TECHNICAL MEMORANDUM

System-wide Evaluation to Identify Restoration Opportunities

Prepared for:

San Bernardino County
Flood Control District

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1 INTRODUCTION

Within Section XI, New Development of the Area-wide Urban Stormwater Runoff Management Program San Bernardino County MS4 Permit (Order No. R8-2010-0036), the County and the Permittees are required to develop a Watershed Action Plan (WAP). The purpose of the WAP is to address water quality and hydromodification impacts and integrate water quality, stream protection, stormwater management and re-use strategies with land use planning policies, ordinances, and plans within each jurisdiction. This integration is also designed to address cumulative impacts of development on vulnerable streams and to the maximum extent practicable preserve or restore the structure and function of streams, and protect surface and groundwater quality. To begin addressing the impacts of development on vulnerable streams as part of the development of the WAP, Section x. specifies

- development of a system-wide evaluation to identify opportunities for joint or coordinated development planning to address stream segments vulnerable to hydromodification; and

- coordinated re-development planning to identify restoration opportunities for hardened and engineered streams and channels.

RBF Consulting performed this system-wide evaluation on behalf of the County of San Bernardino and Permittees. Twenty potential channel restoration sites were identified within the permitted area. This document describes the methodology used to identify each potential channel restoration site.

2 RESTORATION SITE DETERMINATION METHODOLOGY

Channel restoration sites were identified by the following approach: examining aerial photographs and visual inspection of major channel segments. The first step was to examine aerial photographs, provided by Google Earth, of the existing flood control facilities and locate sites that fit four main criteria:

1. The channel was hardened and engineered and/or vulnerable to hydromodification;

2. There was sufficient room to widen the channel, either by widening the channel bottom or lowering the bank slopes;

3. The overall restoration (including removal of the existing facility) would not have a significantly high cost (example: the removal of an existing regional concrete lined channel);

4. The restoration would not adversely affect the primary flood control/drainage function of the facility.

The second step was to conduct a visual inspection. Field visits were conducted for each site to perform the visual inspections. At each site, a rough cross-section was sketched and pictures were taken. The channel bank protection and overall condition of the channel was assessed. Individual site maps and field visit forms are provided in Appendix A and B, respectively. Also during the field visits, other sites not identified during the investigation of the aerial photographs were encountered. Information about these sites was recorded using the field forms, and visual inspections were conducted.

3 POTENTIAL RESTORATION ACTIVITIES

Channel segments that the Flood Control District and municipality owned or had easements for were the primary targets in this assessment, as implementing retrofit projects in privately owned channels would be less feasible than implementing projects in channels already under public ownership. As for easements, some may contain language restricting channel use solely to flood control purposes, which would preclude retrofit for water quality or other non-flood control related purposes. The removal of existing channel lining (e.g., concrete or riprap) to return the channel to an unlined condition requires significant engineering analysis and is highly unlikely due to physical land and economic constraints. Further, the removal of channel lining would reduce the conveyance capacity of the channel, which is generally impractical. Therefore, the focus of the assessment was primarily on unlined (earthen) channel segments. Channels were assessed for the following potential project opportunities:

1. Create planted/wetland areas. Channel segments were evaluated for the potential to increase habitat value and receiving water quality by creating a planted/wetland area. Since introducing a vegetated lining on an unlined channel may reduce flood conveyance capacity by loss of channel depth or increased channel roughness, the potential to create a wetland/planted area was limited to those channel segments where there appeared to be sufficient right-of-way to accommodate an increased channel width.

2. Reduce channel erosion. Earthen channel segments were assessed for the potential to reduce erosion and thus discharges of sediment to receiving waters where

    a. observed erosion would potentially threaten nearby infrastructure (e.g., roads, buildings, etc.); and

    b. observed erosion would impact habitat resources.

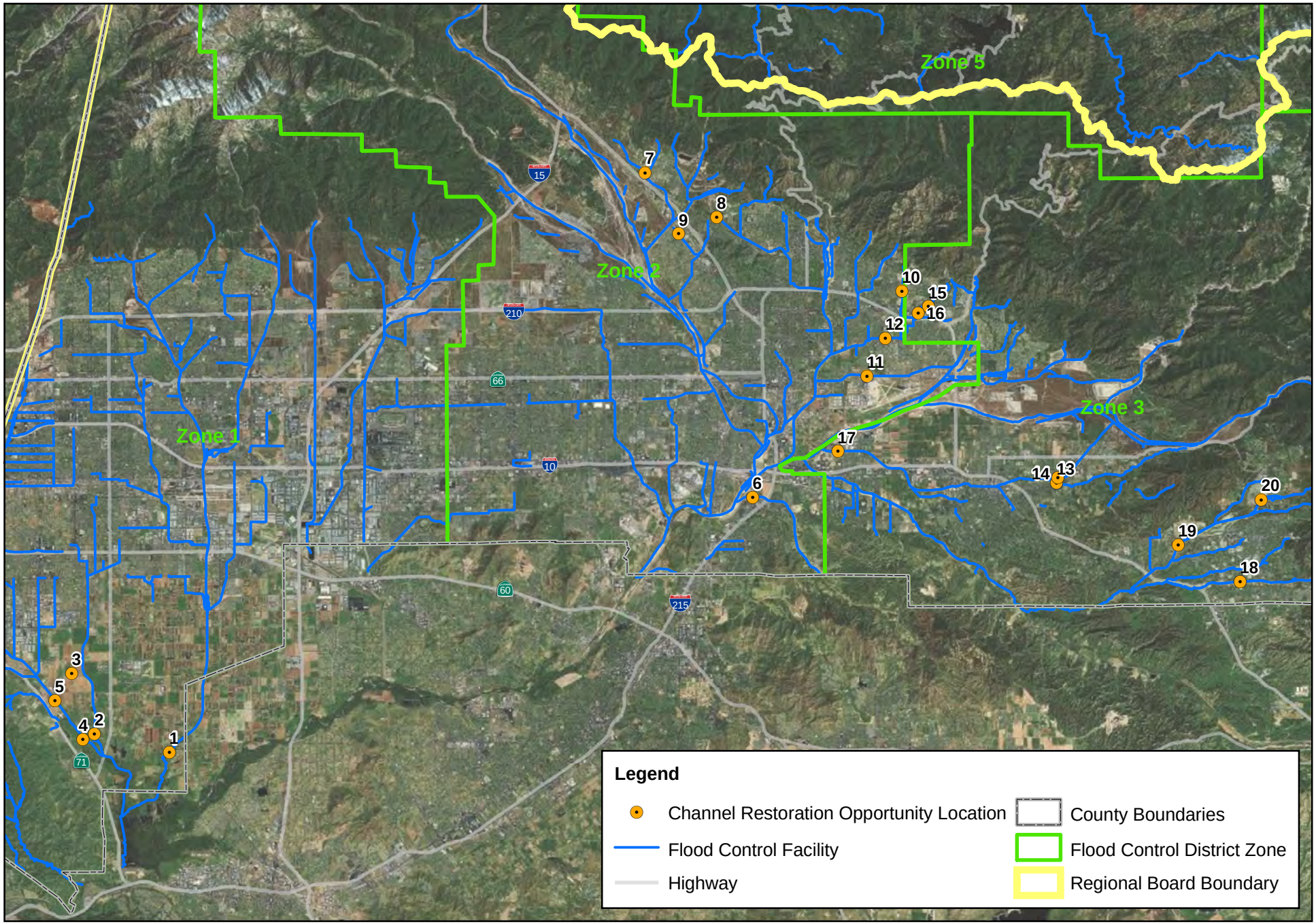
    Potential modifications and stabilization measures for areas include the use of an alternative lining, such as riprap or articulated concrete mat.

4 POTENTIAL RESTORATION SITES

The results of the flood control channel restoration assessment are presented in Table 1. The channel segments listed below are those that appear to be opportunities for retrofit based on the approach discussed in Section 2. Potential channel retrofit locations are also shown on the map provided in Figure 1.

Table 1: Channel Restoration Opportunity Summary

Site No.	FCD Zone	Site Name	City	Length (ft)	Longitude	Latitude
1	1	Cucamonga Channel Restoration Site No. 1	City of Chino	4930	-117.6197	33.9417
2	1	Cypress Channel Restoration Site No. 2	City of Chino	2797	-117.6594	33.9500
3	1	Magnolia Channel Restoration Site No. 3	City of Chino	6056	-117.6715	33.9768
4	1	San Antonio Channel Restoration Site No. 4	City of Chino	1056	-117.6656	33.9476
5	1	San Antonio Channel Restoration Site No. 5	City of Chino/Chino Hill	7807	-117.6806	33.9648
6	2	Reche Canyon Channel Restoration Site No. 6	City of Colton	4288	-117.3080	34.0533
7	2	Cable Creek Restoration Site No. 7	City of San Bernardino	4485	-117.3644	34.1974
8	2	Devil Creek Channel Restoration Site No. 8	City of San Bernardino	851	-117.3263	34.1774
9	2	Ono Storm Drain Restoration Site No. 9	City of San Bernardino	3342	-117.3467	34.1701
10	2	Sand Creek Restoration Site No. 10	City of San Bernardino	1833	-117.2277	34.1441
11	2	City Creek Restoration Site No. 11	City of San Bernardino/Highland	865	-117.2467	34.1065
12	2	Upper Warm Creek Restoration Site No. 12	City of San Bernardino/Highland	4109	-117.2367	34.1232
13	3	Zanja Creek Restoration Site No. 13	City of Redlands	3454	-117.1459	34.0587
14	3	Zanja Creek Restoration Site No. 14	City of Redlands	3887	-117.1452	34.0609
15	3	Baldridge Channel Restoration Site No. 15	City of San Bernardino	790	-117.2136	34.1372
16	3	Baldridge Channel Restoration Site No. 16	City of San Bernardino	1232	-117.2190	34.1342
17	3	Mission Channel Restoration Site No. 17	City of San Bernardino	1480	-117.2625	34.0734
18	3	Wildwood Creek Restoration Site No. 18	City of Yucaipa	12649	-117.0486	34.0142
19	3	Wilson Creek Restoration Site No 19	City of Yucaipa	3103	-117.0814	34.0306
20	3	Wilson Creek Restoration Site No 20	City of Yucaipa	1655	-117.0369	34.0504



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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES

Figure 1: Channel Restoration Opportunity Map

Site No. 1: Cucamonga Channel Restoration Site is located near the Chino Corona Road crossing in the City of Chino, CA. This section of the channel is classified as non- Engineered, Hardened, and Maintained (EHM) with significant degradation and stretches from an upstream EHM channel to Prado Damhere. There is ample space to widen and restore the natural channel.

Figure 2: Site No. 1 Upstream View

Figure 3: Site No. 1 Downstream View

Site No. 2: Cypress Channel Restoration Site is located within the El Prado Golf Course along Pine Avenue in the City of Chino. This section of the channel is classified as non-EHM and varies in size and shape throughout the site. Generally, the channel is a natural earthen trapezoidal channel with turf as the bank protection. There is significant degradation and erosion, and aesthetically, restoration would be very beneficial. This site is owned by the U.S. Army Corps of Engineers.

Figure 4: Site No. 2 Upstream View

Figure 5: Site No. 2 Downstream View

Site No. 3: Magnolia Channel Restoration Site is located between Edison Avenue and Kimball Avenue in the City of Chino, CA. The channel has not been classified but is an earthen trapezoidal channel with a bottom width of approximately 5 feet. The bank protection is in poor condition, and there are signs of bank and toe erosion. There is some potential for widening the channel to the west.

Figure 6: Site No. 3 Upstream View

Figure 7: Site No. 3 Downstream View

Site No. 4: San Antonio Channel Restoration Site is located within the El Prado Golf Course along Pine Avenue in the City of Chino, CA. This section of the channel is classified as non-EHM and is a trapezoidal channel with riprap bank protection. There is some toe erosion, but the majority of the channel is stabilized. Restoration would most likely only consist of a general cleanup of the channel and vegetation stabilization, but there is sufficient room for widening the channel.

Figure 8: Site No. 4 Downstream View

Figure 9: Site No. 4 Upstream View

Site No. 5: San Antonio Channel Restoration Site is located adjacent to El Prado Road and between Central Avenue and the wastewater plant in the City of Chino. This section of the channel is classified as non-EHM and is a natural channel. There is heavy vegetation along the banks, but significant degradation has occurred to the invert of the channel. There is sufficient room to widen the channel.

Figure 10: Site No. 5 Upstream View

Figure 11: Site No. 5 Upstream View

Site No. 6: Reche Canyon Channel Restoration Site is located between Interstate 215 and the Santa Ana River in the City of Colton. This section of the channel is classified as EHM and is an earthen trapezoidal channel. The channel had recently been maintained at the time of the site visit, but there were signs that toe and bank erosion had occurred. The access roads would need to be modified to widen the channel.

Figure 12: Site No. 6 Upstream View

Figure 13: Site No. 6 Upstream View

Site No. 7: Cable Creek Restoration Site is located between N. Little League Drive and Palm Avenue in the City of San Bernardino. This stretch of Cable Creek is classified as an EHM channel and has riprap-lined banks. The channel invert is showing signs of aggradation, most likely due to the downstream drop structures. There is ample room for widening the channel.

Figure 14: Site No. 7 Upstream View

Figure 15: Site No. 7 Downstream View

Site No. 8: Devil Creek Channel Restoration Site is located between University Parkway and Western Avenue in the City of San Bernardino. This section of the channel is classified as EHM and the bank protection consists of corrugated metal piles, which are in poor condition. The channel shows signs of minor toe erosion and invert degradation. Stretches of the channel have sufficient room for widening, but the majority of the channel would require modification to the access roads.

Figure 16: Site No. 8 Downstream View

Figure 17: Site No. 8 Downstream View

Site No. 9: Ono Storm Drain Restoration Site is located adjacent to Cajon Boulevard and the railroad tracks in the City of San Bernardino. This section of the channel is classified as EHM and is a small, vegetated trapezoidal channel. There are signs of toe erosion and invert degradation, but neither is significant. This site will likely require additional right-of-way from the adjacent owner in order to widen the channel.

Figure 18: Site No. 9 Downstream View

Figure 19: Site No. 9 Upstream View

Site No. 10: Sand Creek Restoration Site is located between Lynwood Drive and Patton Basin in the City of Highland. This section of the channel is classified as EHM and is a trapezoidal shaped channel with corrugated metal piles protecting the banks. The channel also has drop structures every 100-200 feet along the invert. Downstream is a large drop structure into Patton Basin. There is some bank and toe erosion, but the invert appears stabilized. There is sufficient room to widen the channel. Restoration could be aesthetically beneficial, because the San Manuel Indian Bingo and Casino has a direct line of sight to the channel.

Figure 20: Site No. 10 Upstream View

Figure 21: Site No. 10 Upstream View

Site No. 11: City Creek Restoration Site is located between 3rd Street and Twin Creek Channel in the City of San Bernardino. This section of the channel is classified as EHM, with the banks being protected by corrugated metal piles and some river rock along the invert. The corrugated metal piles are starting to fail, and there are signs of toe and bank erosion. For approximately 1000 feet downstream of 3rd Street, there is plenty of space for widening the channel, but over the majority of the restoration site, the access roads would have to be modified to accommodate the wider channel.

Figure 22: Site No. 11 Downstream View

Figure 23: Site No. 11 Downstream View

Site No. 12: Upper Warm Creek Restoration Site is located adjacent to Baseline Road, between the confluence with Sand Creek and Sterling Avenue in the City of San Bernardino. This section of the channel is classified as EHM and is an earthen trapezoidal channel with river rock along the invert. The channel is fairly stabilized, but it does show signs of bank erosion. The majority of the site has room to widen the channel with Belcher Park, undeveloped land, and San Gorgonio Senior High School to the north, but portions of the channel would require modifications to the access road.

Figure 24: Site No. 12 Upstream View

Figure 25: Site No. 12 Downstream View

Site No. 13: Zanja Creek Restoration Site is located adjacent to Laramie Avenue and Herrington Drive, and between Wabash Avenue and Lincoln Street in the City of Redlands. This section of the channel is classified as EHM and is an earthen trapezoidal channel. There are non-EHM sections of channel up- and downstream of the site. There is very little invert degradation, and the banks appear stable. Modification of the access roads would be required if the channel were widened.

Figure 26: Site No. 13 Upstream View

Site No. 14: Zanja Creek Restoration Site is an unnamed channel tributary to Zanja Creek and conveys water from the north. The site is located between Wabash Avenue and Sylvan Boulevard in the City of Redlands. This section of the channel is classified as EHM and is an earthen channel with river rock along the invert. The channel invert appears stable, but there is bank and toe erosion. There is sufficient room to widen the channel to the north where railroad tracks have been removed.

Figure 27: Site No. 14 Upstream View

Figure 28: Site No. 14 Downstream View

Site No. 15: Baldridge Channel Restoration Site is located at the North Orange Street crossing in the City of San Bernardino. Two sections of the channel were assessed: the downstream EHM channel that conveys water through the upstream non-EHM (Figure 1) and the jail (Figure 2). The downstream section is a trapezoidal earthen channel with a riprap-lined invert for low flow. There is plenty of room to lower the side slopes. Upstream of North Orange Street is approximately 250 feet of non-EHM channel. The channel is showing signs of toe and bank erosion due to the poor condition of the bank protection and has room to the east for widening.

Figure 29: Site No. 15 Upstream View

Figure 30: Site No. 15 Downstream View

Site No. 16: Baldridge Channel Restoration Site is located between E. Highland Avenue and Highway 210 in the City of San Bernardino. (Figure31). This section of the channel is classified as EHM due to the concrete lining. The majority of the channel is in fair condition, but a portion has failed and allowed a large scour channel to manifest to the west of the concrete channel. (Figure 32) The scour channel is approximately 15 feet deep. There is ample room to widen the channel.

Figure 31: Site No. 16 Upstream View

Figure 32: Site No. 16 Downstream View

Figure 33: Site No. 16 Upstream View

Figure 34: Site No. 16 Downstream View

Site No. 17: Mission Channel Restoration Site is located at Tippecanoe Avenue crossing and extends west for approximately 1550 feet in the City of San Bernardino. This section of the channel is classified as EHM with corrugated metal piles on the southern bank and river rock on the northern bank. The corrugated metal piles are deteriorating and there is bank erosion. The channel invert shows signs of aggradation due to the downstream drop structure. There is room to widen the channel to the south. The stretch of channel upstream of Tippecanoe Avenue is in the same condition, but it has significantly less room to expand.

Figure 35: Site No. 17 Upstream View

Figure 36: Site No. 17 Upstream View

Site No. 18: Wildwood Creek Restoration Site is between Interstate 10 and 1300 feet east of Bryant Street in the City of Yucaipa. This section of the channel is classified as EHM and is a trapezoidal earthen channel. The channel had recently been maintained at the time of the site visit but there were signs that toe and bank erosion had occurred. Upstream of 6th Place, sections of the channel have grouted rip rap bank protection that is in good condition. The majority of the site has sufficient room to widen the channel.

Figure 37: Site No. 18 Downstream View

Figure 38: Site No. 18 Upstream View

Site No. 19: Wilson Creek Restoration Site is located between 10th Street and Avenue E in the City of Yucaipa. This section of channel is classified as EHM and is an earthen, trapezoidal shaped earthen channel with corrugated metal piles protecting the banks. The corrugated metal piles are deteriorating, but significant erosion has not occurred to the toe or bank of the channel. The channel appears to be stabilized due to the drop structures located every 50 feet along the invert. The majority of the site has sufficient room to widen, but most areas seem to be privately owned and, in some stretches, the access roads would require modification.

Figure 39: Site No. 19 Downstream View

Figure 40: Site No. 19 Upstream View

Site No. 20: Wilson Creek Restoration Site is located between Bryant Street and Oak Glen Road in the City of Yucaipa. This section of the channel is classified as EHM and is an earthen trapezoidal shaped channel with corrugated metal piles protecting the west bank and river rock protecting the invert and east bank. This site has non-EHM sections of channel up- and downstream. The channel shows signs of bank erosion and invert degradation. There is sufficient room to widen the channel to the east.

Figure 41: Site No. 20 Downstream View

Figure 42: Site No. 20 Upstream View

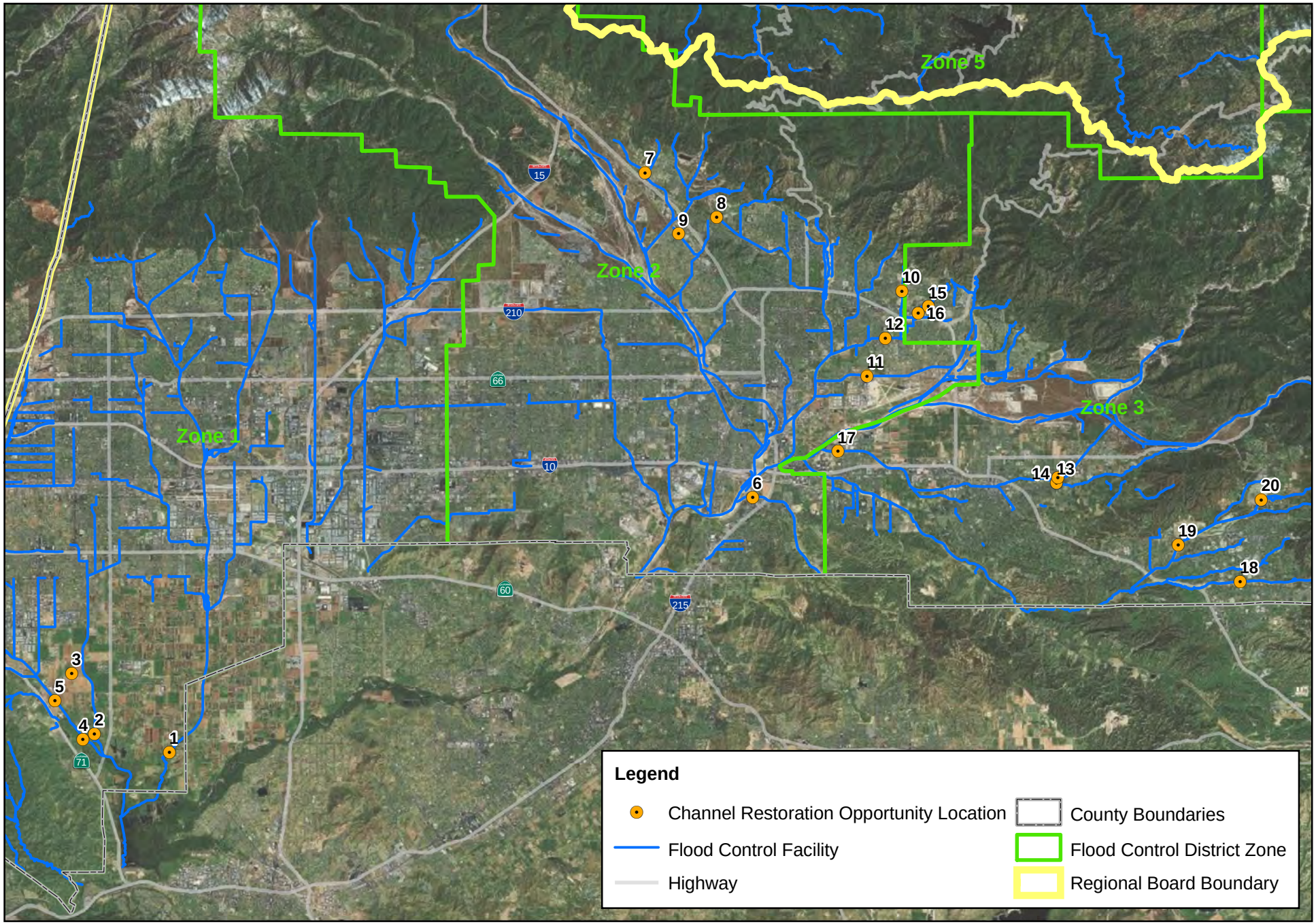
5 FUTURE STEPS

The purpose of this system-wide evaluation was to identify opportunities to address stream segments vulnerable to hydromodification and identify restoration opportunities for hardened and engineered streams and channels. The desktop investigation and visual field inspections identified 20 potential restoration sites. This system-wide evaluation was a qualitative assessment, so the next step in the restoration process is to perform detailed quantitative engineering study of each potential restoration site to identify if it is feasible to restore the channel segment. This analysis would include an assessment to ensure that the potential restoration reconfiguration does not adversely affect the primary flood control/drainage function of the facility. Conceptual designs would be developed as part of the detailed engineering analysis. Costs of each of the restoration projects could then be developed.

After the detailed engineering study is performed and the Hydromodification Management Plan (HMP) is developed, watershed modeling should be performed to identify the benefits of restoring each of the potential channel restoration segments. Scenarios can be developed to identify if each of the channel sites should be restored and whether the sites are consistent with the HMP. If it is decided that a site should be constructed, then funding will need to be secured and final selection of the restoration activities will need to be developed. The final steps will be the restoration design, solving any right-of-way issues, and the completion of permitting. Once all of this is completed, then construction of the restoration project can commence.

APPENDIX A

MAPS



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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES

Figure 1: Channel Restoration Opportunity Map

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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 1

City of Chino

Cucamonga Channel Restoration Site No. 1

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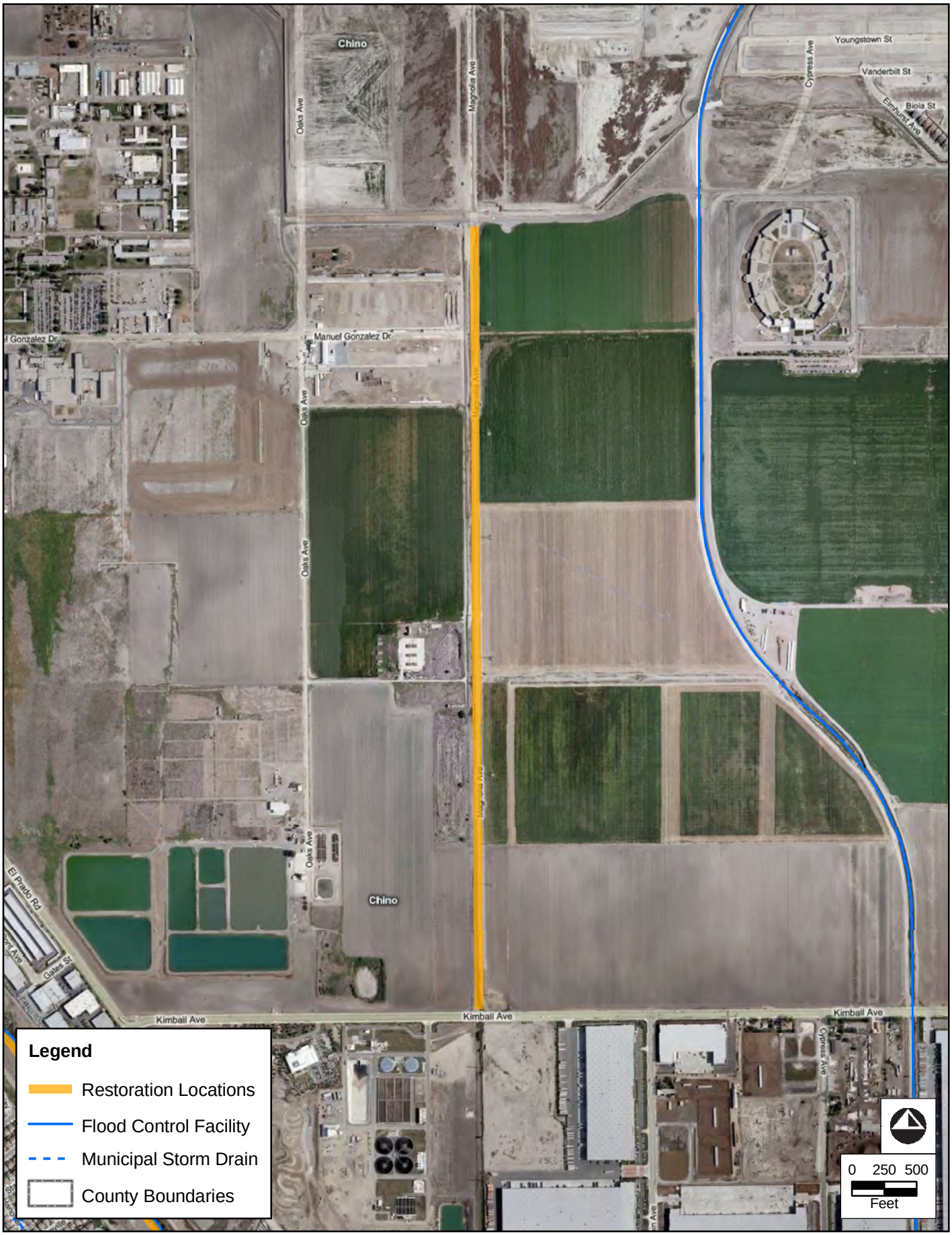
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 1

City of Chino

Cypress Channel Restoration Site No. 2



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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 1

City of Chino

Magnolia Channel Restoration Site No. 3

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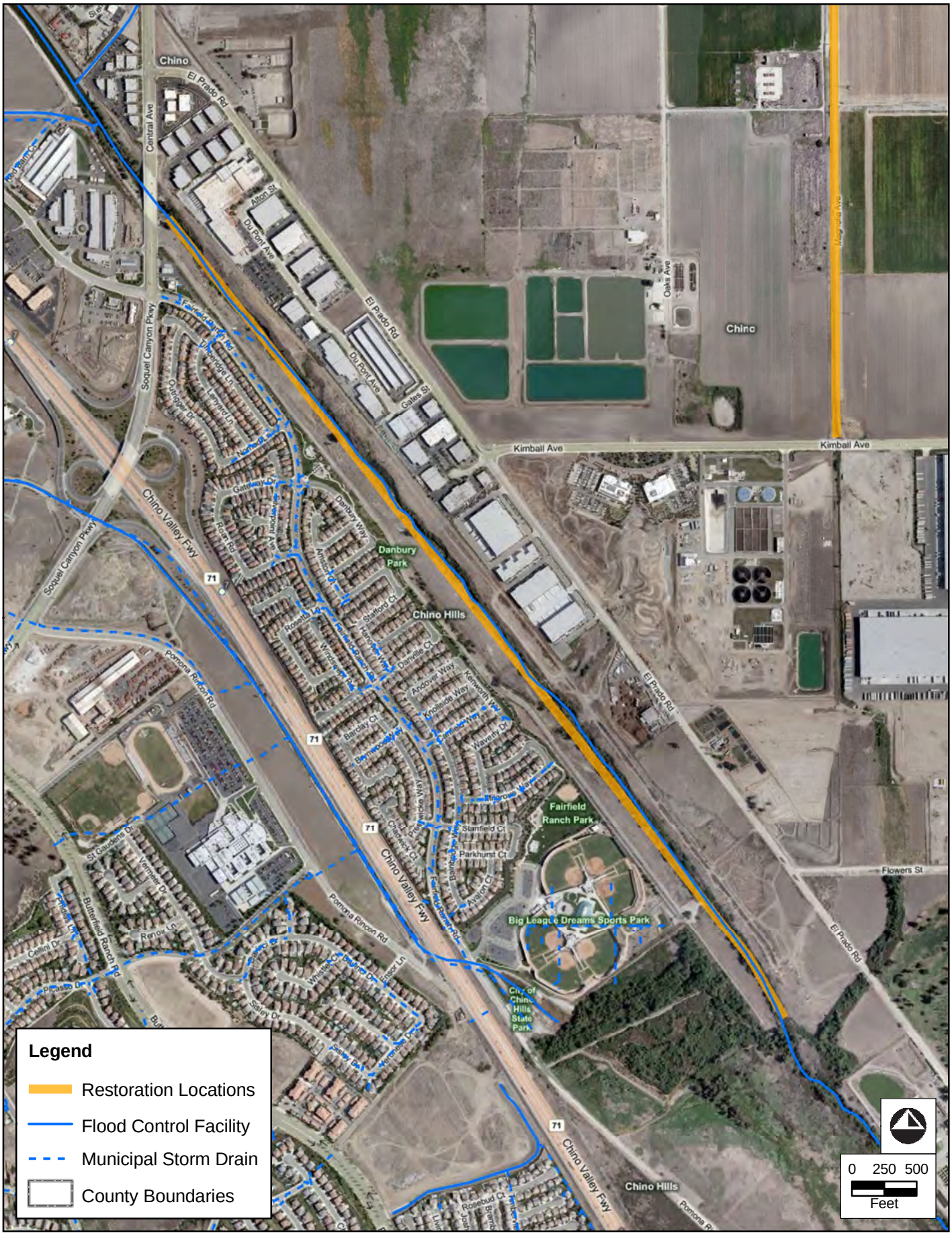
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 1

City of Chino

San Antonio Channel Restoration Site No. 4



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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 1

City of Chino/Chino Hill

San Antonio Channel Restoration Site No. 5

Legend

- Restoration Locations
- Flood Control Facility
- Municipal Storm Drain
- County Boundaries

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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of Colton

Reche Canyon Channel Restoration Site No. 6

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Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino

Cable Creek Restoration Site No. 7

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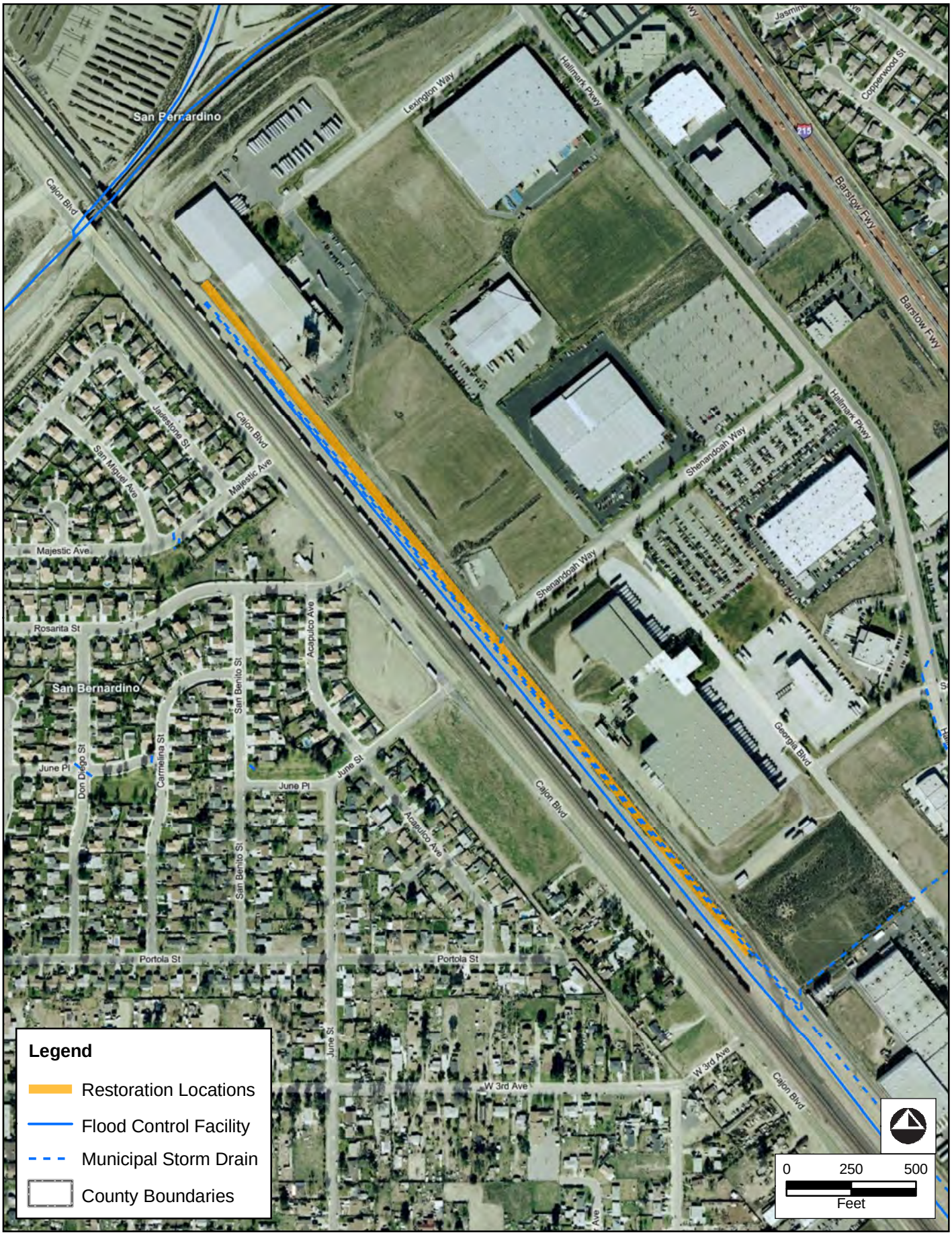
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino

Devil Creek Channel Restoration Site No. 8



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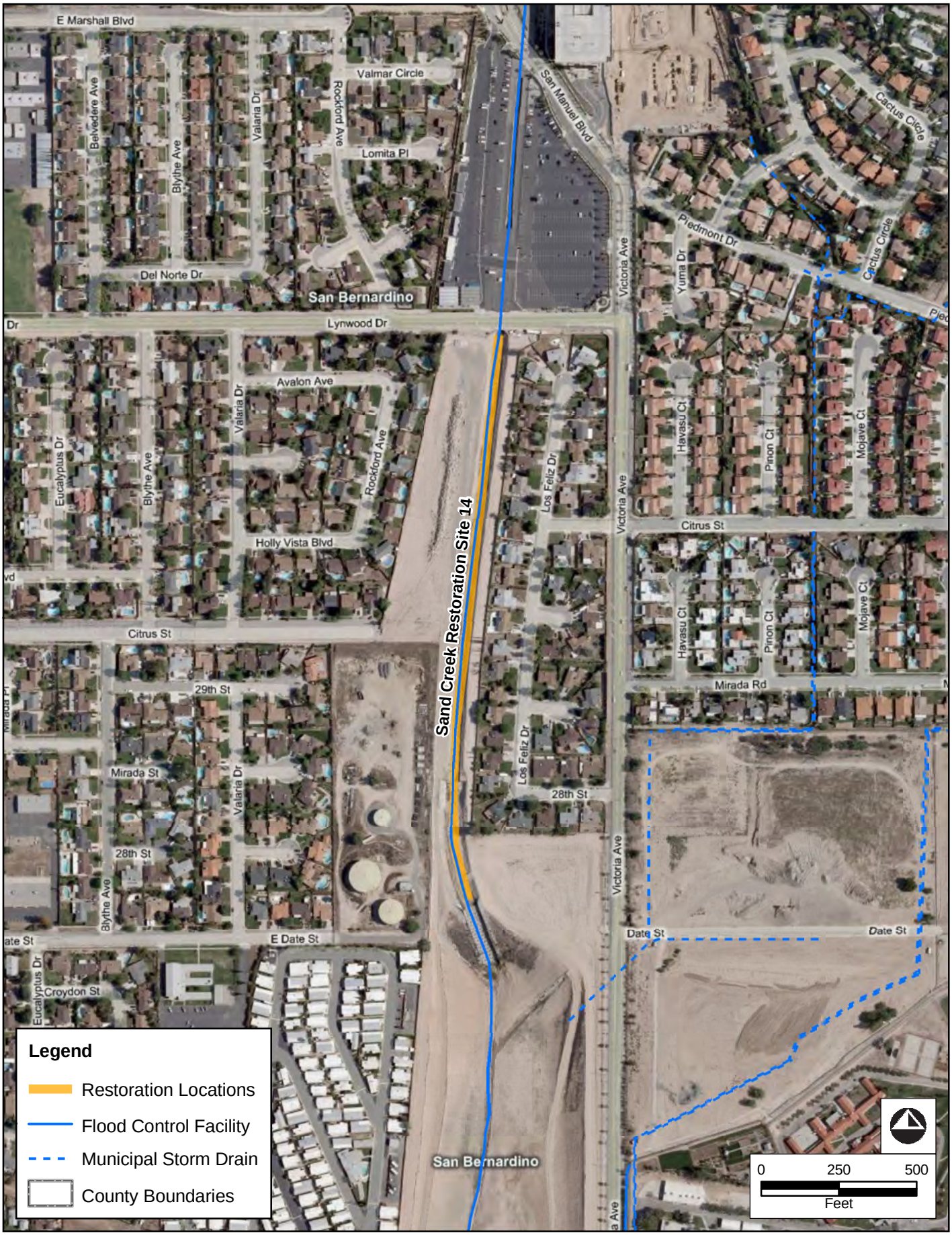
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino

Ono Storm Drain Restoration Site No. 9



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SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino

Sand Creek Restoration Site No. 10

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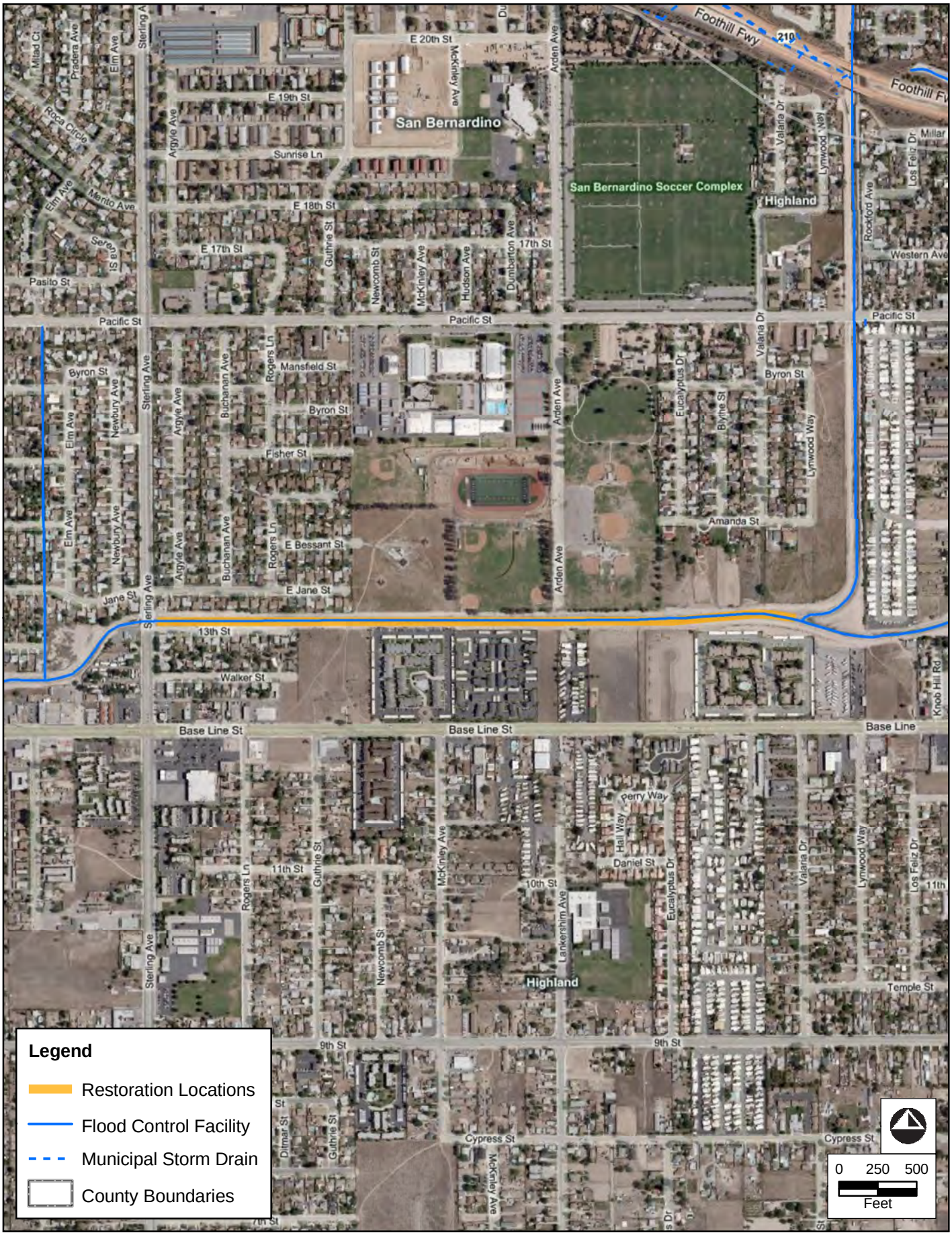
SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino/Highland

City Creek Restoration Site No. 11



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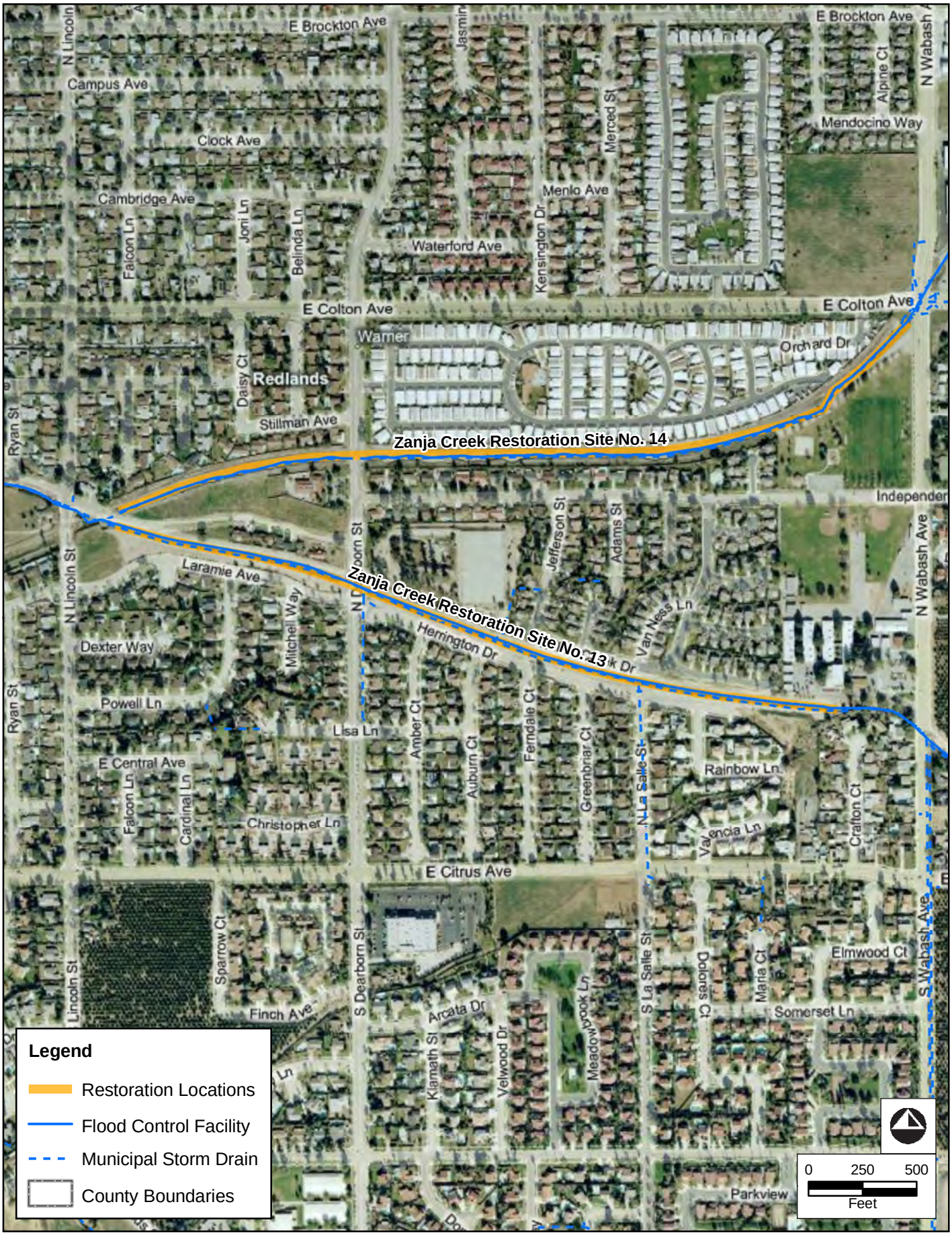
SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 2

City of San Bernardino/Highland

Upper Warm Creek Restoration Site No. 12



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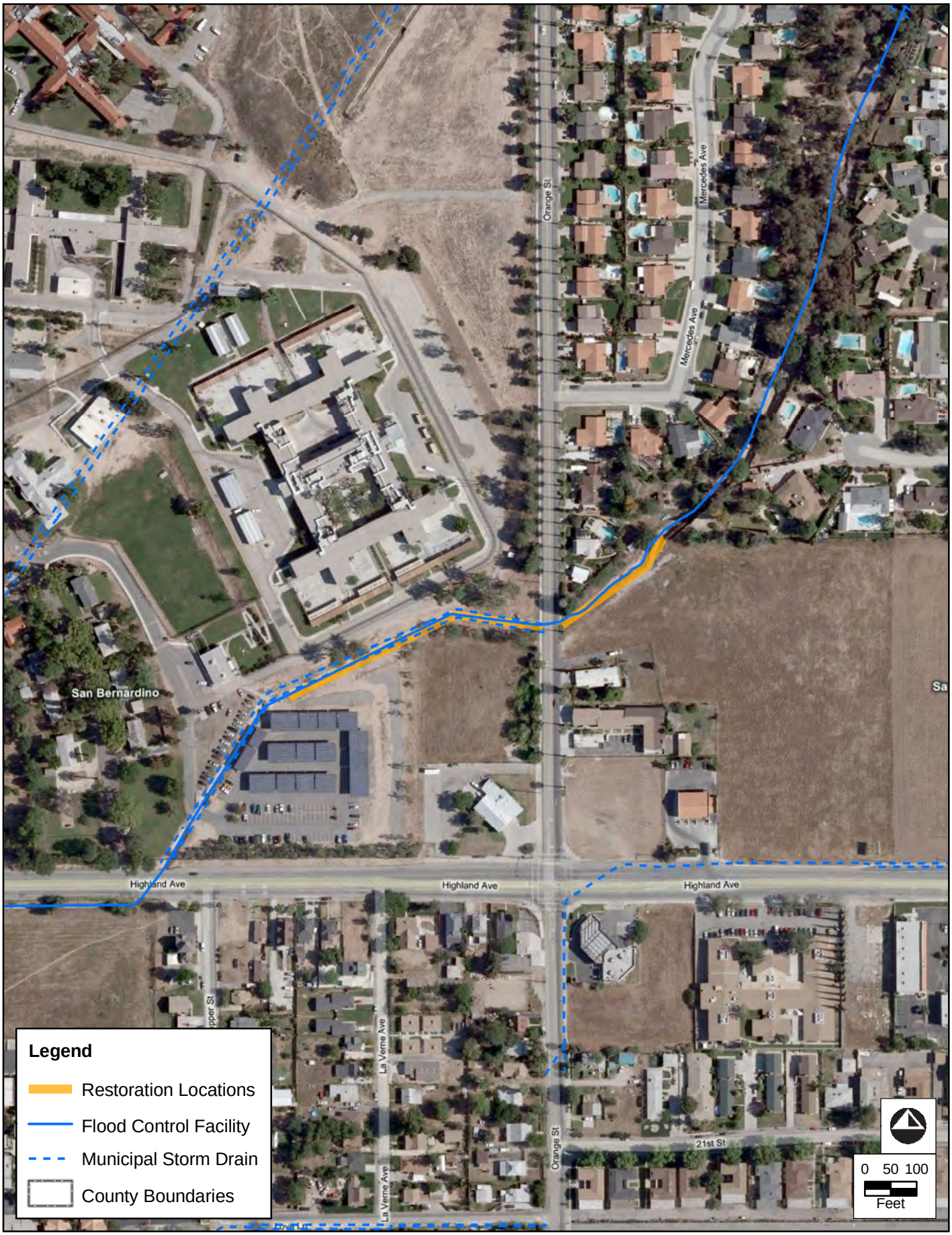
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of Redlands

Restoration Site No. 13 and 14



1/17/11 JN 10106734 M:\Mdata\10106734\GIS\BMPRetrofit\Channel Restoration Opportunity Map DER

Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of San Bernardino

Baldridge Channel Restoration Site No. 15

1/17/11 JN 10106734 M:\Mdata\10106734\GIS\BMPRetrofit\Channel Restoration Opportunity Map DER

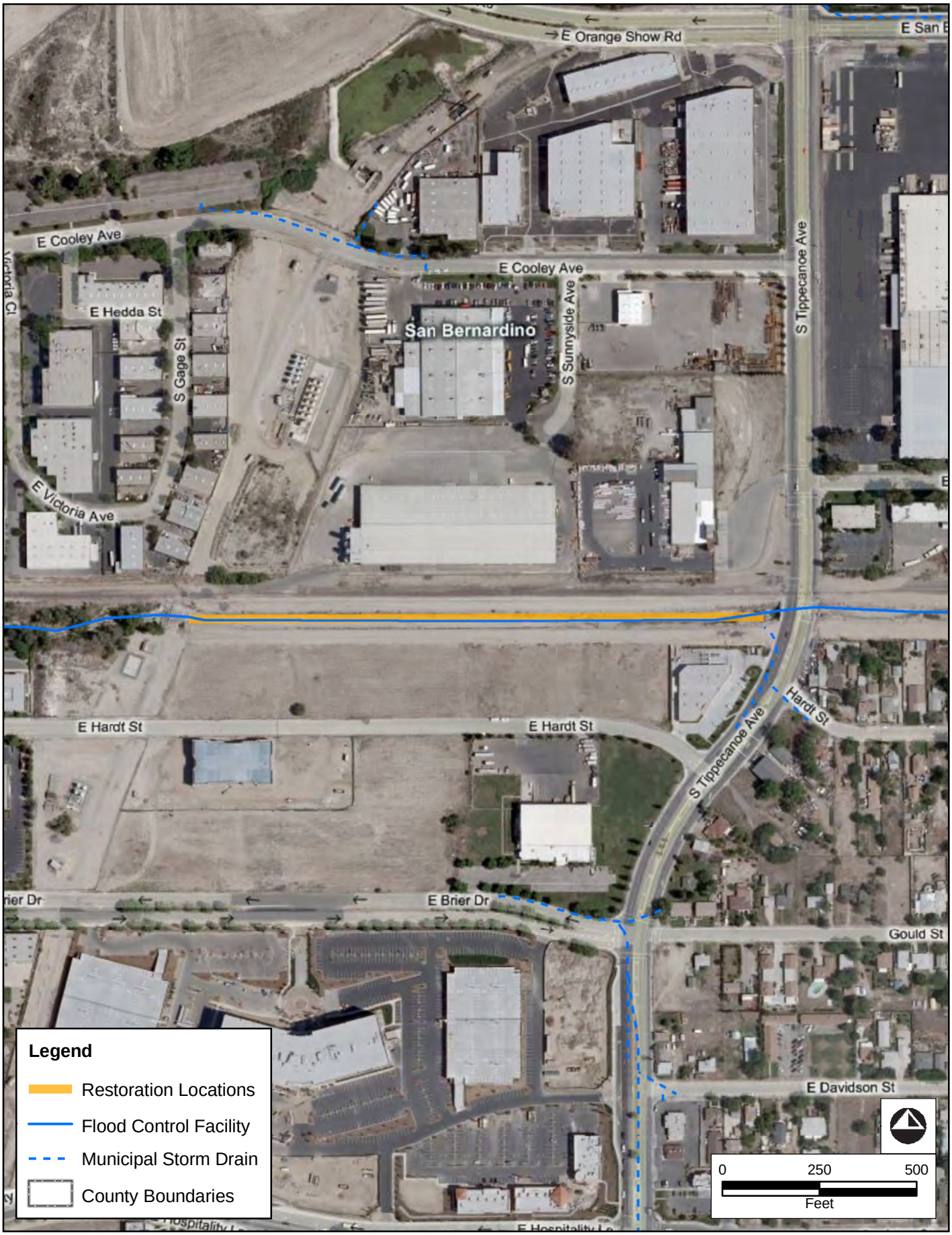
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of San Bernardino

Baldridge Channel Restoration Site No. 16



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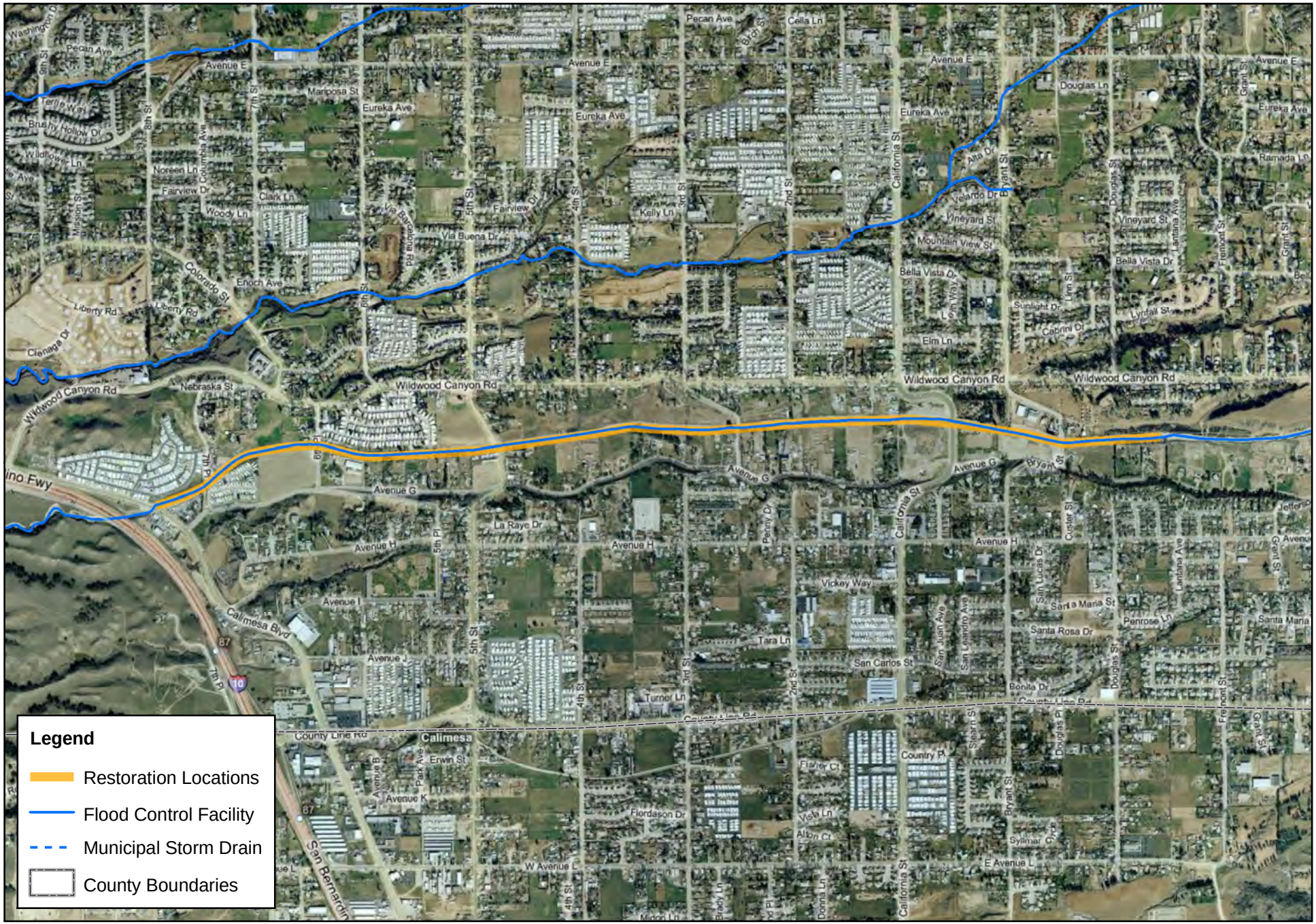
Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of San Bernardino

Mission Channel Restoration Site No. 17



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RBF CONSULTING GIS

0 500 1000
Feet

Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of Yucaipa

Wildwood Creek Restoration Site No. 18

1/17/11 JN 10106734 M:\Mdata\10106734\GIS\BMPRetrofit\Channel Restoration Opportunity Map DER

Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of Yucaipa

Wilson Creek Restoration Site No 19

1/17/11 JN 10106734 M:\Mdata\10106734\GIS\BMPRetrofit\Channel Restoration Opportunity Map DER

Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO RESTORATION OPPORTUNITIES STUDY

Flood Control District Zone 3

City of Yucaipa

Wilson Creek Restoration Site No 20

APPENDIX B

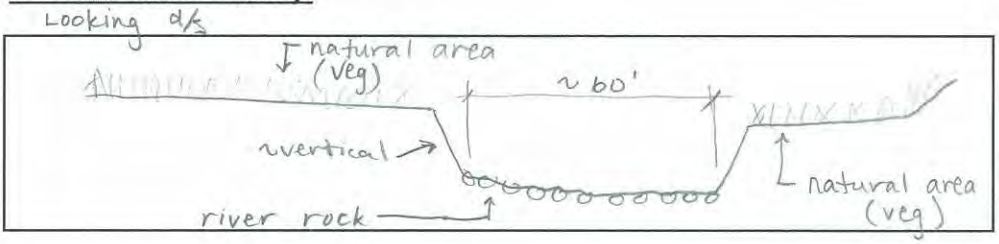
FIELD FORMS

Restoration Opportunities for Hydromodification Mapping

Field Requirements

Facility:	Cucamonga Channel
X-Sec #:	Z1-RS2
Comment:	d/s of Chino Corona Rd
Pictures:	6313 - 6315

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.05	veg
2. Right Bank	0.022	earthen
3. Channel Bottom	0.035	river rock
4. Left Bank	0.022	earthen
5. Left Overbank	0.05	veg

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	y
5. Sediment Source (yes or no)	y

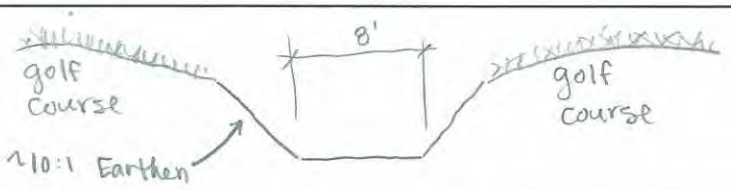
3. Site Notes and Observations:

→ heavily vegetated
→ clear flowing water at bridge
→ u/s concrete EHM channel
→ significant amount of scour
→ plenty of space for restoration

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Golf Course - Cypress Channel
X-Sec #:	in Chino
Comment:	Pine Ave Bridge
Pictures:	5043 - 5053

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.03	grass
2. Right Bank	0.02	earthen
3. Channel Bottom	0.02	earthen
4. Left Bank	0.02	earthen
5. Left Overbank	0.03	grass

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	Y
3. Toe Erosion (yes or no)	Y
4. Invert Degradation (yes or no)	Y
5. Sediment Source (yes or no)	Y

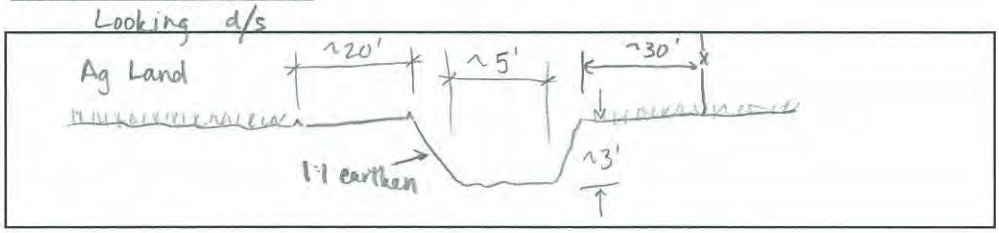
3. Site Notes and Observations:

→ need to verify if Municipal Course (verified)
→ lots of degradation
→ plenty of space for restoration
→ Corp owns land
→ improvements needed on up- & downstream sides of Pine Ave.

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Magnolia Channel
X-Sec #:	Z1 - CP1
Comment:	at Kimball
Pictures:	5039 - 5043

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.025	veg
2. Right Bank	0.03	earthen (non-smooth)
3. Channel Bottom	0.02	sand
4. Left Bank	0.03	earthen (not smooth)
5. Left Overbank	0.025	veg (new growth)

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

→ potential for widening on the right side
- Edison property to the left

→ d/s culvert & channel improvements d/s of culvert

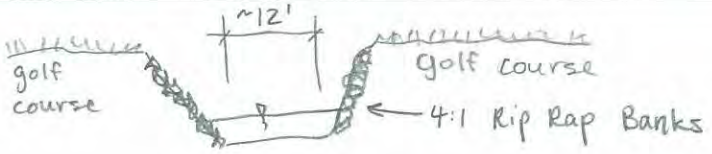
→ bank improvements required

→ channel invert stabilized w/ sand
-storm event was very recent

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Golf Course #2 - San Antonio Channel
X-Sec #:	
Comment:	Pine Ave Arizona Crossing
Pictures:	5053 - 5057

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	grass
2. Right Bank	0.035	rip rap
3. Channel Bottom	N/A	water
4. Left Bank	0.035	rip rap
5. Left Overbank	0.02	grass

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	good
2. Bank Erosion (yes or no)	n
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	n/a
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

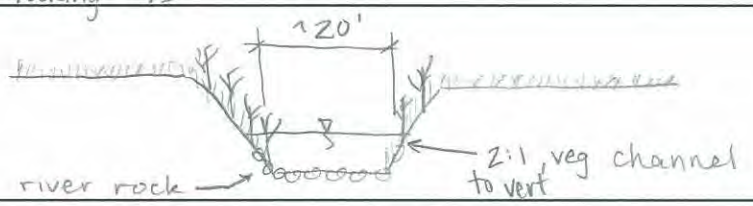
→ u/s natural channel
→ candidate for clean up & veg stabilization
→ plenty of room for widening
→ owned by Corp

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	San Antonio Channel
X-Sec #:	Z1 - RS1
Comment:	adjacent to El Prado Rd, u/s of WWP
Pictures:	6306 - 6309

1. Cross-section survey:

looking d/s



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.05	veg 80%
2. Right Bank	0.05	veg 80%
3. Channel Bottom	0.04	river rock
4. Left Bank	0.05	veg 80%
5. Left Overbank	0.05	veg 80%

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	n
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	y
5. Sediment Source (yes or no)	n

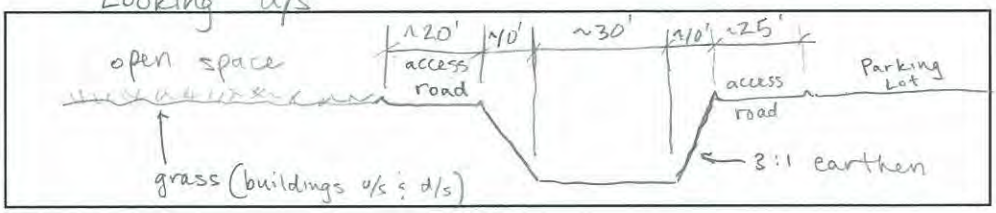
3. Site Notes and Observations:

→ Heavily vegetated banks & overbanks
→ Stream has running water
→ bottom has significant scour
→ plenty of room for restoration

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Reche Canyon Channel
X-Sec #:	Z2-R57
Comment:	u/s of Mt Vernon Ave
Pictures:	5031 - 5038

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.02	earthen
3. Channel Bottom	0.02	earthen
4. Left Bank	0.02	earthen
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	Y
3. Toe Erosion (yes or no)	Y
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	Y

3. Site Notes and Observations:

→ channel looks recently repaired. Has "unfinished" look.

→ banks don't show erosion but it is evident that some has occurred.

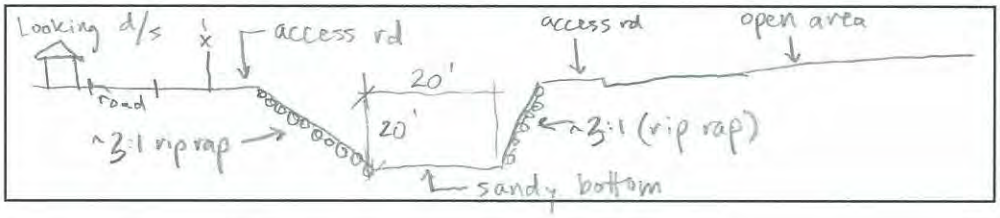
→ u/s section has rip rap lined banks

→ d/s section is earthen w/ gravel on banks

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Cable Creek
X-Sec #:	Z2 - R53
Comment:	d/s of Little League Dr
Pictures:	(100-4847 to 100-4849 d/s section) (100-4850 to 4874 @ site)

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.03	grass
2. Right Bank	0.035	rip rap
3. Channel Bottom	0.02	sand bottom
4. Left Bank	0.035	rip rap
5. Left Overbank	0.03	grass then road

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	good
2. Bank Erosion (yes or no)	no
3. Toe Erosion (yes or no)	y (minor)
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

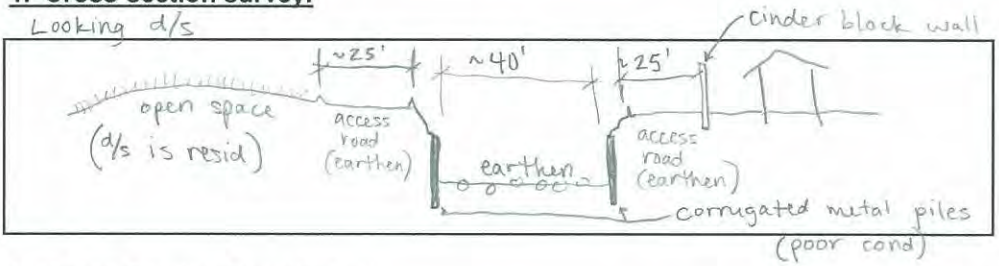
3. Site Notes and Observations:

→ grouted rip rap near culvert outlets
→ invert has sand deposited, could have protection below
→ significant open area to the right & some space to the left
→ d/s channel section has corregated metal piles as bank protection along w/ rip rap above
→ drop structures in channel

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Devil Creek Channel
X-Sec #:	
Comment:	University Pkwy Bridge
Pictures:	5060 - 5063

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.03	piles/rock
3. Channel Bottom	0.025	earthen w/ some rock
4. Left Bank	0.03	piles/rock
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	n
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	y
5. Sediment Source (yes or no)	y

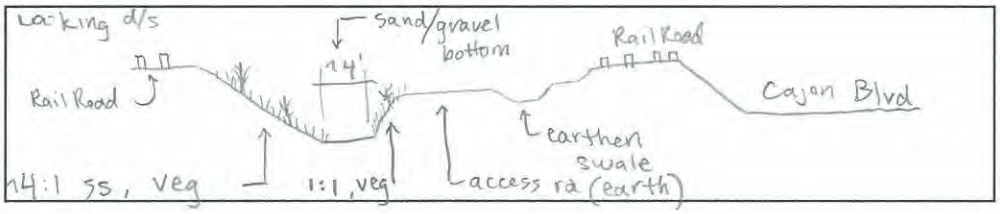
3. Site Notes and Observations:

→ piles are protecting bank but are in poor condition
→ to widen an access road would be removed
→ invert shows scour
→ downstream there are dorms to the left. There is a cinder block wall at the edge of the access road.

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Ono Storm Drain
X-Sec #:	22-R52
Comment:	Adjacent to Cajon Blvd & Railroad
Pictures:	4875 to 4885

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.03	veg (grass) 90%
3. Channel Bottom	0.03	gravel
4. Left Bank	0.03	veg (grass) 90%
5. Left Overbank	0.03	railroad (gravel)

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	decent (grass)
2. Bank Erosion (yes or no)	minor
3. Toe Erosion (yes or no)	Y
4. Invert Degradation (yes or no)	Y
5. Sediment Source (yes or no)	minor

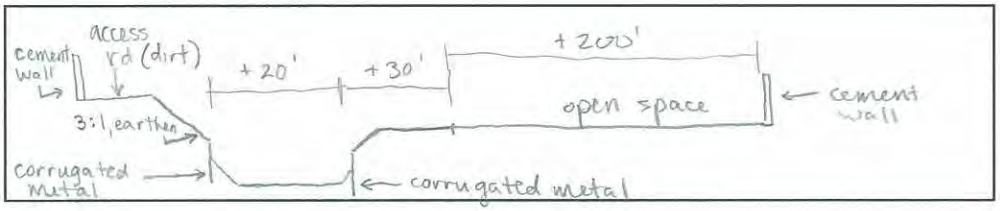
3. Site Notes and Observations:

→ small channel
→ run off from incoming laterals. Most likely from industrial site adjacent
→ not a great option for restoration.

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Sand Creek
X-Sec #:	Z2 - RS4
Comment:	@ end of Citrus
Pictures:	4886 - 4911

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.02	corrugated metal/earthen
3. Channel Bottom	0.02	earthen
4. Left Bank	0.02	corrugated metal/ earthen
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	no
5. Sediment Source (yes or no)	yes

3. Site Notes and Observations:

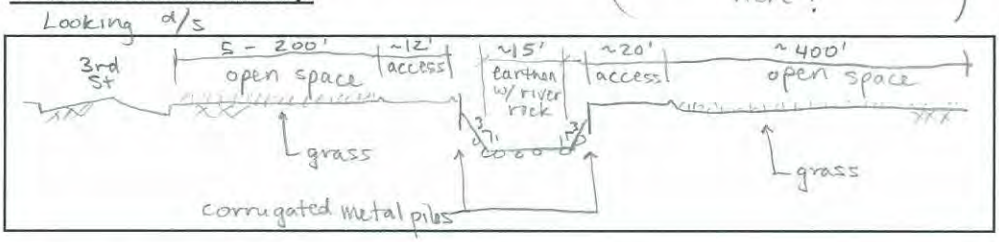
→ drop structures every ~100'- 200'
→ invert looks stabilized
→ corrugated metal piles are failing
→ side slopes showing scour up to ~4'
→ major drops d/s w/ energy dissipators
→ basin d/s

Restoration Opportunities for Hydromodification Mapping

Field Requirements

Facility:	City Creek
X-Sec #:	Z2-RS6
Comment:	d/s 3rd St
Pictures:	4942 - 4962 (4963 - 4968 across from SBCFCD (is there enough room here?)

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.03	grass
2. Right Bank	0.03	earthen/river rock/gravel
3. Channel Bottom	0.025	sand w/ river rock
4. Left Bank	0.03	earthen/river rock/gravel
5. Left Overbank	0.03	grass

*If Vegetated specify %

2. Cross-Section Condition:

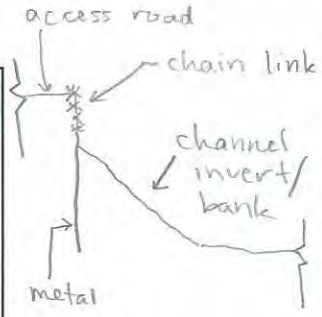
1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y (minor)
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

→ invert looks fairly stabilized

→ corrugated metal piles have chain link fence above (2') to hold back access road (see to right)
- starting to fail in some locations

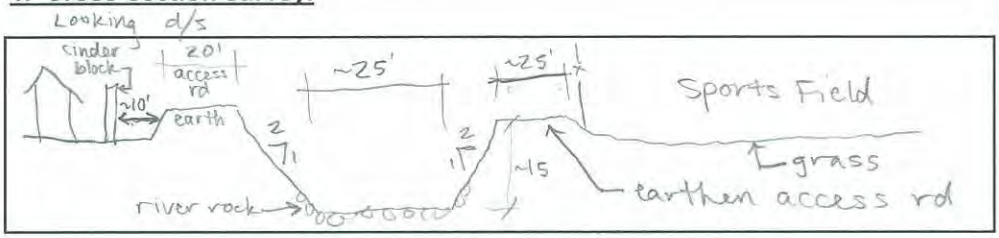
→ u/s channel is 5-10' wider w/ concrete left bank



Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Upper Warm Creek
X-Sec #:	22 - R55
Comment:	North of Baseline, South of Sports Field
Pictures:	4915 – 4934

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.03	gravel/earthen
3. Channel Bottom	0.03	gravel/earthen
4. Left Bank	0.02	gravel/earthen
5. Left Overbank	0.03	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	Y
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	Y

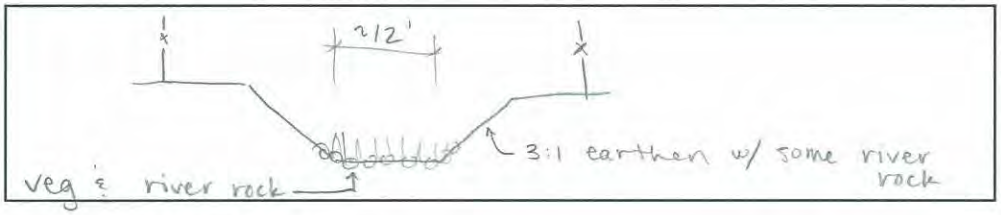
3. Site Notes and Observations:

→ river rock along toe & invert
→ channel is fairly stabalized
→ drop structures upstream
→ room to expand

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Zanja Creek
X-Sec #:	Z3-RS2
Comment:	u/s Lincoln St
Pictures:	

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.03	earthen w/ river rock
3. Channel Bottom	0.035	river rock
4. Left Bank	0.03	earthen w/ river rock
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	n/a
2. Bank Erosion (yes or no)	n
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	y <1'
5. Sediment Source (yes or no)	y

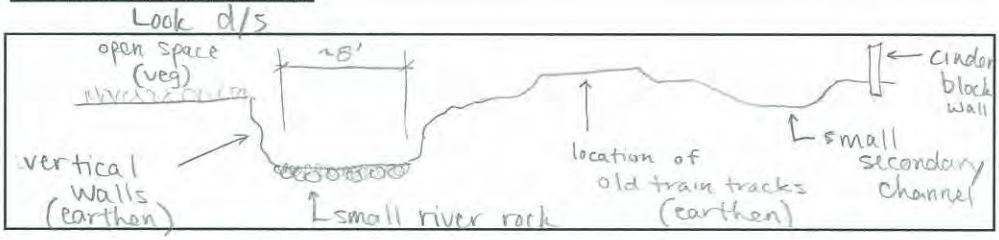
3. Site Notes and Observations:

→ channel seems stable and little sign of erosion
→ little to no bank protection
→ veg growth on channel invert.

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Trib to Zanja
X-Sec #:	
Comment:	Dearborn Bridge
Pictures:	5100 – 5113

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.025	earthen (meangering)
3. Channel Bottom	0.035	river rock
4. Left Bank	0.025	earthen (meangering)
5. Left Overbank	0.03	grass

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

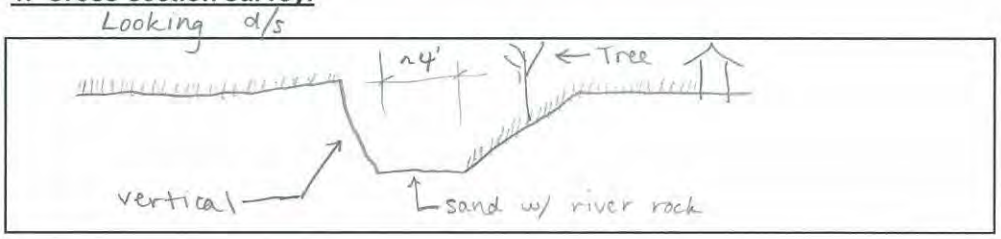
3. Site Notes and Observations:

→ invert looks stable but banks are scouring
→ plenty of space for restoration
- secondary channel could be tied into main
- bank walls could be improved and old railroad track location removed.

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Baldridge Channel
X-Sec #:	
Comment:	u/s of Jail @ Orange St
Pictures:	5063 - 5069

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	grass
2. Right Bank	0.025	grass
3. Channel Bottom	0.025	sand w/ rock
4. Left Bank	0.025	earthen
5. Left Overbank	0.02	grass

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	y
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

→ sand looks to be depositing on invert

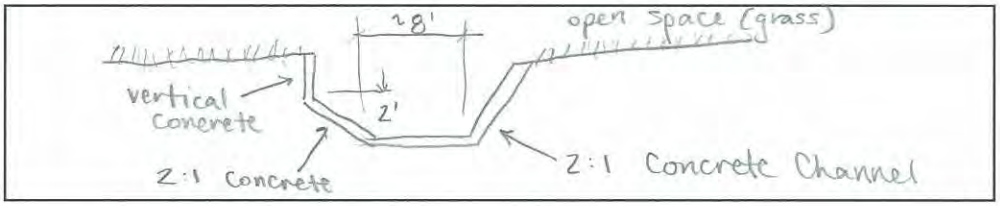
→ d/s channel has rip rap low flow section but could be restored

→ potential for ~300 ft of restoration u/s

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Baldridge Channel
X-Sec #:	
Comment:	D/s of Highland
Pictures:	5070 - 5100

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.03	grass
2. Right Bank	0.015	concrete
3. Channel Bottom	0.015	concrete
4. Left Bank	0.015	concrete
5. Left Overbank	0.03	grass

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor (see notes)
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	n

3. Site Notes and Observations:

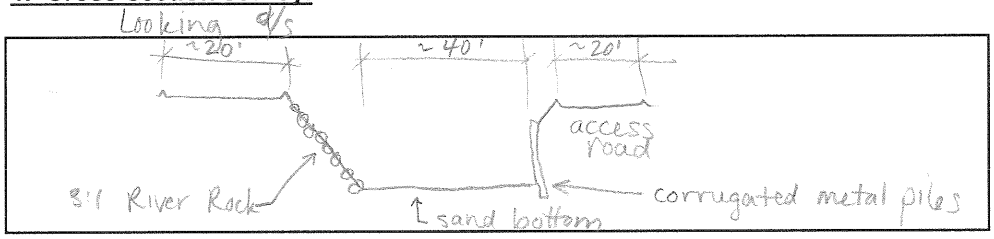
→ majority of channel intact but a portion has completely deteriorated. Large scour hole to right w/ natural channel d/s. Scour is extensive and needs emergency repair. Scour channel is 15+' deep.

→ plenty of space for restoration

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Mission Channel
X-Sec #:	Z3-RS1
Comment:	at Tippecanoe Ave Bridge
Pictures:	6184 & 6190

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.035	river rock
3. Channel Bottom	0.02	sand
4. Left Bank	0.035	piles
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	good
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

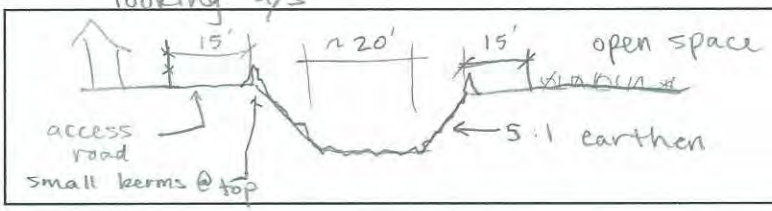
→ bank protection good in most locations but is deteriorating in some
→ sand bottom could be covering hardened invert
→ d/s drop structure is causing aggradation
→ not a lot of space for widening u/s of Tippecanoe

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Wildwood Creek
X-Sec #:	23-RS4
Comment:	@ 6th Place
Pictures:	5013-

1. Cross-section survey:

looking d/s



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.02	earthen
3. Channel Bottom	0.02	earthen
4. Left Bank	0.02	earthen
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor
2. Bank Erosion (yes or no)	Y
3. Toe Erosion (yes or no)	Y
4. Invert Degradation (yes or no)	minor
5. Sediment Source (yes or no)	Y

3. Site Notes and Observations:

→ open spaces upstream & downstream for widening

→ u/s of 6th place channel has grouted rip rap banks of very good quality

→ d/s channel is of poor quality but banks look stable. Doesn't look "finished", aka "rough engineered"
→ seems to have been recently repaired by a tractor but not finished

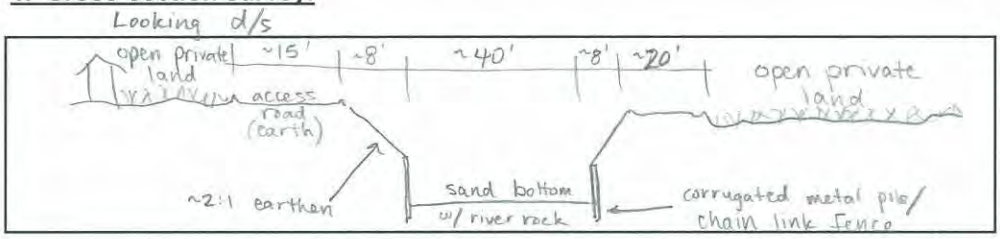
→ found out the channel is maintained regularly.

Restoration Opportunities for Hydromodification Mapping

Field Requirements

Facility:	Wilson Creek
X-Sec #:	Z3 - RS3
Comment:	Ave D
Pictures:	4990 - 5012

1. Cross-section survey:



2. Cross-Section Description:

	n-value	Protection Type*
1. Right Overbank	0.02	earthen
2. Right Bank	0.02	earthen / piles
3. Channel Bottom	0.025	sandy w/ rock
4. Left Bank	0.02	earthen / piles
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	poor (eroding)
2. Bank Erosion (yes or no)	n
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	n
5. Sediment Source (yes or no)	y

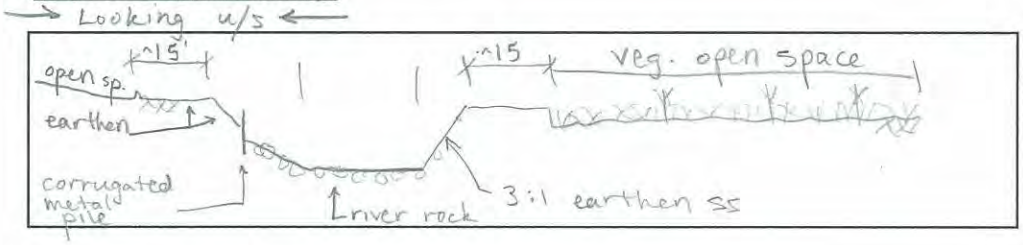
3. Site Notes and Observations:

→ drop structures every ~50'
→ channel is stabilized
→ corrugated metal piles in some locations & others only has fence. Both are deteriating
→ banks above piles/fence are intact and show very little signs of scour
→ some river rock on invert

Restoration Opportunities for Hydromodification Mapping
Field Requirements

Facility:	Wilson Creek
X-Sec #:	Z3-RS5
Comment:	Between Oak Glen Rd & Bryan St
Pictures:	4969 - 4989

1. Cross-section survey:



2. Cross-Section Description:

→ Looking u/s ←

	n-value	Protection Type*
1. Right Overbank	0.02	earthen then veg
2. Right Bank	0.03	earthen w/ some river rock
3. Channel Bottom	0.035	river rock
4. Left Bank	0.035	pile / rock
5. Left Overbank	0.02	earthen

*If Vegetated specify %

2. Cross-Section Condition:

1. Bank Protection Condition (good or poor)	good
2. Bank Erosion (yes or no)	y
3. Toe Erosion (yes or no)	n
4. Invert Degradation (yes or no)	y
5. Sediment Source (yes or no)	y

3. Site Notes and Observations:

→ lots of river rock on invert & on left bank, right bank mainly earthen w/ some rock
→ channel seems stable
→ d/s drop into culvert. drop has grouted rip rap
→ plenty of space for restoration
→ piles intact overall, scour in front of them