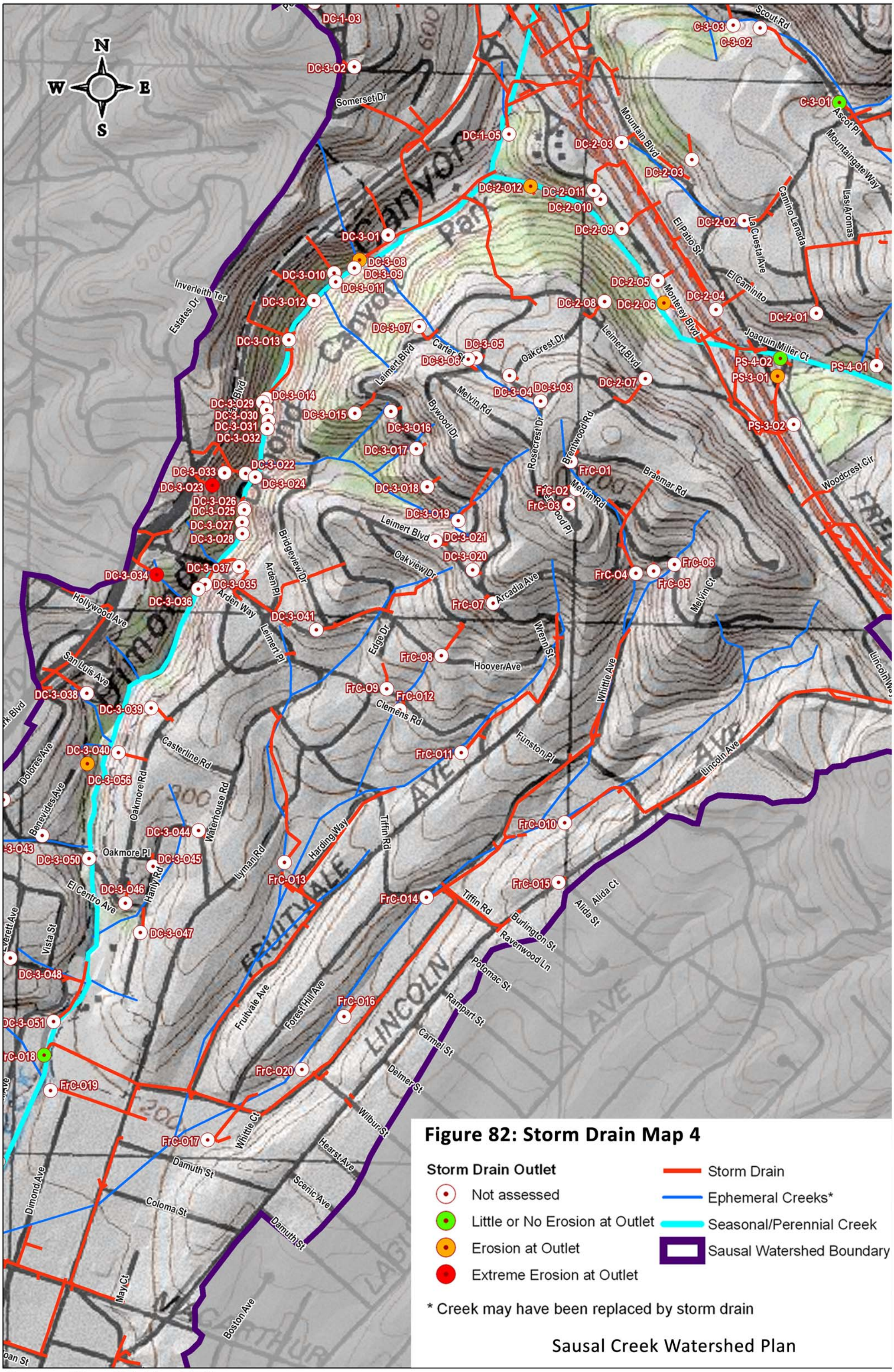


Figure 82: Storm Drain Map 4

Storm Drain Outlet

- Not assessed
- Little or No Erosion at Outlet
- Erosion at Outlet
- Extreme Erosion at Outlet

- Storm Drain
- Ephemeral Creeks*
- Seasonal/Perennial Creek
- Sausal Watershed Boundary

* Creek may have been replaced by storm drain

Sausal Creek Watershed Plan

Source: City of Oakland GIS

Figure 83: Storm Drain Map 5

Storm Drain Outlet

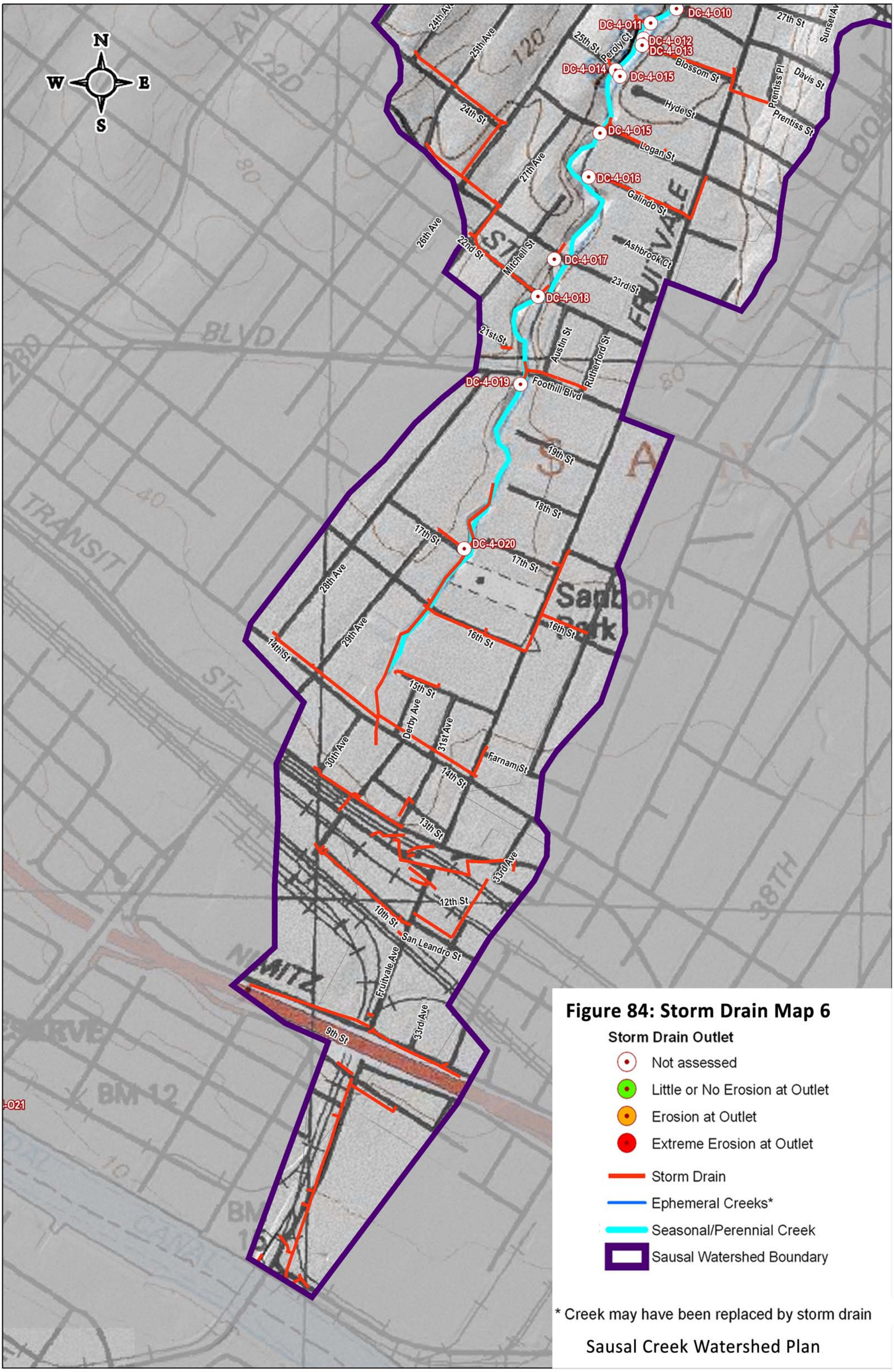
- Not assessed
- Little or No Erosion at Outlet
- Erosion at Outlet
- Extreme Erosion at Outlet

- Storm Drain
- Ephemeral Creeks*
- Seasonal/Perennial Creek
- Sausal Watershed Boundary

* Creek may have been replaced by storm drain

Sausal Creek Watershed Plan

Source: City of Oakland GIS



Source: City of Oakland GIS

Table 48: Erosion Levels for Assessed Storm Drain Outlets

Storm Drain Outlet*	Gully Length	Gully Width	Gully Depth	Condition at Outlet
C-2-O7	> 60 ft.	5 ft.	6 ft.	extreme erosion
DC-3-O23	> 150 ft.	15 ft.	20 ft.	extreme erosion
DC-3-O34	> 200 ft.	15 ft.	6 ft.	extreme erosion
SC-1-O12	> 50 ft.	4 ft.	5 ft.	extreme erosion
SC-3-O22	> 500 ft.	3 ft.	4 ft.	extreme erosion
SC-3-O23	> 40 ft.	4 ft.	6 ft.	extreme erosion
SC-4-O9		8 ft.	8 ft.	extreme erosion
C-1-O10				eroding
C-1-O13			2 ft.	eroding
C-1-O21	15 ft.	3 ft.	2 ft.	eroding
C-2-O19				eroding
C-2-O20				eroding
C-2-O8	20 ft.	2 ft.	1 ft.	eroding
C-2-O9	20 ft.	4 ft.	3 ft.	eroding
C-3-O1				eroding
DC-2-O12				eroding
DC-2-O6				eroding
DC-3-O56		3 ft.	2 ft.	eroding
DC-3-O8				eroding
PS-1-O2	> 100 ft.	3 ft.	3 ft.	eroding
PS-1-O5	> 100 ft.	3 ft.	2 ft.	eroding
PS-3-O1				eroding
SC-1-O16	30 ft.	3 ft.	1 ft.	eroding
SC-1-O23	> 30 ft.	3 ft.	4 ft.	eroding
SC-1-O31	12 ft.	1 ft.	1 ft.	eroding
SC-2-O25	3 ft.	1 ft.	1 ft.	eroding
SC-2-O26	30 ft.	3 ft.	3 ft.	eroding
SC-2-O27	> 40 ft.	8 ft.	5 ft.	eroding
SC-3-O17				eroding
SC-3-O18				eroding
SC-4-O6	15 ft.	6 ft.	3 ft.	eroding
SC-4-O7	> 40 ft.	4 ft.	3 ft.	eroding
SC-4-O8	> 100 ft.	6 ft.	6 ft.	eroding
SC-5-O11				eroding
SC-5-O14	> 50 ft.	4 ft.	3 ft.	eroding
SC-7-O5				eroding
C-1-O16				stable
C-1-O17				stable
C-1-O19				stable

Table 48: Erosion Levels for Assessed Storm Drain Outlets

Storm Drain Outlet*	Gully Length	Gully Width	Gully Depth	Condition at Outlet
C-1-O2				stable
C-1-O8				stable
C-2-O14				stable
C-2-O21				stable
FrC-O18				stable
PS-4-O2				stable
SC-1-O18				stable
SC-2-O14				stable
SC-2-O22	40 ft.	3 ft.	5 ft.	stable
SC-7-O3				stable
SC-7-O7				stable

* See Figures 79-84 for location

The assessment also found that in many locations homeowners have installed plastic pipes on roof downspouts to extend the outlet onto adjacent lands, roads, or creeks. These pipes increase the volume of runoff reaching the creek and, if directed onto a road, may increase the volume of runoff into a nearby storm drain and the level of erosion at the outlet. On such steep lands as make up the upper Sausal Creek watershed, management of storm water, storm drains, and creek channels is essential to reduce ecological and water quality problems as well as private and public property damage.

Figure 85: Erosion at storm drain outlet where concentrated flow is released onto the slope without a rock energy dissipater.

Figure 86: Top: House built over creek channel in Sausal Creek watershed. Bottom: Ephemeral creek with sanitary sewer and house foundation.

Figure 87: Ephemeral creek channels adjacent and under house with signs of erosion likely from increased volumes of runoff from urbanization of upper Sausal Creek watershed.

Figure 88: Top: Erosion of ephemeral creek from urban runoff in upper Sausal Creek watershed. Bottom: Erosion from storm drain outlet.

Figure 89: Lining creeks with cement or rock riprap to reduce erosion can result in storm flows undercutting or going around the improvement.

Soil Erosion in Parks

Parks in the Sausal Creek watershed have several primary areas of erosion: recreational facilities such as trails and roads, outlets of concentrated flows from adjoining urban lands, and changes to creeks from watershed changes and management actions.

Joaquin Miller Park:

Many of the trails in Joaquin Miller Park date from prior logging activities and were not built for long-term use (Figure 90). There is a general lack of stream crossing culverts, waterbars, and proper drainage on trails. Table 51 lists the most significant erosion sites. These problems have been causing erosion and polluting Palo Seco Creek with fine sediment for a long time (Figure 91-99). City maintenance of these facilities is not funded most years, leading to continued degradation.

In 2000 the City had an assessment of trails and creeks completed (Lettis & Associates 2000). Many of the erosion problems identified in this report are included in Table 49 and have not been repaired.

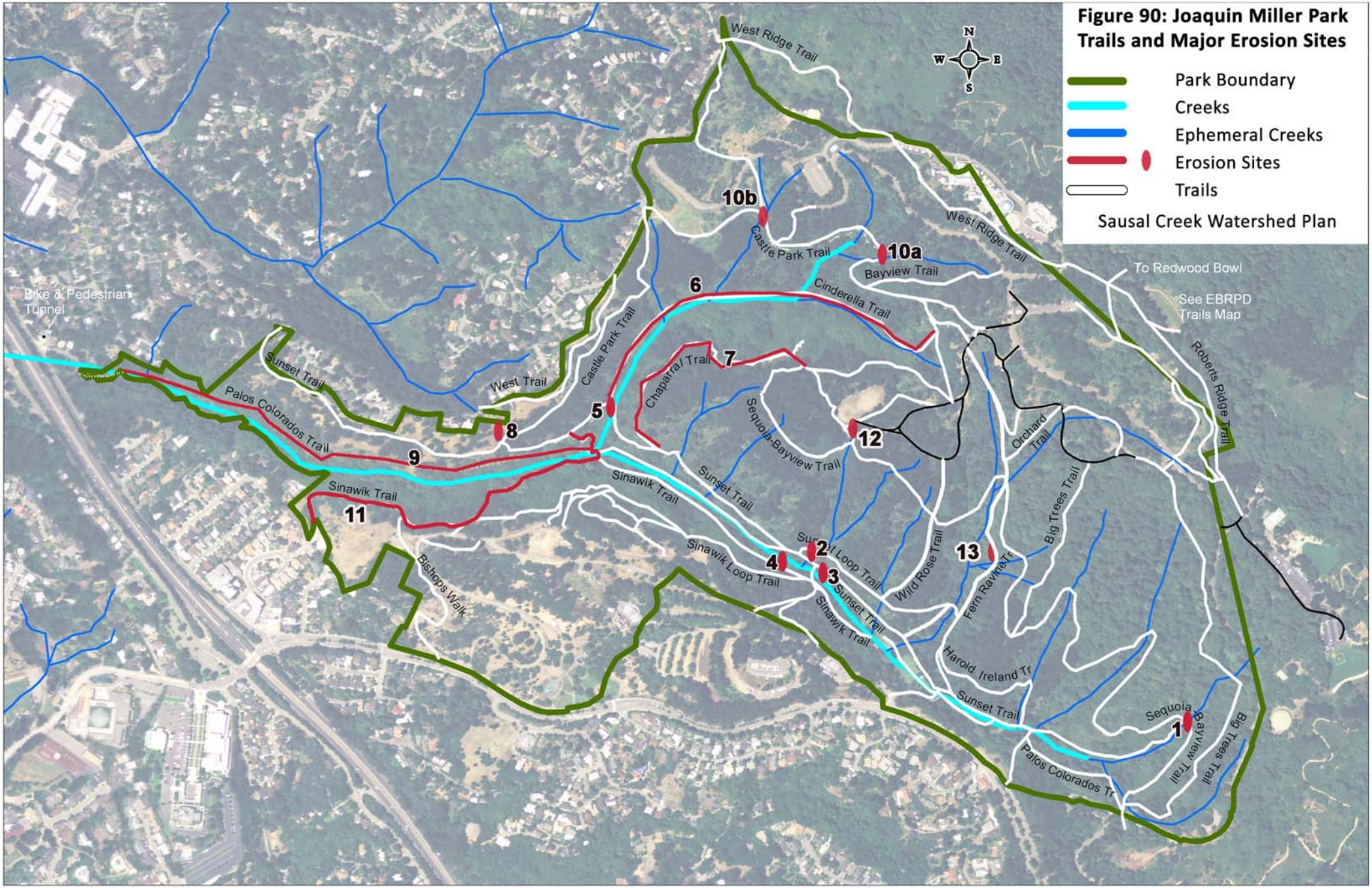


Figure 90: Joaquin Miller Park Trails and Major Erosion Sites
Park Boundary
Creeks
Ephemeral Creeks
Erosion Sites
Trails
Sausal Creek Watershed Plan
N
W
E
S
West Ridge Trail
10b
Castle Park Trail
10a
Bayview Trail
West Ridge Trail
To Redwood Bowl
See EBRPD Trails Map
Bike & Pedestrian Tunnel
6
Cinderella Trail
Castle Park Trail
Chaparral Trail
7
Sequoia-Bayview Trail
Roberts Ridge Trail
Sunset Trail
West Trail
Palos Colorados Trail
8
5
12
Orchard Trail
9
Sinawik Trail
Sunset Trail
Big Trees Trail
Sinawik Trail
11
Sunset Loop Trail
2
Wild Rose Trail
13
Fern Ravine Tr
Sinawik Loop Trail
4
3
Sunset Trail
Bishops Walk
Sinawik Trail
Harold Ireland Tr
Sunset Trail
Sequoia
1
Bayview Trail
Big Trees Trail
Palos Colorados Tr

Table 49: High Priority Erosion Sites in Joaquin Miller Park

Erosion Site	Priority for Repair	Comments and Recommendations	Figure
1	High – direct delivery to creek; trail damage	Sequoia-Bayiew Trail crosses an ephemeral creek with no bridge or culvert. Creek flow is eroding trail and directly delivering fine sediment to Palo Seco Creek. Culvert needs to be installed and sized for 100-year flood event on creek, and set at the level of the streambed to minimize erosion at the outlet. At least 18 inches of trail fill over the culvert is needed.	
2	High – direct delivery to creek; damage to vegetation and trail	The Sunset Loop Trail crosses an ephemeral creek with no culvert and captures the creek flow. Consequently, creek flow courses down the trail, eroding 3-4 inch deep rills and delivering fine sediment to the base of the oak tree on Sunset Trail and into Palo Seco Creek. A culvert needs to be installed to route the stream flow under the trail and back into the creek.	91
3	High – direct delivery to the creek	This is the most upstream grade control on Palo Seco Creek and consists of a trail bridge with three 20-inch culverts and an upstream trash rack. Trails at this junction are rilling, particularly Sinawik Loop Trail. In addition, the ephemeral creek on the north side of Sunset Trail is actively eroding from storm drain runoff along Skyline Blvd. directed into this small creek. A major repair will be needed here as major runoff events deepen Palo Seco Creek at the downstream side of the bridge. Trail and ephemeral creek runoff flows down the creek banks, eroding and widening the channel. The channel bed is up to seven feet deeper below the bridge than in the areas upstream of the trash rack. The bridge and trash rack cannot simply be removed, as removal will cause the channel to adjust and undercut numerous redwoods along the creek banks. Any replacement structure should be designed as a grade control structure. Stream banks should be revegetated and the culvert under Sunset Trail between the northern ephemeral creek and Palo Seco Creek replaced with a much larger culvert which will not clog with rocks but will allow for the transport of rock into Palo Seco Creek.	92; 62
4	High – direct delivery to creek	This is another major knickpoint in Palo Seco Creek at a casual creek crossing. The knickpoint is over five vertical feet and has eroded approximately five feet upstream in the past ten years. Several tree roots are temporarily preventing the site from further erosion moving upstream. This site should have a rock grade control structure to avoid further upstream migration of this knickpoint. Downstream banks need to be set back to reduce erosive velocities and allow willow sprigging. Large wood debris in the channel should also be retained at this location.	61
5	Moderate	Sunset Trail crosses Cinderella Trail and a very large erosion site occurs in the channel of Cinderella Creek downstream of this crossing. The addition of urban runoff from Chabot Space & Science Center greatly increased the level of erosion at this site. The channel downstream of this crossing is over 20 ft. lower in elevation from the upstream side. Unfortunately, a culvert replacement completed in 2007 was installed incorrectly. Stream crossing culverts need to be installed at the same slope as the stream channel. The repair set the culvert at no slope, resulting in a large drop for the water at the outlet. The culvert also appears undersized, with flow overwhelming the culvert during the 2006 flood and flowing over the trail. This site should have a critical dip installed to avoid flow coursing down the trail and causing additional erosion.	93

Table 49: High Priority Erosion Sites in Joaquin Miller Park

Erosion Site	Priority for Repair	Comments and Recommendations	Figure
6	High – direct delivery to creek; trail damage	Cinderella Trail borders Cinderella Creek and probably was originally constructed as a skid trail for logs. This trail is very steep and highly eroded. It currently functions as a bucket road: the convex road surface concentrates flow in the low point at the center of the trail and erodes fine sediment in storms. These fines are deposited on Sunset Trail and in Cinderella Creek. This trail needs to be re-graded to an outsloped condition with rolling dips to intercept sheet flow from the road. Several ephemeral tributaries and one spring to Cinderella Creek also course over the trail, adding to the runoff on the trail. These tributaries need culverts to move the water to Cinderella Creek. This trail should be considered for closure due to the high cost to repair and stop the environmental damage it causes.	94
7	Moderate	Chaparral Trail has numerous rills and gullies and needs to be rebuilt in sections using new grade control steps to stabilize the trail and reduce erosion.	
8	Moderate – monitor repairs for downstream effects	A storm drain at the top of the ridge on Castle Drive combined with clearcutting of Eucalyptus caused a major erosion site in an ephemeral creek channel. An expensive repair was installed following over 10 years of erosion, ineffective repairs, direct delivery to Palo Seco Creek, and environmental damage. Several temporary repairs, installed prior to current project, failed. Current repair includes a pipe to move runoff through the gully and beneath the trail. The pipe outlets in the ephemeral creek channel just downslope from the trail crossing. This creek has significantly eroded and needs to be carefully monitored to avoid continued erosion. Pipe should be extended to culvert at Palos Colorados Trail to avoid eroding the creek.	95-98
9	Moderate	Palos Colorado Trail is eroding in numerous locations with direct delivery to Palo Seco Creek. Repairs should avoid filling or narrowing the creek to support the trail.	
10	High – direct delivery to creek; trail damage	Stormwater runoff from Chabot Space & Science Center parking lots is eroding the Castle Park Trail. Directly delivers sediment to Cinderella Creek.	
11	Moderate	Gully on Sinawik Trail	
12	Moderate	Rill erosion on short steep trail near Horse Arena	
13	Moderate	Rill erosion on steep section of Fern Ravine Trail	

Figure 91: Erosion site #2. Lack of a culverted stream crossing causes water to flow down Sunset Loop Trail, eroding the trail and creating a pile of mud on Sunset Trail (bottom)and in Palo Seco Creek.

Figure 92: Trail erosion (red arrows) flowing directly into Palo Seco Creek near Erosion Site #3.

Figure 93: Top: Cinderella Creek with culverted crossing at Sunset Trail erodes and overflows the culvert. Stormwater from the Chabot Space and Science Center has increased the volume of flow in Cinderella creek, increasing erosion. Bottom: Repair in 2007 was done incorrectly by setting the culvert at a flat angle; the proper method is to set the culvert at the slope of the creek bed to reduce downstream erosion. Culvert is also undersized and continues to be overwhelmed by storm flows.

Figure 94: Top: Cinderella Trail is a major erosion site and needs to be re-designed or re-located. Bottom: Casual trails cause soil erosion directly into Palo Seco Creek.

Figure 95: The headwaters of this small creek were clear-cut of Eucalyptus and had storm drain runoff from Castle Drive, causing a major erosion site to form. The erosion produced from this site filled in portions of Palo Seco Creek in the January 1, 2006 flood. Photos are from 2004 and 2006.

Figure 96: One of many temporary and ineffective repair projects done at Castle Drive erosion site.

Figure 97: Sunset Trail crossing of small ephemeral creek below Castle Drive erosion site in 2006. Logs indicate this is an historic Humboldt crossing from logging days. Despite rock and plastic pipe, water is flowing along right side of crossing and eroding slope. Humboldt crossing is failing and not able to support rock dumped on it as part of ineffective repair.

Figure 98: After over 10 years of erosion and several ineffective repairs, an engineered repair was implemented in 2008. Flow was placed in a pipe and buried in rock which fills the gully.

Figure 99: Two examples of ineffective trail crossing repairs. Plastic pipes are too small and can easily clog; both are not placed in the crossing at the proper angle, and are not covered with enough soil to avoid damage. Top: Ineffective repair to trail crossing creek in Joaquin Miller Park. Bottom: Creek can easily flow over trail in higher water events and erode soil and pollute Palo Seco Creek.

The following observations of conditions in Dimond Canyon, Shepherd Canyon, and Cobbledick Basin were provided by Karen Paulsell of FOSC. Laurel Marcus & Associates did not validate these conclusions:

Dimond Canyon

- Two of the "extreme" culvert outlets; the first is the gigantic hole created by the "shotgun culvert" at Estates Drive on Park Blvd; the second is near Park Blvd, just south of the Leimert Bridge; water runs down the trail for a considerable distance, and has created numerous gullies.
- The storm drain outlet near San Luis Avenue creates a huge gully in the restoration area, shown in this photo

- The storm drain outlet at the end of Benevides Ave. has created a small landslide into the creek.
- There is a significant amount of erosion due to off-trail dogs; they've done a tremendous amount of damage to the native plantings in the El Centro restoration area, and there are denuded swathes between Sam's Trail and the creek, and also along the Bridgeview switchbacks.
- Montclair Golf Course uses a golf ball vacuum on the lower area of the driving range, creating a bare sediment source just above the culvert outfall.

Shepherd Canyon and Montclair Railroad Trail Park

- The Zinn Drive/trail area is the source of a lot of sediment. There are two or three shotgun culverts with large gullies below the trail, the deteriorating edge of the "fire road" has many small landslides, and the very large landslide below Cortez Court has blocked the creek channel, creating rills and gullies for about 150 feet along the fire road. The 500 feet of ephemeral creek channel above is basically an eroding gully, up to 3 feet deep and 5 feet wide. See photos at: http://picasaweb.google.com/KarenPaulsell/ZinnTrailErosion#.
- Escher Creek is eroding very quickly – former eroding ephemeral creek channels upstream were culverted a few years ago; I estimate that the creek has downcut at least 1 foot in about 5 years at one creek crossing.
- Partially due to the WPD vegetation management, a lot of the steep hillsides above and below Escher Drive are regularly denuded, with a lot of bare soil exposure. Erosion continues all the way down the Escher Creek channel, and is extreme between the restroom and the standpipe at Shepherd Canyon Road.
- Storm drain outlets SC-4-O4 and SC-4-O5 join up to form a large gully, 6 feet wide, 8 feet deep, at least 100 feet in length.
- Many homeowners also clear like the WPD does: down to bare soil, adding to the silt load.

Cobbledick Basin

- Due to the landslide at Haverhill Dr., the situation in Beaconsfield Canyon is rapidly growing worse, with the landslide deposition blocking the creek channel and flow diverted onto the fire road, due to landslide deposition blocking the creek channel.
- Upstream from Haverhill Dr., the creek is eroding soil from under the edge of the road
- A new and significant gully has appeared in Castle Canyon; a possible cause is a new storm drain installed on private property at the top of the canyon; it's very likely that this gully is responsible for the large amounts of deposition in the channel along Larry Lane.
- One of the "extreme" creek channels is located on Holyrood Dr. in the upper part of the watershed; the homes next to this creek channel have soil eroded from underneath their foundations.

V. LAND USE AND MANAGEMENT

Sausal Creek watershed is home to about 80,000 residents and includes 2127.6 acres of urban land (Figure 43). The density of housing varies between the steep hills of the upper watershed and flatter lands of the lower watershed. Above and just below Highway 13, residential density has less than 49% cover of impervious surfaces. From Dimond Park downstream, high intensity urban areas have 50-100% impervious coverage. Most of this urban area is residential, with commercial areas in Montclair, along Fruitvale Ave., and along MacArthur Blvd. Parkland covers approximately 650 acres in the watershed.

RELEVANT PLANS, POLICIES, AND PERMITTING

City of Oakland General Plan and Land Use Designations

Above Hwy. 13 the City of Oakland General Plan designates the primary land uses as Hillside Residential, Resource Conservation Areas, and Urban Open Space (Table 50). Most of the three major sub-basins are located above Highway 13. Shephard Creek flows through underground storm drains in Hillside Residential areas until it reaches Shepherd Canyon Park, designated as a Resource Conservation Area and Urban Open Space. Cobbledick Creek flows above ground and through storm drains through Hillside Residential areas and under Joaquin Miller Elementary/Montara Middle School. Palo Seco Creek flows almost entirely through Joaquin Miller Park, designated as a Resource Conservation Area and Urban Open Space.

Between Highway 13 and I-580 most of the watershed land use is designated as Hillside Residential and Detached Unit Residential, with the exception of Dimond Canyon, a Resource Conservation Area. Nearing I-580, however, these land uses transition to medium density Mixed Housing Type Residential, which is the dominant land use between I-580 and the neighborhood around I-880 and International Blvd. In this area, land use is designated for a mix of Urban Residential, Mixed Housing Type Residential, Community Commercial, and Neighborhood Center Mixed Use, including transit-oriented development.