Darnell & ASSOCIATES

TRANSPORTATION PLANNING & TRAFFIC ENGINEERING

May 19, 2021

Joe Esposito
Estrada Land Planning
750 B Street suite 1620
San Diego, CA 92101

D&A Ref. No: 201001

Subject: Chollas Creek Trail Crosswalk Analysis at Sunshine Berardini Field Park Crossing Federal Boulevard (PTS# 669559).

Dear Mr. Esposito,

Darnell & Associates Inc., has completed our review of the proposed crossing of Federal Boulevard at Sunshine Berardini Field Park for a project in the Chollas Creek Watershed generally located along the south side of Federal Boulevard between Home Avenue and Sunshine Berardini Field. The project includes the improvement of approximately 1,885 linear feet (LF) of stream bed and the construction of a 3,100 LF Class I multi-use pedestrian and bicycle trail (the Chollas Creek Trail).

Existing Conditions

A pedestrian crossing was evaluated across Federal Boulevard between the proposed trail on the south side and Sunshine Berardini Field Park on the north side at the driveway to the Sunshine Berdini Field, located approximately 600' feet east of the Interstate 805 overcrossing and 200' feet east of the SR-94 westbound overcrossing ramp to I-805A copy of the Chollas Creek Trail and Revegetation Plans for the project is presented in A**ttachment A**. Figure 1 is a Vicinity Map and Figure 2 presents the location of the proposed Chollas Creek Trail project from Home Avenue to the Sunshine Berardini Field Park. A copy of the Chollas Creek Trail Plans are presented in Attachment A showing the proposed Chollas Creek Trail Plans and the crossing of Federal Boulevard at Sunshine Berardini Field Park. The proposed crossing at Federal Boulevard is 3,200' feet east of the Home Avenue signalized intersection and 2,200' feet west of the 47th Street signalized intersection.

Darnell & Associates, Inc. conducted site visits, collected speed surveys and daily traffic volumes on Federal Boulevard on Wednesday, November 4, 2020 at the proposed crossing location. Speed surveys found the 85th percentile speeds of vehicles approaching the crossing on Federal Boulevard where the posted speed limit is 45 mph. The surveys found the following:

- Eastbound Federal Boulevard = 50 miles per hour;
- Westbound Federal Boulevard = 44 miles per hour.

The volume of traffic on Federal Boulevard was counted as 3,469 daily vehicles, with 2,449 vehicles going eastbound and 1,020 vehicles going westbound during the period of the speed survey. A copy of the speed surveys and traffic count sheets are presented in **Attachment B**. Federal Boulevard currently has one lane of travel in each direction and parking on both sides of the road, with a curb-to-curb width of 62 feet at the proposed Federal Boulevard at Sunshine Berardini Field Park. A center turn lane is provided on Federal Boulevard to serve the Sunshine Berardini Park driveway and developmental easterly to 47th street.

In addition to the traffic data collected, Darnell & Associates, Inc. researched the City of San Diego daily traffic counts and found historical 24-hour machine count data for April 2018 to be 5,570 daily vehicles and February 18, 2020 to be 4,356 daily vehicles.

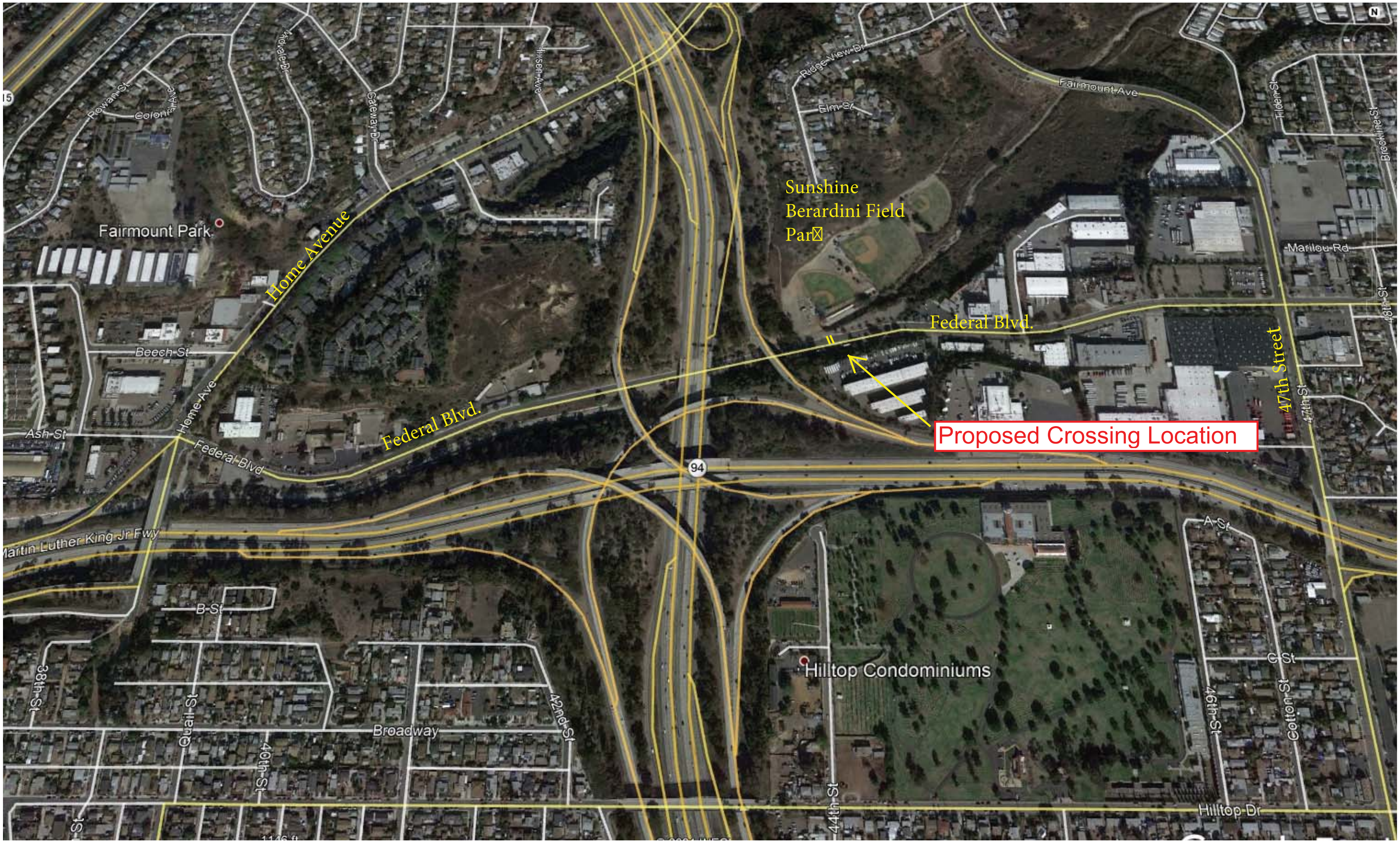


FIGURE 1 - VICINITY MAP

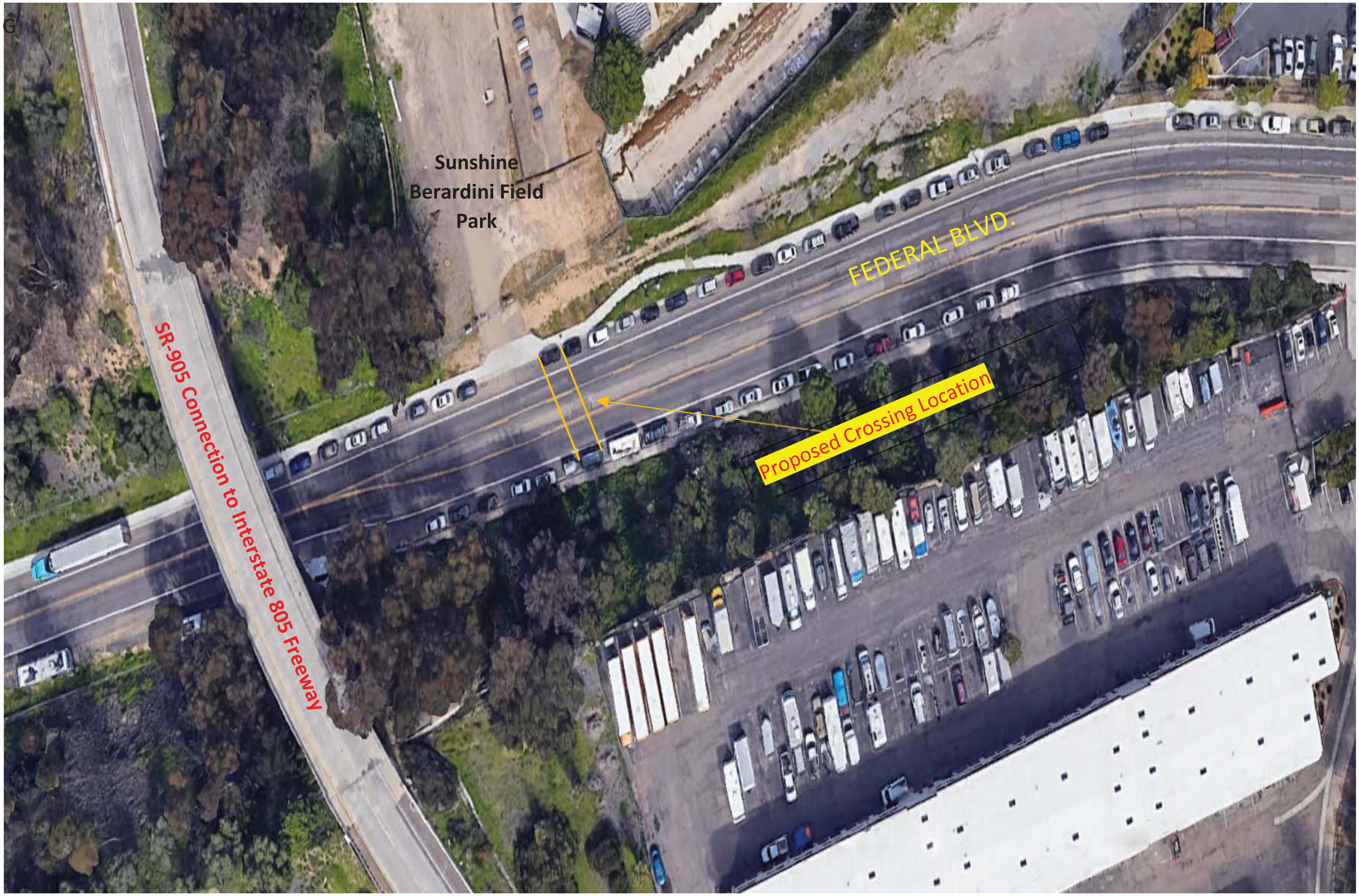


FIGURE 2 – CHOLLAS CREEK FEDERAL BOULEVARD PROPOSED CROSSING LOCATION

D&A reviewed SANDAG 2035 Traffic Forecasts for Federal Boulevard to identify the forecasted future daily traffic volumes to be 7,100 daily vehicles. Figure 3 presents the Year 2035 SANDAG Series 13 Traffic Forecasts. Based on this review, Darnell & Associates, Inc. concluded that the existing daily traffic of 3,469 vehicles may be lower due to COVID-19 conditions that are occurring at this time with fewer vehicles on the roadways.

In addition to the speed surveys and daily traffic count data, we reviewed the proposed crossing location and the activities at the existing Sunshine Berardini Field Park driveway. The Sunshine Berardini Field Park has three (3) baseball fields and contact with the operators of the field identified softball on the fields typically is limited to the evenings during the week and on the weekends. However, due to Covid-19 the use of the baseball fields and remainder of the park is limited. Several observations found activities at the Sunshine Berardini Field Park driveway to be closed at this time with the gate to the park closed and locked.

Mid-Block Crossing Warrant Analysis

The City of San Diego 2015 Pedestrian Crosswalk Guidelines were developed to expand Council Policy 200-07 to improve pedestrian and safety and enhance street crossings. Excerpts of the City of San Diego 2015 Pedestrian Crosswalk Guidelines and Council Policy 200-07 are presented in Attachment **C**. The installation of the proposed trail crossing has been evaluated; based on the City- of San Diego Pedestrian Crosswalk Guidelines 2015 to determine whether the proposed crossing meets warrants and to discuss its potential design. The City of San Diego Guidelines identify uncontrolled and controlled crosswalk warrants to be used for implementation.

The San Diego Council Policy 200-07 outlines six (6) basic warrants that must be met in order for an uncontrolled crossing to be considered for a marked crosswalk. The basic warrants are stated as item a) and the results of the analysis for the project are stated as item b) as follows:

Basic Warrants

- Pedestrian Volume Warrant: (Warrant not met)
  a) The requirement of 10 pedestrians or greater per hour,
  b) There were only 4 pedestrians observed during the analysis period.

- Approach Speed Warrant: (Warrant not met)
  a) The requirement for 85th percentile speed must be equal to or lower than 40 mph,
  b) This requirement was not met, the measured 85th percentile speed was 50 and 44 mph, which is higher than the 40 mph criteria.

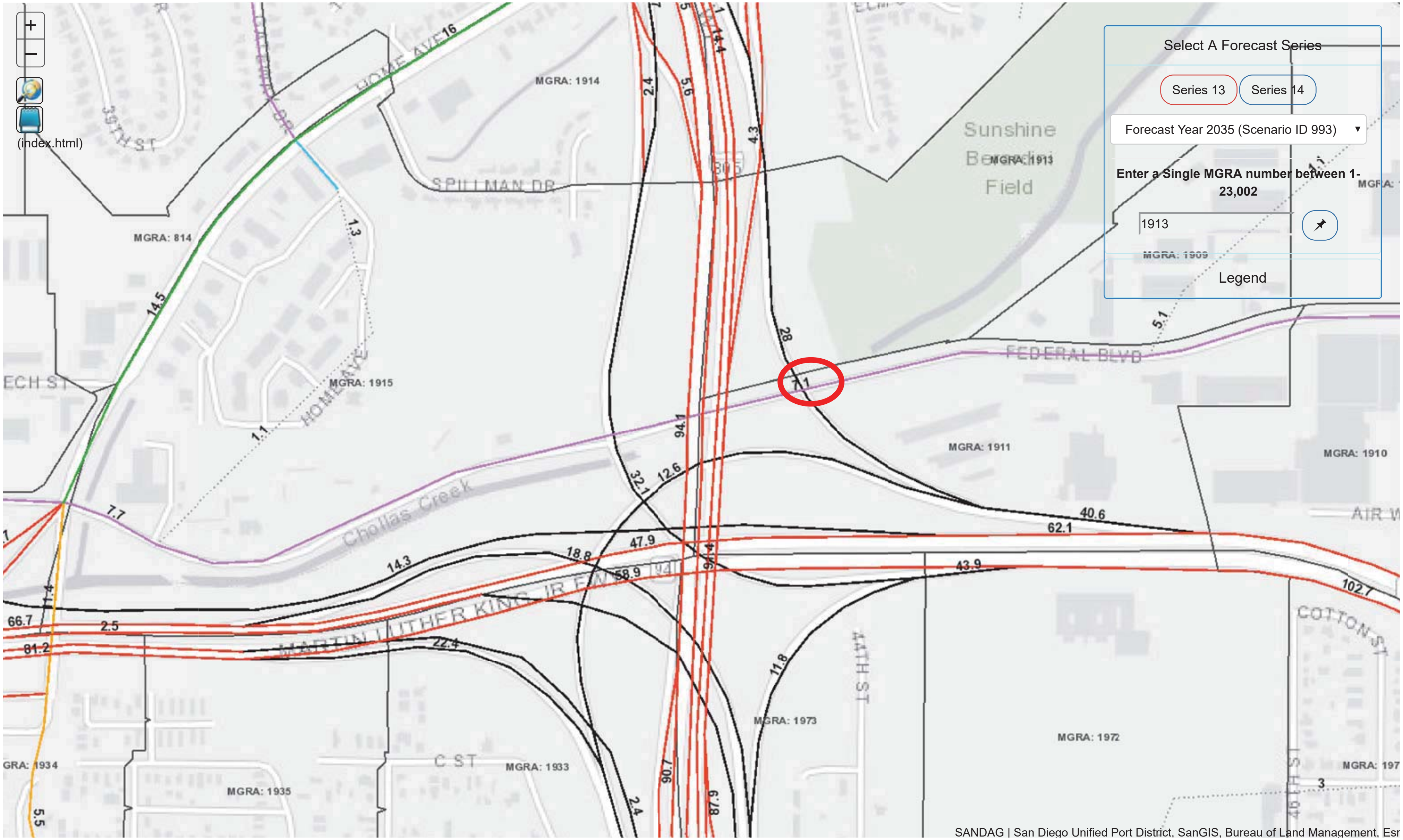
- Nearest Controlled Crossing Warrant: (Warrant Met under Existing Conditions)
  a) The requirement for the nearest crossing location is greater than 250 feet,
  b) This requirement was met, the proposed crossing location on Federal Boulevard at the Sunshine Berardini Field Park driveway is more than 300 feet to the nearest controlled intersection of Home Avenue (3,200 feet) and 47th Street (2,200 feet).

- Visibility Warrant: (Warrant not met)
  a) The requirement is that motorist must have an unrestricted view of all pedestrians in the proposed crossing from a sight distance outlined in the Council Policy 200-07 of 360’ feet for the posted 45 mph approach speed and 430’ feet for the observed 50 mph approach speed.

LEGEND

XX.X = DAILY TRAFFIC IN THOUSANDS

SOURCE: SAN DIEGO ASSOCIATION OF GOVERNMENTS (SANDAG) SERIES 13 FORECAST YEAR 2035 DAILY TRAFFIC VOLUMES



https://tfic.sandag.org

DATE: 05-19-2021

FIGURE 3 - SANDAG YEAR 2035 SERIES 13 TRAFFIC FORECASTS

b) This requirement was not met, the sight distance measured for the proposed crossing location on Federal Boulevard calculated 404’ feet looking to the east and 423’ feet looking to the west from the Sunshine Berardini Field Park driveway. Visibility in both directions is blocked by existing on-street parking. To meet the requirement would require existing on-street parking to be removed.

- Illumination Warrant: (Warrant not met)
  a) The requirement that is the proposed crossing location must have existing lighting,
  b) This requirement was not met. Therefore, the proposed crossing location is presently illuminated with a streetlight on the south side of Federal Boulevard and may require the addition of a street light on the north side of Federal Boulevard at the crossing.

- Accessibility Warrant: (Warrant not met)
  a) The requirement is that the proposed crossing must be ADA accessible,
  b) ADA Ramps are not proposed at this time as a part of the project. Therefore, ADA accessibility will not be provided.
  c) This requirement was not met.

The San Diego Council Policy 200-07 outlines four (4) Point Warrants categories that must be met. Sixteen (16) points are required in order for an uncontrolled crossing to be considered for a marked crosswalk. A total of fourteen (14) points was identified listed on Table 1 and have been discussed below. Therefore the Basic Warrant is not met. The point warrants are as follows:

Point Warrants

T1.1a Pedestrian Volume Warrant

The requirements are:

Pedestrian Volume	Warrant Points
10-25	4
26-50	8
51+	10

Points received 4.

T1.1b Latent Pedestrian Demand Warrant:

The requirements are:

(a) Proposed location is in commercial, mixed land use, or high-density residential area
(b) A pedestrian or shared use path is interrupted by restricted crossing.
(c) A pedestrian attractor/generator is directly adjacent to the proposed crosswalk as defined in the table footnotes.

Points received 4.

T1.2 General Condition Warrant:

(a) Nearest controlled crossing is greater than 300 feet from proposed crosswalk,
(b) The proposed crosswalk will position pedestrians to be better seen by motorist, but require parking removal,
(c) The proposed crosswalk will establish mid-block crossing between adjacent signalized intersection or will connect at a proposed pedestrian path,
(d) The proposed crosswalk is Located within ¼ mile of pedestrian attractors/generators as defined,
(e) There is no Bus Stop is located within 100 feet from the Sunshine Berardini Field Park driveway between Home Avenue and 47th Street. There is an MTS Bus Route on Federal Boulevard.
(f) Other factors.

Points received 6.

<u>T1.3 Time Gap Warrant: Average number of vehicular gaps per Five-Minute Period</u>

Average number of vehicle gaps per Five-Minute period is as follows:

0-0.99
1-1.99
2-2.99
3-3.99
4-4.99
5-5.99
6 or over

Average gap time observed was 7.34 seconds

Points received 0.

Conclusion:

The City of San Diego Pedestrian Crosswalk Guidelines identifies Basic and Point Warrants to be used in the analysis. Table 1 presents the Based Warrants and Point Warrants sheet for the proposed crossing. Table 2 presents the results of the gap time analysis used in the warrant analysis using gap times to cross Federal Boulevard. Table 2 presents the City of San Diego Worksheet used for this analysis. The warrant worksheet Table 1 summarizes the Basic Warrants and the Point Warrants and shows the Basic Warrants are not met and the Point Warrants are also not satisfied at this time.

TABLE 1

Council Policy 200-07: Marked Crosswalk Evaluation at Uncontrolled Locations

Location: FEDERAIL BOULEVARD AT BERARDINI PARK	
TR#:	Date: 12/07/2020
Investigator: BILL E. DARNELL	Section: DARNELL & ASSOCIATES

BASIC WARRANT		
Pedestrian Volume Warrant	4	
Latent Pedestrian Demand	N/A	
Approach Speed Warrant	EB=50 WB=44	
Visibility Warrant	ADEQUATE	
Illumination Warrant	EXISTING	✓
Nearest Controlled Crossing	>250'	✓
Accessibility Warrant	PROPOSED	✓

Basic Warrant Met	
Basic Warrant Not Met	✓

Point Warrant		14
T1.1a Pedestrian Volume Warrant		4
10 – 25	4	✓
26 – 50	8	
51+	10	
T1.1b Latent Pedestrian Demand Warrant		4
(a) The proposed location is in a commercial, mixed land use, or high density residential area.	3	
(b) A pedestrian or shared use path is interrupted by a restricted crossing.	3	
(c) A pedestrian attracting land use is directly adjacent to the proposed crosswalk as defined in the attached notes.	4	✓
T1.2 General Condition Warrant		6
(a) Nearest controlled crossing is greater than 300 feet from proposed crosswalk.	3	✓
(b) Will position pedestrians to be better seen by motorists.	3	
(c) Will establish mid-block crossing between adjacent signalized intersections or will connect an existing pedestrian path.	3	
(d) Is located within 1/4 mile of pedestrian attractors/generators as defined in the attached notes.	3	✓
(e) Bus stop is located within 100 feet from the Berardini Park proposed crosswalk.	3	
(f) Other factors.	3	
T1.3 Gap Time Warrant		0
0 – 0.99	0	
1 – 1.99	1	
2 – 2.99	8	
3 – 3.99	10	
4 – 4.99	8	
5 – 5.99	1	
6 or over	0	✓

Notes:

POSTED SPEED LIMIT FOR BOTH DIRECTIONS OF TRAFFIC IS 45 MPH
85TH IS 50 MPH FOR EASTBOUND AND 44MPH FOR WESTBOUND DIRECTIONS OF TRAFFIC (85TH TAKEN FROM SPEED SURVEY)
ADT FROM MACHINE COUNT 3,469
ONE TRAVEL LANE AND BIKE LANE IN EACH DIRECTION OF TRAFFIC
ACCESS TO/FFROM BERARDINI PARK IS LOCATED ADJACENT TO THE PROPOSED CROSSING
P E DGA P =4 P M -5 A M

ADT	3,469
CROSSING DISTANCE	62'

Point Warrant Met	
Point Warrant Not Met	✓

Table 2 - Federal Boulevard at Sunshine Berardini Access			
	Observed Pedestrian Gaps		
Time	**Duration Gaps Observed (seconds) (a)**	**Total (seconds)**	**Gaps/ 5 Min (b)**
4:00 PM	26, 22, 18, 31	107	6.9
4:05 PM	17, 39, 26, 36, 18	136	8.8
4:10 PM	28, 18, 27, 17, 16	106	6.8
4:15 PM	18, 36, 42, 28, 32	156	10.1
4:20 PM	16, 36, 27, 18, 20	117	7.5
4:25 PM	36, 27, 42, 19	124	8.0
4:30 PM	50, 18, 20, 43	131	8.5
4:35 PM	28, 27, 62, 18	135	8.7
4:40 PM	21, 18, 41, 36, 16	132	8.5
4:45 PM	24, 26, 27, 42, 18	137	8.8
4:50 PM	28, 28, 36, 17	109	7.0
4:55 PM	32, 36, 16, 24	108	6.9
	Total:	**1,366 seconds**	**7.34 seconds**

Notes:

a) Gaps in traffic that exceed 15.5 seconds (62 ft ÷ 4 ft /sec)

b) Average number of gaps per five-minute period (total Gap Time ÷ Available Gap/Time Period)

c) During the observation period a total of 4 pedestrians was observed. The Chollas Creek Trail designers provided an estate of 10 or more pedestrians using the Chollas Creek Trail could cross the road.

The final step in our analysis evaluated the sight distance for pedestrians that would cross Federal Boulevard and vehicles exiting the Sunshine Berardini Field Park driveway was evaluated per AASHTO Guidelines. The visibility of pedestrians was examined, based on corner sight distance for the 50 mile per hour (85th percentile) speed eastbound on Federal Boulevard and westbound 45 miles per hour (85th percentile) speed on Federal Boulevard. Review of the City of San Diego's Pedestrian Crosswalk Guidelines concludes that in the future, when traffic volumes return to typical conditions and traffic volumes return to previous levels, and the Sunshine Berardini Field Park is allowed to return to normal operating conditions, the warrants for uncontrolled and controlled crossing should be re-evaluated.

An uncontrolled crossing is considered a location where the crossing is not marked and/or signed and the pedestrian, cyclist and/or horse riders cannot give a physical signal in order to stop for them to cross. Controlled crossings are ones that pedestrians, cyclist, and or horse riders have the power to activate controls to warn motorist of the crossing.

Corner Sight Distance

Corner sight distance was calculated using AASHTO Corner Sight Distance criteria to identify the need to restrict parking on Federal Boulevard approaching the driveway to accommodate vehicles to enter Federal Boulevard and pedestrians to cross. Table 3 presents the AASHTO Corner Sight Distance calculations for the Sunshine Berardini Field Park Driveway and are shown graphically on Figure 4.

Table 3 - Corner Sight Distance Requirements Per AASHTO for the Sunshine Berardini Field Park Driveway

Location	Speed - V (a) (mph)	Reaction Time - t (seconds)	Deceleration Rate - a (ft/sec^2)	Grade (%)	Reaction Distance - d_1 (feet)	Braking Distance d_2 (feet)	Required Vehicle Corner Sight Distance ($d_1 + d_2$) (feet) (a)
FEDERAL BOULEVARD							
(Eastbound Traffic)	50 (PS)	2.5	11.2	N/A	183.8'	239.6'	423'
(Westbound Traffic)	45 (DS)	2.5	11.2	-6.5%	165.4'	239.2'	404'

Review of Table 3 shows 423 feet of corner sight distance is required looking west at eastbound traffic from the Sunshine Berardini Field Park Driveway. Looking east from the Sunshine Berardini Field Park Driveway at westbound traffic there is 404 feet of corner sight distance required. Figure 4 was then prepared to show the corner sight distance and location of recommended red curbs to accommodate vehicles entering Federal Boulevard from the park driveway. Review of Figure 4 identifies the need for 240 feet of red curb and/or "No Stopping" restrictions looking east and 171 feet of red curb looking west on the northside of Federal Boulevard .

FIGURE 4 - CORNER SIGHT DISTANCE AND RED CURB FOR THE SUNSHINE BERARDINI FIELD PARK DRIVEWAY

The recommended red curb is only shown along the north side of Federal Boulevard.

Table 4 was then prepared to show the recommended red curb/ no stopping restrictions and estimated parking spaces to be removed to accommodate adequate visibility of potential pedestrians in the area of the Sunshine Berardini Field Park driveway.

Table 4 – Parking Restrictions Recommended for the Sunshine Berardini Field Park Driveway

Location	Corner Sight Distance	"Red Curb/No Stopping" Restrictions	Estimated Parking Spaces to be Removed(a)
North side of Federal Boulevard			
Looking East	404' Feet	240 Feet	7
Looking West	423' Feet	171 Feet	8
			15

(a) Based on 20 feet of red curb for each vehicle.

Review of Table 4 identifies the loss of seven (7) parking spaces east of the driveway and eight (8) parking spaces west of the driveway.

The line of sight for the project driveway was measured from a point in the center of the driveway ten (10') feet from the curb to the center of the approaching travel lane. To identify the recommended red curb restriction, the line of sight for the driveway was reviewed to determine the recommended distance. The line of sight is eight (8') feet from the curb line.

To identify the recommended red curb for the pedestrian crossing the measurement was taken from the curb line of the crossing to accommodate the visibility of the pedestrian to see approaching vehicles and the vehicle to see the pedestrian entering the crossing.

Summary

- To accommodate vehicles exiting the Sunshine Berardini Field Park driveway red curb on the north side is recommended as follows:

  West of driveway 171 feet
  East of driveway 240 feet

- The installation of a marked Pedestrian Crossing of Federal Boulevard as shown on Figure 2 is not recommended at this time, however red curb markings and/or “No Stopping” restrictions on the north side of Federal Boulevard is recommended for vehicles exiting the Sunshine Berardini Field Park driveway.

- Table 4 identifies the Corner Sight Distance requirements for the Sunshine Berardini Field Park driveway and shows an estimated existing 15 parking spaces along the north side of Federal Blvd would need to be removed.

- In the future, when traffic volumes return to more typical levels and activities at the Sunshine Berardini Field Park are resumed, the proposed crossing should be re-evaluated to determine if a marked and signed crossing including the applicable warning devices such as a Pedestrian Hybrid Beacon should be considered.

Sincerely,

DARNELL & ASSOCIATES,

Bill E. Darnell, P.E.
RCE: 22338

BED/jam
~$1001 - Revised Federal Blvd-Chollas Creek Trail Crosswalk Analysis-05-19-21.doc

May 20, 2021
(Date)

Attachment A

- Chollas Creek Trail and Revegetation Plans

GENERAL NOTES (see additional notes this sheet)

1. APPROVAL OF THESE PLANS BY THE CITY ENGINEER DOES NOT AUTHORIZE ANY WORK TO BE PERFORMED UNTIL A PERMIT HAS BEEN ISSUED.

2. UPON ISSUANCE OF A PERMIT, NO WORK WILL BE PERMITTED ON WEEKENDS OR HOLIDAYS UNLESS APPROVED BY TRAFFIC CONTROL PERMIT FROM THE DEVELOPMENT SERVICES DEPARTMENT.

3. THE APPROVAL OF THIS PLAN OR ISSUANCE OF A PERMIT BY THE CITY OF SAN DIEGO DOES NOT AUTHORIZE THE PERMIT HOLDER OR OWNER TO VIOLATE ANY FEDERAL, STATE OR CITY LAWS, ORDINANCES, REGULATIONS, OR POLICIES.

4. IMPORTANT NOTICE: SECTION 4216 OF THE GOVERNMENT CODE REQUIRES A DIG ALERT IDENTIFICATION NUMBER ISSUED BEFORE A "PERMIT TO EXCAVATE" WILL BE VALID. FOR YOUR DIG ALERT I.D. NUMBER, CALL UNDERGROUND SERVICE ALERT, TOLL FREE (800) 422-4133, TWO DAYS BEFORE YOU DIG.

5. CONTRACTOR SHALL BE RESPONSIBLE FOR POTHOLING AND LOCATING ALL EXISTING UTILITIES THAT CROSS THE PROPOSED TRENCH LINE WHILE MAINTAINING A 1 FOOT VERTICAL CLEARANCE.

6. "PUBLIC IMPROVEMENT SUBJECT TO DESUETUDE OR DAMAGE." IF REPAIR OR REPLACEMENT OF SUCH PUBLIC IMPROVEMENTS IS REQUIRED, CONTRACTOR SHALL OBTAIN THE REQUIRED PERMITS FOR WORK IN THE PUBLIC RIGHT-OF-WAY, SATISFACTORY TO THE PERMIT ISSUING AUTHORITY.

7. DEVIATIONS FROM THESE SIGNED PLANS WILL NOT BE ALLOWED UNLESS A CONSTRUCTION CHANGE IS APPROVED BY THE CITY ENGINEER OR THE CHANGE IS REQUIRED BY THE RESIDENT ENGINEER.

8. CONTRACTOR SHALL REPLACE OR REPAIR ALL TRAFFIC SIGNAL LOOPS, CONDUITS, AND LANE STRIPING DAMAGED DURING CONSTRUCTION.

9. PRIOR TO SITE DISTURBANCE, CONTRACTOR SHALL MAKE ARRANGEMENTS FOR A PRECONSTRUCTION MEETING WITH THE CITY OF SAN DIEGO, CONSTRUCTION MANAGEMENT AND FIELD SERVICES DIVISION (858) 627-3200.

10. CONTRACTOR SHALL ONLY PERFORM SITE SURVEY AND UTILITY MARK OUT SERVICES PRIOR TO THE PRECONSTRUCTION MEETING.

11. CONTRACTOR SHALL IMPLEMENT AN EROSION CONTROL PROGRAM DURING THE PROJECT'S CONSTRUCTION ACTIVITIES. THE PROGRAM SHALL COMPLY WITH ALL APPLICABLE REQUIREMENTS OF THE STATE WATER RESOURCES CONTROL BOARD.

12. CONTRACTOR SHALL HAVE EMERGENCY MATERIAL AND EQUIPMENT ON HAND FOR UNFORESEEN SITUATIONS, SUCH AS DAMAGE TO UNDERGROUND WATER, SEWER, AND STORM DRAIN FACILITIES WHERE FLOW MAY GENERATE EROSION AND SEDIMENT POLLUTION.

13. AN AS-GRADED GEOTECHNICAL REPORT AND SET OF THE REDLINE "AS-BUILT" GRADING PLANS SHALL BE SUBMITTED TO AREA 3 ON THE THIRD FLOOR OF DEVELOPMENT SERVICES WITHIN 30 CALENDAR DAYS OF THE COMPLETION OF GRADING. AN ADDITIONAL SET SHALL BE PROVIDED TO THE RESIDENT ENGINEER OF THE CONSTRUCTION MANAGEMENT & FIELD SERVICES DIVISION AT 9573 CHESAPEAKE DRIVE, SAN DIEGO, CA 92123.

14. "AS-BUILT" DRAWINGS MUST BE SUBMITTED TO THE RESIDENT ENGINEER PRIOR TO ACCEPTANCE OF THIS PROJECT BY THE CITY OF SAN DIEGO.

15. MANHOLES AND PULL BOX COVER SHALL BE LABELED WITH NAME OF COMPANY.

16. CONTRACTOR SHALL PROVIDE RED-LINE DRAWINGS IN ACCORDANCE WITH 2-5.4 OF THE WHITEBOOK, "RED-LINES AND RECORD DOCUMENTS."

17. CONTRACTOR SHALL MAINTAIN A MINIMUM OF 1 FOOT VERTICAL SEPARATION TO ALL UTILITIES UNLESS OTHERWISE SPECIFIED ON THE PLANS.

18. CONTRACTOR SHALL REMOVE AND REPLACE ALL UTILITY BOXES SERVING AS HANDHOLES THAT ARE NOT IN "AS-NEW" CONDITION IN PROPOSED SIDEWALK, DAMAGED BOXES, OR THOSE THAT ARE NOT IN COMPLIANCE WITH CURRENT CODE SHALL BE REMOVED AND REPLACED WITH NEW BOXES, INCLUDING WATER, SEWER, TRAFFIC SIGNALS, STREET LIGHTS, DRY UTILITIES-SDG&E, COX, ETC. ALL NEW METAL LIDS SHALL BE SLIP RESISTANT AND INSTALLED FLUSH WITH PROPOSED SIDEWALK GRADE. IF A SLIP RESISTANT METAL LID IS NOT COMMERCIALLY AVAILABLE FOR THAT USE, NEW BOXES AND LIDS SHALL BE INSTALLED.

19. THE AREA WHICH IS DEFINED AS A NON GRADING AREA AND WHICH IS NOT TO BE DISTURBED SHALL BE STAKED PRIOR TO START OF THE WORK. THE PERMIT APPLICANT AND ALL OF THEIR REPRESENTATIVES OR CONTRACTORS SHALL COMPLY WITH THE REQUIREMENTS FOR PROTECTION OF THIS AREA AS REQUIRED BY ANY APPLICABLE AGENCY. ISSUANCE OF THE CITY'S GRADING PERMIT SHALL NOT RELIEVE THE APPLICANT OR ANY OF THEIR REPRESENTATIVES OR CONTRACTORS FROM COMPLYING WITH ANY STATE OR FEDERAL REQUIREMENTS BY AGENCIES INCLUDING, BUT NOT LIMITED TO, CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, CALIFORNIA DEPARTMENT OF FISH AND GAME. COMPLIANCE MAY INCLUDE OBTAINING PERMITS, OTHER AUTHORIZATIONS, OR COMPLIANCE WITH MANDATES BY ANY APPLICABLE STATE OR FEDERAL AGENCY.

20. PRIOR TO CONSTRUCTION, SURVEY MONUMENTS (HORIZONTAL AND VERTICAL) THAT ARE LOCATED IN THE CONSTRUCTION AREA SHALL BE TIED-OUT AND REFERENCED BY A LAND SURVEYOR.

21. UPON COMPLETION OF CONSTRUCTION, ALL DESTROYED SURVEY MONUMENTS ARE REQUIRED TO BE REPLACED, AND A CORNER RECORD OR RECORD OF SURVEY SHALL BE PREPARED AND FILED WITH THE COUNTY SURVEYOR AS REQUIRED BY THE PROFESSIONAL LAND SURVEYOR ACT, SECTION 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA.

MONUMENT PRESERVATION CERTIFICATION

THE PERMITTEE SHALL BE RESPONSIBLE FOR THE COST OF REPLACING ALL SURVEY MONUMENTS DESTROYED BY CONSTRUCTION. IF A VERTICAL CONTROL MONUMENT IS TO BE DISTURBED OR DESTROYED, THE CITY OF SAN DIEGO FIELD SURVEY SECTION SHALL BE NOTIFIED IN WRITING AT LEAST 7 DAYS PRIOR TO DEMOLITION/CONSTRUCTION.

☐ THE TYPE OF CONSTRUCTION WILL NOT AFFECT ANY SURVEY MONUMENTS (THIS LINE IS FOR PROJECTS THAT ARE PROPOSING NO DEMOLITION, TRENCHING, ASSOCIATED WITH A CIP, ETC)

NAME DATE

PRIOR TO PERMIT ISSUANCE, THE PERMITTEE SHALL RETAIN THE SERVICE OF A PROFESSIONAL LAND SURVEYOR OR CIVIL ENGINEER AUTHORIZED TO PRACTICE LAND SURVEYING WHO WILL BE RESPONSIBLE FOR MONUMENT PRESERVATION AND SHALL PROVIDE A CORNER RECORD OR RECORD OF SURVEY TO THE COUNTY SURVEYOR AS REQUIRED BY THE PROFESSIONAL LAND SURVEYORS ACT, IF APPLICABLE. (SECTION 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA)

I HAVE INSPECTED THE SITE AND DETERMINED THAT:

☐ NO SURVEY MONUMENTS WERE FOUND WITHIN THE LIMITS OF WORK
☐ SURVEY MONUMENTS EXISTING IN OR NEAR LIMITS OF WORK WILL BE PROTECTED IN PLACE
☐ SURVEY MONUMENTS HAVE BEEN TIED OUT AND A FINAL OR PARCEL MAP WILL BE FILED (NO CORNER RECORD OR RECORD OF SURVEY WILL BE REQUIRED)
☐ OTHER AGENCY SURVEY MONUMENT (CORNER RECORD OR RECORD OF SURVEY MAY NOT BE REQUIRED). AGENCY HAS BEEN NOTIFIED OF POSSIBLE MONUMENT DESTRUCTION AND A LETTER PROVIDED TO CITY
☐ A PRE-CONSTRUCTION CORNER RECORD (OR RECORD OF SURVEY) FOR SURVEY MONUMENTS FOUND WITHIN THE LIMITS OF WORK HAS BEEN FILED.

CORNER RECORD #_____________ OR RECORD OF SURVEY #_____________

NAME P.L.S. / R.C.E. NO. XXXXX EXP. XX-XX-XX DATE

POST CONSTRUCTION CORNER RECORD (AS-BUILT ITEM)

☐ POST CONSTRUCTION CORNER RECORD FOR SURVEY MONUMENTS DESTROYED DURING CONSTRUCTION AND REPLACED AFTER CONSTRUCTION.

CORNER RECORD #_____________ OR RECORD OF SURVEY #_____________

NAME P.L.S. / R.C.E. NO. XXXXX EXP. XX-XX-XX DATE

IMPROVEMENT PLANS FOR: FEDERAL BLVD CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

VICINITY MAP

NO SCALE

GRADING + GEOTECHNICAL SPECIFICATIONS

1. ALL GRADING SHALL BE CONDUCTED UNDER THE OBSERVATION AND TESTING BY A QUALIFIED PROFESSIONAL ENGINEER AND, IF REQUIRED, A QUALIFIED PROFESSIONAL GEOLOGIST. ALL GRADING MUST BE PERFORMED IN ACCORDANCE WITH APPLICABLE CITY ORDINANCES AND THE RECOMMENDATIONS AND SPECIFICATIONS SET FORTH IN THE PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT(S) ENTITLED:

UPDATE GEOTECHNICAL EVALUATION
FEDERAL BOULEVARD DECHANNELIZATION AND TRAIL PROJECT
SAN DIEGO, CALIFORNIA

NINYO AND MOORE
OCTOBER 16, 2020 | PROJECT NO. 109052001

THESE DOCUMENTS WILL BE FILED IN THE RECORDS SECTION OF DEVELOPMENT SERVICES UNDER THE PROJECT NUMBER INDICATED IN THE TITLE BLOCK OF THESE PLANS.

2. ALL FILL SOIL SHALL BE COMPACTED TO A MINIMUM OF 90% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY THE MOST RECENT VERSION OF A.S.T.M. D-1557 OR AN APPROVED ALTERNATIVE STANDARD.

3. AT THE COMPLETION OF THE GRADING OPERATIONS FOR THE EARTHWORK SHOWN ON THIS PLAN, AN AS-GRADED GEOTECHNICAL REPORT SHALL BE PREPARED IN ACCORDANCE WITH THE MOST RECENT EDITION OF THE CITY OF SAN DIEGO GUIDELINES FOR GEOTECHNICAL REPORTS. THE FINAL "AS-GRADED" GEOTECHNICAL REPORT SHALL BE SUBMITTED IN ACCORDANCE WITH THE GENERAL NOTES ON THESE PLANS WITHIN 30 DAYS OF THE COMPLETION OF GRADING. WHERE GEOLOGIC INSPECTION IS INDICATED IN THE PERMIT, PLANS, SPECIFICATIONS, OR GEOTECHNICAL REPORT(S), THE FINAL "AS-GRADED" GEOTECHNICAL REPORT MUST ALSO BE REVIEWED AND SIGNED BY A QUALIFIED PROFESSIONAL GEOLOGIST.

4. THE COMPANY OR COMPANIES REPRESENTED BY THE INDIVIDUALS SIGNING ITEM NO. 5 OF THIS CERTIFICATE IS/ARE THE GEOTECHNICAL CONSULTANT(S) OF RECORD. IF THE GEOTECHNICAL CONSULTANT OF RECORD IS CHANGED FOR THE PROJECT, THE WORK SHALL BE STOPPED UNTIL THE REPLACEMENT HAS SUBMITTED AN ACCEPTABLE TRANSFER OF GEOTECHNICAL CONSULTANT OF RECORD DECLARATION PREPARED IN ACCORDANCE WITH THE MOST RECENT EDITION OF THE CITY OF SAN DIEGO GUIDELINES FOR GEOTECHNICAL REPORTS. IT SHALL BE THE DUTY OF THE PERMITTEE TO NOTIFY THE RESIDENT ENGINEER AND THE GEOLOGY SECTION OF DEVELOPMENT SERVICES IN WRITING OF SUCH CHANGE PRIOR TO THE RECOMMENCEMENT OF GRADING.

5. THESE GRADING PLANS HAVE BEEN REVIEWED BY THE UNDERSIGNED AND FOUND TO BE IN CONFORMANCE WITH THE RECOMMENDATIONS AND SPECIFICATIONS CONTAINED IN THE REFERENCED GEOTECHNICAL REPORT(S) PREPARED FOR THIS PROJECT.

(SIGNATURE)
JEFFERY T. KENT PE, GE DATE

(SIGNATURE)
CHRISTINA A. TRETINJAK PG, CEG DATE

NINYO AND MOORE
5710 RUFFIN ROAD, SAN DIEGO, CA 92123
(858) 576-1000

DECLARATION OF RESPONSIBLE CHARGE

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

OWNERS/APPLICANTS

CITY OF SAN DIEGO STORMWATER DIVISION	CALTRANS
1250 SIXTH AVENUE	4050 TAYLOR STREET
(858) 541-4336	(619) 688-6681

REFERENCE DRAWINGS

DWG 14805-3-D	ABANDONED SEWER	(1974)
DWG 24874-7-D	HOME AVE. TRUNK SEWER	(1999)
DWG 14762-2-D	12" AC WATER MAIN	(1971)

SITE ADDRESS

PUBLIC LANDS – CHOLLAS CREEK CHANNEL BETWEEN HOME AVE & I-805 RAMP

TOPOGRAPHY SOURCE

TOPO PROVIDED THROUGH STATE OF CALIFORNIA DEPT. OF TRANSPORTATION & DIGITAL MAPPING INC., 21062 BROOKHURST #101, HUNTINGTON BEACH, CA 92646
AERIAL FLOWN 11-16-2006

BENCHMARK

CITY OF SAN DIEGO BENCHMARK, VERTICAL CONTROL BOOK PAGE 312
BRASS PLUG AT THE SW CORNER OF HOME AVE. AND BEECH ST.
ELEVATION: 97.717 FT. DATUM: MSL

ASSESSORS PARCEL NUMBER

N/A

ADDITIONAL NOTES

1. THE CONTRACTOR WILL BE RESPONSIBLE FOR PROTECTING IN PLACE ALL EXISTING PUBLIC WATER AND SEWER FACILITIES.
2. APPLICANT WILL OBTAIN ALL NECESSARY PERMITS/APPROVALS/AUTHORIZATIONS FOR PROPOSED WORK WITHIN CALTRANS JURISDICTION.
3. PER MUN. CODE (142.0610 a) ALL PUBLIC IMPROVEMENTS ADJACENT TO THE SITE MUST BE PER CURRENT CITY OF SAN DIEGO STANDARDS.
4. THE ENTIRE PROPOSED TRAIL WILL BE MAINTAINED BY CITY OF SAN DIEGO PARKS AND RECREATION.

GRADING QUANTITIES

GRADED AREA	4.8 [ACRES]	MAX. CUT DEPTH	16 [FT]
CUT QUANTITIES	45,000 [CYD]	MAX CUT SLOPE RATIO (2:1MAX)	2:1
FILL QUANTITIES	0 [CYD]	MAX. FILL DEPTH	N/A [FT]
IMPORT/EXPORT	45,000 [CYD]	MAX FILL SLOPE RATIO (2:1MAX)	N/A

THIS PROJECT PROPOSES TO EXPORT 44,000 CUBIC YARDS OF MATERIAL FROM THIS SITE. ALL EXPORT MATERIAL SHALL BE DISCHARGED TO A LEGAL DISPOSAL SITE. THE APPROVAL OF THIS PROJECT DOES NOT ALLOW PROCESSING AND SALE OF THE MATERIAL. ALL SUCH ACTIVITIES REQUIRE A SEPARATE CONDITIONAL USE PERMIT.

CONSTRUCTION STORM WATER PROTECTION NOTES

1. TOTAL SITE DISTURBANCE AREA (ACRES) ____6.9____
WATERSHED: PUEBLO SAN DIEGO
HYDRAULIC SUB AREA NAME AND NUMBER: CHOLLAS 908.22

2. THE PROJECT SHALL COMPLY WITH THE REQUIREMENTS OF THE
☐ WPCP
THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NUMBER R9-2013-0001 AND SUBSEQUENT AMENDMENTS..

☐ SWPPP
THE PROJECT IS SUBJECT TO MUNICIPAL STORM WATER PERMIT NUMBER R9-2013-0001 AND CONSTRUCTION GENERAL PERMIT ORDER NUMBER 2009-009-DWQ AS AMENDED BY ORDER 2010-0014 DWQ AND 2012-0006-DWQ

TRADITIONAL: RISK LEVEL ☐ 1 ☐ 2 ☐ 3
LUP RISK LEVEL ☐ 1 ☐ 2 ☐ 3
WDID NO: ____________________

3. CONSTRUCTION SITE PRIORITY
☐ ASBS ☐ HIGH ☐ MEDIUM ☐ LOW

WORK TO BE DONE

THE PUBLIC IMPROVEMENTS SHOWN ON THESE PLANS SHALL BE CONSTRUCTED ACCORDING TO THE FOLLOWING STANDARD SPECIFICATIONS AND STANDARD DRAWINGS OF THE CITY OF SAN DIEGO.

STANDARD SPECIFICATIONS:

DOCUMENT NO.	DESCRIPTION
PWPI010119-01	STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (GREENBOOK), 2018 EDITION
PWPI010119-02	CITY OF SAN DIEGO STANDARD SPECIFICATIONS FOR PUBLICWORKS CONSTRUCTION (WHITEBOOK), 2018 EDITION
PWPI010119-04	CITYWIDE COMPUTER AIDED DESIGN AND DRAFTING (CADD) STANDARDS, 2018 EDITION
PWPI030119-07	CALIFORNIA DEPARTMENT OF TRANSPORTATION MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (REVISION 3), 2014 EDITION
PWPI030119-05	CALIFORNIA DEPARTMENT OF TRANSPORTATION U.S CUSTOMARY STANDARD SPECIFICATIONS, 2018 EDITION

STANDARD DRAWINGS:

DOCUMENT NO.	DESCRIPTION
PWPI010119-03	CITY OF SAN DIEGO STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, 2018 EDITION
PWPI030119-06	CALIFORNIA DEPARTMENT OF TRANSPORTATION U.S CUSTOMARY STANDARD PLANS, 2018 EDITION

LEGEND

PROPOSED IMPROVEMENTS

IMPROVEMENTS	STANDARD DWG. NO.	SYMBOL
CONCRETE DEMOLITION		
NATURAL STONE CHANNEL		
DROP STRUCTURE		
GRAVITY BLOCK RETAINING WALL		
TRAIL		
D-34 HEADWALL	D-34	
AC BERM	G-5, TYPE A	
SEWER RELOCATION		
SEWER MANHOLE REBUILD		
24" MANHOLE FRAME & COVER LIGHT DUTY	DWG M-02	
TRENCH TYPE G, H & I BACKFILL FOR DRY UTILITY	DWG SDG-119	

EXISTING IMPROVEMENTS

ITEM	SYMBOL
STORM DRAIN	
FIRE HYDRANT	FH
SEWER MAIN & MANHOLES	S
WATER MAIN	W
JOINT TRENCH GAS COND. ELECTRIC, CATV	E
AT&T CONDUIT PACKAGE	AT&T
STREET LIGHT	SL

SHEET INDEX

SHEET DESCRIPTION	SHEET #/RANGE
TITLE SHEET & NOTES	1-2
CEQA	3
DEMOLITION PLAN	4
PROPOSED CHANNEL CONSTRUCTION PLANS	5-6
DETAIL PLANS	7-8
FEMA FLOODPLAIN DATA	9
CHANNEL CROSS SECTIONS	10-11
STREET AND CHANNEL CROSS SECTIONS	12
RETAINING WALL DETAILS	13
LANDSCAPE PLANS	14-18

ENGINEERING PERMIT NO: ________________
DISCRETIONARY PERMIT NO: ______________ RETAINING WALL PROJECT NO: ___________

MAY 19, 2021

CONSTRUCTION CHANGE TABLE

CHANGE	DATE	EFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.	PROJECT NO.

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TITLE SHEET FOR:
FEDERAL BLVD CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 1 OF 22 SHEETS

PROJECT NO. ________

FOR CITY ENGINEER DATE

V.T.M. ________

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

CONTRACTOR ________ DATE STARTED ________
INSPECTOR ________ DATE COMPLETED ________

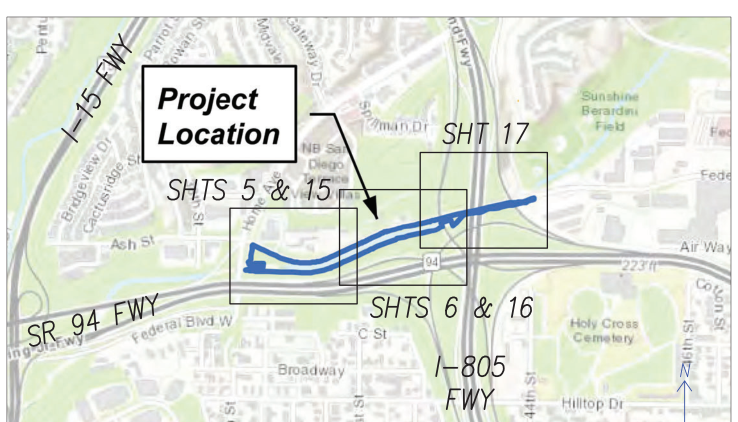
XXXXX-1-D

(REV 5/13/2019)

PROJECT NARRATIVE

- REMOVE 2,030 LINEAR FEET OF TRAPEZOIDAL CONCRETE CHANNEL IN CHOLLAS CREEK AND REPLACE WITH NATURALIZED CREEK.
- LINE RESTORED STREAM WITH NATURAL STONE AND NATURAL GRADE CONTROL STRUCTURES FOR GRADE STABILITY.
- WIDEN CHANNEL FROM EXISTING BOTTOM WIDTH OF 30 FEET TO A WIDTH OF 50 TO 68 FEET.
- LINE CHANNEL BOTTOM WITH NATURAL STONE, LIGHT CLASS ($W_{50}\approx$200 LB, $D_{50}\approx$16-INCHES)
- INSTALL 5 UNGROUTED NATURAL-STONE DROP STRUCTURES USING 1/2-TON STONE, 1-TON ROCK, AND 2-TON ROCK
- CONSTRUCT CONCRETE ENERGY DISSIPATOR AT UPSTREAM END OF PROJECT WITH 1-TON AND 2-TON STONE DOWNSTREAM.
- CONSTRUCT TRANSITION FROM NATURAL STONE TO CONCRETE CHANNEL ABOUT 200 FEET UPSTREAM FROM HOME AVE.
- NORTH BANK OF CHANNEL WILL BE STONE-LINED, GRADED AT A 2:1 SLOPE, AND PLANTED WITH NATIVE VEGETATION.
- SOUTH BANK OF CHANNEL IS MADE UP OF CONCRETE BLOCK RETAINING WALL VARYING IN HEIGHT FROM 7 FEET TO 12 FEET, DESIGNED TO RESIST GRAFFITI .
- CONSTRUCT 3,100-FT ADA-COMPLIANT RECREATIONAL TRAIL EXTENDING FROM HOME AVENUE TO SUNSHINE BERARDINI FIELD BETWEEN NEW CREEK CHANNEL AND FEDERAL BLVD.
- THE TRAIL IS DESIGNED TO PROVIDE ACCESS TO EXISTING TRUNK SEWER MANHOLES IN THE VICINITY.
- TRAIL WILL BE CONSTRUCTED OF AC AND WILL RANGE FROM 5 TO 12 FEET IN WIDTH.
- THE PROJECT INCLUDES A SAFE CROSSING FROM THE NEW TRAIL ON THE SOUTH SIDE OF FEDERAL BLVD ACROSS THE STREET TO SUNSHINE BERARDINI PARK.
- TRAIL WILL BE LINED WITH NATIVE TREES WITH LOW-FLOW IRRIGATION.
- THE PROJECT WILL REQUIRE THE FOLLOWING DISCRETIONARY PERMITS AND APPROVALS: CITY OF SAN DIEGO SITE DEVELOPMENT PERMIT AND GRADING PERMIT, CALTRANS ENCROACHMENT PERMIT, US ARMY CORPS OF ENGINEERS SECTION 404 PERMIT, CA DEPT OF FISH AND WILDLIFE STREAMBED ALTERATION AGREEMENT, REGIONAL WATER QUALITY CONTROL BOARD SECTION 401 PERMIT.

KEY MAP (1"=X')



(REV 5/13/2019)

CONSTRUCTION BMP GENERAL NOTES

PRIOR TO ANY SOIL DISTURBANCE, TEMPORARY EROSION AND SEDIMENT CONTROL SHALL BE INSTALLED BY THE CONTRACTOR OR QUALIFIED PERSON(S) AS INDICATED BELOW:

1. ALL REQUIREMENTS OF THE CITY OF SAN DIEGO "LAND DEVELOPMENT MANUAL, STORM WATER STANDARDS" MUST BE INCORPORATED INTO THE DESIGN AND CONSTRUCTION OF THE PROPOSED GRADING/IMPROVEMENTS CONSISTENT WITH THE APPROVED STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND/OR WATER POLLUTION CONTROL PLAN (WPCP) FOR CONSTRUCTION LEVEL BMP'S AND, IF APPLICABLE, THE STORM WATER QUALITY MANAGEMENT PLAN (SWQMP) FOR POST CONSTRUCTION TREATMENT CONTROL BMP'S.

2. THE CONTRACTOR SHALL INSTALL AND MAINTAIN ALL STORM DRAIN INLETS. INLET PROTECTION IN THE PUBLIC RIGHT OF WAY MAY BE TEMPORARILY REMOVED WHERE IT IS PRONE TO FLOODING PRIOR TO A RAIN EVENT AND REINSTALLED AFTER RAIN IS OVER.

3. ALL CONSTRUCTION BMPS SHALL BE IN PLACE AT THE END OF EACH WORKING DAY WHEN RAIN IS IMMINENT.

4. THE CONTRACTOR SHALL ONLY GRADE, INCLUDING CLEARING AND GRUBBING, AREAS FOR WHICH THE CONTRACTOR OR QUALIFIED PERSON CAN PROVIDE EROSION AND SEDIMENT CONTROL MEASURES.

5. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ALL SUB-CONTRACTORS AND SUPPLIERS ARE AWARE OF ALL STORM WATER QUALITY MEASURES AND IMPLEMENT SUCH MEASURES. FAILURE TO COMPLY WITH THE APPROVED SWPPP/WPCP WILL RESULT IN THE ISSUANCE OF CORRECTION NOTICES, CITATIONS, CIVIL PENALTIES AND/OR STOP WORK NOTICES.

6. THE CONTRACTOR OR QUALIFIED PERSON SHALL BE RESPONSIBLE FOR CLEANUP OF ALL SILT, DEBRIS AND MUD ON AFFECTED AND ADJACENT STREET(S) AND WITHIN STORM DRAIN SYSTEM DUE TO CONSTRUCTION VEHICLES/EQUIPMENT AND CONSTRUCTION ACTIVITY AT THE END OF EACH WORK DAY.

7. THE CONTRACTOR SHALL PROTECT NEW AND EXISTING STORM WATER CONVEYANCE SYSTEMS FROM SEDIMENTATION, CONCRETE RINSE, OR OTHER CONSTRUCTION RELATED DEBRIS AND DISCHARGES WITH THE APPROPRIATE BMPS THAT ARE ACCEPTABLE TO THE ENGINEER AND AS INDICATED IN THE SWPPP/WPCP

8. THE CONTRACTOR OR QUALIFIED PERSON SHALL CLEAR DEBRIS, SILT AND MUD FROM ALL DITCHES AND SWALES PRIOR TO AND AFTER EACH RAIN EVENT.

9. IF A NON-STORM WATER DISCHARGE LEAVES THE SITE, THE CONTRACTOR SHALL IMMEDIATELY STOP THE ACTIVITY AND REPAIR THE DAMAGES. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER OF THE DISCHARGE. AS SOON AS PRACTICAL, ANY AND ALL WASTE MATERIAL, SEDIMENT AND DEBRIS FROM EACH NON STORM WATER DISCHARGE SHALL BE REMOVED FROM THE STORM DRAIN CONVEYANCE SYSTEM AND PROPERLY DISPOSED OF BY THE CONTRACTOR.

10. EQUIPMENT AND WORKERS FOR EMERGENCY WORK SHALL BE MADE AVAILABLE AT ALL TIMES. ALL NECESSARY MATERIALS SHALL BE STOCKPILED ON SITE AT CONVENIENT LOCATIONS TO FACILITATE RAPID DEPLOYMENT OF CONSTRUCTION BMPS WHEN RAIN IS IMMINENT.

11. THE CONTRACTOR SHALL RESTORE AND MAINTAIN ALL EROSION AND SEDIMENT CONTROL BMPS TO WORKING ORDER YEAR ROUND.

12. THE CONTRACTOR SHALL INSTALL ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES DUE TO GRADING INACTIVITY OR UNFORESEEN CIRCUMSTANCES TO PREVENT NON-STORM WATER AND SEDIMENT-LADEN DISCHARGES.

13. THE CONTRACTOR SHALL BE RESPONSIBLE AND SHALL TAKE NECESSARY PRECAUTIONS TO PREVENT PUBLIC TRESPASS ONTO AREAS WHERE IMPOUNDED WATERS CREATE A HAZARDOUS CONDITION.

14. ALL EROSION AND SEDIMENT CONTROL MEASURES PROVIDED PER THE APPROVED SWPPP/WPCP SHALL BE INSTALLED AND MAINTAINED. ALL EROSION AND SEDIMENT CONTROL FOR INTERIM CONDITIONS SHALL BE PROPERLY DOCUMENTED AND INSTALLED TO THE SATISFACTION OF THE RESIDENT ENGINEER.

15. UPON NOTIFICATION BY THE RESIDENT ENGINEER, THE CONTRACTOR SHALL ARRANGE FOR MEETINGS DURING OCTOBER 1ST TO APRIL 30TH FOR PROJECT TEAM (GENERAL CONTRACTOR, QUALIFIED PERSON, EROSION CONTROL SUBCONTRACTOR IF ANY, ENGINEER OF WORK, OWNER/DEVELOPER AND THE RESIDENT ENGINEER) TO EVALUATE THE ADEQUACY OF THE EROSION AND SEDIMENT CONTROL MEASURES AND OTHER BMPS RELATIVE TO ANTICIPATED CONSTRUCTION ACTIVITIES.

16. THE CONTRACTOR SHALL CONDUCT VISUAL INSPECTIONS DAILY AND MAINTAIN ALL BMPS AS NEEDED. VISUAL INSPECTIONS AND MAINTENANCE OF ALL BMPS SHALL BE CONDUCTED BEFORE, DURING AND AFTER EVERY RAIN EVENT AND EVERY 24 HOURS DURING ANY PROLONGED RAIN EVENT. THE CONTRACTOR SHALL MAINTAIN AND REPAIR ALL BMPS AS SOON AS POSSIBLE AS SAFETY ALLOWS.

17. TEMPORARY CONSTRUCTION ENTRANCE AND EXIT AREA SHALL BE ON LEVEL, STABILIZED GROUND. THE ENTRANCE AND EXIT AREA SHALL BE CONSTRUCTED BY OVERLAYING THE STABILIZED ACCESS AREA WITH 3 TO 6"DIAMETER STONES. THE AREA SHALL BE MINIMUM 50' LONG X 30' WIDE. IN LIEU OF STONE COVERED AREA, THE CONTRACTOR MAY CONSTRUCT RUMBLE RACKS OF STEEL PANELS WITH RIDGES MINIMUM 20' LONG X 30' WIDE CAPABLE OF PREVENTING THE MIGRATION OF CONSTRUCTION MATERIALS INTO THE TRAVELED WAYS.

18. PERFORMANCE STANDARDS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING WATER POLLUTION CONTROL MEASURES BASED ON PERFORMANCE STANDARDS. PERFORMANCE STANDARDS SHALL INCLUDE:

   A. NON-STORM WATER DISCHARGES FROM THE SITE SHALL NOT OCCUR TO THE MEP3. STORM WATER DISCHARGES SHALL BE FREE OF POLLUTANTS INCLUDING SEDIMENT TO THE MEP.

   B. EROSION SHALL BE CONTROLLED BY ACCEPTABLE BMPS TO THE MEP. IF RILLS AND GULLIES APPEAR THEY SHALL BE REPAIRED AND ADDITIONAL BMPS INSTALLED TO PREVENT A REOCCURRENCE OF EROSION.

   C. AN INACTIVE AREA SHALL BE PROTECTED TO PREVENT POLLUTANT DISCHARGES. A SITE OR PORTIONS OF A SITE SHALL BE CONSIDERED INACTIVE WHEN CONSTRUCTION ACTIVITIES HAVE CEASED FOR A PERIOD OF 14 OR MORE CONSECUTIVE DAYS.

GRADING NOTES

1. GRADING AS SHOWN ON THESE PLANS SHALL BE IN CONFORMANCE WITH CURRENT STANDARD SPECIFICATIONS AND CHAPTER 14, ARTICLE 2, DIVISION 1, OF THE SAN DIEGO MUNICIPAL CODE.

2. PLANT AND IRRIGATE ALL CUT AND FILL SLOPES AS REQUIRED BY ARTICLE 2, DIVISION 4, SECTION 142.0411 OF THE SAN DIEGO LAND DEVELOPMENT CODE AND ACCORDING TO SECTION IV OR THE LAND DEVELOPMENT MANUAL LANDSCAPE STANDARDS.

3. GRADED, DISTURBED, OR ERODED AREAS THAT WILL NOT BE PERMANENTLY PAVED, COVERED BY STRUCTURE, OR PLANTED FOR A PERIOD OVER 90 DAYS SHALL BE TEMPORARILY RE-VEGETATED WITH A NON-IRRIGATED HYDROSEED MIX, GROUND COVER, OR EQUIVALENT MATERIAL. SEE SHEET 14 FOR MIX AND SPECIFICATIONS.

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

GROUND WATER DISCHARGE NOTES

1. ALL GROUND WATER EXTRACTION AND SIMILAR WASTE DISCHARGES TO SURFACE WATERS NOT TRIBUTARY TO THE SAN DIEGO BAY ARE PROHIBITED UNTIL IT CAN BE DEMONSTRATED THAT THE OWNER HAS APPLIED FOR AND OBTAINED AUTHORIZATION FROM THE STATE OF CALIFORNIA VIA AN OFFICIAL "ENROLLMENT LETTER" FROM THE REGIONAL WATER QUALITY CONTROL BOARD IN ACCORDANCE WITH THE TERMS, PROVISIONS AND CONDITIONS OF STATE ORDER NO R9-2015-0013 NPDES CAG919003.

2. THE ESTIMATED MAXIMUM DISCHARGE RATES MUST NOT EXCEED THE LIMITS SET IN THE OFFICIAL "ENROLLMENT LETTER" FROM THE REGIONAL BOARD UNLESS PRIOR NOTIFICATION AND SUBSEQUENT AUTHORIZATION HAS BEEN OBTAINED, AND DISCHARGE OPERATIONS MODIFIED TO ACCOMMODATE THE INCREASED RATES.

3. ALL GROUND WATER EXTRACTIONS AND SIMILAR WASTE DISCHARGES TO SURFACE WATERS TRIBUTARY TO THE SAN DIEGO BAY ARE PROHIBITED UNTIL IT CAN BE DEMONSTRATED THAT THE OWNER HAS APPLIED FOR AND OBTAINED AUTHORIZATION FROM THE STATE OF CALIFORNIA VIA AN OFFICIAL "ENROLLMENT LETTER" FROM THE REGIONAL WATER QUALITY CONTROL BOARD IN ACCORDANCE WITH THE TERMS, PROVISIONS AND CONDITIONS OF STATE ORDER NO R9-2015-0013 NPDES NO. CAG919003.

MINIMUM POST-CONSTRUCTION MAINTENANCE PLAN

AT THE COMPLETION OF THE WORK SHOWN, THE FOLLOWING PLAN SHALL BE FOLLOWED TO ENSURE WATER QUALITY CONTROL IS MAINTAINED FOR THE LIFE OF THE PROJECT:

1. STABILIZATION: ALL PLANTED SLOPES AND OTHER VEGETATED AREAS SHALL BE INSPECTED PRIOR TO OCTOBER 1 OF EACH YEAR AND AFTER MAJOR RAINFALL EVENTS (MORE THAN ½ INCH) AND REPAIRED AN REPLANTED AS NEEDED UNTIL A NOTICE OF TERMINATION (NOT) IS FILLED.

2. STRUCTURAL PRACTICES: DESILTING BASINS, DIVERSION DITCHES, DOWNDRAINS, INLETS, OUTLET PROTECTION MEASURES, AND OTHER PERMANENT WATER QUALITY AND SEDIMENT AND EROSION CONTROLS SHALL BE INSPECTED PRIOR TO OCTOBER 1ST OF EACH YEAR AND AFTER MAJOR RAINFALL EVENTS (MORE THAN ½ INCH). REPAIRS AND REPLACEMENTS SHALL BE MADE AS NEEDED AND RECORDED IN THE MAINTENANCE LOG IN PERPETUITY.

3. OPERATION AND MAINTENANCE, FUNDING: POST-CONSTRUCTION MANAGEMENT MEASURES ARE THE RESPONSIBILITY OF THE DEVELOPER UNTIL THE TRANSFER OF RESPECTIVE SITES TO HOME BUILDERS, INDIVIDUAL OWNERS, HOMEOWNERS ASSOCIATIONS, SCHOOL DISTRICTS, OR LOCAL AGENCIES AND/OR GOVERNMENTS AT THAT TIME, THE NEW OWNERS SHALL ASSUME RESPONSIBILITY FOR THEIR RESPECTIVE PORTIONS OF THE DEVELOPMENT.

PROJECT PROPONENT AND CONSULTANTS

PROJECT OWNERS:	CITY OF SAN DIEGO STORMWATER DIVISION CONTACT: SUMER HASENIN, ASSISTANT DEPUTY DIRECTOR (858) 541-4336
	CALTRANS CONTACT: ANN FOX, DEPUTY DISTRICT DIRECTOR, PLANNING AND LOCAL ASSISTANCE (619) 688-6681
PROJECT PROPONENT:	GROUNDWORK SAN DIEGO CONTACT: KIRSTIN SKADBERG, PROJECT MANAGER (619) 972-4441
PROJECT ENGINEER:	TORY R. WALKER ENGINEERING, INC. CONTACT: TORY WALKER (760) 414-9212
PROJECT LANDSCAPE ARCHITECT:	ESTRADA LAND PLANNING CONTACT: VICKI ESTRADA (619) 236-0143
PROJECT BIOLOGIST:	TRESTLES ENVIRONMENTAL CORPORATION CONTACT: JULIE FONTAINE (949) 246-3117
CEQA COMPLIANCE SPECIALIST:	TTG ENVIRONMENTAL & ASSOCIATES CONTACT: TERESA WILKINSON (619) 200-1577
CULTURAL RESOURCES SPECIALIST:	SPINDRIFT ARCHAEOLOGICAL CONSULTING CONTACT: ARLEEN GARCIA-HERBST (858) 333-7202
SURVEYING:	GOLD COAST SURVEYING, INC. CONTACT: BRUCE BONDE (760) 758-7732

TRAFFIC CONTROL NOTE

(DELETE IF GREATER THAN 5000 ADT)

THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN (11"X17") FOR APPROVAL PRIOR TO STARTING WORK. THE PLAN SHOULD BE SUBMITTED TO THE TRAFFIC CONTROL PERMIT COUNTER, 3RD FLOOR, BOOTH 22, BUILDING, SAFETY & CONSTRUCTION DIVISION, DEVELOPMENT SERVICES CENTER, 1222 FIRST AVENUE, SAN DIEGO (619-446-5150). CONTRACTOR SHALL OBTAIN A TRAFFIC CONTROL PERMIT A MINIMUM OF TWO (2) WORKING DAYS PRIOR TO STARTING WORK, AND A MINIMUM OF FIVE (5) DAYS IF WORK WILL AFFECT A BUS STOP OR AN EXISTING TRAFFIC SIGNAL, OR IF WORK WILL REQUIRE A ROAD OR ALLEY CLOSURE.

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

MAY 14, 2021

NOTES FOR:

FEDERAL BLVD CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 2 OF 22 SHEETS

PROJECT NO. ______

FOR CITY ENGINEER ______ DATE ______

V.T.M. ______

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

XXXXX-2-D

SHEET RESERVED FOR CEQA/ENVIRONMENTAL NOTES

TORY R. WALKER ENGINEERING, INC. R.C.E. NO. 45005 EXP. 03-31-2022 DATE

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

APRIL 21, 2021

PRIVATE CONTRACT

CEQA/ENVIRONMENTAL NOTES FOR:

FEDERAL BLVD. CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 3 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER DATE

V.T.M.

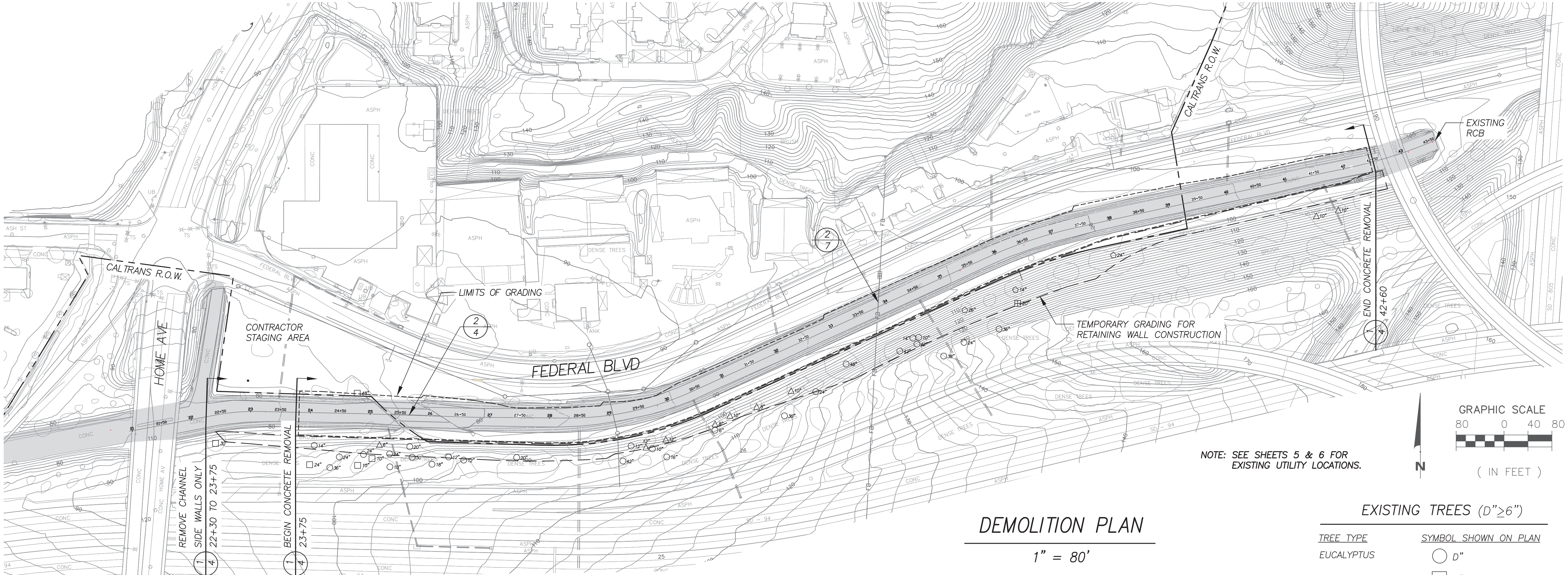
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXXX-3-D



DEMOLITION PLAN

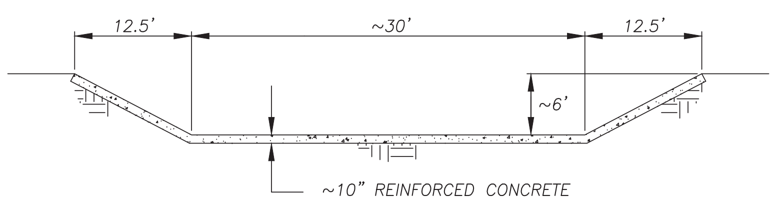
1" = 80'

EXISTING TREES (D"≥6")

TREE TYPE	SYMBOL SHOWN ON PLAN
EUCALYPTUS	○ D"
PEPPER	□ D"
SYCAMORE	⬠ D"
OAK	⊞ D"
UNKNOWN	△ D"

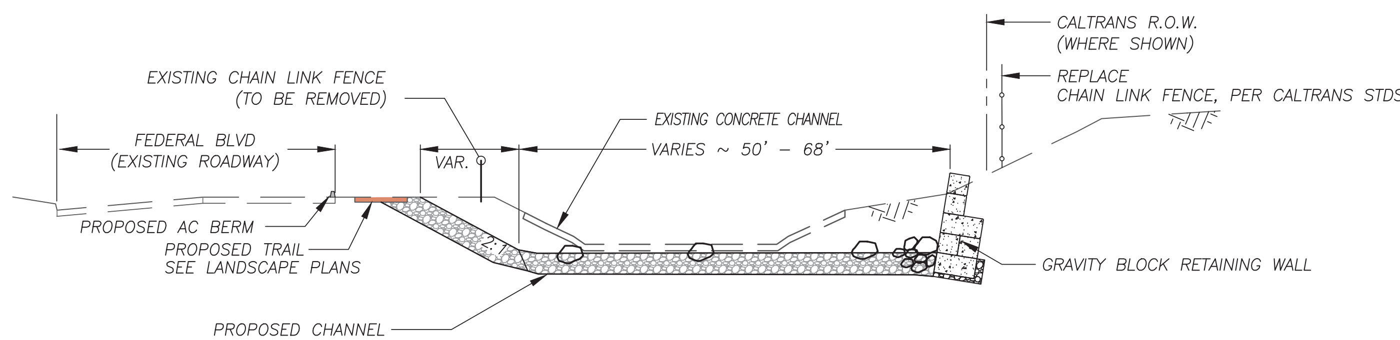
NOTES:

1. D" IS THE TREE DIAMETER AT BREAST HEIGHT (DBH) MEASURED IN INCHES AT 4.5-FT ABOVE GROUND.
2. CONTRACTOR TO REMOVE EXISTING TREES AS NEEDED FOR TEMPORARY GRADING AND RETAINING WALL CONSTRUCTION. GRIND STUMPS.
3. REMOVE TREES IF OVER ONE-HALF OF DRIP LINE IS GRADED.



EXISTING CONCRETE CHANNEL TO BE REMOVED 1/4

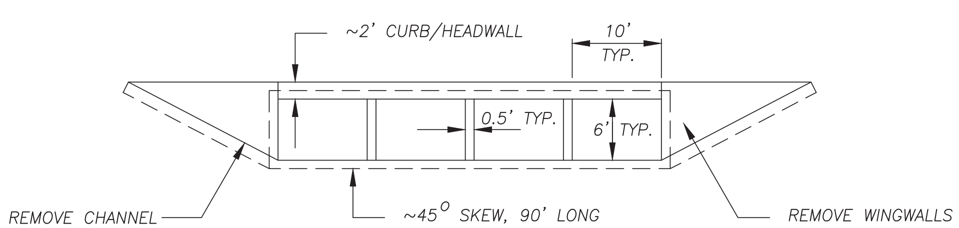
NTS



TYPICAL PROPOSED CHANNEL CROSS-SECTION 3/4

LOOKING UPSTREAM, NTS

NOTE: SEE FOLLOWING SHEETS FOR CHANNEL CROSS-SECTIONS AND DETAILS



EXISTING RCB TO BE REMOVED 2/4

PERPENDICULAR VIEW, NTS

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

MARCH 15, 2021

PRIVATE CONTRACT

DEMOLITION PLAN FOR:

FEDERAL BLVD CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 4 OF 22 SHEETS

PROJECT NO.

V.T.M.

FOR CITY ENGINEER DATE

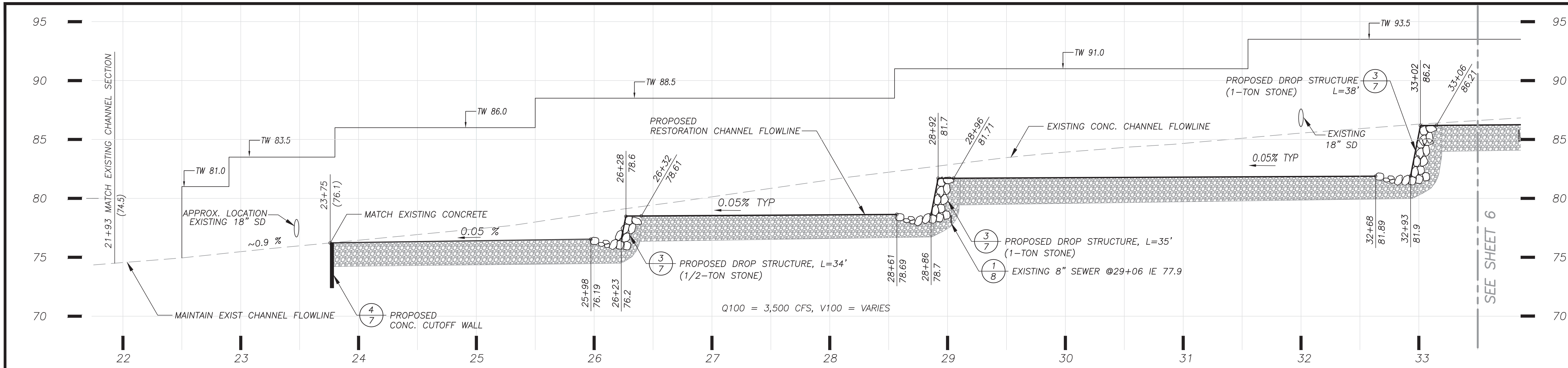
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

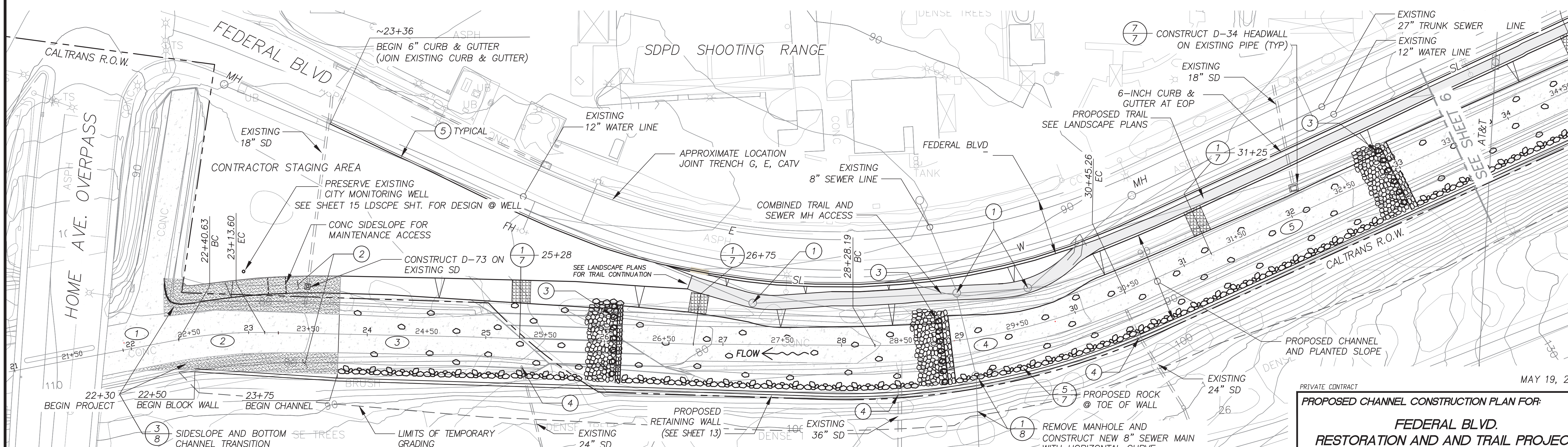
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXXX-4-D



PROFILE

HORIZ. 1"= 40'
VERT. 1" = 4'



PLAN

1" = 40'

GRAPHIC SCALE
40 0 20 40
4 0 2 4
(IN FEET)

Channel Centerline Data

Data Symbol	Delta or Bearing	Length (FT)	Radius (FT)
1	Δ= 11° 56' 45"	47.63	-
2	N 79° 16' 51" E	72.79	350
3	N 88° 09' 17" W	514.59	-
4	24° 52' 27"	217.07	500
5	N 65° 34' 15" E	541.82	-

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

CONSTRUCTION NOTES:

1. LOWER SEWER MH RIM TO MATCH TRAIL PER STD M-02
2. PROPOSED CONCRETE SIDE WALLS AND CHANNEL BOTTOM (560-C-3250 CONCRETE, 12" THICK) SEE DETAIL SHEET 8
3. PLACE ROW OF 2-TON ROCK ALONG DROP STRUCTURE TOE SPACED ~3-FT APART (TYP)
4. CUT STORM DRAIN AT OUTER FACE OF WALL. CAST-IN-PLACE CUSTOM FILLET HEADWALL TO BE FORMED AND CONSTRUCTED CONCURRENT WITH BLOCK PLACEMENT.
5. 6" CURB & GUTTER PER SDG-151

MAY 19, 2021

PRIVATE CONTRACT

PROPOSED CHANNEL CONSTRUCTION PLAN FOR:

FEDERAL BLVD. RESTORATION AND AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 5 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER DATE

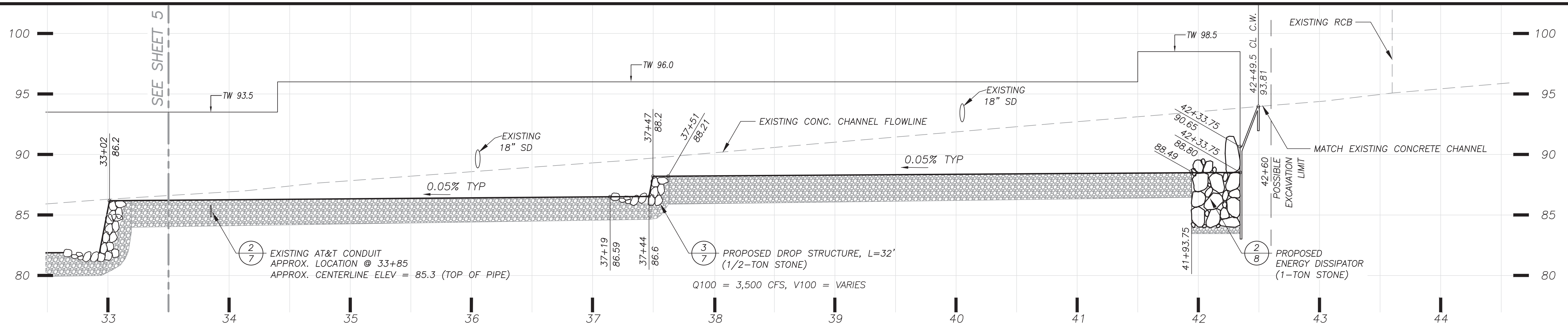
V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297 NAD83 COORDINATES
194-1725 LAMBERT COORDINATES

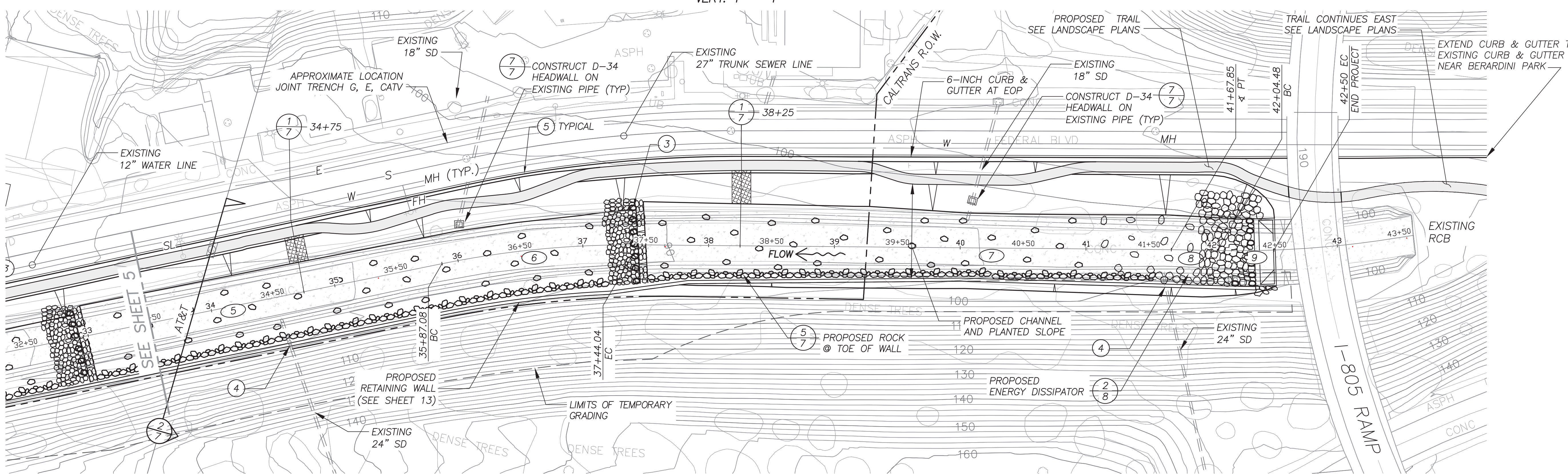
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXXX-5-D



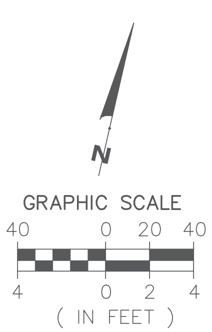
PROFILE

HORIZ. 1"= 40'
VERT. 1" = 4'



PLAN

1" = 40'



Channel Centerline Data			
Data Symbol	**Delta or Bearing**	**Length (FT)**	**Radius (FT)**
5	N 65° 34' 15"	541.82	-
6	Δ = 11° 59' 26"	156.96	750
7	N 77° 33' 41"	423.21	-
8	N 78° 10' 13"	35.05	-
9	Δ = 03° 13' 27"	45.02	300

CONSTRUCTION NOTES:

3 PLACE ROW OF 2-TON ROCK ALONG DROP STRUCTURE TOE SPACED ~3-FT APART (TYP)

4 CUT STORM DRAIN AT OUTER FACE OF WALL. CAST-IN-PLACE CUSTOM FILLET HEADWALL TO BE FORMED AND CONSTRUCTED CONCURRENT WITH BLOCK PLACEMENT.

5 6" CURB & GUTTER PER SDG-151

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER — R.C.E. NO. 45005 — EXP. 03-31-2022 — DATE

MAY 19, 2021

PRIVATE CONTRACT

PROPOSED CHANNEL CONSTRUCTION PLAN FOR:

FEDERAL BLVD.
RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 6 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER — DATE

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			

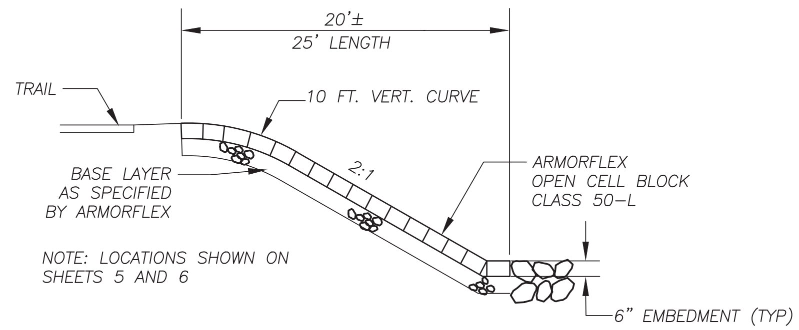
AS-BUILTS

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

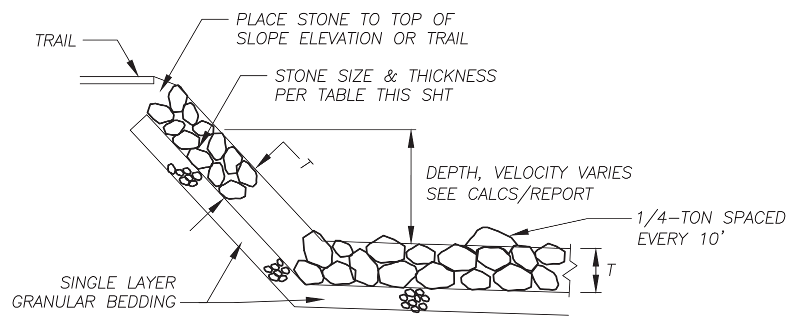
CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

XXXXX-6-D



MAINTENANCE ACCESS RAMP 1/7

NTS



DETAIL: CHANNEL ROCK PLACEMENT 6/7

NTS

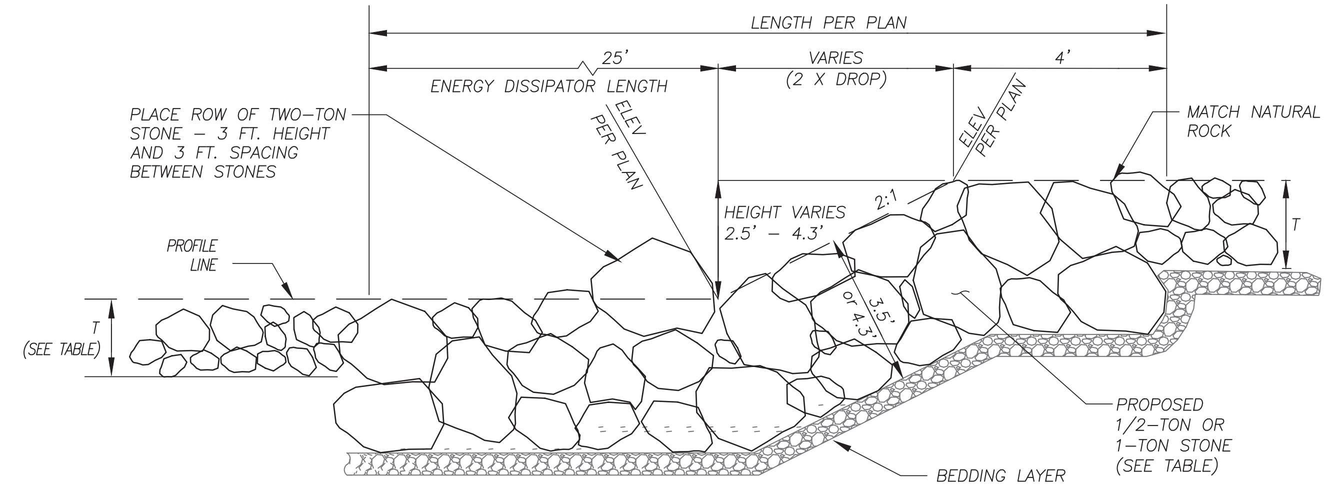
NATURAL STONE CONSTRUCTION NOTES

1. USE NATURAL STONE FOR CHANNEL BOTTOM, NORTH SLOPE, UPSTREAM DISSIPATOR AND GRADE CONTROLS.
2. NATURAL STONE SHALL BE HARD, DURABLE, ROUNDED IN SHAPE, AND FREE FROM CRACKS, SHALE AND ORGANIC MATTER. ALL STONE TO HAVE A NATURAL BROWN-TO-RED COLORATION; NO GRAY/QUARRIED APPEARANCE. QUARRIED ROCK/RIPRAP NOT ACCEPTABLE.
3. STONE GRADATION TO BE PER THE CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL TABLE 7-5; GRADED AND PLACED TO PROVIDE FOR SMALLER STONES IN THE VOIDS BETWEEN LARGE STONES.
4. STONE PLACEMENT TO BE TYPE B, TAMPING DOWN STONE AFTER SPREADING FOR INCREASED INTERLOCKING.
5. A SINGLE-LAYER GRANULAR BEDDING OF 2-INCH ANGULAR AGGREGATE, 6-INCH THICK, TO BE PLACED UNDER ALL NATURAL STONE SECTIONS.
6. ONE-QUARTER TON STONES SHALL BE PARTIALLY EMBEDDED THROUGHOUT THE CHANNEL BOTTOM AT AN APPROXIMATELY RANDOM 10-FOOT SPACING TO PROVIDE A NATURAL RIVER APPEARANCE.
7. SEE THE TABLE BELOW FOR MEDIAN STONE SIZE, LAYER THICKNESS, AND STATIONING FOR LOCATION.

NATURAL STONE SIZES AND LOCATIONS

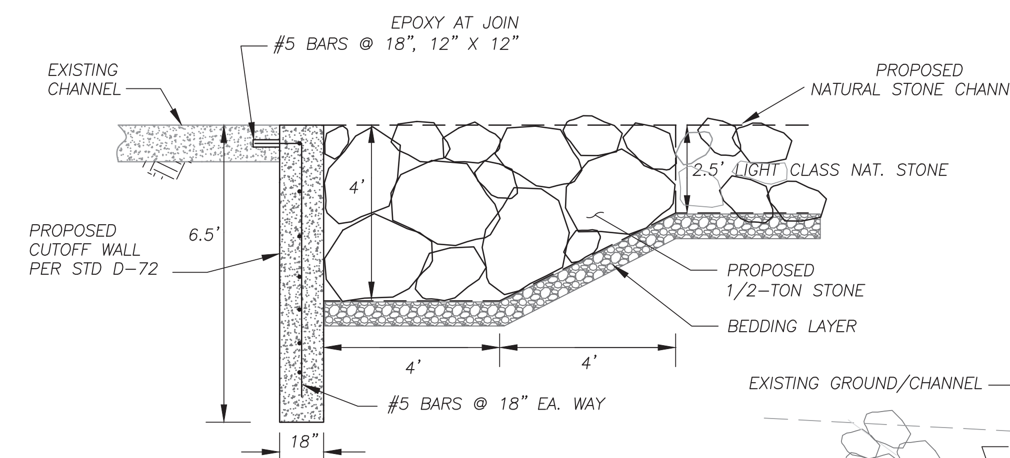
Station	W50 Stone Wt. (lbs)	D50 Stone Diameter (ft)	T Stone Layer Thickness (ft)	Rock Classification
4215	2,000	2.9	4.3	1 Ton*
4139	200	1.3	2.5	Light
3750	1,000	2.3	3.5	1/2 Ton*
3744	1,000	2.3	3.5	1/2 Ton*
3652	200	1.3	2.5	Light
3513	200	1.3	2.5	Light
3402	200	1.3	2.5	Light
3299	2,000	2.9	4.3	1 Ton*
3293	2,000	2.9	4.3	1 Ton*
3267	200	1.3	2.5	Light
3031	200	1.3	2.5	Light
2966	200	1.3	2.5	Light
2892	2,000	2.9	4.3	1 Ton*
2886	2,000	2.9	4.3	1 Ton*
2861	200	1.3	2.5	Light
2744	200	1.3	2.5	Light
2623	1,000	2.3	3.5	1/2 Ton*
2621	1,000	2.3	3.5	1/2 Ton*
2375	200	1.3	2.5	Light

* Drop structure locations



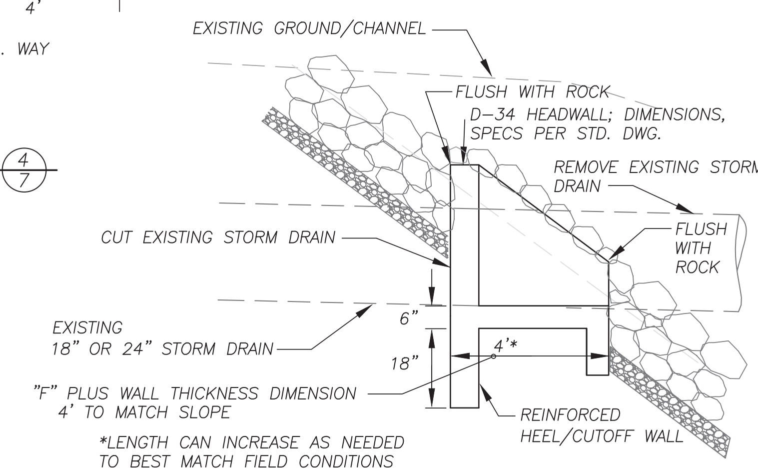
TYP STONE DROP STRUCTURE 3/7

SEE TABLE AT LEFT FOR DROP STRUCTURE LOCATIONS & STONE SIZES
1" = 2'



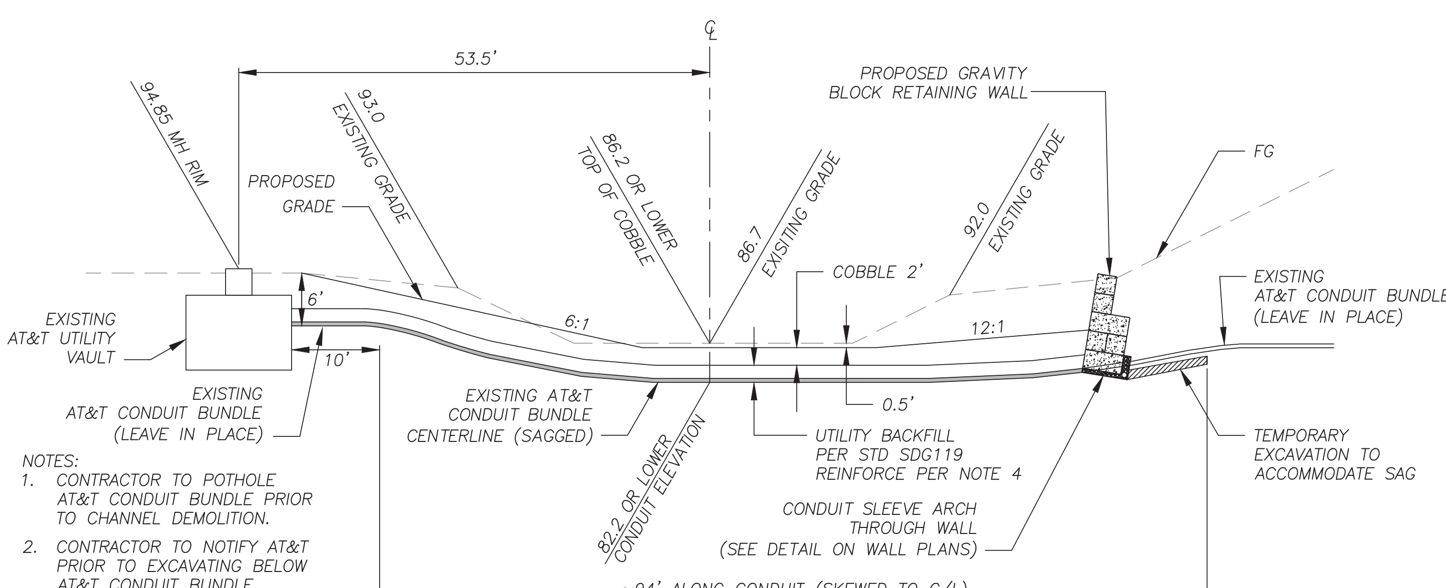
DOWNSTREAM CUTOFF WALL @ C/L 4/7

STA 23+75, 1" = 2'



D–34 HEADWALL AT SD OUTLETS 7/7

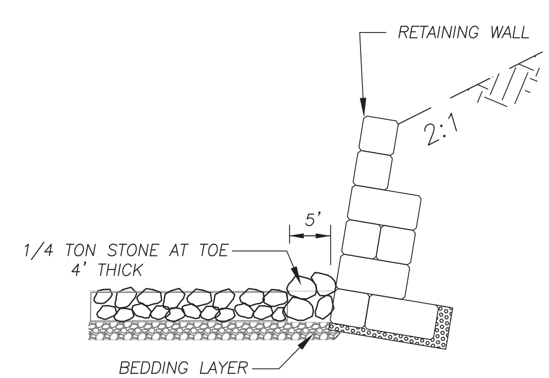
NO SCALE



NOTES:
1. CONTRACTOR TO POTHOLE AT&T CONDUIT BUNDLE PRIOR TO CHANNEL DEMOLITION.
2. CONTRACTOR TO NOTIFY AT&T PRIOR TO EXCAVATING BELOW AT&T CONDUIT BUNDLE.
3. HAND EXCAVATE UNDER CONDUIT BUNDLE TO ALLOW SAG TO ELEVATION 82.2 OR LOWER AT CHANNEL CENTER.
4. REINFORCE UTILITY BACKFILL SLURRY CAP WITH #5 CONTINUOUS, #4 @ 24"

AT&T CONDUIT PROFILE AT C/L STA 33+85 2/7

1" = 10'



STONE PROTECTION AT TOE OF WALL 5/7

NO SCALE

GRAPHIC SCALE

10 0 5 10

1" = 10'

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

MAY 17, 2021

PRIVATE CONTRACT

DETAIL PLAN FOR:

FEDERAL BLVD.
RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 7 OF 22 SHEETS

PROJECT NO.______

FOR CITY ENGINEER ______ DATE ______

V.T.M.______

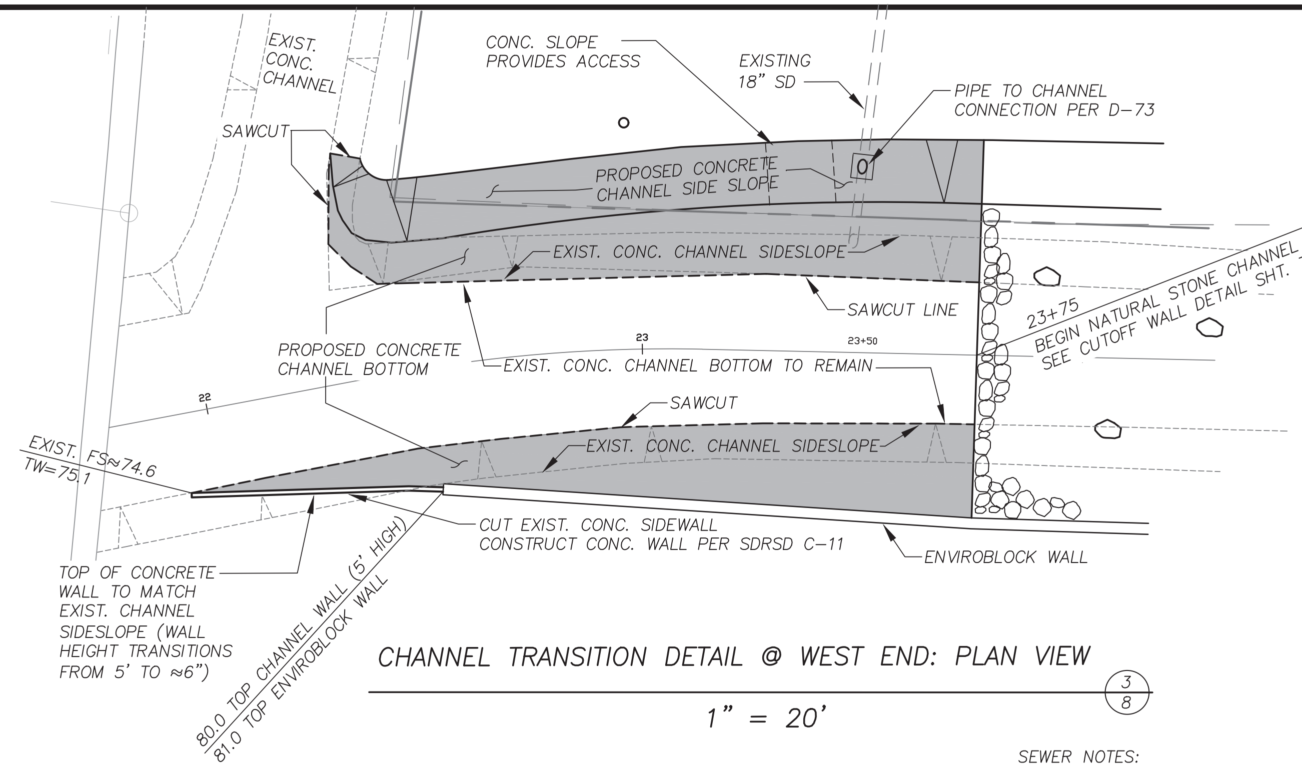
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

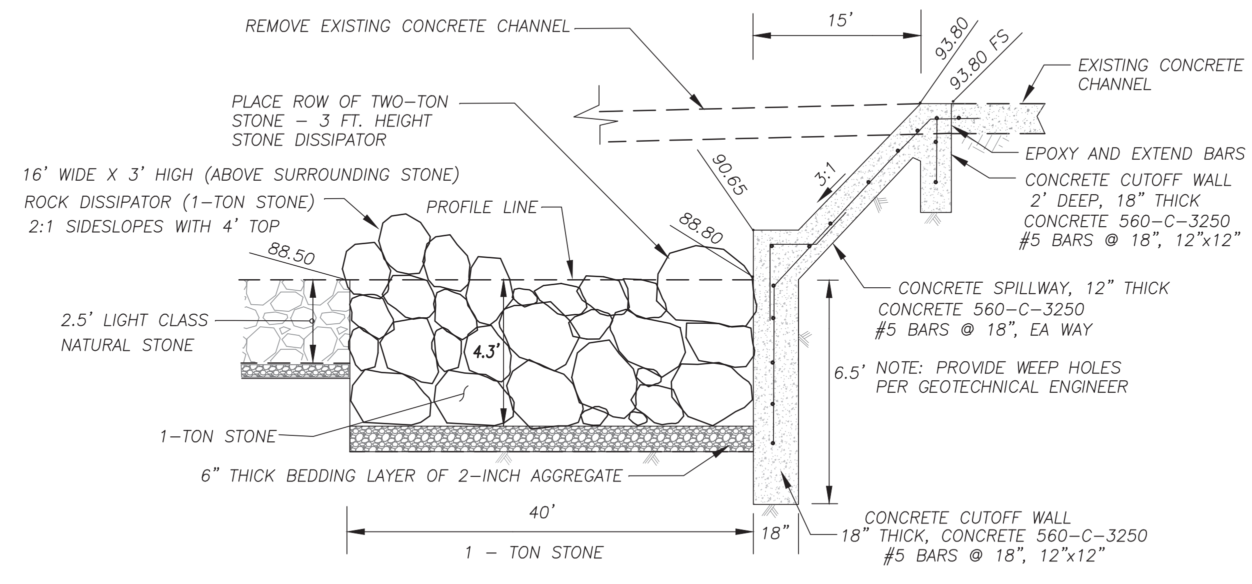
CONTRACTOR______ DATE STARTED______
INSPECTOR______ DATE COMPLETED______

XXXXX-7-D



CHANNEL TRANSITION DETAIL @ WEST END: PLAN VIEW (3/8)

1" = 20'

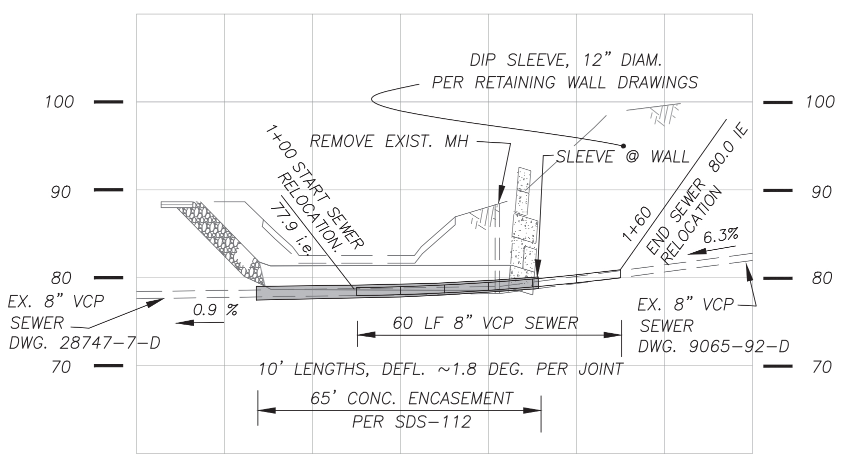


SECTION A-A

NO SCALE

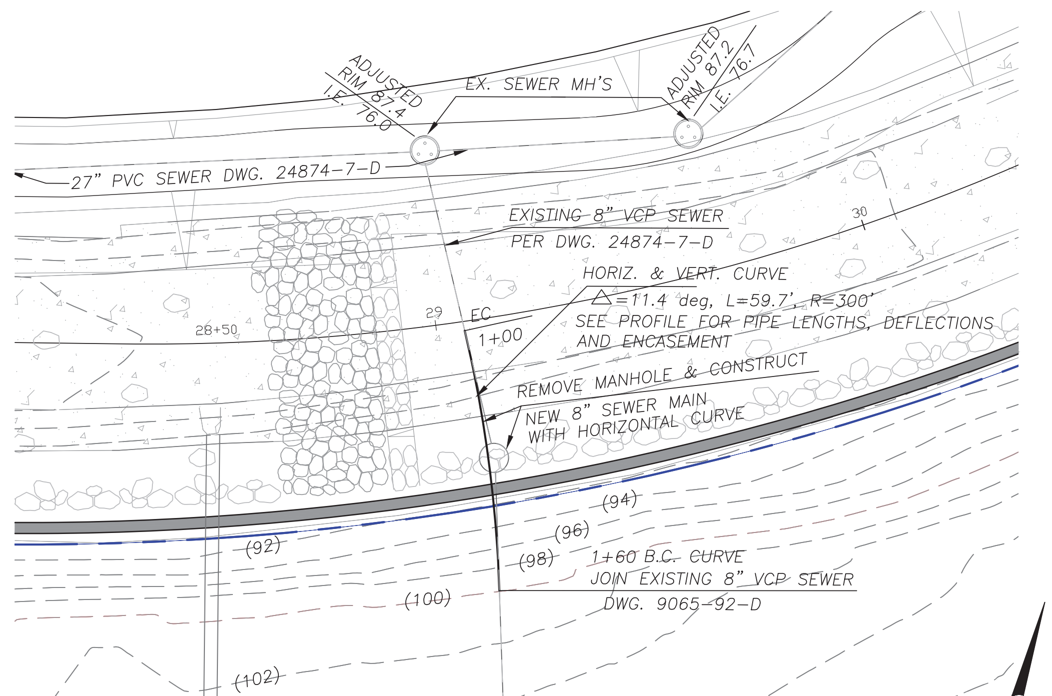
SEWER NOTES:

1. ENCASE SEWER LINE IN C3250 CONCRETE. ENCASEMENT SHALL COMPLETELY SURROUND PIPE AND SHALL HAVE A MINIMUM THICKNESS OF 6".
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR KEEPING THE SEWERLINE IN SERVICE EITHER WITH A BYPASS OR THROUGH OTHER MEANS ACCEPTABLE TO THE CITY OF SD PUBLIC UTILITIES DEPARTMENT.
3. THE SEWER TRENCH SHALL BE COVERED WITH A STEEL PLATE DURING WALL CONSTRUCTION.



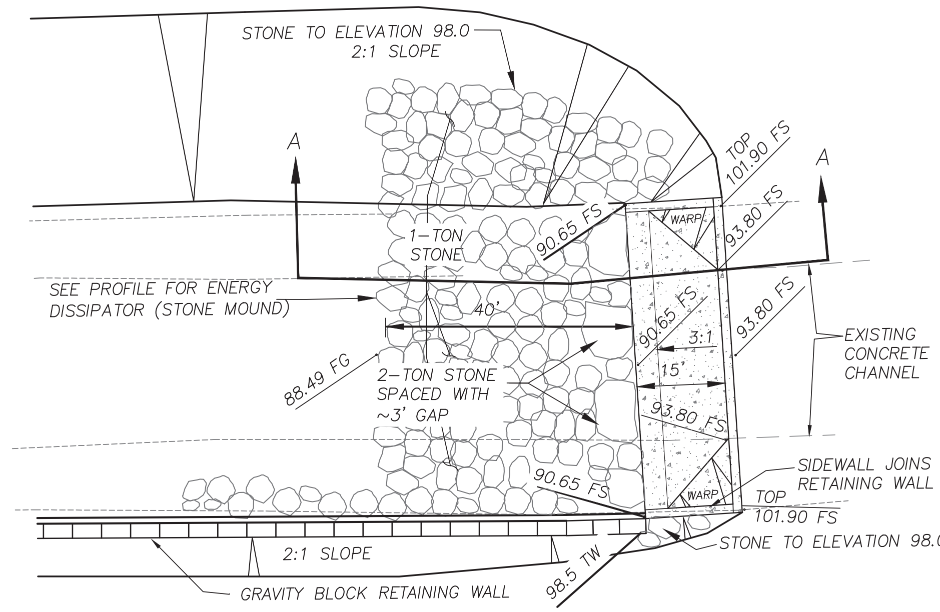
SEWER RELOCATION DETAIL: PROFILE

HORIZ. 1" = 20'
HORIZ. 1" = 10'



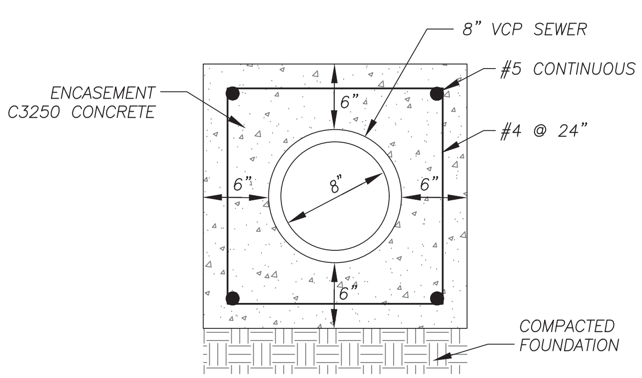
SEWER RELOCATION DETAIL @ STA 29+06: PLAN VIEW (1/8)

1" = 20'



DETAIL: PLAN VIEW CONCRETE SPILLWAY AND STONE ENERGY DISSIPATOR (2/8)

NO SCALE



SEWER ENCASEMENT SECTION DETAIL

NO SCALE

GRAPHIC SCALE
20 0 10 20
10 0 5 10
(IN FEET)

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

APRIL 21, 2021

PRIVATE CONTRACT

DETAIL PLAN FOR:

FEDERAL BLVD. RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 8 OF 22 SHEETS

PROJECT NO.
V.T.M.

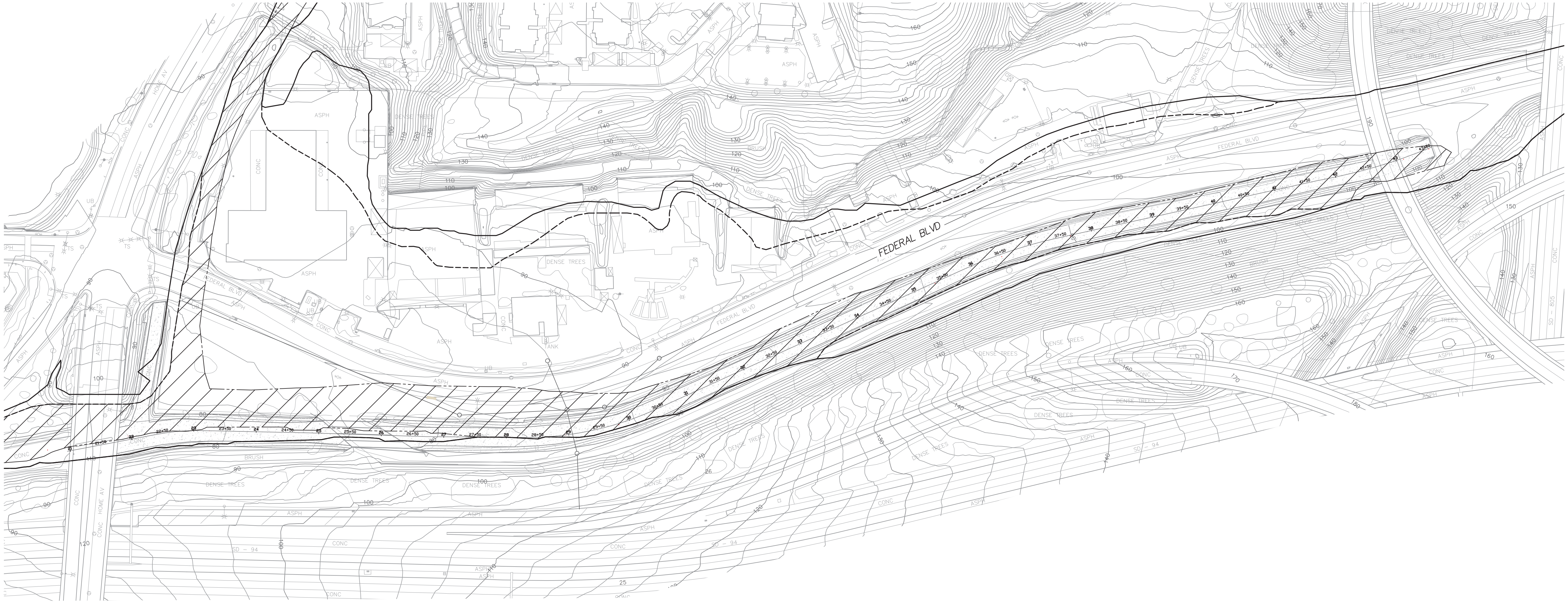
FOR CITY ENGINEER DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

XXXX-XXXX NAD83 COORDINATES
XXX-XXXX LAMBERT COORDINATES

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXXX-8-D



EXISTING FEMA FLOODPLAIN

1" = 80'

LEGEND

500-YEAR FLOODPLAIN

100-YEAR FLOODPLAIN

REGULATORY FLOODWAY

DATA SOURCE:
NATIONAL FLOOD HAZARD LAYER
PANEL 06073C1901G EFF. 05/16/2012

GRAPHIC SCALE
80 0 40 80
(IN FEET)

N

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

PRIVATE CONTRACT

MARCH 10, 2021

EXISTING FEMA FLOODPLAIN DATA FOR:

FEDERAL BLVD CHOLLAS CREEK RESTORATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 9 OF 22 SHEETS

PROJECT NO.______

FOR CITY ENGINEER ______ DATE ______

V.T.M.______

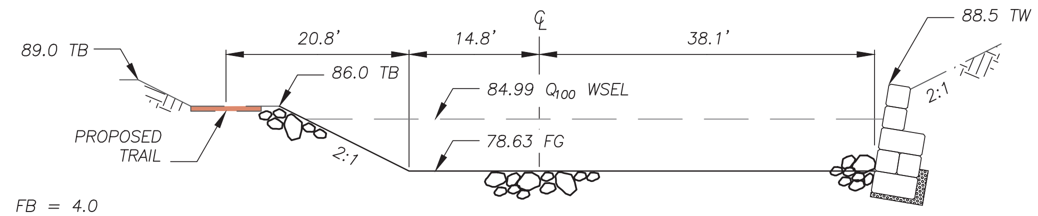
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

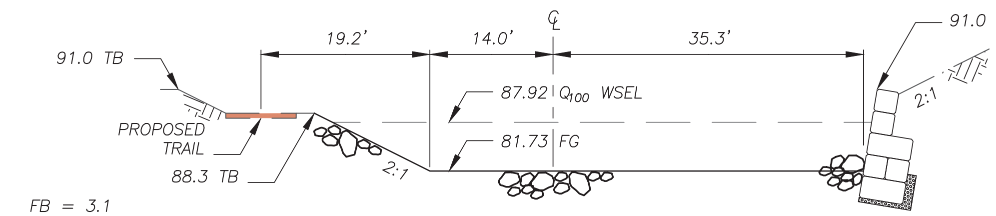
CONTRACTOR______ DATE STARTED______
INSPECTOR______ DATE COMPLETED______

XXXXX-9-D



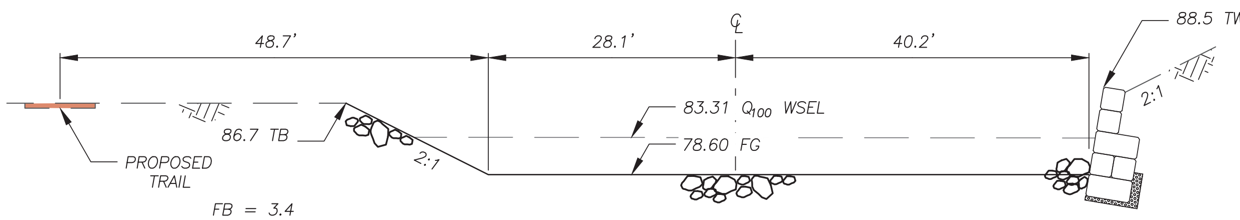
PROPOSED CHANNEL CROSS SECTION STA 27+44.11

LOOKING UPSTREAM, 1"=10'



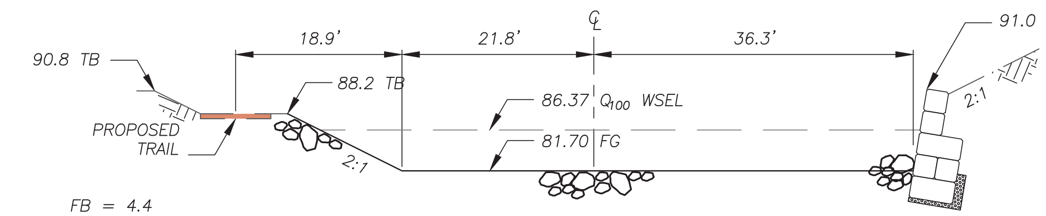
PROPOSED CHANNEL CROSS SECTION STA 29+65.96

LOOKING UPSTREAM, 1"=10'



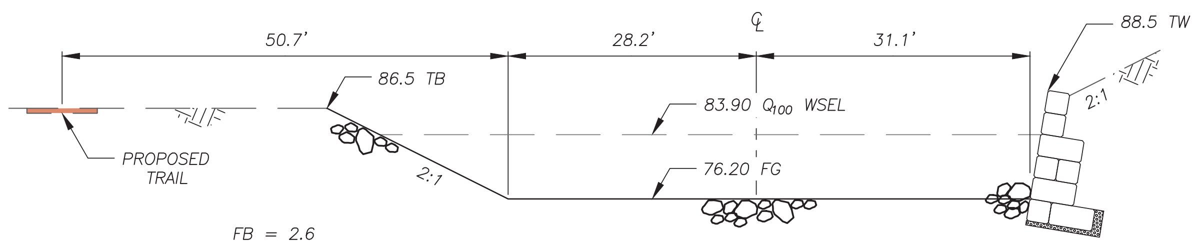
PROPOSED CHANNEL CROSS SECTION STA 26+23.00

LOOKING UPSTREAM, 1"=10' U.S. OF DROP



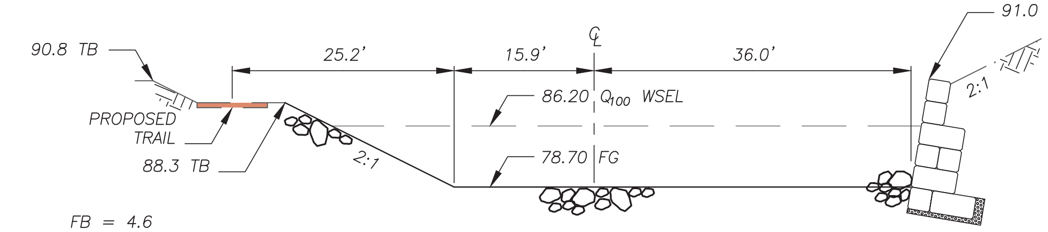
PROPOSED CHANNEL CROSS SECTION STA 28+92.27

LOOKING UPSTREAM, 1"=10' U.S. OF DROP



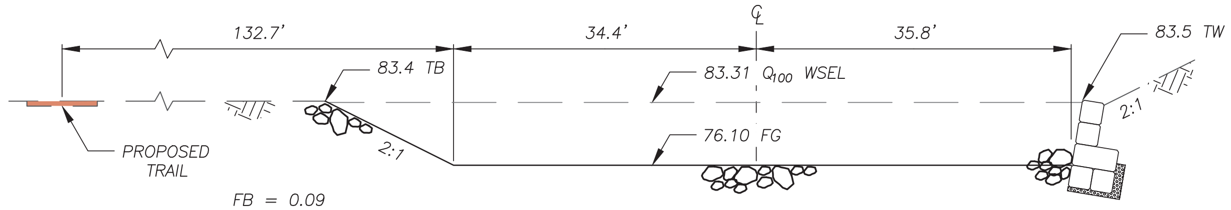
PROPOSED CHANNEL CROSS SECTION STA 26+21.00

LOOKING UPSTREAM, 1"=10' D.S. OF DROP



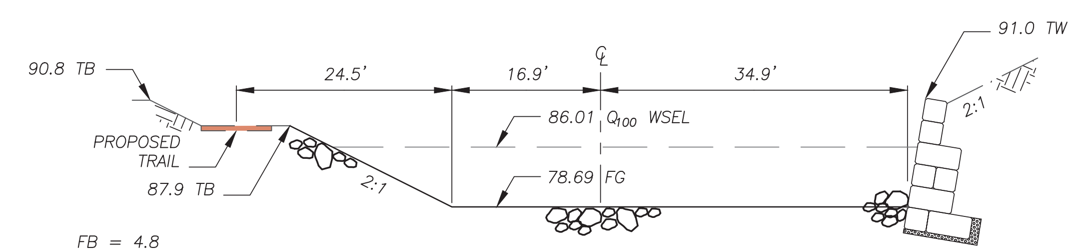
PROPOSED CHANNEL CROSS SECTION STA 28+86.27

LOOKING UPSTREAM, 1"=10' D.S. OF DROP



PROPOSED CHANNEL CROSS SECTION STA 23+75.43

LOOKING UPSTREAM, 1"=10'

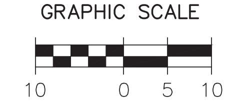


PROPOSED CHANNEL CROSS SECTION STA 28+61.00

LOOKING UPSTREAM, 1"=10'

NOTES:
1. SEE LANDSCAPE PLANS FOR TRAIL DETAILS.
2. RETAINING WALL HEIGHT VARIES. MANUFACTURE WILL PROVIDE DETAILED ASSEMBLY PLANS PRIOR TO CONSTRUCTION.

GRAPHIC SCALE



(IN FEET)

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER R.C.E. NO. 45005 EXP. 03-31-2022 DATE

MARCH 10, 2021

PRIVATE CONTRACT

DETAIL PLAN FOR:

FEDERAL BLVD.
CHANNEL CROSS SECTIONS

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 10 OF 22 SHEETS

PROJECT NO.
V.T.M.

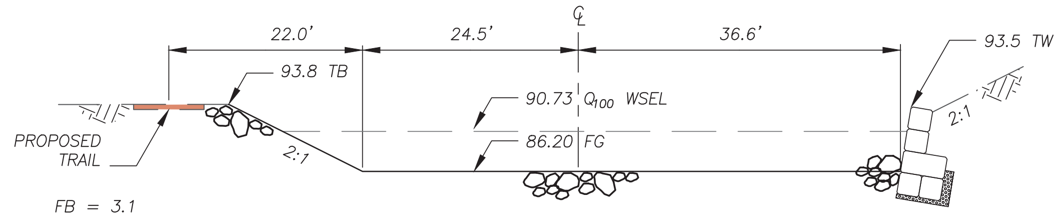
FOR CITY ENGINEER DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES
194-1725
LAMBERT COORDINATES

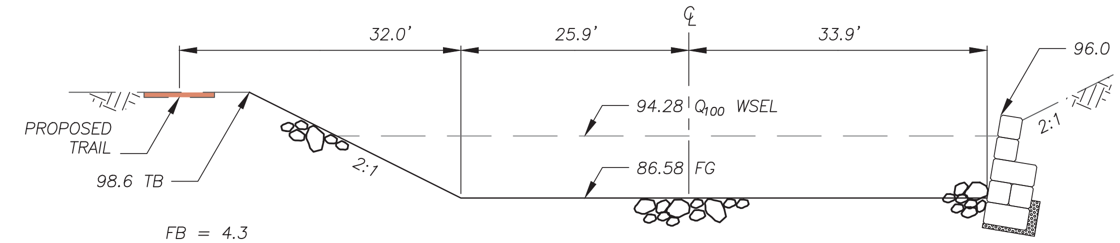
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXXX-10-D



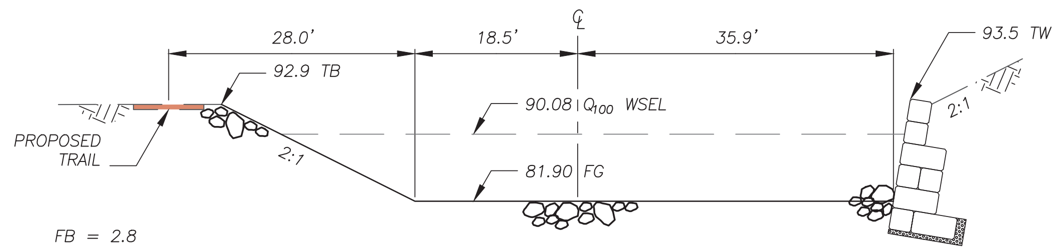
PROPOSED CHANNEL CROSS SECTION STA 32+98.97

LOOKING UPSTREAM, 1"=10'   U.S. OF DROP



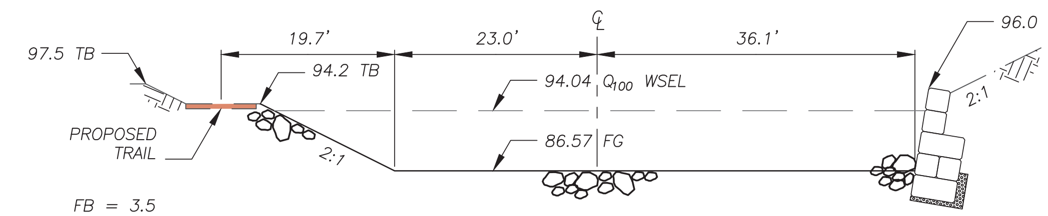
PROPOSED CHANNEL CROSS SECTION STA 37+18.00

LOOKING UPSTREAM, 1"=10'



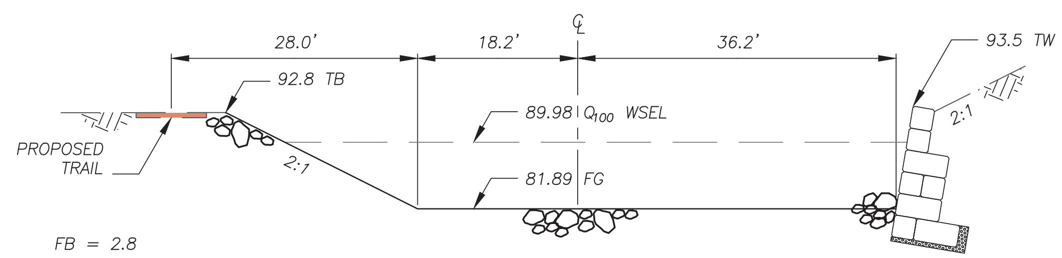
PROPOSED CHANNEL CROSS SECTION STA 32+92.97

LOOKING UPSTREAM, 1"=10'   D.S. OF DROP



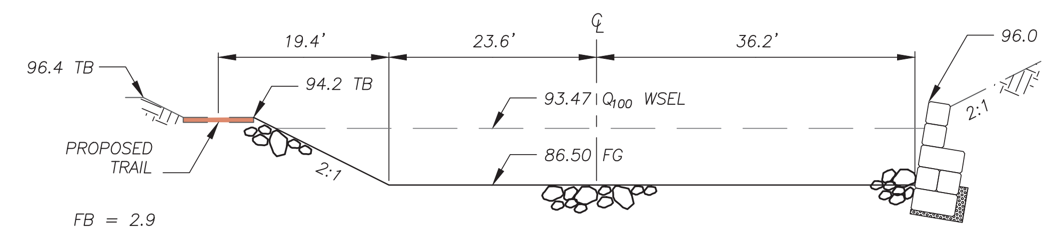
PROPOSED CHANNEL CROSS SECTION STA 36+52.00

LOOKING UPSTREAM, 1"=10'



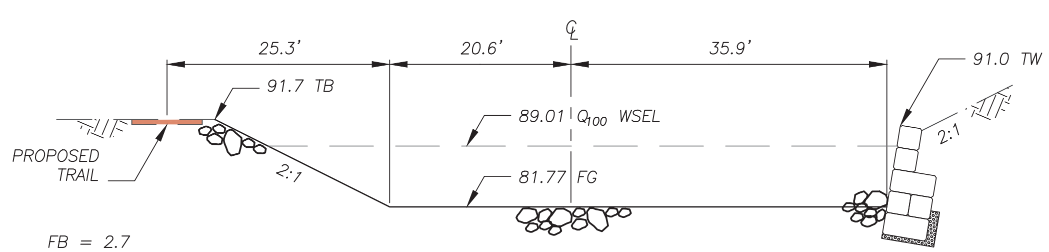
PROPOSED CHANNEL CROSS SECTION STA 32+67.00

LOOKING UPSTREAM, 1"=10'



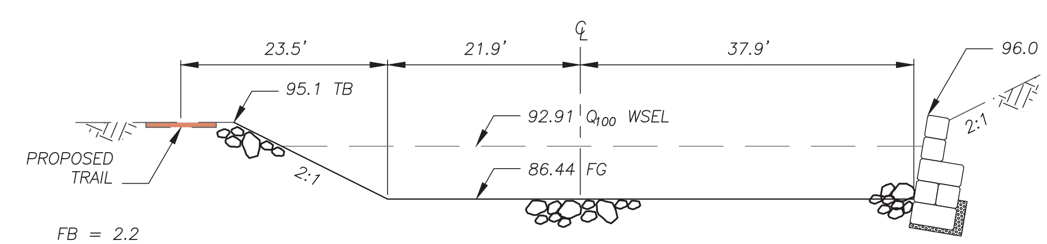
PROPOSED CHANNEL CROSS SECTION STA 35+13.00

LOOKING UPSTREAM, 1"=10'



PROPOSED CHANNEL CROSS SECTION STA 30+31.27

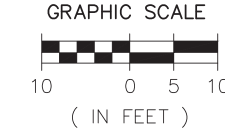
LOOKING UPSTREAM, 1"=10'



PROPOSED CHANNEL CROSS SECTION STA 34+02.00

LOOKING UPSTREAM, 1"=10'

GRAPHIC SCALE



TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

TORY R. WALKER   R.C.E. NO. 45005   EXP. 03-31-2022   DATE

MARCH 10, 2021

PRIVATE CONTRACT

DETAIL PLAN FOR:

FEDERAL BLVD.
CHANNEL CROSS SECTIONS

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 11 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER   DATE

V.T.M.

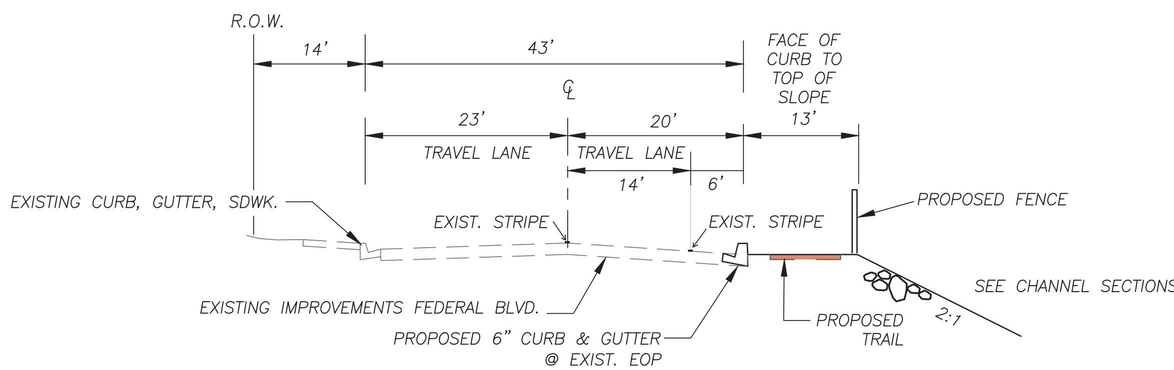
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

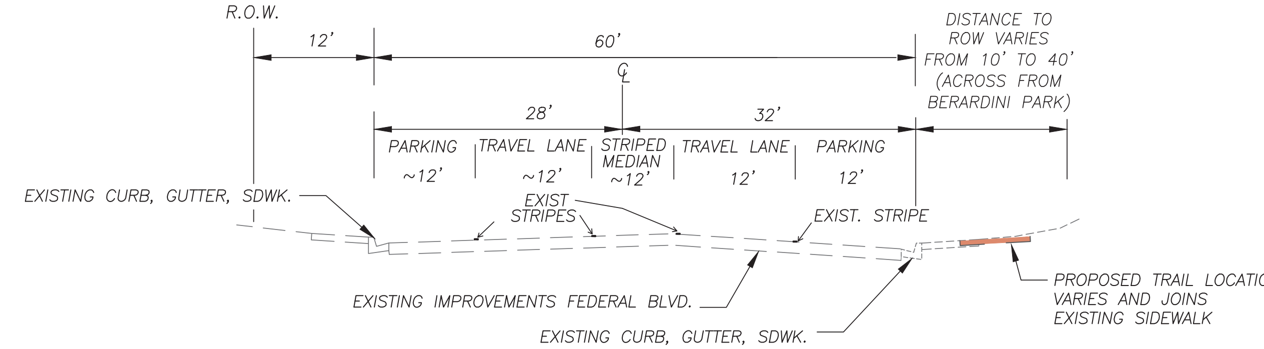
CONTRACTOR   DATE STARTED
INSPECTOR   DATE COMPLETED

XXXXX-11-D



FEDERAL BLVD. CROSS SECTION STA. 34+30 LOOKING EAST

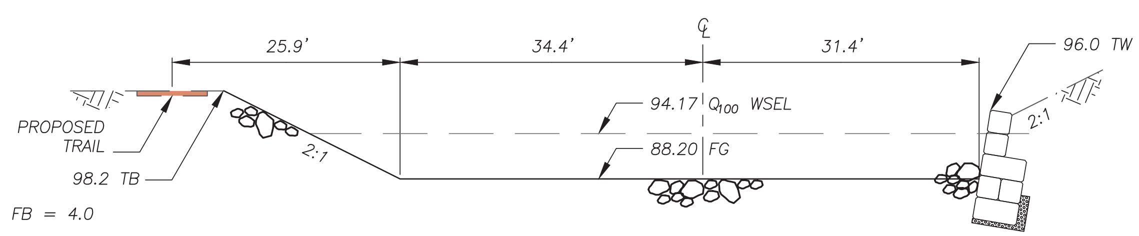
NO SCALE



FEDERAL BLVD. CROSS SECTION @ BERARDINI PARK* LOOKING EAST

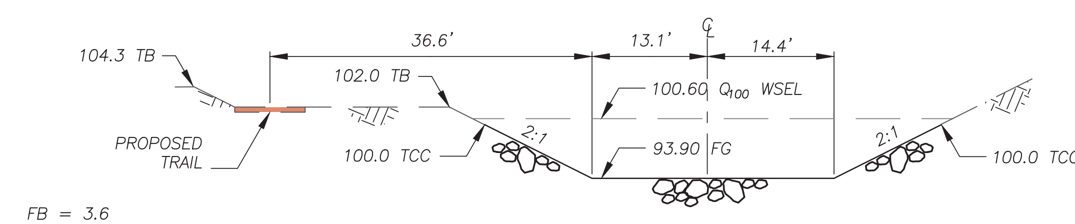
NO SCALE

*TRAIL JOINS EXIST. SIDEWALK JUST WEST OF PARK



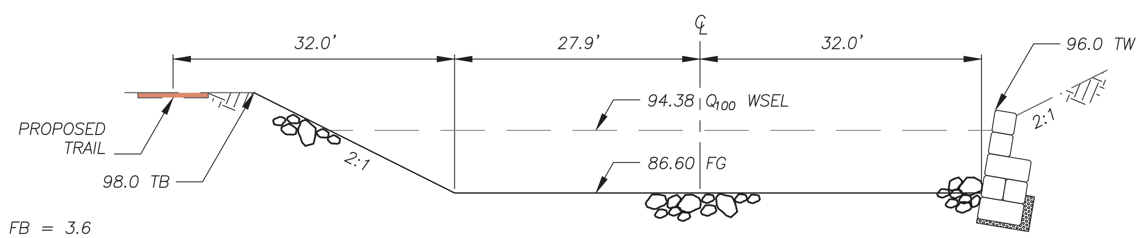
PROPOSED CHANNEL CROSS SECTION STA 37+49.99

LOOKING UPSTREAM, 1"=10'　　U.S. OF DROP



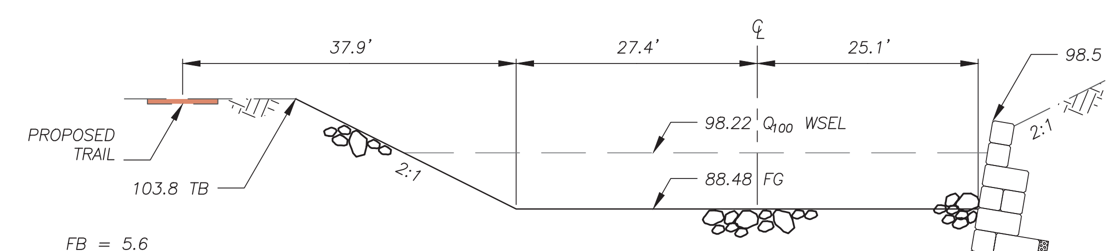
PROPOSED CHANNEL CROSS SECTION STA 42+61.38

LOOKING UPSTREAM, 1"=10'



PROPOSED CHANNEL CROSS SECTION STA 37+43.98

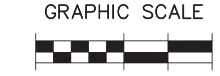
LOOKING UPSTREAM, 1"=10'　　D.S. OF DROP



PROPOSED CHANNEL CROSS SECTION STA 41+56.00

LOOKING UPSTREAM, 1"=10'

GRAPHIC SCALE



(IN FEET)

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

MAY 20, 2021

PRIVATE CONTRACT

DETAIL PLAN FOR:

FEDERAL BLVD.
STREET AND CHANNEL CROSS SECTIONS

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 12 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER　DATE

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			

AS-BUILTS

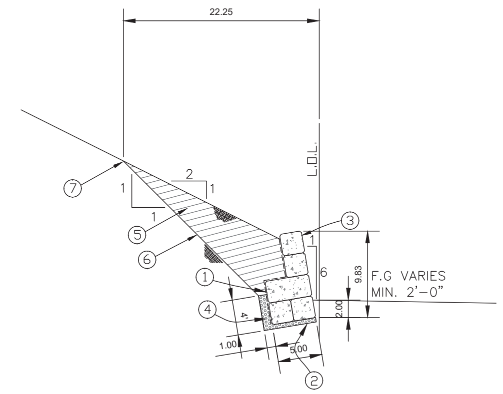
1843-6297
NAD83 COORDINATES

194-1725
LAMBERT COORDINATES

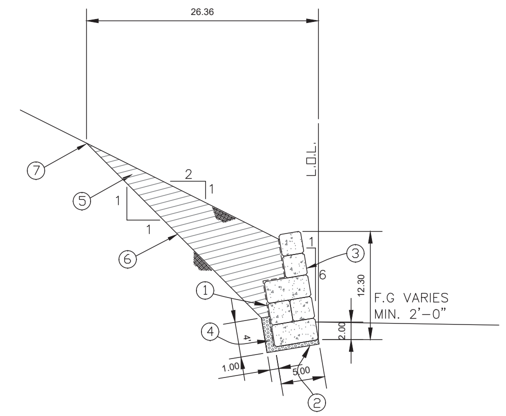
CONTRACTOR　DATE STARTED
INSPECTOR　DATE COMPLETED

XXXXX-12-D

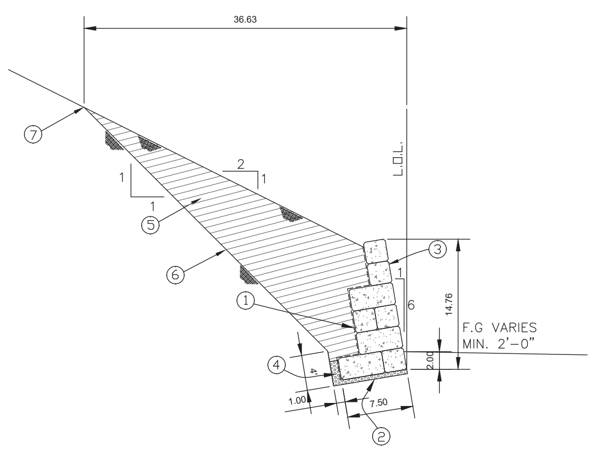
TORY R. WALKER　R.C.E. NO. 45005　EXP. 03-31-2022　DATE



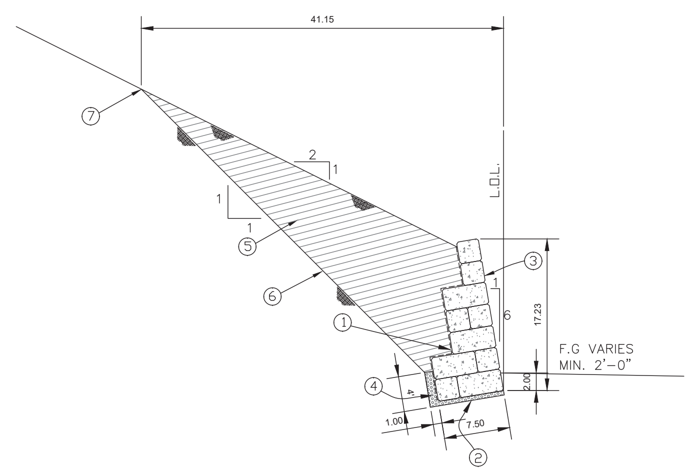
Typical Wall Section 10' High
Scale: 1"=10'



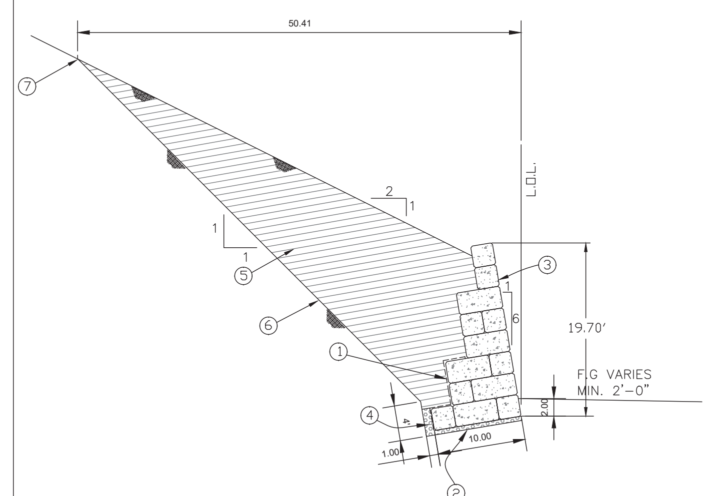
Typical Wall Section 12.5' High
Scale: 1"=10'



Typical Wall Section 15' High
Scale: 1"=10'



Typical Wall Section 17.5' High
Scale: 1"=10'



Typical Wall Section 20' High
Scale: 1"=10'

CONSTRUCTION NOTES:

1. FILTER FABRIC MIRAFI 140N OR APPROVED EQUAL.
2. INSTALL 6" THK. CRUSHED ROCK BASE.
3. INSTALL BLOCK PER PLAN & PROFILE.
4. INSTALL 3/4" CRUSHED ROCK.
5. BACKFILL TO MINIMUM 90% RELATIVE COMPACTION PER SOILS REPORT.
6. 1H:1V TEMPORARY EXCAVATION TO BE VERIFIED AND APPROVED BY GEOTECHNICAL ENGINEER.
7. LIMIT OF EXCAVATION

GRAPHIC SCALE
10 0 5 10
1" = 10'

TORY R. WALKER ENGINEERING, INC. R.C.E. NO. 45005 EXP. 03-31-2022 DATE

TORY R. WALKER ENGINEERING
122 Civic Center Drive, Suite 206 Vista, CA 92084

MARCH 10, 2021

PRIVATE CONTRACT

RETAINING WALL DETAILS FOR:

FEDERAL BLVD. DECHANNELIZATION AND TRAIL PROJECT

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 13 OF 22 SHEETS

PROJECT NO.

FOR CITY ENGINEER DATE

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

1843-6297
NAD83 COORDINATES
194-1725
LAMBERT COORDINATES

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

XXXX-13-D

PLANTING NOTES

1. THE PLANTING PLANS ARE DIAGRAMMATIC. MINOR ADJUSTMENTS IN PLANT LOCATIONS AND TYPE MAY BE MADE AT THE DISCRETION OF THE RESIDENT ENGINEER.
2. THE CONTRACTOR SHALL COORDINATE THIS WORK WITH THE OTHER TRADES AND MAINTAIN DRAINAGE DURING CONSTRUCTION.
3. PLANT QUANTITIES AND AREAS SHOWN ON LEGENDS ARE FOR CONTRACTOR'S CONVENIENCE IN ESTIMATING ONLY. CONTRACTOR IS RESPONSIBLE FOR PROVIDING PLANT MATERIALS TO COVER ALL AREAS SHOWN ON PLANS.
4. DO NOT DAMAGE PLANT ROOTBALL DURING TRANSPORTATION OR PLANTING PROCESS.
5. ALL PLANT MATERIAL SHALL BE SUBJECT TO THE APPROVAL OF THE RESIDENT ENGINEER AND REPLACED UPON REQUEST BEFORE OR AFTER PLANTING.
6. RESIDENT ENGINEER SHALL APPROVE FINAL PLACEMENT OF ALL TREES AND SHRUBS PRIOR TO PLANTING.
7. ALL PLANTS PLANTED FROM CONTAINERS SHALL HAVE THEIR ROOTBALLS SCORED WITH A SHARP TOOL TO A DEPTH OF ONE HALF INCH IN THREE LONGITUDINAL INCISIONS AT LOCATIONS SPACED AROUND THE ROOTBALL BEFORE PLACING PLANT IN HOLE.
8. ALL TYING MATERIAL AND MARKING TAPES SHALL BE REMOVED AT THE TIME OF PLANTING. NURSERY STAKES SHALL BE REMOVED AND HOLES BACKFILLED WITH BACKFILL MIX SOIL, PER SPECIFICATIONS.
9. MULCH: ALL REQUIRED PLANTING AREAS AND ALL EXPOSED SOIL AREAS WITHOUT VEGETATION SHALL BE COVERED WITH MULCH TO A MINIMUM DEPTH OF 3 INCHES, EXCLUDING SLOPES REQUIRING REVEGETATION PER SDMC 142.04.0411.

IRRIGATION NOTES

THE PARK WILL BE IRRIGATED WITH POTABLE WATER USING AN AUTOMATIC IRRIGATION SYSTEM, ACCURATELY PROGRAMMABLE CONTROLLER AND LOW FLOW IRRIGATION HEADS. WATERING WILL GRADUALLY BE REDUCED AS THE NATIVE VEGETATION MATURES. A SEPARATE BUBBLER SYSTEM WILL BE INSTALLED TO PROVIDE MOISTURE TO TREES.

MAXIMUM APPLIED WATER ALLOWANCE (MAWA)

MAWA FORMULA = (Eto)(0.62)[(.45 x LA) + ((1-.45) x SLA)]

WHERE:	TORREY MEADOWS NEIGHBORHOOD PARK, SAN DIEGO, CA	
MAWA=	MAXIMUM APPLIED WATER ALLOWANCE	
ETo=	EVAPOTRANSPIRATION IN INCHES PER YEAR	
.45=	ET ADJUSTMENT FACTOR FOR LA	
1.0-ETAF=	ET ADJUSTMENT FACTOR FOR SLA	
LA=	LANDSCAPED AREA	
SLA=	SPECIAL LANDSCAPE AREA	
0.62=	CONVERSION FACTOR TO GALLONS PER SQUARE FOOT	
PROJECT SPECIFIC FACTORS:		
Eto=	46.5	
ETAF=	0.45	
1.0-ETAF=	0.55	
LA=	118,800	TOTAL SQUARE FEET
SLA=	0	NO SPECIAL LANDSCAPE AREA
.62=	0.62	

MAWA FOR LA = (46.5)(0.62)((0.45)(173016)+(.55)(0))

MAWA=	**1,541,252**	**GALLONS PER YEAR**
Total MAWA=	**1,541,252**	**GALLONS PER YEAR**

HYDROSEED MIX (SR-94 SLOPES SEED MIX) (1.64 ACRES)

SYMBOL	BOTANICAL NAME	COMMON NAME	CATEGORY	PURITY / GERMINATION*	POUNDS / ACRE
	ACMISPON GLABER	DEERWEED	RIPARIAN	95 / 80	3
	ARTEMESIA CALIFORNICA	CALIFORNIA SAGEBRUSH	RIPARIAN	30 / 60	3
	DEINANDRA FASCICULATA	FASCICLED TARWEED	RIPARIAN	25 / 65	2
	ENCELIA CALIFORNICA	CALIFORNIA ENCELIA	RIPARIAN	30 / 45	2
	ERIOGONUM FASCICULATUM	CALIFORNIA BUCKWHEAT	RIPARIAN	55 / 20	6
	ERIOPHYLLUM CONFERTIFLORUM	LONG-STEM GOLDEN YARROW	RIPARIAN	TBD	1.5
	ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY	RIPARIAN	98 / 80	2
	ISOCOMA MENZIESII	COASTAL GOLDENBUSH	RIPARIAN	18 / 40	2
	LASTHENIA CALIFORNICA	GOLDFIELDS	RIPARIAN	98 / 95	2
	LUPINUS BICOLOR	MINIATURE LUPINE	RIPARIAN	98 / 85	1
	MELICA IMPERFECTA	SMALL-FLOWERED MELIC GRASS	RIPARIAN	90 / 67	1
	SISYRINCHIUM BELLUM	BLUE-EYED GRASS	RIPARIAN	98 / 80	0.5
	SALVIA APIANA	WHITE SAGE	RIPARIAN	88 / 30	1
	SALVIA MELLIFERA	BLACK SAGE	RIPARIAN	85 / 50	2
	STIPA PULCHRA	PURPLE NEEDLEGRASS	RIPARIAN	90 / 75	3
	PLANTAGO INSULARIS (OVATA-INDICA)	PLANTAIN	RIPARIAN	98 / 75	8
	VULPIA MICROSTACHYS**	SMALL FESCUE	RIPARIAN	90 / 70	6
				TOTAL	46

** THIS MAY INCLUDE VAR. MICROSTACHYS, VAR. PAUCIFLORA, OR VAR CILIATE *UPDATE PRIOR TO SEED ORDERING

NOTE: IN ADDITION TO HYDROSEED MIX ADD1 GALLON CSS SHRUBS AT 1 PER 100 SQUARE FEET

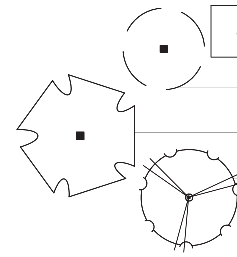
MATERIALS LEGEND

SYMBOL	DESCRIPTION	REQUIREMENTS	DETAIL
	CONSTRUCT ASPHALT TRAIL	SEE CIVIL DRAWINGS	-
	CONSTRUCT DECOMPOSED GRANITE AREA	SEE CIVIL DRAWINGS	-
	CONSTRUCT CURB AND GUTTER	SEE CIVIL DRAWINGS	-
	BARK MULCH SHREDDED (IN ALL PLANTING AREAS)	3" LAYER DEPTH; SEE SPECIFICATIONS	-
	ROOT BARRIER	24" DEPTH - INSTALL AT PAVING EDGE PER PLAN; SEE SPECIAL PROVISIONS	SDL-106
	FENCE	36" HIGH 'WOODCRETE' FENCE - INSTALL PER MANUFACTURER RECOMMENDATION, PER PLAN	-
•	DEMOUNTABLE POST	-	SDM-16

MIN. TREE SEPARATION DISTANCE

IMPROVEMENT	MIN. DISTANCE TO STREET TREE
TRAFFIC SIGNAL, STOP SIGN	20 FEET
UNDERGROUND UTILITY LINES (EXCEPT SEWER)	5 FEET
SEWER LINES	10 FEET
ABOVE GROUND UTILITY STRUCTURES (TRANSFORMERS, HYDRANTS, UTILITY POLES, ETC.)	10 FEET
DRIVEWAYS	10 FEET
INTERSECTIONS (INTERSECTING CURB LINES OF TWO STREETS)	25 FEET

TREES



SYMBOL	BOTANICAL NAME	COMMON NAME	ABBREV.	SIZE	COMMENTS	CATEGORY	HT. x SP.	MATURE HT. x SP.	DETAIL
	EXISTING TREE TO REMAIN	-	-	-	-	-	-	-	-
	PLATANUS RACEMOSA	CALIFORNIA SYCAMORE	PLA RAC	15 GAL	FULL, VIGOROUS, STANDARD FORM, SINGLE TRUNK	RIPARIAN	6'-7' x 2'-3'	40' x 30'	SDL-101
	QUERCUS AGRIFOLIA	COAST LIVE OAK	QUE AGR	15 GAL	FULL, VIGOROUS, STANDARD FORM	RIPARIAN	6'-8' x 3'-4'	30' x 40'	SDL-101

SHRUBS

SYMBOL	BOTANICAL NAME	COMMON NAME	ABBREV.	SIZE	COMMENTS	CATEGORY	MATURE HT. x SP.	SPACING (O.C.)	PLANTS/ ACRE	DETAIL
	ARTEMESIA CALIFORNICA	COASTAL SAGE BRUSH	ART CAL	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 7'	6'	250	SDL-102
	DIPLACUS AURANTIACUS	STICKY MONKEY FLOWER	DIP AUR	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	3'	300	SDL-102
	ELYMUS CONDENSATUS	GIANT WILD RYE	ELY CON	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	4'	150	SDL-102
	OENETHERA ELETA SSP HOOKERI	EVENING PRIMROSE	OEN ELE	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	1' x 2'	3'	300	SDL-102
	SALVIA APIANA	WHITE SAGE	SAL API	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 4'	6'	200	SDL-102
	SALVIA MELLIFERA	BLACK SAGE	SAL MEL	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	6'	200	SDL-102
	STIPA PULCHRA	PURPLE NEEDLEGRASS	STI PUL	1 GAL	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 2'	3'	700	SDL-102

CHOLLAS CREEK NORTH PLANTING MIX (0.74 ACRES)

SHRUBS

SYMBOL	BOTANICAL NAME	COMMON NAME	ABBREV.	SIZE	COMMENTS	CATEGORY	MATURE HT. x SP.	SPACING (O.C.)	PLANTS/ ACRE	DETAIL
	ARTEMESIA CALIFORNICA	COASTAL SAGE BRUSH	ART CAL	D-40 OR ROSE SPOTS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 7'	6'	250	SDL-102
	DIPLACUS AURANTIACUS	STICKY MONKEY FLOWER	DIP AUR	ROSE POTS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	3'	300	SDL-102
	ELYMUS CONDENSATUS	GIANT WILD RYE	ELY CON	D-40 OR PLUGS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	4'	150	SDL-102
	OENETHERA ELETA SSP HOOKERI	EVENING PRIMROSE	OEN ELE	ROSE POTS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	1' x 2'	3'	300	SDL-102
	SALVIA APIANA	WHITE SAGE	SAL API	ROSE POTS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 4'	6'	200	SDL-102
	SALVIA MELLIFERA	BLACK SAGE	SAL MEL	ROSE POTS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 3'	6'	200	SDL-102
	STIPA PULCHRA	PURPLE NEEDLEGRASS	STI PUL	D-40 OR PLUGS	FULL, VIGOROUS, STANDARD FORM	TRANSITIONAL	3' x 2'	0.25'	700	SDL-102

HYDROSEED MIX

BOTANICAL NAME	COMMON NAME	CATEGORY	PURITY / GERMINATION*	POUNDS / ACRE
ACMISPON GLABER	DEERWEED	RIPARIAN	95 / 80	3
ARTEMESIA CALIFORNICA	CALIFORNIA SAGEBRUSH	RIPARIAN	30 / 60	3
DEINANDRA FASCICULATA	FASCICLED TARWEED	RIPARIAN	25 / 65	2
ENCELIA CALIFORNICA	CALIFORNIA ENCELIA	RIPARIAN	30 / 45	2
ERIOGONUM FASCICULATUM	CALIFORNIA BUCKWHEAT	RIPARIAN	55 / 20	6
ERIOPHYLLUM CONFERTIFLORUM	LONG-STEM GOLDEN YARROW	RIPARIAN	TBD	1.5
ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY	RIPARIAN	98 / 80	2
ISOCOMA MENZIESII	COASTAL GOLDENBUSH	RIPARIAN	18 / 40	2
LASTHENIA CALIFORNICA	GOLDFIELDS	RIPARIAN	98 / 95	2
LUPINUS BICOLOR	MINIATURE LUPINE	RIPARIAN	98 / 85	1
MELICA IMPERFECTA	SMALL-FLOWERED MELIC GRASS	RIPARIAN	90 / 67	1
SISYRINCHIUM BELLUM	BLUE-EYED GRASS	RIPARIAN	98 / 80	0.5
SALVIA APIANA	WHITE SAGE	RIPARIAN	88 / 30	1
SALVIA MELLIFERA	BLACK SAGE	RIPARIAN	85 / 50	2
STIPA PULCHRA	PURPLE NEEDLEGRASS	RIPARIAN	90 / 75	3
PLANTAGO INSULARIS (OVATA-INDICA)	PLANTAIN	RIPARIAN	98 / 75	8
VULPIA MICROSTACHYS**	SMALL FESCUE	RIPARIAN	90 / 70	6
			TOTAL	46

** THIS MAY INCLUDE VAR. MICROSTACHYS, VAR. PAUCIFLORA, OR VAR CILIATE *UPDATE PRIOR TO SEED ORDERING

L-1

PLANTING LEGEND

PLANS FOR THE CONSTRUCTION OF
CHOLLAS CREEK TRAIL AND REVEGETATION
PLANTING LEGEND

CONSULTANT

SPEC. NO.

750 B Street
Suite 1620
San Diego
California 92101
619.236.0143
ESTRADA Estrada Land Planning

REGISTERED LANDSCAPE ARCHITECT
VICKI ESTRADA
No. 1685
Exp. 4/30/2022
SIGNATURE
DATE
STATE OF CALIFORNIA

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 14 OF 18 SHEETS

WBS

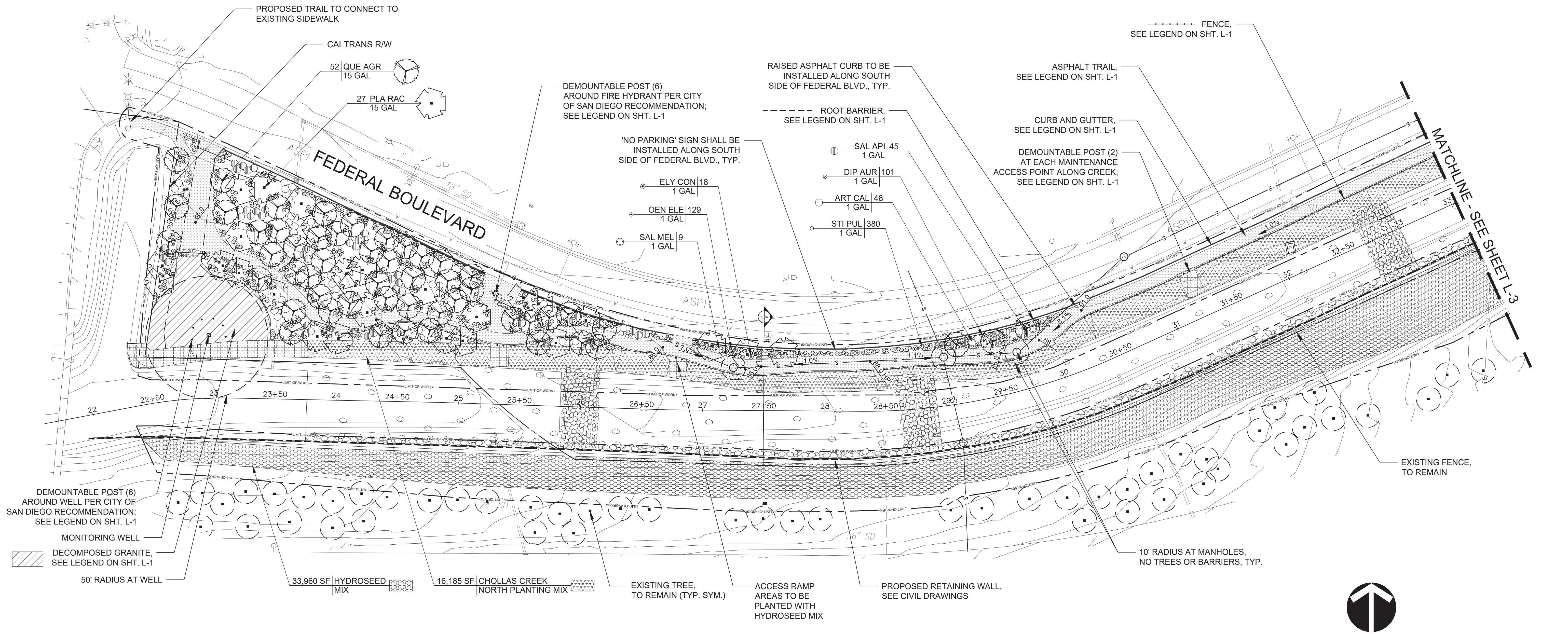
APPROVED:
FOR CITY ENGINEER DATE
PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	ELP			

SUBMITTED BY:
PROJECT MANAGER
CHECKED BY:
PROJECT ENGINEER
CCS27 COORDINATE
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

14 -D



SEE SHEET L-1 FOR PLANTING LEGEND AND NOTES.

SEE SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

MIN. TREE SEPARATION DISTANCE

IMPROVEMENT	MIN. DISTANCE TO STREET TREE
TRAFFIC SIGNAL, STOP SIGN	20 FEET
UNDERGROUND UTILITY LINES (EXCEPT SEWER)	5 FEET
SEWER LINES	10 FEET
ABOVE GROUND UTILITY STRUCTURES (TRANSFORMERS, HYDRANTS, UTILITY POLES, ETC.)	10 FEET
DRIVEWAYS	10 FEET
INTERSECTIONS (INTERSECTING CURB LINES OF TWO STREETS)	25 FEET

NOTE:
NO TREES OR SHRUBS EXCEEDING THREE FEET IN HEIGHT AT MATURITY SHALL BE INSTALLED WITHIN TEN FEET OF ANY SEWER FACILITIES AND FIVE FEET OF ANY WATER FACILITIES.

L-2

PLANTING PLAN

PLANS FOR THE CONSTRUCTION OF
CHOLLAS CREEK TRAIL AND REVEGETATION
PLANTING PLAN

CONSULTANT

ESTRADA Estrada Land Planning
750 B Street
Suite 1620
San Diego
California 92101
619.236.0143

REGISTERED LANDSCAPE ARCHITECT
VICKI ESTRADA
No. 1685
Exp. 4/30/2022
SIGNATURE
DATE
STATE OF CALIFORNIA

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 15 OF 18 SHEETS

WBS

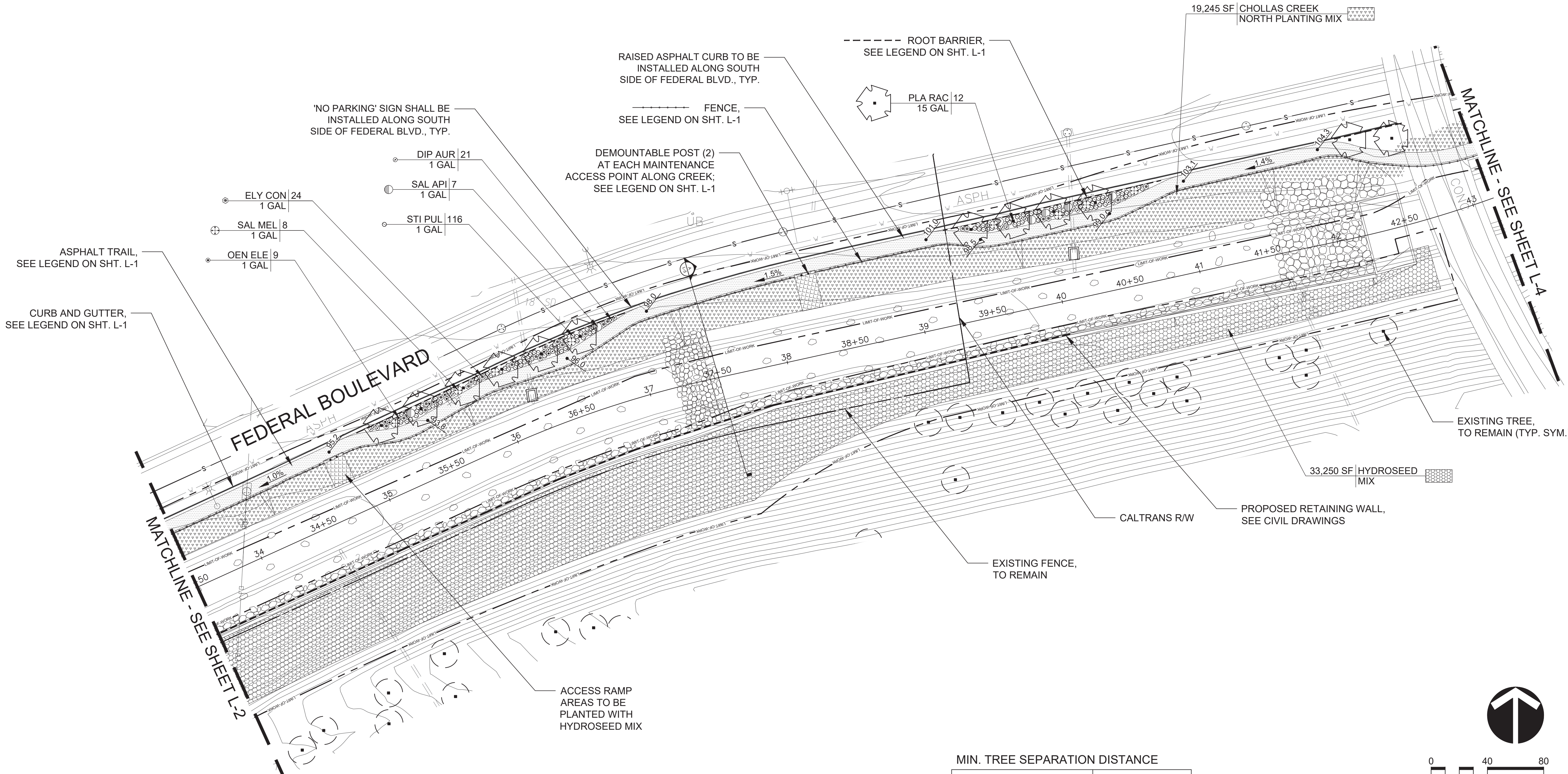
APPROVED:
FOR CITY ENGINEER DATE
PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	ELP			

SUBMITTED BY:
PROJECT MANAGER
CHECKED BY:
PROJECT ENGINEER
CCS27 COORDINATE
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

15 -D



0 40 80 120

SCALE: 1" = 40'

SEE SHEET L-1 FOR PLANTING LEGEND AND NOTES.

SEE SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

MIN. TREE SEPARATION DISTANCE

IMPROVEMENT	MIN. DISTANCE TO STREET TREE
TRAFFIC SIGNAL, STOP SIGN	20 FEET
UNDERGROUND UTILITY LINES (EXCEPT SEWER)	5 FEET
SEWER LINES	10 FEET
ABOVE GROUND UTILITY STRUCTURES (TRANSFORMERS, HYDRANTS, UTILITY POLES, ETC.)	10 FEET
DRIVEWAYS	10 FEET
INTERSECTIONS (INTERSECTING CURB LINES OF TWO STREETS)	25 FEET

NOTE:
NO TREES OR SHRUBS EXCEEDING THREE FEET IN HEIGHT AT MATURITY SHALL BE INSTALLED WITHIN TEN FEET OF ANY SEWER FACILITIES AND FIVE FEET OF ANY WATER FACILITIES.

PLANTING PLAN

L-3

PLANS FOR THE CONSTRUCTION OF
CHOLLAS CREEK TRAIL AND REVEGETATION
PLANTING PLAN

CONSULTANT

ESTRADA
750 B Street
Suite 1620
San Diego
California 92101
619.236.0143
Estrada Land Planning

REGISTERED LANDSCAPE ARCHITECT
VICKI ESTRADA
No. 1685
Exp. 4/30/2022
SIGNATURE
DATE
STATE OF CALIFORNIA

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 16 OF 18 SHEETS

WBS

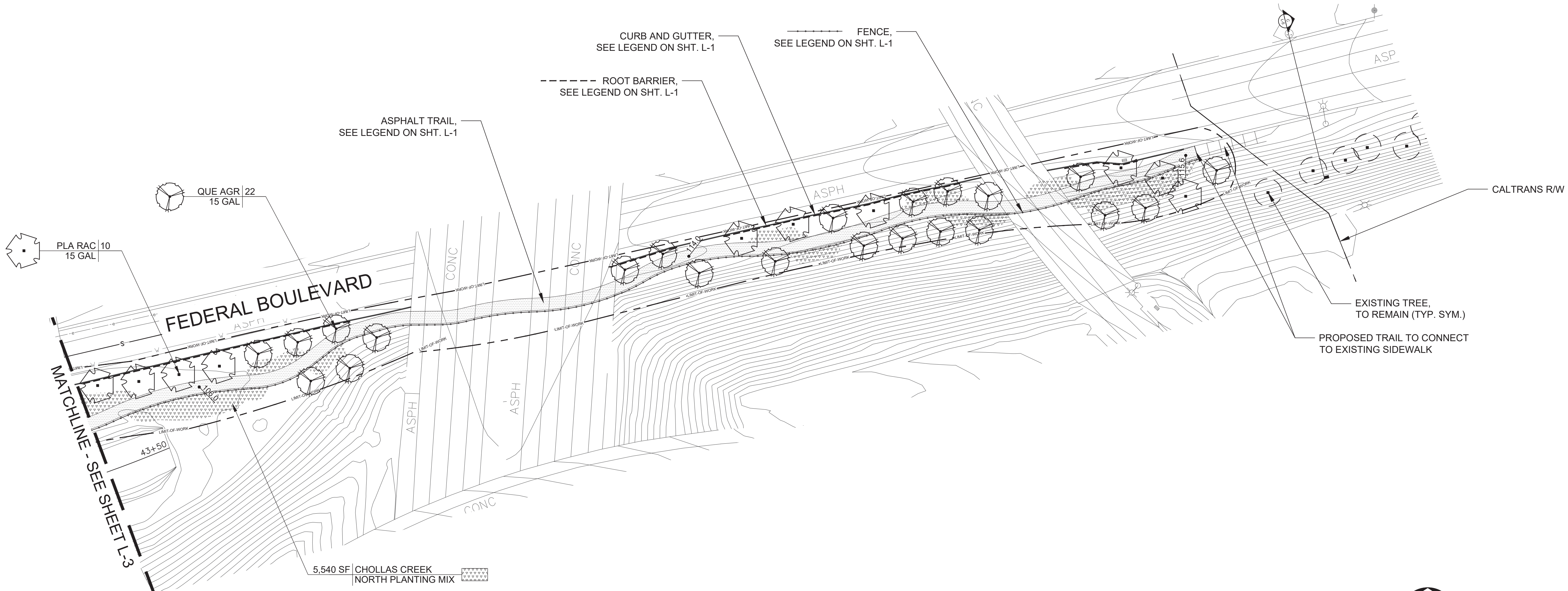
APPROVED:
FOR CITY ENGINEER DATE
PRINT DCE NAME RCE#

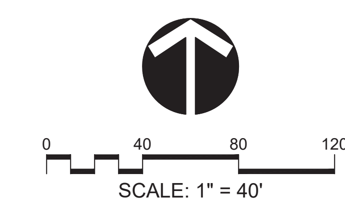
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	ELP			

SUBMITTED BY:
PROJECT MANAGER
CHECKED BY:
PROJECT ENGINEER
CCS27 COORDINATE
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

16 -D





SEE SHEET L-1 FOR PLANTING LEGEND AND NOTES.

SEE SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

MIN. TREE SEPARATION DISTANCE

IMPROVEMENT	MIN. DISTANCE TO STREET TREE
TRAFFIC SIGNAL, STOP SIGN	20 FEET
UNDERGROUND UTILITY LINES (EXCEPT SEWER)	5 FEET
SEWER LINES	10 FEET
ABOVE GROUND UTILITY STRUCTURES (TRANSFORMERS, HYDRANTS, UTILITY POLES, ETC.)	10 FEET
DRIVEWAYS	10 FEET
INTERSECTIONS (INTERSECTING CURB LINES OF TWO STREETS)	25 FEET

NOTE:
NO TREES OR SHRUBS EXCEEDING THREE FEET IN HEIGHT AT MATURITY SHALL BE INSTALLED WITHIN TEN FEET OF ANY SEWER FACILITIES AND FIVE FEET OF ANY WATER FACILITIES.

PLANTING PLAN

L-4

PLANS FOR THE CONSTRUCTION OF
CHOLLAS CREEK TRAIL AND REVEGETATION
PLANTING PLAN

CONSULTANT

ESTRADA
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California 92101
619.236.0143
Estrada Land Planning

REGISTERED LANDSCAPE ARCHITECT
VICKI ESTRADA
No. 1685
Exp. 4/30/2022
SIGNATURE
DATE
STATE OF CALIFORNIA

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 17 OF 18 SHEETS

WBS

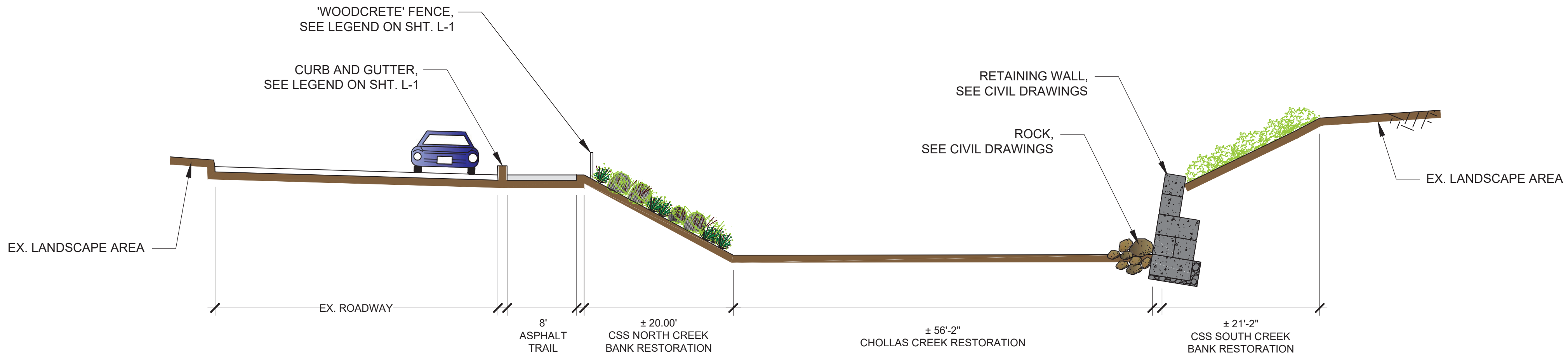
APPROVED:
FOR CITY ENGINEER DATE
PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	ELP			

SUBMITTED BY:
PROJECT MANAGER
CHECKED BY:
PROJECT ENGINEER
CCS27 COORDINATE
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

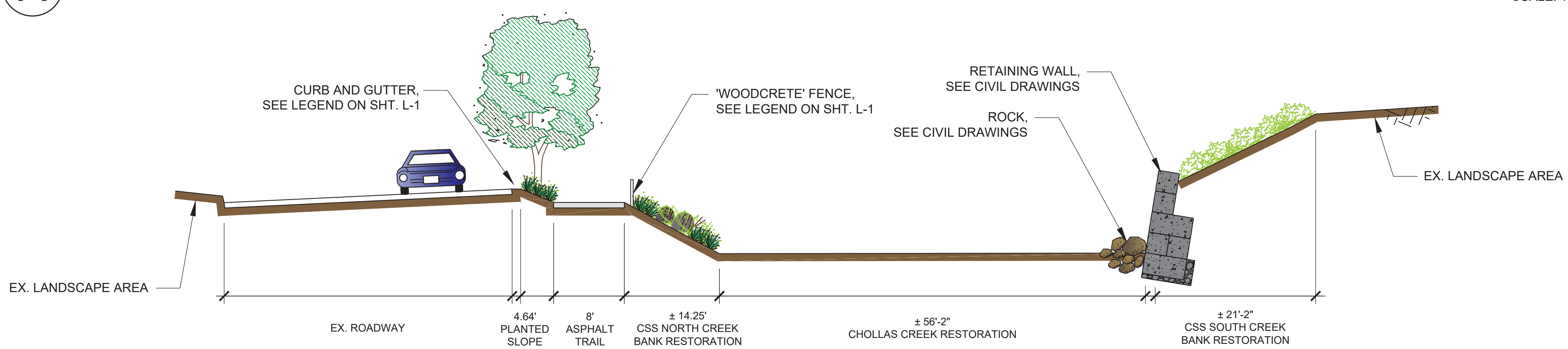
17 -D



A SECTION @ STA. 38+50

SCALE: 1" = 10'-0"

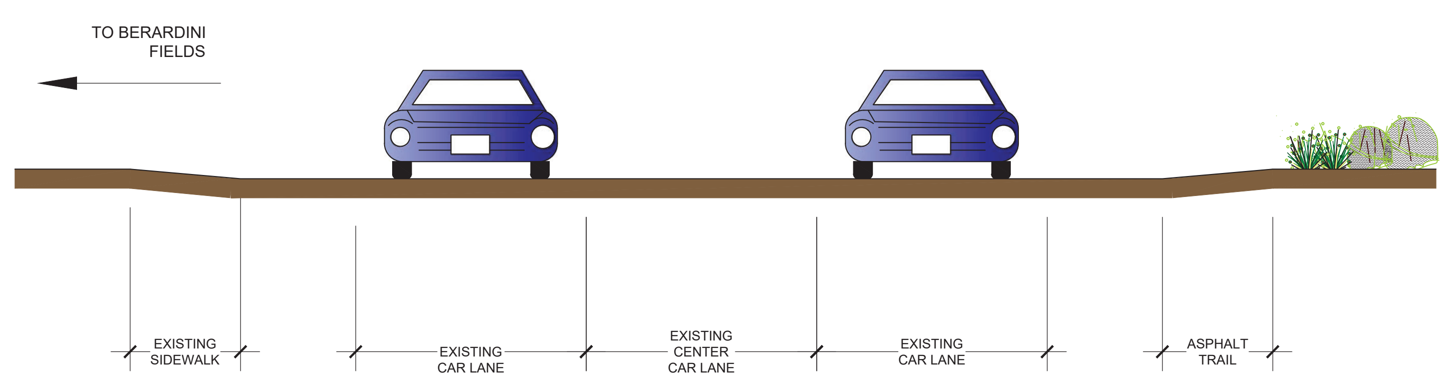
0 10 20 30
SCALE: 1" = 10'



B SECTION @ STA. 27+50

SCALE: 1" = 10'-0"

0 10 20 30
SCALE: 1" = 10'



C SECTION AT BERARDINI FIELD ENTRY

SCALE: 1" = 5'-0"

0 5 10 15
SCALE: 1" = 5'

SEE SHEET L-1 FOR PLANTING LEGEND AND NOTES.

SEE SPECIFICATIONS AND SPECIAL PROVISIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

PLANTING SECTIONS

L-5

PLANS FOR THE CONSTRUCTION OF
CHOLLAS CREEK TRAIL AND REVEGETATION
PLANTING SECTIONS

CONSULTANT

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San Diego
California 92101
619.236.0143
Estrada Land Planning

REGISTERED LANDSCAPE ARCHITECT
VICKI ESTRADA
No. 1685
Exp. 4/30/2022
SIGNATURE
DATE
STATE OF CALIFORNIA

SPEC. NO.

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 18 OF 18 SHEETS

WBS

APPROVED:
FOR CITY ENGINEER DATE
PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	ELP			

SUBMITTED BY:
PROJECT MANAGER
CHECKED BY:
PROJECT ENGINEER
CCS27 COORDINATE
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

18 -D

Attachment B

- Speed Surveys
- Daily Traffic Volumes

Prepared by National Data & Surveying Services

SPEED

Federal Blvd Bet. Home Ave & 47th St

Day: Wednesday
Date: 11/4/2020

City: San Diego
Project #: CA20_040218_001e

East Bound

Time	< 15	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 +	Total
00:00 AM	0	0	0	0	0	1	5	8	2	0	1	0	0	17
01:00	0	0	0	0	0	3	3	3	3	0	0	0	0	12
02:00	0	0	0	0	0	3	4	3	2	0	0	0	0	12
03:00	0	0	1	0	1	0	4	5	3	1	1	0	0	16
04:00	0	0	0	0	0	2	1	9	3	1	0	0	0	16
05:00	0	0	1	1	1	8	22	18	5	3	1	0	0	60
06:00	0	0	0	0	4	13	31	26	11	4	0	0	0	89
07:00	0	0	1	1	4	21	33	32	8	2	0	0	0	102
08:00	0	0	1	1	3	10	28	32	14	1	0	0	0	90
09:00	0	1	1	1	7	16	33	25	8	2	0	0	0	94
10:00	3	0	0	4	10	20	38	28	12	3	0	0	0	118
11:00	0	0	0	3	4	12	54	26	20	3	0	0	0	122
12:00 PM	0	0	0	1	7	18	51	56	24	1	1	0	0	159
13:00	0	0	1	1	11	36	61	48	16	4	1	1	0	180
14:00	0	1	0	1	8	47	71	62	16	6	1	0	0	213
15:00	0	0	0	4	12	25	99	101	25	4	2	0	0	272
16:00	0	0	1	0	6	26	80	100	36	7	2	0	0	258
17:00	0	0	0	2	3	29	92	75	22	4	1	0	0	228
18:00	0	0	0	0	3	18	44	39	14	2	2	0	0	122
19:00	0	0	0	2	2	17	38	24	2	2	0	1	0	88
20:00	0	0	0	0	2	11	19	19	4	0	0	0	0	55
21:00	0	1	0	0	2	7	22	17	4	1	1	0	0	55
22:00	0	0	0	1	2	5	17	18	0	0	1	0	0	44
23:00	0	0	0	0	0	7	7	7	4	1	1	0	0	27
Totals	3	3	7	23	92	355	857	781	258	52	16	2		2449
% of Totals	0%	0%	0%	1%	4%	14%	35%	32%	11%	2%	1%	0%		100%

	< 15	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 +	Total
AM Volumes	3	1	5	11	34	109	256	215	91	20	3	0	0	748
% AM	0%	0%	0%	0%	1%	4%	10%	9%	4%	1%	0%			31%
AM Peak Hour	10:00	09:00	03:00	10:00	10:00	07:00	11:00	07:00	11:00	06:00				11:00
Volume	3	1	1	4	10	21	54	32	20	4	1			122
PM Volumes	0	2	2	12	58	246	601	566	167	32	13	2	0	1701
% PM		0%	0%	0%	2%	10%	25%	23%	7%	1%	1%	0%		69%
PM Peak Hour		14:00	13:00	15:00	15:00	14:00	15:00	15:00	16:00	16:00	15:00	13:00		15:00
Volume		1	1	4	12	47	99	101	36	7	2	1		272

Directional Peak Periods All Speeds	AM 7-9		NOON 12-2		PM 4-6		Off Peak Volumes	
	Volume ⟷	%	Volume ⟷	%	Volume ⟷	%	Volume ⟷	%
	192	8%	339	14%	486	20%	1432	58%

Street Name	Direction	Percentiles					
		15th	50th	Average	85th	95th	ADT
Federal Blvd	East Bound	38	44	44	50	54	2449
Federal Blvd	West Bound	31	38	38	44	48	1020

Prepared by National Data & Surveying Services

SPEED

Federal Blvd Bet. Home Ave & 47th St

Day: Wednesday
Date: 11/4/2020

City: San Diego
Project #: CA20_040218_001

Summary

Time	< 15	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 +	Total
00:00 AM	0	0	0	0	0	1	7	9	3	0	1	0	0	21
01:00	0	0	0	0	3	4	4	3	3	0	0	0	0	17
02:00	0	0	1	0	1	7	4	3	2	0	0	0	0	18
03:00	0	1	1	4	1	2	5	5	3	1	1	0	0	24
04:00	0	0	1	1	1	5	5	10	3	1	0	0	0	27
05:00	1	0	5	4	5	20	26	20	5	3	1	0	0	90
06:00	0	2	2	11	18	33	36	28	11	4	0	0	0	145
07:00	0	0	5	3	16	36	48	43	9	2	0	0	0	162
08:00	0	0	4	6	17	23	46	32	14	2	0	0	0	144
09:00	1	2	3	8	12	49	54	28	8	2	0	0	0	167
10:00	3	0	4	9	26	38	50	31	14	3	0	0	0	178
11:00	0	0	1	7	15	29	72	27	22	3	0	0	0	176
12:00 PM	0	0	0	5	18	41	70	64	24	1	1	0	0	224
13:00	0	0	4	11	23	50	92	51	16	4	1	1	0	253
14:00	0	1	1	2	34	75	85	64	17	7	1	0	0	287
15:00	1	1	1	5	23	50	117	109	26	4	2	0	0	339
16:00	0	1	1	7	16	52	93	109	37	8	2	0	0	326
17:00	0	0	3	4	14	53	116	85	25	4	1	0	0	305
18:00	0	1	3	5	12	42	65	52	16	2	2	0	0	200
19:00	0	0	0	3	5	27	47	32	4	2	0	1	0	121
20:00	0	0	0	2	9	21	22	24	4	0	0	0	0	82
21:00	1	1	1	0	5	11	27	19	6	1	1	0	0	73
22:00	0	1	0	2	4	9	18	21	0	0	1	0	0	56
23:00	0	0	0	2	1	9	8	7	5	1	1	0	0	34
Totals	7	11	41	101	279	687	1117	876	277	55	16	2		3469
% of Totals	0%	0%	1%	3%	8%	20%	32%	25%	8%	2%	0%	0%		100%

	< 15	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 +	Total
AM Volumes	5	5	27	53	115	247	357	239	97	21	3	0	0	1169
% AM	0%	0%	1%	2%	3%	7%	10%	7%	3%	1%	0%			34%
AM Peak Hour	10:00	06:00	05:00	06:00	10:00	09:00	11:00	07:00	11:00	06:00				10:00
Volume	3	2	5	11	26	49	72	43	22	4	1			178
PM Volumes	2	6	14	48	154	440	760	637	180	34	13	2	0	2300
% PM	0%	0%	0%	1%	5%	13%	22%	18%	5%	1%	0%	0%		66%
PM Peak Hour	15:00	14:00	13:00	13:00	14:00	14:00	15:00	15:00	16:00	16:00	15:00	13:00		15:00
Volume	1	1	4	11	34	75	117	109	37	8	2	1		339

Directional Peak Periods All Speeds	AM 7-9		NOON 12-2		PM 4-6		Off Peak Volumes	
	Volume	%	Volume	%	Volume	%	Volume	%
	306 ⟷	9%	477 ⟷	14%	631 ⟷	18%	2055 ⟷	59%

Street Name	Direction	Percentiles					
		15th	50th	Average	85th	95th	ADT
Federal Blvd	Summary	36	43	42	49	53	3469

Prepared by NDS/ATD

Prepared by National Data & Surveying Services

VOLUME

Federal Blvd Bet. Home Ave & 47th St

Day: Wednesday
Date: 11/4/2020

City: San Diego
Project #: CA20_040218_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,449	1,020	3,469

AM Period	NB	SB	EB		WB		TOTAL	
00:00	0	0	3		2		5	
00:15	0	0	5		0		5	
00:30	0	0	3		0		3	
00:45	0	0	6	17	2	4	8	21
01:00	0	0	3		1		4	
01:15	0	0	4		2		6	
01:30	0	0	3		1		4	
01:45	0	0	2	12	1	5	3	17
02:00	0	0	3		1		4	
02:15	0	0	3		0		3	
02:30	0	0	4		5		9	
02:45	0	0	2	12	0	6	2	18
03:00	0	0	5		1		6	
03:15	0	0	4		2		6	
03:30	0	0	5		5		10	
03:45	0	0	2	16	0	8	2	24
04:00	0	0	3		0		3	
04:15	0	0	2		2		4	
04:30	0	0	1		4		5	
04:45	0	0	10	16	5	11	15	27
05:00	0	0	4		2		6	
05:15	0	0	13		4		17	
05:30	0	0	15		15		30	
05:45	0	0	28	60	9	30	37	90
06:00	0	0	13		19		32	
06:15	0	0	27		7		34	
06:30	0	0	22		15		37	
06:45	0	0	27	89	15	56	42	145
07:00	0	0	19		18		37	
07:15	0	0	19		18		37	
07:30	0	0	29		11		40	
07:45	0	0	35	102	13	60	48	162
08:00	0	0	20		10		30	
08:15	0	0	25		13		38	
08:30	0	0	20		19		39	
08:45	0	0	25	90	12	54	37	144
09:00	0	0	17		13		30	
09:15	0	0	28		31		59	
09:30	0	0	20		16		36	
09:45	0	0	29	94	13	73	42	167
10:00	0	0	40		17		57	
10:15	0	0	23		11		34	
10:30	0	0	30		16		46	
10:45	0	0	25	118	16	60	41	178
11:00	0	0	29		10		39	
11:15	0	0	23		13		36	
11:30	0	0	36		21		57	
11:45	0	0	34	122	10	54	44	176
TOTALS				748		421		1169
SPLIT %				64.0%		36.0%		33.7%

PM Period	NB	SB	EB		WB		TOTAL	
12:00	0	0	40		15		55	
12:15	0	0	30		12		42	
12:30	0	0	50		16		66	
12:45	0	0	39	159	22	65	61	224
13:00	0	0	38		20		58	
13:15	0	0	43		17		60	
13:30	0	0	50		18		68	
13:45	0	0	49	180	18	73	67	253
14:00	0	0	51		21		72	
14:15	0	0	42		18		60	
14:30	0	0	55		24		79	
14:45	0	0	65	213	11	74	76	287
15:00	0	0	57		21		78	
15:15	0	0	55		21		76	
15:30	0	0	84		12		96	
15:45	0	0	76	272	13	67	89	339
16:00	0	0	62		17		79	
16:15	0	0	52		22		74	
16:30	0	0	72		17		89	
16:45	0	0	72	258	12	68	84	326
17:00	0	0	71		17		88	
17:15	0	0	65		17		82	
17:30	0	0	56		18		74	
17:45	0	0	36	228	25	77	61	305
18:00	0	0	32		23		55	
18:15	0	0	36		14		50	
18:30	0	0	24		21		45	
18:45	0	0	30	122	20	78	50	200
19:00	0	0	19		7		26	
19:15	0	0	25		7		32	
19:30	0	0	25		8		33	
19:45	0	0	19	88	11	33	30	121
20:00	0	0	10		5		15	
20:15	0	0	10		7		17	
20:30	0	0	15		7		22	
20:45	0	0	20	55	8	27	28	82
21:00	0	0	18		8		26	
21:15	0	0	7		3		10	
21:30	0	0	13		3		16	
21:45	0	0	17	55	4	18	21	73
22:00	0	0	13		3		16	
22:15	0	0	13		1		14	
22:30	0	0	8		6		14	
22:45	0	0	10	44	2	12	12	56
23:00	0	0	7		5		12	
23:15	0	0	7		0		7	
23:30	0	0	5		1		6	
23:45	0	0	8	27	1	7	9	34
TOTALS				1701		599		2300
SPLIT %				74.0%		26.0%		66.3%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,449	1,020	3,469

	EB	WB	Total		EB	WB	Total
AM Peak Hour	11:45	09:15	11:45	PM Peak Hour	16:30	17:15	16:30
AM Pk Volume	154	77	207	PM Pk Volume	280	83	343
Pk Hr Factor	0.770	0.621	0.784	Pk Hr Factor	0.972	0.830	0.963
7 - 9 Volume	192	114	306	4 - 6 Volume	486	145	631
7 - 9 Peak Hour	07:30	07:00	07:00	4 - 6 Peak Hour	16:30	17:00	16:30
7 - 9 Pk Volume	109	60	162	4 - 6 Pk Volume	280	77	343
Pk Hr Factor	0.779	0.833	0.844	Pk Hr Factor	0.972	0.770	0.963

Daily 3580

Attachment C

Excerpts from:

- City of San Diego Transportation and Storm Water Street Design Manual March 2017 Edition
- City of San Diego Pedestrian Crosswalk Guidelines 2015
- Council policy 200-07
- Caltrans Highway Design Manual Seventh Edition
- AASHTO “A Policy of Geometric Design of Highways and Streets
- California Manual on Uniform Traffic Control Devices 2014 Edition

- City of San Diego Transportation and Storm Water Street Design Manual
  March 2017 Edition

THE CITY OF SAN DIEGO

Transportation & Storm Water Design Manuals

Street Design Manual

March 2017 Edition

The City of SAN DIEGO

hampered. The spacing of intersections or crossing points is also an important element in the creation of a supportive pedestrian environment.

This section describes how intersections can be made more pedestrian-friendly by reducing crossing distances and improving visibility for both pedestrians and drivers. Detailed discussion of specific crossing designs and elements is included in Section 2.5, "Pedestrian Crossings."

2.4.1 Issues to Consider

The following are general issues that should be considered for intersection design:

- Pedestrians should be made as visible as possible because multiple conflict points for vehicles and pedestrians exist at intersections.
- Intersections that minimize pedestrain crossing distance and crossing time reduce the exposure to traffic and pedestrian/vehicular conflicts.
- Drivers traveling at a slower rate of speed have more time to process and react to pedestrian conflicts at intersections.

2.4.2 ADA Accessibility

Pedestrian facilities (including curb ramps, signal equipment, etc.) must comply with ADA standards and California Title 24 regulations and take into account the entire range of disability categories.

2.4.3 New Development versus Retrofit

- Prior to improvements to an existing intersection, utilities (e.g., lighting, electrical, and storm drains) should be identified and either incorporated into the design or relocated.
- New intersections provide the opportunity to clarify new forms of traffic control that may create a more pedestrian-friendly setting.

2.4.4 Relation to Transit

The location and design of transit stops at intersections should consider the access needs of adjacent land uses that generate pedestrian demand for transit as well as pedestrian and traffic safety issues at the intersection.

2.5 Pedestrian Crossings

One of the most effective means of turning an important corridor into a community "spine" or "seam" rather than a community "divider" is providing for safe street crossings. Guidelines for installation of marked crosswalks at uncontrolled intersections and mid-block crossings are contained in Council Policy 200-07, "Marked Crosswalk Criteria at Uncontrolled Locations".

2.5.1 Issues to Consider

The following are general issues that should be considered for pedestrian crossings, including residential street crossings and mid-block crosswalks:

- The width of the street, the geometry of the intersection, the timing of signalization, and the frequency of crossing opportunities all play important roles in achieving a pedestrian-friendly environment.
- Crossing opportunities should be provided at regular and convenient intervals.
- Marked crosswalks are useful in channelizing pedestrian crossing activity at specified locations.
- Marked crosswalks identify appropriate crossing locations for pedestrians and alert drivers to the possible presence of pedestrians.
- The use of marked crosswalks is generally considered appropriate at signalized intersections where pedestrian activity occurs.
- Street width and traffic speed can be mitigated with the use of sidewalk pop-outs.
- Some pedestrians may become overconfident or be less aware of vehicles when crossing in a marked crosswalk; therefore, marked crosswalks should not be used indiscriminately.

2.5.2 Accessibility

Appropriate curb ramps must be provided at all pedestrian crossings and island passageways.

2.5.3 Relation to Transit

All transit stops require that pedestrians be able to cross the street safely and within proximity to the stop.

2.5.4 Guidelines

The following guidelines should be followed for pedestrian crossings:

1. The width of all crosswalks shall be a minimum of 10 feet wide or per dimensions specified by the ADA and California Title 24 regulations. Unless small-scale intersection conditions dictate otherwise, widths shall be increased where there is greater pedestrian activity.
2. Adequate lighting at the levels specified in Chapter 4, "Street Lighting", should be present.
3. The installation of crosswalks shall conform to Council Policy 200-07 and in accordance with CA MUTCD.
4. Marked crosswalks should be provided at all signalized intersections where pedestrian crossing is allowed.
5. Curb ramps shall be provided at all crosswalks. If a raised median extends into the crosswalk, the median nose should be relocated out of the crosswalk or an island passageway with truncated domes must be provided through the median.

2.5.5 Residential Street Crossings

2.5.5.1 Issues to consider

- Enhanced pedestrian crossings in residential neighborhoods are a key component of pedestrian-oriented street design and lead to both improved pedestrian safety and the livability of the neighborhood.
- Residential street crossings are often combined with traffic-calming measures that are designed to maintain low vehicle speeds, such as raised crosswalks, chicanes, and gateway narrowings (see Chapter 3, "Traffic Calming").
- Enhanced pedestrian crossings in residential neighborhoods may not be used if traffic volumes are low enough that pedestrians are comfortable crossing at any location.

2.5.5.2 Guidelines

- Enhanced pedestrian crossing measures should be considered in residential neighborhoods where a demonstrated crossing demand exists.
- On residential streets that experience excessive vehicle speeds, enhanced pedestrian crossings should be combined with traffic-calming measures such as pop-outs.

2.5.6 Mid-Block Crosswalks

2.5.6.1 Issues to consider

- Mid-block crosswalks provide convenient crossing locations for pedestrians when other crossing opportunities are distant or where there is a presence of concentrated mid-block pedestrian crossing demand.
- Guidelines for installation of mid-block crossings are contained in the Council Policy 200-07, "Marked Crosswalk Criteria at Uncontrolled Locations."

2.5.6.2 Guidelines

1. Crosswalks at uncontrolled intersections and mid-block crosswalks shall be installed in accordance with Council Policy 200-07.
2. Mid-block crosswalks shall be well illuminated (refer to Chapter 4, "Street Lighting").
3. A curb ramp shall be provided at each end of the crosswalk.
4. Curb extensions may be considered at the crosswalk to enhance pedestrian crossing visibility and reduce crossing distance.
5. If mid-block crosswalks are signalized, accessible pedestrian signals and devices shall be installed.
6. On streets that experience excessive vehicle speeds, enhanced pedestrian crossings should be combined with traffic calming measures such as raised crosswalks or curb extensions.

2.6 Island Passageways

Island passageways in wide or busy streets improve safety for pedestrians and vehicles. They are defined as areas within an intersection or between lanes of traffic where pedestrians may safely walk until vehicular traffic clears, allowing them to cross a street. Another benefit to pedestrians is that it can significantly reduce delay in crossing unsignalized intersections because pedestrians need only search for vehicles in one direction at a time.

2.6.1 Issues to Consider

In general, island passageways work best on wider streets with long pedestrian crossing times and exposure to vehicular traffic or on streets with speeds higher than 35 mph.

2.6.2 Accessibility

Island passageways are particularly useful for slower pedestrians such as the very young, the elderly, or those with mobility disabilities. Where it is not possible to include ramps and waiting pads that meet accessibility requirements waiting areas should be at-grade with the roadway (channels).

2.6.3 New Development versus Retrofit

Island passageways may be installed at intersections or mid-block locations deemed appropriate through engineering studies. They should be considered from the outset of design for intersections that are either complex, irregular in shape, excessively wide, or in areas where children and the elderly are expected to cross frequently.

2.6.4 Relation to Transit

The use of island passageways should be considered where transit is "running" with the street ROW, particularly in station areas.

2.6.5 Guidelines

The following guidelines should be followed for island passageways:

1. Island passageways with truncated domes shall be designed per the City of San Diego Standard Drawings.
2. Pedestrian island passageways should be well illuminated.

2.7 Sight Distance

More often than not, sight distance is discussed only from the standpoint of the driver, not the pedestrian. This is of particular concern at crosswalk locations where parked cars, utility poles, street furnishings, or landscapes can obstruct the line of sight for pedestrians.

2.7.1 Issues to Consider

Streets that support pedestrian movements allow for the placement of elements such as trees and medians with landscaping. The presence of such elements creates a slower speed environment that is more conducive to pedestrian travel. These elements shall be placed in such a way that adequate sight distance is provided for all users of the public ROW.

All pedestrian crossing facilities in the City shall take into consideration Council Policy 200-07, "Marked Crosswalk Criteria at Uncontrolled Locations."

2.7.2 Relation to Current Standards and Practices

- AASHTO Green Book recommends a 90-degree angle of roadways whenever possible.
- The CalTrans Highway Design Manual defines stopping sight distance requirements based on the approaching speed of vehicles (Section 201.3). These standards range from 125 feet for speeds of 20 mph to 360 feet for speeds of 45 mph on flat terrain.

2.7.3 Guidelines

The following guidelines should be followed for sight distance:

1. Parking restrictions near crosswalks should be considered to remove potential obstructions to the pedestrian's line of sight, particularly for young children and those in wheelchairs.
2. When street furnishings or other objects that obstruct view cannot be relocated, curb extension or other treatments should be considered.

2.8. Sidewalks for Overpasses, Underpasses, and Highway On/Off Ramps

Access on an overpass across a highway is often along a narrow sidewalk where the pedestrian is against a wall or guardrail and is highly exposed and vulnerable to speeding traffic. The unappealing environment of underpasses is often exacerbated by poor lighting and obscured sightlines. Pedestrian access across on- and off-ramps can also be difficult because drivers are preoccupied with making the transition between the highway and the street network.

The overpass discussion is applicable to all bridges with pedestrian access, and the overpass and underpass discussions are applicable to grade-separated railroad crossings.

2.8.1 Overpasses and Underpasses

2.8.1.1 Issues to Consider

Overpasses and underpasses are required to be accessible. Pedestrian ramps or elevators may be incorporated as part of the access elements. Pedestrian ramps may require a considerable amount of land for installation and elevators may have potential security and maintenance issues.

- City of San Diego Pedestrian Crosswalk Guidelines 2015

City of San Diego
Pedestrian Crosswalk Guidelines
2015

Prepared for:

City of San Diego

Prepared by:

Transportation Engineering Operations Division
City of San Diego

CHEN RYAN

Safe Transportation
Research & Education Center
SafeTREC

yellow for marking crosswalks in school areas is mandated by the California Vehicle Code and the California Manual on Uniform Traffic Control Devices (CA MUTCD). The risk model results validate the conclusions of previous studies and recommend an engineering warrant approach to the installation of all marked crosswalks.

Locations where pedestrian restrictions have been placed to prevent pedestrians from crossing are identified in the risk model as having a higher propensity for pedestrian collisions. These results highlight the need for pedestrians to be educated on the high risk of injury from crossing at locations where drivers are not expecting pedestrians.

The following variables are associated with a decrease in pedestrian risk: presence of pedestrian warning signage, presence of pedestrian signal heads, population levels, and employment levels.

Locations where pedestrian warning signage was present in advance of the crosswalks showed lower pedestrian risk. This finding validates the need to maintain at least the minimum advance warning signage that supplements marked crossings following the standards in the CA MUTCD. When a location is controlled with a traffic signal and has a pedestrian signal head, pedestrian risk is lower; however, vehicle turning movements may impact pedestrian risk at these locations and turning movements should be closely evaluated when determining signal phasing and turning restrictions. Population and employment levels were evaluated based on census tract data. This analysis showed that high population and employment density locations had lower pedestrian risk near the study locations.

In addition to the pedestrian risk model analysis, an isolated variable analysis was conducted which looked at each variable individually without the impacts of all other variables. Through this analysis, the presence of a bus stop was found to be associated with an increase in pedestrian risk. This variable has been included as a factor to be considered in the marked crosswalk warrants.

The remainder of this chapter presents methods for determining whether a marked crosswalk is warranted at a proposed uncontrolled pedestrian crossing location, as well as any additional treatments that may be required with the installation of a marked crosswalk. Pedestrian crossing treatment toolboxes for both uncontrolled and controlled crossings are also provided in this section.

Uncontrolled Crosswalk Warrants and Implementation

This section presents guidance for assessing uncontrolled intersections and mid-block locations for potential installation of marked crosswalks and additional pedestrian safety treatments.

This warrant system builds on the warrant system in Council Policy 200–07, and incorporates findings from the pedestrian risk model. This warrant system is more flexible and also includes new factors to improve alignment with regional smart growth goals, complete streets principles, and community members' overall desire to make streets and roadways more walkable. It elevates the status of pedestrians to be more in balance with vehicles, bicycles, and other modes of transportation. It is expected to result in more proposed marked crosswalk locations meeting the warrants. The warrant system also provides a comprehensive list of treatments that can improve safety at marked crosswalk locations and provide an enhanced walking environment across the city.

Engineering judgment should be used to apply these guidelines or adjust them to fit individual field site conditions. These guidelines are not intended to be a substitute for engineering knowledge, experience or judgment.

Overview of Evaluation Process

This report proposes a warrant system (Basic Warrants and Point Warrants) to assess the installation of marked crosswalks at uncontrolled crossing locations. The warrants and treatment evaluation are described below.

Basic Warrants – Requirements contained in each of the six (6) Basic Warrants (pedestrian volume or latent pedestrian demand, approach speed, distance to nearest controlled crossing, visibility, illumination, and accessibility) must be met in order for a currently uncontrolled location to be considered for the installation of a marked crosswalk.

Point Warrant – If the requirements contained in each of the Basic Warrants are met, the uncontrolled location is then evaluated using the Point Warrants. The Point Warrants have separate categories, with 38 possible points available. An uncontrolled location needs 16 points or more to qualify for the installation of a marked crosswalk.

Additional Treatments – Before a marked crosswalk can be approved, additional crossing treatments need to be installed. **Table 2-3** identifies categories for crossing treatments that that are based on thresholds considering vehicle volumes, vehicle speeds, and crossing distances. **Table 2-4** lists the crossing treatments for each category.

Inputs to Evaluation of Uncontrolled Crossing Locations

The following data inputs are required to evaluate an uncontrolled location for installation of a marked crosswalk:

- Peak Hour Pedestrian Volumes or Latent Pedestrian Demand
- 85th Percentile Speed
- Vehicular Approach Visibility
- Presence of Lighting
- Accessibility
- Nearest Controlled Crossing Distance
- Surrounding Land Uses
- Presence of Bus Stop
- Additional Extenuating Factors

2. CROSSWALK WARRANTS AND TREATMENT GUIDELINES

Basic Warrants

In order for a proposed uncontrolled location to qualify for a marked crosswalk and supplemental treatments, a location must meet each of the following Basic Warrants.

1. Pedestrian Volume Warrant
   Pedestrian volumes must be equal to or greater than ten (10) pedestrians per hour during the peak pedestrian hour. Children under 13, elderly over 64 years and/or disabled persons count as 1.5 pedestrians. Alternatively, this warrant can be satisfied using Latent Pedestrian Demand if conditions (a), (b), or (c) under Table 2-2, 2-2.1b are met.

2. Approach Speed Warrant
   The 85th percentile approach speed must be equal to or lower than 40 MPH. This warrant does not apply when a pedestrian hybrid beacon or a pedestrian traffic signal will be installed.

3. Nearest Controlled Crossing
   The proposed location must be further than 250 feet from the nearest controlled crossing location (measured from the nearest edge of the proposed marked crosswalk to the closest edge of the controlled crossing).

4. Visibility Warrant
   The motorist must have an unrestricted view of all pedestrians at the proposed location for the distance required by the following table (stopping sight distance is to be interpolated when 85th percentile speed is between 5 mph increments):

85th Percentile Speed (MPH)	Stopping Sight Distance (feet)
25	150
30	200
35	250
40	300

Source: Caltrans Highway Design Manual, Table 201.1(March 7, 2014)

5. Illumination Warrant
   The proposed location must have existing lighting.

6. Accessibility Warrant
   The proposed location must have existing accessibility to disabled pedestrians or have accessibility improvements programmed.

Point Warrants

The Point Warrant has a total possible score of 38 points. As stated above, to qualify for installation of a marked crosswalk, a location must meet each of the Basic Warrants and score a minimum of 16 points in the Point Warrants. A summary of each of the Point Warrants and the allocation of points is presented in **Table 2-2**. A discussion of each of the Point Warrant variables follows the table.

Table 2-2: Point Warrants

2-2.1a Pedestrian Volume Warrant		
Number of Pedestrians (Peak Hour)	**Points**	**Total Available Points**
10 – 25	4	10
26 – 50	8	
51+	10	
2-2.1b Latent Pedestrian Demand Warrant (in lieu of Pedestrian Volume Warrant)		
Condition	**Points**	**Total Available Points**
(a) The proposed crosswalk is in a commercial, mixed land use, or high density residential area.	3	10
(b) A pedestrian or shared use path is interrupted by a restricted crossing.	3	
(c) A pedestrian attractor/generator is directly adjacent to the proposed crosswalk as defined in the explanatory notes below.	4	
2-2.2 General Condition Warrant		
Condition	**Points**	**Total Available Points**
(a) The nearest controlled crossing is greater than 300 feet from the proposed crosswalk.	3	18
(b) The proposed crosswalk will position pedestrians to be better seen by motorists.	3	
(c) The proposed crosswalk will establish a mid-block crossing between adjacent signalized intersections or it will connect an existing pedestrian path.	3	
(d) The proposed crosswalk is located within ¼ mile of pedestrian attractors/generators as defined in the explanatory notes below.	3	
(e) An existing bus stop is located within 100 feet of the proposed crosswalk.	3	
(f) Other factors.	3	

Table 2-2: Point Warrants (continued)

2-2.3 Gap Time Warrant		
Average Number of Vehicular Gaps per 5-Minute Period	**Points**	**Total Available Points**
0 – 0.99	0	10
1 – 1.99	1	
2 – 2.99	8	
3 – 3.99	10	
4 – 4.99	8	
5 – 5.99	1	
6 or over	0	
Total Available Points		38

Table 2-2 Explanatory Notes:

2-2.1a Pedestrian Volume Warrant

The Pedestrian Volume Warrant assigns point values based on pedestrian crossing volumes at the proposed crosswalk. Children under 13, elderly over 64 years and/or disabled persons count as 1.5 pedestrians.

2-2.1b Latent Pedestrian Demand Warrant (in lieu of Pedestrian Volume Warrant)

The Latent Pedestrian Demand Warrant may be used in lieu of the Pedestrian Volume Warrant.

2-2.2 General Condition Warrant

The General Condition Warrant presents six (6) unique categories. A location can score either zero (0) or three (3) points for each unique category, making a total 18 possible points available. The general conditions include the following:

(a) *The nearest controlled crossing is greater than 300 feet from the proposed crosswalk.*
The distance should be measured from the proposed location of the crosswalk to the nearest controlled intersection, i.e. stop sign, traffic signal, etc.

(b) *The proposed crosswalk will position pedestrians to be better seen by motorists.*
This condition should be considered at locations where one leg of the intersection provides better sight distance than the other legs.

(c) *The proposed crosswalk will establish a mid-block crossing between adjacent signalized intersections.*
This warrant refers to a condition where there is a high pedestrian attractor/generator nearby, and adequate crossing can be provided that could help channelize a recognized heavy flow of mid-block pedestrians.

(d) *The proposed crosswalk is located within ¼ mile of the following pedestrian attractors/generators as defined below:*
- International Border Crossing
- Major Multi-Modal Transit Centers (>10,000 boardings per day)
- Transit Stops (>1,000boardings per day)
- Elementary/Middle/ High Schools
- Universities and Colleges
- Neighborhood Civic Facilities (Libraries, Post Office & Religious Facilities)

- Neighborhood and Community Retail
- Pedestrian Intensive Beaches
- Parks & Recreation (excludes non-useable open space)
- Mixed Land Uses (housing near employment and/or commercial)

(e) *A bus stop is located within 100 feet of the proposed crosswalk.*
This warrant is applicable if there is a bus stop within 100-feet of the proposed crosswalk.

(f) *Other factors.*
Other factors allow for extenuating circumstances not covered in the proposed warrants. This is to be evaluated using engineering judgment.

2-2.3 Gap Time Warrant

Gap time is the time needed for a pedestrian to cross the travelled lanes of a roadway at an average walking speed without the need for a driver to yield. The number of usable gaps (or gaps that exceed the minimum time needed to cross) are counted during the peak vehicular hour and averaged per five-minute period.

Crossing Treatments

If the proposed crossing location meets the criteria set by both the Basic and Point Warrants, the next step is to evaluate the most appropriate crossing treatment(s) to be installed with the marked crosswalk. **Table 2-3** provides thresholds for determining whether additional treatments are required prior to installing a marked crosswalk. The thresholds are based on vehicle volumes, vehicle speeds, and pedestrian crossing distance at the proposed location. Location types are divided into categories A, B, C and D, and are used to determine the appropriate treatment for the proposed location.

Table 2-3: Crossing Treatment Thresholds for Uncontrolled Marked Crosswalks if Warrants are Met

<table>
<tr><th>Crossing Distance[2]</th><th colspan="9">Roadway ADT (vehicles per day)</th></tr>
<tr><td></td><td>< 1,500</td><td colspan="2">1,501 – 5,000</td><td colspan="2">5,001 – 12,000</td><td colspan="2">12,001 – 15,000</td><td colspan="2">> 15,000</td></tr>
<tr><td>< 40'</td><td>A</td><td colspan="2">B</td><td colspan="2">B</td><td colspan="2">C</td><td>C</td><td>D[1]</td></tr>
<tr><td>40' to 52'</td><td>A</td><td colspan="2">B</td><td colspan="2">C</td><td>C</td><td>D[1]</td><td colspan="2">D</td></tr>
<tr><td>> 52'</td><td>A</td><td>B</td><td>C[1]</td><td>C</td><td>D[1]</td><td colspan="2">D</td><td colspan="2">D</td></tr>
</table>

1. For streets with more than one lane at an approach or posted speed limit 30 mph or greater.
2. Crossing distance can be measured to a pedestrian refuge island if one is present.

Source: City of San Diego (February, 2015)

Crossing Treatments

Table 2-4 presents treatment requirements for the categories shown in **Table 2-3**. As new devices or treatments are proven, they may be considered in lieu of these treatments, with the City Engineer's approval.

Table 2-4: Crossing Treatments for Uncontrolled Marked Crosswalks if Warrants are Met

Category	Crossing Treatments
A	**The following is required:** • (W11-2) Pedestrian Warning Signage with the corresponding (W16-7P) arrow plaque
B	**At least one of the following is required:** • (R1-6) State Law – Yield to Pedestrian sign if median is present • Rectangular Rapid Flashing Beacons (RRFBs) • Raised crosswalk or other traffic calming treatments if the City of San Diego's Traffic Calming Guidelines are met
C	**At least two of the following are required:** • Radar Speed Feedback Signs • Striping changes such as narrower lanes, painted medians, road diets, or other speed reducing treatments. • RRFBs • Staggered crosswalks and pedestrian refuge island • Horizontal deflection traffic calming treatments[1] if the City of San Diego's Traffic Calming Guidelines are met
D	**A Traffic Signal is required if the CA MUTCD warrants are met and it is recommended by a traffic engineering study. Otherwise at least one of the following is required:** • Pedestrian Hybrid Beacon if the CA MUTCD warrants are met • Horizontal deflection traffic calming treatment[1] with RRFBs if the City of San Diego's Traffic Calming Guidelines are met

1. Horizontal deflection treatments include, but are not limited to: roundabouts, pedestrian refuge islands, and pedestrian bulb-outs.

Source: City of San Diego (February, 2015)

Continental Crosswalks

The continental crosswalk, which is a high visibility crosswalk, is the City's standard crosswalk design for all marked crosswalk locations. Continental crosswalks have been shown to be more visible to approaching motorists and have been shown to improve yielding behavior. Continental crosswalks, along with the treatments identified in **Table 2-4** will enhance the pedestrian environment at marked crosswalks.

Table 2-5 provides a toolbox of crossing treatments including a graphic example and definition of the treatments.

Table 2-5: Uncontrolled Intersection and Mid-Block Crossing Treatments

Treatment	Description	When to Use
(Pedestrian Hybrid Beacon)  Photo: Mike Cynecki (2009), from pedbikesafe.org	A pedestrian hybrid beacon is a special type of beacon used to warn and control traffic at an unsignalized, marked crossing location. Pedestrian hybrid beacons should only be used in conjunction with a marked crosswalk. The alternating red flashers allow vehicles to stop and then proceed if the pedestrian has already passed them, reducing motorist delay. Reference CA MUTCD Chapter 4F	Best suited for uncontrolled crossing locations on multi-lane, higher speed or volume roadways where there is a need to provide pedestrian crossings without excessive delay to motor vehicles. Examples of these locations include school crossings, access to parks and senior centers, or neighborhood street crossings. *Applicable Crossing Treatment Categories:* D
Rectangular Rapid Flash Beacon (RRFB) 	The Rectangular Rapid Flash Beacon (RRFB) is a pedestrian crossing warning sign supplemented with flashing beacons that provide a high-visibility strobe-like warning to drivers when activated. Pedestrians activate the beacon through pushbuttons or other detectors, which then begin flashing the lights, alerting drivers of a pedestrian. Signs are placed on both sides of a crosswalk, to face each direction of traffic.	RRFBs should be used to supplement standard crossing warning signage and markings at locations without YIELD, STOP, or traffic signal controls. RRFBs should be reserved for locations with significant pedestrian safety issues. RRFBs are best suited for two-lane streets. *Applicable Crossing Treatment Category:* B, C and D
Curb Extensions (Pop-outs) 	Intersection pop-outs are curb extensions that narrow the street at intersections by widening the sidewalks at the point of crossing. They are used to make pedestrian crossings shorter and reduce the width of long, straight streets. Intersection pop-outs must accommodate cyclists, transit vehicles and emergency response vehicles. Pop-outs improve pedestrian visibility to the driver, create shorter pedestrian crossing widths, and may reduce vehicle speeds. Reference City of San Diego Traffic Calming Guidelines	Locations with useable space next to the curb, like that provided by on-street parking. *Applicable Crossing Treatment Categories:* B, C, and D

- Council Policy 200-07

1.3 Summary

Council Policy 200-07 provides the requirements uncontrolled pedestrian crossings must meet in order to be considered for a marked crosswalk, how a crosswalk must be marked, and the process of removal, if necessary.

If a location meets each of the Basic Warrants and scores a minimum of 16 points in the Point Warrants, it qualifies for a marked crosswalk. Point Warrants are indicated in Table 1. In addition, crossing treatments and/or warning devices must accompany the crosswalk. Table 2 identifies categories for crossing treatments that are needed based on thresholds of vehicle volumes and crossing distances. Table 3 lists the crossing treatments for each category.

For unusual conditions not identified in this policy, engineering judgment should be used to apply these guidelines or adjust them to fit individual field site conditions. These guidelines are not intended to be a substitute for engineering knowledge, experience or judgment.

In addition, any removal of a marked crosswalk must follow the procedure outlined in the California Vehicle Code.

2.0 POLICY

2.1 Basic Warrants

Each of the following warrants must be satisfied in order for an uncontrolled location to be considered for a marked crosswalk.

2.1.1. Pedestrian Volume Warrant
The pedestrian volumes must be equal to or greater than ten (10) pedestrians per hour during the peak pedestrian hour. Children under 13, elderly over 64 years and/or disabled persons count as 1.5 pedestrians. Alternatively, this warrant can be satisfied using Latent Pedestrian Demand if conditions (a), (b), or (c) under Table 1, T1.1b are met.

2.1.2. Approach Speed Warrant
The 85th percentile approach speed must be equal to or lower than 40 MPH. This warrant does not apply when a pedestrian hybrid beacon or a pedestrian traffic signal will be installed.

2.1.3. Nearest Controlled Crossing
The proposed location must be farther than 250 feet from the nearest controlled pedestrian crossing (measured from the nearest edge of the proposed marked crosswalk to the closest edge of the controlled crossing).

2.1.4. Visibility Warrant
The motorist must have an unrestricted view of all pedestrians at the proposed location for a distance required by the following table (stopping sight distance is to be interpolated when 85^{th} percentile speed is between 5 mph increments):

85^{th} Percentile Speed (MPH)	Stopping Sight Distance (feet)
25	150
30	200
35	250
40	300

2.1.5. Illumination Warrant
The proposed location must have existing lighting.

2.1.6. Accessibility Warrant
The proposed location must have existing accessibility to disabled pedestrians or have accessibility improvements programmed.

2.2 Point Warrants

Point warrants are the number of points a location is required to meet (in with the Basic Warrants above) to qualify for a marked crosswalk. Sixteen points are required and can be achieved through pedestrian volumes or latent pedestrian demand, general conditions, and/or the average gaps in traffic. A summary of each Point Warrant and the allocation of points are presented in Table 1. A discussion of each Point Warrant variable follows the table.

Table 1: Point Warrants

T1.1a Pedestrian Volume Warrant		
Number of Pedestrians (Peak Hour)	**Points**	**Total Available Points**
10 – 25	4	10
26 – 50	8	
51+	10	

T1.1b Latent Pedestrian Demand Warrant (in lieu of Pedestrian Volume Warrant)		
Condition	**Points**	**Total Available Points**
(a) The proposed crosswalk is in a commercial, mixed land use, or high density residential area.	3	10
(b) A pedestrian or shared use path is interrupted by a restricted crossing.	3	
(c) A pedestrian attractor/generator is directly adjacent to the proposed crosswalk as defined in the explanatory notes below.	4	

T1.2 General Condition Warrant		
Condition	**Points**	**Total Available Points**
(a) The nearest controlled crossing is greater than 300 feet from the proposed crosswalk.	3	18
(b) The proposed crosswalk will position pedestrians to be better seen by motorists.	3	
(c) The proposed crosswalk will establish a mid-block crossing between adjacent signalized intersections or it will connect an existing pedestrian path.	3	
(d) The proposed crosswalk is located within ¼ mile of pedestrian attractors/generators as defined in the explanatory notes below.	3	
(e) An existing bus stop is located within 100 feet of the proposed crosswalk.	3	
(f) Other factors.	3	

Table 1: Point Warrants (continued)

T1.3 Gap Time Warrant		
Average Number of Vehicular Gaps per Five-Minute Period	**Points**	**Total Available Points**
0 – 0.99	0	10
1 – 1.99	1	
2 – 2.99	8	
3 – 3.99	10	
4 – 4.99	8	
5 – 5.99	1	
6 or over	0	
Total Available Points		**38**

Table 1, Explanatory Notes:

T1.1a Pedestrian Volume Warrant
The Pedestrian Volume Warrant assigns point values based on pedestrian crossing volumes at the proposed location. Children under 13, elderly over 64 years and/or disabled persons count as 1.5 pedestrians.

T1.1b Latent Pedestrian Demand Warrant (in lieu of Pedestrian Volume Warrant)
The Latent Pedestrian Demand Warrant may be used in lieu of the Pedestrian Volume Warrant.

T1.2 General Condition Warrant
The General Condition Warrant presents six (6) unique categories. A location can score either zero (0) or three (3) points for each unique category, making a total of 18 points possible. The general conditions include the following:

(a) *The nearest controlled crossing is greater than 300 feet from the proposed crosswalk.*
The distance should be measured from the proposed location of the crosswalk to the nearest controlled intersection, i.e. stop sign, traffic signal, etc.

(b) *The proposed crosswalk will position pedestrians to be better seen by motorists.*
This condition should be considered at locations where one leg of the intersection provides better sight distance than the other legs or midblock location with better sight distance.

(c) *The proposed crosswalk will establish a mid-block crossing between adjacent signalized intersections.*
This warrant refers to a condition where there is a major pedestrian attractor/generator nearby, and an adequate crossing can be provided that could help channelize a heavy flow of mid-block pedestrians.

Table 1: Point Warrants (continued)

(d) *The proposed crosswalk is located within ¼ mile of a pedestrian attractor/generator as defined below:*
- International Border Crossing
- Major Multi-Modal Transit Centers
- Transit Stops
- Elementary/Middle/High Schools
- Universities and Colleges
- Neighborhood Civic Facilities (Libraries, Post Office & Religious Facilities)
- Neighborhood and Community Retail
- Pedestrian Intensive Beaches
- Parks & Recreation (excludes non-useable open space)
- Mixed Land Uses (housing near employment and/or commercial)

(e) *A bus stop is located within 100 feet of the proposed location.*
This warrant applies if there is a bus stop within 100 feet of the proposed crosswalk.

(f) *Other factors.*
Other factors allow for extenuating circumstances not covered in the proposed warrants. These are to be evaluated using engineering judgment.

T1.3 Gap Time Warrant

Gap time is the time needed for a pedestrian to cross the travelled lanes of a roadway at an average walking speed without the need for a driver to yield. The number of usable gaps (or gaps that exceed the minimum time needed to cross) are counted during the peak vehicular hour and averaged per five-minute period.

2.3 Crossing Treatments

2.3.1 Crossing Treatment Thresholds

If the proposed crossing location meets the criteria set by both the Basic and Point warrants, the next step is to evaluate the most appropriate crossing treatment(s) to be installed with the marked crosswalk. Marked crosswalks at streets that have less than 1,500 ADT can be installed with signs and markings alone. Table 2 provides thresholds for determining whether additional treatments are required prior to installing a marked crosswalk. The thresholds are based on vehicle volumes, vehicle speeds, and pedestrian crossing distance at the proposed location. Location types are divided into categories A, B, C, and D, and are used to determine the appropriate treatment for the proposed marked crosswalk location.

Table 2: Crossing Treatment Thresholds for Uncontrolled Marked Crosswalks if Warrants are Met

<table>
<tr><th>Crossing Distance[2]</th><th colspan="9">Roadway ADT (vehicles per day)</th></tr>
<tr><td></td><td>< 1,500</td><td colspan="2">1,501 – 5,000</td><td colspan="2">5,001 – 12,000</td><td colspan="2">12,001 – 15,000</td><td colspan="2">> 15,000</td></tr>
<tr><td>< 40’</td><td>A</td><td colspan="2">B</td><td colspan="2">B</td><td colspan="2">C</td><td>C</td><td>D[1]</td></tr>
<tr><td>40’ to 52’</td><td>A</td><td colspan="2">B</td><td colspan="2">C</td><td>C</td><td>D[1]</td><td colspan="2">D</td></tr>
<tr><td>> 52’</td><td>A</td><td>B</td><td>C[1]</td><td>C</td><td>D[1]</td><td colspan="2">D</td><td colspan="2">D</td></tr>
<tr><td colspan="10">1. For streets with more than one lane at an approach or posted speed limit 30 mph or greater.
2. Crossing distance can be measured to a pedestrian refuge island if one is present.</td></tr>
</table>

2.3.2 <u>Crossing Treatments</u>

Table 3 presents treatment requirements for the categories shown in Table 2. As new devices or treatments are proven, they may be considered in lieu of these treatments, with the City Engineer’s approval.

Table 3: Crossing Treatments for Uncontrolled Marked Crosswalks if Warrants are Met

Category	Crossing Treatments
A	**The following is required:** • (W11-2) Pedestrian Warning Signage with the corresponding (W16-7P) arrow plaque as shown in CA MUTCD Section 2C.50
B	**At least one of the following is required:** • (R1-6) State Law – Yield to Pedestrian sign if median is present • Rectangular Rapid Flashing Beacons (RRFBs) • Raised crosswalk or other traffic calming treatments if the City of San Diego’s Traffic Calming Guidelines are met
C	**At least two of the following are required:** • Radar Speed Feedback Signs • Striping changes such as narrower lanes, painted medians, road diets, or other speed reducing treatments. • RRFBs • Staggered crosswalks and pedestrian refuge island • Horizontal deflection traffic calming treatments[1] if the City of San Diego’s Traffic Calming Guidelines are met
D	**A Traffic Signal is required if the CA MUTCD warrants are met and it is recommended by a traffic engineering study. Otherwise at least one of the following is required:** • Pedestrian Hybrid Beacon if the CA MUTCD warrants are met • Horizontal deflection traffic calming treatment[1] with RRFBs if the City of San Diego’s Traffic Calming Guidelines are met
1. Horizontal deflection treatments include, but are not limited to: roundabouts, pedestrian refuge islands, and pedestrian pop-outs.	

2.4 Stop Controlled Crosswalks
At stop controlled intersection approaches, stop signs are the major factor controlling both the motorist's and pedestrian's behavior, rather than crosswalk markings. The warrants reflected in this policy do not apply at stop controlled intersection approaches. At such approaches stop bars are intended to define pedestrian paths. A marked crosswalk may be installed at a stop controlled intersection on a case by case basis if a clear benefit to pedestrians is demonstrated. Examples of such demonstrated benefits are:

- An all-way stop controlled intersection where at least one street is a one-way street with more than one lane, and marking the far side crossing will highlight pedestrian crossing (all approaches that pedestrians are allowed to cross should be marked in this case).

- An all-way stop controlled intersection where pedestrians are restricted on one or more legs and marking the alternate crossing routes will highlight where pedestrians are allowed to cross.

2.5 Removal of Crosswalks
It shall be the Policy of the City of San Diego to follow the California Vehicle Code requirements when a crosswalk is considered for removal.

The California Vehicle Code, Section 21950.5, states the following:

(a) An existing marked crosswalk may not be removed unless notice and opportunity to be heard is provided to the public not less than 30 days prior to the scheduled date of removal. In addition to any other public notice requirements, the notice of proposed removal shall be posted at the crosswalk identified for removal.

(b) The notice required by subdivision (a) shall include, but is not limited to, notification to the public of both of the following:

(1) That the public may provide input relating to the scheduled removal.

(2) The form and method of providing the input authorized by paragraph (1).

3.0 HISTORY:

"Installation of Parking Facility Guide Signs"
Adopted by Resolution R-171103 - 05/31/1962
Repealed by Resolution R-212199 - 12/12/1974
"Comprehensive Pedestrian Crossing Policy"
Adopted by Resolution R-275560 - 04/23/1990
"Marked Crosswalk Criteria at Uncontrolled Locations"
Amended by Resolution R-309772 - 06/11/2015

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(5) *Lock To Lock Time* - The time in seconds that an average driver would take under normal driving conditions to turn the steering wheel of a vehicle from the lock position on one side to the lock position on the other side. The default in AutoTurn software is 6 seconds.

(6) *Steering Lock Angle* - The maximum angle that the steering wheels can be turned. It is further defined as the average of the maximum angles made by the left and right steering wheels with the longitudinal axis of the vehicle.

(7) *Articulating Angle* - The maximum angle between the tractor and semitrailer.

Topic 405 – Intersection Design Standards

405.1 Sight Distance

(1) *Stopping Sight Distance.* See Index 201.1 for minimum stopping sight distance requirements.

(2) *Corner Sight Distance.*

(a) General. At unsignalized intersections a substantially clear line of sight should be maintained between the driver of a vehicle, bicyclist or pedestrian stopped on the minor road and the driver of an approaching vehicle on the major road that has no stop. Line of sight for all users should be included in right of way, in order to preserve sight lines.

See DIB 79 for 2R, 3R, certain storm damage, protective betterment, operational, and safety projects on two-lane and three-lane conventional highways.

Adequate time should be provided for the stopped vehicle on the minor road to either cross all lanes of through traffic, cross the near lanes and turn left, or turn right, without requiring through traffic to radically alter their speed. The visibility required for these maneuvers form a clear sight triangle with the corner sight distance b and the crossing distance a_1 or a_2 (see Figure 405.1 as an example of corner sight distance at a two-lane, two-way highway). Dimensions a_1 and a_2 are measured from the decision point to the center of the lane. The actual number of lanes will vary on the major and minor roads. <u>There should be no sight obstruction within the clear sight triangle.</u>

The methodology used for the driver on the minor road that is stopped to complete the necessary maneuver while the approaching vehicle travels at the design speed of the major road is based on gap-acceptance behavior. A 7-1/2 second criterion is applied to a passenger car (including pickup trucks) for a left turn from a stop on the minor road. However, this time gap does not account for a single-unit truck (no semitrailer), a combination truck (see Index 404.4 for truck tractor-semitrailer guidance), a right-turn from a stop, or for a crossing maneuver. See Table 405.1A for the time gap that addresses these situations for the assumed design vehicle making these maneuvers from the minor road.

In determining corner sight distance, a set back distance for the vehicle waiting on the minor road must be assumed as measured from the edge of traveled way of the major road. <u>Set back for the driver of the vehicle on the minor road should be a minimum of 10 feet plus the shoulder width of the major road but not less than 15 feet.</u> The location of the driver's eye for the set back is the decision point per Figure 405.1. Corner sight distance and the driver's eye set back are also illustrated in Figures 405.7 and 504.3I. Line of sight for corner sight distance for passenger cars is to be determined from a 3 and 1/2-foot height at the location of the driver of the vehicle in the center of the minor road lane to a 3 and 1/2-foot object height in the center of the approaching outside lane of the major road. This provides for reciprocal sight by both vehicles. The passenger car driver's eye height should be applied to all minor roads. In addition, a truck driver's eye height of 7.6 feet should be applied to the minor road where applicable. Additionally, if the major road has a median barrier, a 2-foot object height should be used to determine the median barrier set back. A median that is wide enough to accommodate a stopped vehicle should also provide a clear sight triangle.

The minimum corner sight distance (feet) should be determined by the equation: $1.47V_mT_g$, where V_m is the design speed (mph) of the major road and T_g is the time gap (seconds) for the minor road vehicle to enter the major road. The values given in Table 405.1A should be used to determine T_g based on the design vehicle, the type of maneuver, and whether the stopped vehicle's rear wheels are on an upgrade exceeding 3 percent. The distance from the edge of traveled way to the rear wheels at the minor road stop location should be assumed as: 20 feet for a passenger car, 30 feet for a single-unit truck, and 72 feet for a combination truck.

(b) Public Road Intersections (Refer to Topic 205 and Index 405.7); corner sight distance applies, see Table 405.1A.

At signalized intersections the corner sight distances should also be applied whenever possible. Even though traffic flows are designed to move at separate times, unanticipated conflicts can occur due to violation of signal, right turns on red, malfunction of the signal, or use of flashing red/yellow mode.

The minimum value for corner sight distance at signalized intersections should be equal to the stopping sight distance as given in Table 201.1, measured as previously described. This includes an urban driveway that forms a leg of the signalized intersection.

(c) Private Road Intersections (Refer to Index 205.2) and Rural Driveways (Refer to Index 205.4); corner sight distance applies, see Table 405.1A. If signalized, the minimum corner sight distance should be equal to the stopping sight distance as given in Table 201.1, measured as previously described.

(d) Urban Driveways (Refer to Index 205.3); corner sight distance requirements as described above are not applied to urban driveways unless signalized. See Index 405.1(2)(b) underlined standard. If parking is allowed on the major road, parking should be prohibited on both sides of the driveway per the California MUTCD, 3B.19.

(3) *Decision Sight Distance.* At intersections where the State route turns or crosses another State route, the decision sight distance values given in Table 201.7 should be used. In computing and measuring decision sight distance, the 3.5-foot eye height and the 0.5-foot object height should be used, the object being located on the side of the intersection nearest the approaching driver.

The application of the various sight distance requirements for the different types of intersections is summarized in Table 405.1B

Table 405.1B

Application of Sight Distance Requirements

Intersection Types	Sight Distance		
	Stopping	Corner	Decision
Private Roads	X	X[1]	
Public Streets and Roads	X	X	
Signalized Intersections	X	X[2]	
State Route Intersections & Route Direction Changes, with or without Signals	X	X	X

NOTES:

(1) Per Index 405.1(2)(c), the minimum corner sight distance shall be equal to the stopping sight distance as given in Table 201.1. See Index 405.1(2)(a) for setback requirements.

(2) Apply corner sight distance requirements at signalized intersections whenever possible due to unanticipated violations of the signals or malfunctions of the signals. See Index 405.1(2)(b).

(4) *Acceleration Lanes for Turning Moves onto State Highways.* At rural intersections, with "STOP" control on the local cross road, acceleration lanes for left and right turns onto the State facility should be considered. At a minimum, the following features should be evaluated for both the major highway and the cross road:

- divided versus undivided
- number of lanes
- design speed
- gradient
- lane, shoulder and median width
- traffic volume and composition of highway users, including trucks and transit vehicles

Figure 405.1
Corner Sight Distance (b)

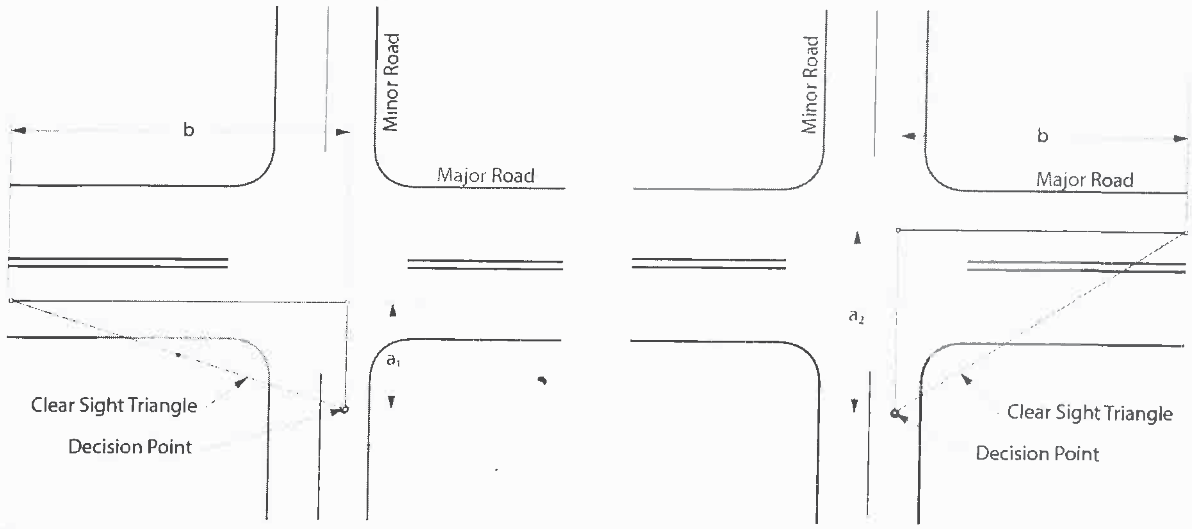

Table 405.1A
Corner Sight Distance Time Gap (T_g) for Unsignalized Intersections

Design Vehicle	Left-turn from Stop (s) [4]	Right-turn from Stop and Crossing Maneuver (s)
Passenger Car Private Road Intersection Rural Driveway	7½	6½
Single-Unit Truck Public Road Intersection	9½	8½
Combination Truck Major and Minor Roads on Routes: National Network Terminal or Service Access California Legal KPRA Advisory	11½	10½

Notes: Time gaps are for a stopped vehicle to turn left, right or cross a two-lane highway with no median and with minor road grades of 3 percent or less. The table values should be adjusted as follows:

[1]For multilane highways—When crossing or making a left-turn onto a two-way major road with more than two lanes, add 0.5 s for passenger cars or 0.7 s for trucks for each additional lane to be crossed. Median widths should be converted to an equivalent number of lanes in applying the 0.5 s and 0.7 s criteria. For example, an 18-foot wide median is equivalent to 1.5 lanes; this requires an additional 0.75 s for a passenger car to cross or an additional 1.05 s for a truck to cross.

[2]For minor road approach grades—If the minor road approach grade is an upgrade that exceeds 3 percent and the rear wheels of the design vehicle are on the grade exceeding 3 percent, add 0.2 s for each percent grade for left-turns and crossing maneuvers; or add 0.1 s for each percent grade for right-turns. For example, a passenger car is turning right from a minor road and at the stop location its rear wheels are on a 4 percent upgrade; this requires an additional 0.4 s for the right-turn.

[3]Unique situations may necessitate a different design vehicle for a particular minor road than those listed here (e.g., predominant combination trucks out of a rural driveway). Additionally, for intersections at skewed angles less than 60 degrees, a further adjustment is needed. See the AASHTO "A Policy on Geometric Design of Highways and Streets" for guidance.

[4]Time gap for vehicles approaching from the left can be the same as the right-turn from stop maneuver.

- turning volumes
- horizontal curve radii
- sight distance
- proximity of adjacent intersections
- types of adjacent intersections

For additional information and guidance, refer to AASHTO, A Policy on Geometric Design of Highways and Streets, the District Traffic Engineer or designee, the District Design Liaison, and the Project Delivery Coordinator.

405.2 Left-turn Channelization

(1) General. The purpose of a left-turn lane is to expedite the movement of through traffic by, controlling the movement of turning traffic, increasing the capacity of the intersection, and improving safety characteristics.

The District Traffic Branch normally establishes the need for left-turn lanes.

(2) Design Elements.

(a) Lane Width – **The lane width for both single and double left-turn lanes on State highways shall be 12 feet.**

For conventional State highways with posted speeds less than or equal to 40 miles per hour and AADTT (truck volume) less than 250 per lane that are in urban, city or town centers (rural main streets), the minimum lane width shall be 11 feet.

When considering lane width reductions adjacent to curbed medians, refer to Index 303.5 for guidance on effective roadway width, which may vary depending on drivers' lateral positioning and shy distance from raised curbs.

(b) Approach Taper – On conventional highways without a median, an approach taper provides space for a left-turn lane by moving traffic laterally to the right. The approach taper is unnecessary where a median is available for the full width of the left-turn lane. Length of the approach taper is given by the formula on Figures 405.2A, B and C.

Figure 405.2A shows a standard left-turn channelization design in which all widening is to the right of approaching traffic and the deceleration lane (see below) begins at the end of the approach taper. This design should be used in all situations where space is available, usually in rural and semi-rural areas or in urban areas with high traffic speeds and/or volumes.

Figures 405.2B and 405.2C show alternate designs foreshortened with the deceleration lane beginning at the 2/3 point of the approach taper so that part of the deceleration takes place in the through traffic lane. Figure 405.2C is shortened further by widening half (or other appropriate fraction) on each side. These designs may be used in urban areas where constraints exist, speeds are moderate and traffic volumes are relatively low.

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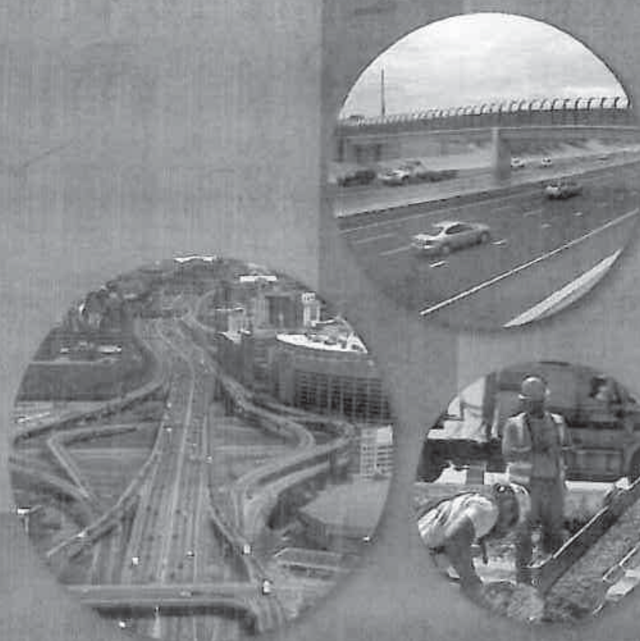

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3 Elements of Design

3.1 INTRODUCTION

The alignment of a highway or street produces a great impact on the environment, the fabric of the community, and the highway user. The alignment consists of a variety of design elements that combine to create a facility that serves traffic safely and efficiently, consistent with the facility's intended function. Each alignment element should complement others to achieve a consistent, safe, and efficient design.

The design of highways and streets within particular functional classes is treated separately in later chapters. Common to all classes of highways and streets are several principal elements of design. These include sight distance, superelevation, traveled way widening, grades, horizontal and vertical alignments, and other elements of geometric design. These alignment elements are discussed in this chapter, and, as appropriate, in the later chapters pertaining to specific highway functional classes.

3.2 SIGHT DISTANCE

3.2.1 General Considerations

A driver's ability to see ahead is needed for safe and efficient operation of a vehicle on a highway. For example, on a railroad, trains are confined to a fixed path, yet a block signal system and trained operators are needed for safe operation. In contrast, the path and speed of motor vehicles on highways and streets are subject to the control of drivers whose ability, training, and experience are quite varied. The designer should provide sight distance of sufficient length that drivers can control the operation of their vehicles to avoid striking an unexpected object in the traveled way. Certain two-lane highways should also have sufficient sight distance to enable drivers to use the opposing traffic lane for passing other vehicles without interfering with oncoming vehicles. Two-lane rural highways should generally provide such passing sight distance at frequent intervals and for substantial portions of their length. On the other hand, it is normally of little practical value to provide passing sight distance on two-lane urban streets or arterials. The proportion of a highway's length with sufficient sight distance to pass another vehicle and interval between passing opportunities should be compatible with the intended function of the highway and the desired level of service. Design criteria and guidance applicable to specific functional classifications of highways and streets are presented in Chapters 5 through 8.

Four aspects of sight distance are discussed below: (1) the sight distances needed for stopping, which are applicable on all highways; (2) the sight distances needed for the passing of overtaken vehicles, applicable only on two-lane highways; (3) the sight distances needed for decisions at complex locations; and (4) the criteria for measuring these sight distances for use in design. The design of alignment and profile to provide sight distances and to satisfy the applicable design criteria are described later in this chapter. The special conditions related to sight distances at intersections are discussed in Section 9.5.

3.2.2 Stopping Sight Distance

Sight distance is the length of the roadway ahead that is visible to the driver. The available sight distance on a roadway should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Although greater lengths of visible roadway are desirable, the sight distance at every point along a roadway should be at least that needed for a below-average driver or vehicle to stop.

Stopping sight distance is the sum of two distances: (1) the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied, and (2) the distance needed to stop the vehicle from the instant brake application begins. These are referred to as brake reaction distance and braking distance, respectively.

Brake Reaction Time

Brake reaction time is the interval from the instant that the driver recognizes the existence of an obstacle on the roadway ahead that necessitates braking until the instant that the driver actually applies the brakes. Under certain conditions, such as emergency situations denoted by flares or flashing lights, drivers accomplish these tasks almost instantly. Under most other conditions, the driver needs not only to see the object but also to recognize it as a stationary or slowly moving object against the background of the roadway and other objects, such as walls, fences, trees, poles, or bridges. Such determinations take time, and the amount of time needed varies considerably with the distance to the object, the visual acuity of the driver, the natural rapidity with which the driver reacts, the atmospheric visibility, the type and the condition of the roadway, and nature of the obstacle. Vehicle speed and roadway environment probably also influence reaction time. Normally, a driver traveling at or near the design speed is more alert than one traveling at a lesser speed. A driver on an urban street confronted by innumerable potential conflicts with parked vehicles, driveways, and cross streets is also likely to be more alert than the same driver on a limited-access facility where such conditions should be almost nonexistent.

The study of reaction times by Johansson and Rumar (*39*) referred to in Section 2.2.6 was based on data from 321 drivers who expected to apply their brakes. The median reaction-time value for these drivers was 0.66 s, with 10 percent using 1.5 s or longer. These findings correlate with those of earlier studies in which alerted drivers were also evaluated. Another study (*44*) found 0.64 s as the average reaction time, while 5 percent of the drivers needed over 1 s. In a third study (*48*), the values of brake reaction time ranged from 0.4 to 1.7 s. In the Johansson and Rumar study (*39*), when the event that prompted application of the brakes was unexpected, the drivers' response times were found to increase by approximately 1 s or more; some reaction times were greater than 1.5 s. This increase in reaction time substantiated earlier laboratory and road tests in which the conclusion was drawn that a driver who needed 0.2 to 0.3 s of reaction time under alerted conditions would need 1.5 s of reaction time under normal conditions.

Minimum brake reaction times for drivers could thus be at least 1.64 s, 0.64 s for alerted drivers plus 1 s for the unexpected event. Because the studies discussed above used simple prearranged signals, they represent the least complex of roadway conditions. Even under these simple conditions, it was found that some drivers took over 3.5 s to respond. Because actual conditions on the highway are generally more complex than those of the studies, and because there is wide variation in driver reaction times, it is evident that the criterion adopted for use should be greater than 1.64 s. The brake reaction time used in design should be long enough to include the reaction times needed by nearly all drivers under most highway conditions. Both recent research (*17*) and the studies documented in the literature (*39*, *44*, *48*) show that a 2.5-s brake reaction time for stopping sight situations encompasses the capabilities of most drivers, including those of older drivers. The recommended design criterion of 2.5 s for brake reaction time exceeds the 90th percentile of reaction time for all drivers and was used in the development of Table 3-1.

A brake reaction time of 2.5 s is considered adequate for conditions that are more complex than the simple conditions used in laboratory and road tests, but it is not adequate for the most complex conditions encountered in actual driving. The need for greater reaction time in the most complex conditions encountered on the roadway, such as those found at multiphase at-grade intersections and at ramp terminals on through roadways, can be found in Section 3.2.3 on "Decision Sight Distance."

Braking Distance

The approximate braking distance of a vehicle on a level roadway traveling at the design speed of the roadway may be determined from the following equation:

Metric	U.S. Customary	
$d_B = 0.039 \dfrac{V^2}{a}$	$d_B = 1.075 \dfrac{V^2}{a}$	(3-1)
where:	where:	
d_B = braking distance, m	d_B = braking distance, ft	
V = design speed, km/h	V = design speed, mph	
a = deceleration rate, m/s^2	a = deceleration rate, ft/s^2	

Studies documented in the literature (*17*) show that most drivers decelerate at a rate greater than 4.5 m/s^2 [14.8 ft/s^2] when confronted with the need to stop for an unexpected object in the roadway. Approximately 90 percent of all drivers decelerate at rates greater than 3.4 m/s^2 [11.2 ft/s^2]. Such decelerations are within the driver's capability to stay within his or her lane and maintain steering control during the braking maneuver on wet surfaces. Therefore, 3.4 m/s^2 [11.2 ft/s^2] (a comfortable deceleration for most drivers) is recommended as the deceleration threshold for determining stopping sight distance. Implicit in the choice of this deceleration threshold is the assessment that most vehicle braking systems and the tire-pavement friction levels of most roadways are capable of providing a deceleration rate of at least 3.4 m/s^2 [11.2 ft/s^2]. The friction available on most wet pavement surfaces and the capabilities of most vehicle braking systems can provide braking friction that exceeds this deceleration rate.

Table 3-1. Stopping Sight Distance on Level Roadways

Metric					U.S. Customary				
Design Speed (km/h)	Brake Reaction Distance (m)	Braking Distance on Level (m)	Stopping Sight Distance		Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance	
			Calculated (m)	Design (m)				Calculated (ft)	Design (ft)
20	13.9	4.6	18.5	20	15	55.1	21.6	76.7	80
30	20.9	10.3	31.2	35	20	73.5	38.4	111.9	115
40	27.8	18.4	46.2	50	25	91.9	60.0	151.9	155
50	34.8	28.7	63.5	65	30	110.3	86.4	196.7	200
60	41.7	41.3	83.0	85	35	128.6	117.6	246.2	250
70	48.7	56.2	104.9	105	40	147.0	153.6	300.6	305
80	55.6	73.4	129.0	130	45	165.4	194.4	359.8	360
90	62.6	92.9	155.5	160	50	183.8	240.0	423.8	425
100	69.5	114.7	184.2	185	55	202.1	290.3	492.4	495
110	76.5	138.8	215.3	220	60	220.5	345.5	566.0	570
120	83.4	165.2	248.6	250	65	238.9	405.5	644.4	645
130	90.4	193.8	284.2	285	70	257.3	470.3	727.6	730
					75	275.6	539.9	815.5	820
					80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s^2 [11.2 ft/s^2] used to determine calculated sight distance.

Design Values

The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. The computed distances for various speeds at the assumed conditions on level roadways are shown in Table 3-1 and were developed from the following equation:

Metric	U.S. Customary	
$SSD = 0.278Vt + 0.039\frac{V^2}{a}$	$SSD = 1.47Vt + 1.075\frac{V^2}{a}$	(3-2)

Metric — where:

SSD = stopping sight distance, m

V = design speed, km/h

t = brake reaction time, 2.5 s

a = deceleration rate, m/s^2

U.S. Customary — where:

SSD = stopping sight distance, ft

V = design speed, mph

t = brake reaction time, 2.5 s

a = deceleration rate, ft/s^2

Stopping sight distances exceeding those shown in Table 3-1 should be used as the basis for design wherever practical. Use of longer stopping sight distances increases the margin for error for all drivers and, in particular, for those who operate at or near the design speed during wet pavement conditions. New pavements should have initially, and should retain, friction coefficients consistent with the deceleration rates used to develop Table 3-1.

Effect of Grade on Stopping

When a highway is on a grade, Equation 3-1 for braking distance is modified as follows:

Metric	U.S. Customary
$d_B = \dfrac{V^2}{254\left[\left(\dfrac{a}{9.81}\right) \pm G\right]}$	$d_B = \dfrac{V^2}{30\left[\left(\dfrac{a}{32.2}\right) \pm G\right]}$ (3-3)
where:	where:
d_B = braking distance on grade, m	d_B = braking distance on grade, ft
V = design speed, km/h	V = design speed, mph
a = deceleration, m/s^2	a = deceleration, ft/s^2
G = grade, rise/run, m/m	G = grade, rise/run, ft/ft

In this equation, G is the rise in elevation divided by the distance of the run and the percent of grade divided by 100, and the other terms are as previously stated. The stopping distances needed on upgrades are shorter than on level roadways; those on downgrades are longer. The stopping sight distances for various grades shown in Table 3-2 are the values determined by using Equation 3-3 in place of the second term in Equation 3-2. These adjusted sight distance values are computed for wet-pavement conditions using the same design speeds and brake reaction times used for level roadways in Table 3-1.

Table 3-2. Stopping Sight Distance on Grades

Metric							U.S. Customary						
Design Speed (km/h)	Stopping Sight Distance (m)						Design Speed (mph)	Stopping Sight Distance (ft)					
	Downgrades			Upgrades				Downgrades			Upgrades		
	3 %	6 %	9 %	3 %	6 %	9 %		3 %	6 %	9 %	3 %	6 %	9 %
20	20	20	20	19	18	18	15	80	82	85	75	74	73
30	32	35	35	31	30	29	20	116	120	126	109	107	104
40	50	50	53	45	44	43	25	158	165	173	147	143	140
50	66	70	74	61	59	58	30	205	215	227	200	184	179
60	87	92	97	80	77	75	35	257	271	287	237	229	222
70	110	116	124	100	97	93	40	315	333	354	289	278	269
80	136	144	154	123	118	114	45	378	400	427	344	331	320
90	164	174	187	148	141	136	50	446	474	507	405	388	375
100	194	207	223	174	167	160	55	520	553	593	469	450	433
110	227	243	262	203	194	186	60	598	638	686	538	515	495
120	263	281	304	234	223	214	65	682	728	785	612	584	561
130	302	323	350	267	254	243	70	771	825	891	690	658	631
							75	866	927	1003	772	736	704
							80	965	1035	1121	859	817	782

On nearly all roads and streets, the grade is traversed by traffic in both directions of travel, but the sight distance at any point on the highway generally is different in each direction, particularly on straight roads in rolling terrain. As a general rule, the sight distance available on downgrades is larger than on upgrades, more or less automatically providing the appropriate corrections for grade. This may explain why some designers do not adjust stopping sight distance because of grade. Exceptions are one-way roadways or streets, as on divided highways with independent profiles. For these separate roadways, adjustments for grade may be needed.

Variation for Trucks

The recommended stopping sight distances are based on passenger car operation and do not explicitly consider design for truck operation. Trucks as a whole, especially the larger and heavier units, need longer stopping distances for a given speed than passenger vehicles. However, there is one factor that tends to balance the additional braking lengths for trucks with those for passenger cars. The truck driver is able to see substantially farther beyond vertical sight obstructions because of the higher position of the seat in the vehicle. Separate stopping sight distances for trucks and passenger cars, therefore, are not generally used in highway design.

There is one situation in which the goal should be to provide stopping sight distances greater than the design values in Table 3-1. Where horizontal sight restrictions occur on downgrades, particularly at the ends of long downgrades where truck speeds closely approach or exceed those of passenger cars, the greater height of eye of the truck driver is of little value. Although the average truck driver tends to be more experienced than the average passenger car driver and quicker to recognize potential risks, it is desirable under such conditions to provide stopping sight distance that exceeds the values in Tables 3-1 or 3-2.

3.2.3 Decision Sight Distance

Stopping sight distances are usually sufficient to allow reasonably competent and alert drivers to come to a hurried stop under ordinary circumstances. However, greater distances may be needed where drivers must make complex or instantaneous decisions, where information is difficult to perceive, or when unexpected or unusual maneuvers are needed. Limiting sight distances to those needed for stopping may preclude drivers from performing evasive maneuvers, which often involve less risk and are otherwise preferable to stopping. Even with an appropriate complement of standard traffic control devices in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD) (*22*), stopping sight distances may not provide sufficient visibility distances for drivers to corroborate advance warning and to perform the appropriate maneuvers. It is evident that there are many locations where it would be prudent to provide longer sight distances. In these circumstances, decision sight distance provides the greater visibility distance that drivers need.

Decision sight distance is the distance needed for a driver to detect an unexpected or otherwise difficult-to-perceive information source or condition in a roadway environment that may be visually cluttered, recognize the condition or its potential threat, select an appropriate speed and path, and initiate and complete complex maneuvers (*9*). Because decision sight distance offers drivers additional margin for error and affords them sufficient length to maneuver their vehicles at the same or reduced speed, rather than to just stop, its values are substantially greater than stopping sight distance.

Drivers need decision sight distances whenever there is likelihood for error in either information reception, decision making, or control actions (*40*). Examples of critical locations where these kinds of errors are likely to occur, and where it is desirable to provide decision sight distance include interchange and intersection locations where unusual or unexpected maneuvers are needed, changes in cross section such as toll plazas and lane drops, and areas of concentrated demand where there is apt to be "visual noise" from competing sources of information, such as roadway elements, traffic, traffic control devices, and advertising signs.

The decision sight distances in Table 3-3 may be used to (1) provide values for sight distances that may be appropriate at critical locations, and (2) serve as criteria in evaluating the suitability of the available sight distances at these locations. Because of the additional maneuvering space provided, decision sight distances should be considered at critical locations or critical decision points should be moved to locations where sufficient decision sight distance is available. If it is not practical to provide decision sight distance because of horizontal or vertical curvature or if relocation of decision points is not practical, special attention should be given to the use of suitable traffic control devices for providing advance warning of the conditions that are likely to be encountered.

Table 3-3. Decision Sight Distance

Metric						U.S. Customary					
Design Speed (km/h)	Decision Sight Distance (m)					Design Speed (mph)	Decision Sight Distance (ft)				
	Avoidance Maneuver						Avoidance Maneuver				
	A	B	C	D	E		A	B	C	D	E
50	70	155	145	170	195	30	220	490	450	535	620
60	95	195	170	205	235	35	275	590	525	625	720
70	115	235	200	235	275	40	330	690	600	715	825
80	140	280	230	270	315	45	395	800	675	800	930
90	170	325	270	315	360	50	465	910	750	890	1030
100	200	370	315	355	400	55	535	1030	865	980	1135
110	235	420	330	380	430	60	610	1150	990	1125	1280
120	265	470	360	415	470	65	695	1275	1050	1220	1365
130	305	525	390	450	510	70	780	1410	1105	1275	1445
						75	875	1545	1180	1365	1545
						80	970	1685	1260	1455	1650

Avoidance Maneuver A: Stop on rural road—t = 3.0 s

Avoidance Maneuver B: Stop on urban road—t = 9.1 s

Avoidance Maneuver C: Speed/path/direction change on rural road—t varies between 10.2 and 11.2 s

Avoidance Maneuver D: Speed/path/direction change on suburban road—t varies between 12.1 and 12.9 s

Avoidance Maneuver E: Speed/path/direction change on urban road—t varies between 14.0 and 14.5 s

Decision sight distance criteria that are applicable to most situations have been developed from empirical data. The decision sight distances vary depending on whether the location is on a rural or urban road and on the type of avoidance maneuver needed to negotiate the location properly. Table 3-3 shows decision sight distance values for various situations rounded for design. As can be seen in the table, shorter distances are generally needed for rural roads and for locations where a stop is the appropriate maneuver.

For the avoidance maneuvers identified in Table 3-3, the pre-maneuver time is greater than the brake reaction time for stopping sight distance to allow the driver additional time to detect and recognize the roadway or traffic situation, identify alternative maneuvers, and initiate a response at critical locations on the highway (*45*). The pre-maneuver component of decision sight distance uses a value ranging between 3.0 and 9.1 s (*51*).

The braking distance for the design speed is added to the pre-maneuver component for avoidance maneuvers A and B as shown in Equation 3-4. The braking component is replaced in avoidance maneuvers C, D, and E with a maneuver distance based on maneuver times, between 3.5 and 4.5 s, that decrease with increasing speed (*45*) in accordance with Equation 3-5.

The decision sight distances for avoidance maneuvers A and B are determined as:

Metric	U.S. Customary	
$DSD = 0.278Vt + 0.039\frac{V^2}{a}$	$DSD = 1.47Vt + 1.075\frac{V^2}{a}$	(3-4)
where:	where:	
DSD = decision sight distance, m	DSD = decision sight distance, ft	
t = pre-maneuver time, s (see notes in Table3- 3)	t = pre-maneuver time, s (see notes in Table3- 3)	
V = design speed, km/h	V = design speed, mph	
a = driver deceleration, m/s^2	a = driver deceleration, ft/s^2	

The decision sight distances for avoidance maneuvers C, D, and E are determined as:

Metric	U.S. Customary	
$DSD = 0.278Vt$	$DSD = 1.47Vt$	(3-5)
where:	where:	
DSD = decision sight distance, m	DSD = decision sight distance, ft	
t = total pre-maneuver and maneuver time, s (see notes in Table 3-3)	t = total pre-maneuver and maneuver time, s (see notes in Table 3-3)	
V = design speed, km/h	V = design speed, mph	

3.2.4 Passing Sight Distance for Two-Lane Highways

Criteria for Design

Most roads and many streets are two-lane, two-way highways on which vehicles frequently overtake slower moving vehicles. Passing maneuvers in which faster vehicles move ahead of slower vehicles are accomplished on lanes regularly used by opposing traffic. If passing is to be accomplished without interfering with an opposing vehicle, the passing driver should be able to see a sufficient distance ahead, clear of traffic, so the passing driver can decide whether to initiate and to complete the passing maneuver without cutting off the passed vehicle before meeting an opposing vehicle that appears during the maneuver. When appropriate, the driver can return to the right lane without completing the pass if he or she sees opposing traffic is too close when the maneuver is only partially completed. Many passing maneuvers are accomplished without the driver being able to see any potentially conflicting vehicle at the beginning of the maneuver. An alternative to providing passing sight distance is found in Section 3.4.4 under "Passing Lanes."

Minimum passing sight distances for use in design are based on the minimum sight distances presented in the MUTCD (*22*) as warrants for no-passing zones on two-lane highways. Design practice should be most effective when it anticipates the traffic controls (i.e., passing and no-passing zone markings) that will be placed on the highways. The potential for conflicts in passing operations on two-lane highways is ultimately determined by the judgments of drivers that initiate and complete passing maneuvers in response to (1) the driver's view of the road ahead as provided by available passing sight distance and (2) the passing and no-passing zone markings. Recent research has shown that the MUTCD passing sight distance criteria result in two-lane highways that experience very few crashes related to passing maneuvers (*20*, *34*).

Design Values

The design values for passing sight distance are presented in Table 3-4 and are shown in comparison to stopping sight distance criteria in Figure 3-1. It is apparent from the comparison in Figure 3-1 that more sight distance is needed to accommodate passing maneuvers on a two-lane highway than for stopping sight distance that is provided continuously along the highway.

Table 3-4. Passing Sight Distance for Design of Two-Lane Highways

Metric				U.S. Customary			
Design Speed (km/h)	Assumed Speeds (km/h)		Passing Sight Distance (m)	Design Speed (mph)	Assumed Speeds (mph)		Passing Sight Distance (ft)
	Passed Vehicle	Passing Vehicle			Passed Vehicle	Passing Vehicle	
30	11	30	120	20	8	20	400
40	21	40	140	25	13	25	450
50	31	50	160	30	18	30	500
60	41	60	180	35	23	35	550
70	51	70	210	40	28	40	600
80	61	80	245	45	33	45	700
90	71	90	280	50	38	50	800
100	81	100	320	55	43	55	900
110	91	110	355	60	48	60	1000
120	101	120	395	65	53	65	1100
130	111	130	440	70	58	70	1200
				75	63	75	1300
				80	68	80	1400

Research has verified that the passing sight distance values in Table 3-4 are consistent with field observation of passing maneuvers (*34*). This research used two theoretical models for the sight distance needs of passing drivers; both models were based on the assumption that a passing driver will abort the passing maneuver and return to his or her normal lane behind the passed vehicle if a potentially conflicting vehicle comes into view before reaching a critical position in the passing maneuver beyond which the passing driver is committed to complete the maneuver. The Glennon model (*26*) assumes that the critical position occurs where the passing sight distance to complete the maneuver is equal to the sight distance needed to abort the maneuver. The Hassan et al. model (*35*) assumes that the critical position occurs where the passing sight distances to complete or abort the maneuver are equal or where the passing and passed vehicles are abreast, whichever occurs first.

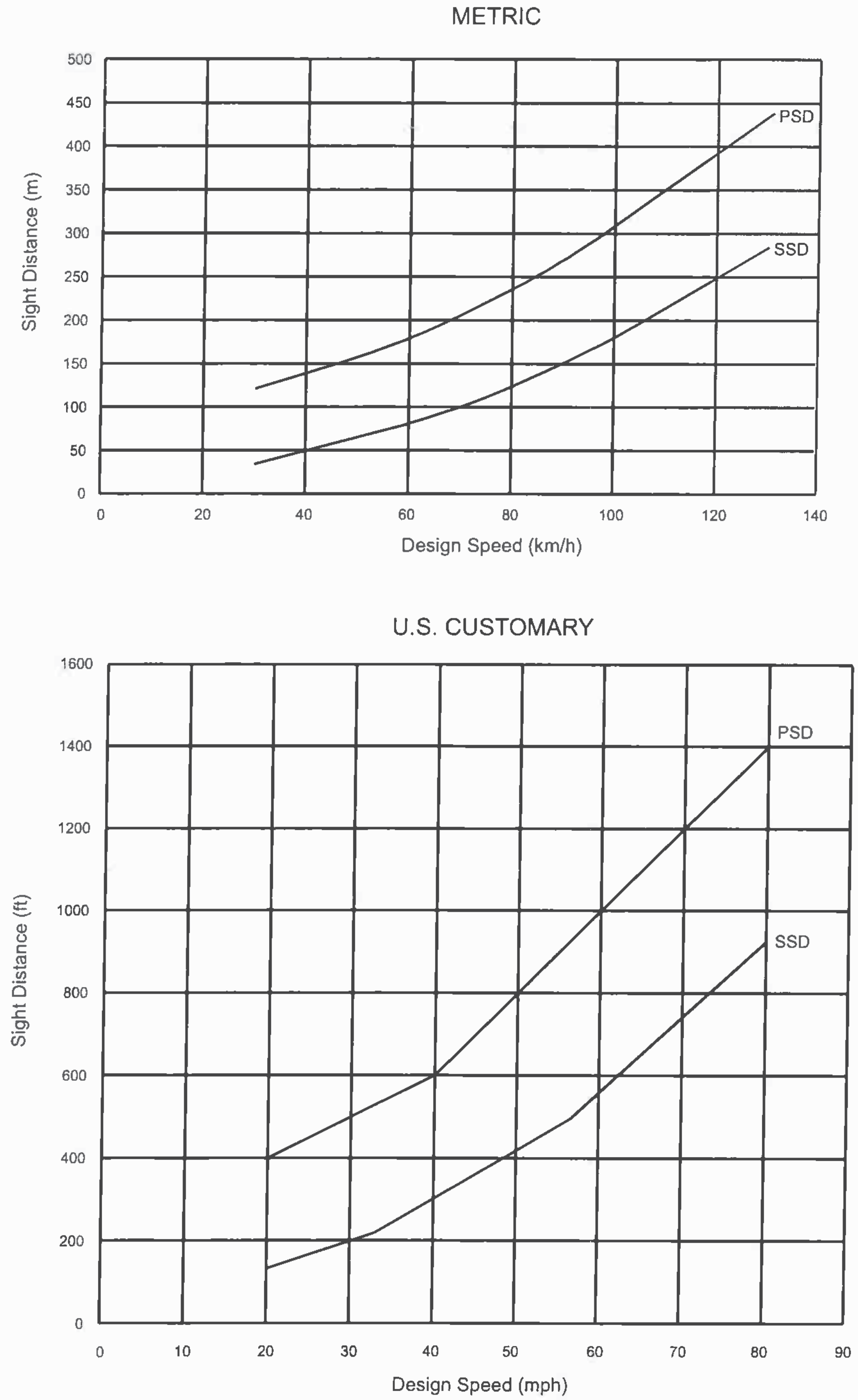

Figure 3-1. Comparison of Design Values for Passing Sight Distance and Stopping Sight Distance

Minimum passing sight distances for design of two-lane highways incorporate certain assumptions about driver behavior. Actual driver behavior in passing maneuvers varies widely. To accommodate these variations in driver behavior, the design criteria for passing sight distance should accommodate the behavior of a high percentage of drivers, rather than just the average driver. The assumptions made in applying the Glennon and Hassan et al. models (*25*, *35*) are as follows:

1. The speeds of the passing and opposing vehicles are equal and represent the design speed of the highway.
2. The passed vehicle travels at uniform speed and speed differential between the passing and passed vehicles is 19 km/h [12 mph].
3. The passing vehicle has sufficient acceleration capability to reach the specified speed differential relative to the passed vehicle by the time it reaches the critical position, which generally occurs about 40 percent of the way through the passing maneuver.
4. The lengths of the passing and passed vehicles are 5.8 m [19 ft], as shown for the P design vehicle in Section 2.1.1.
5. The passing driver's perception-reaction time in deciding to abort passing a vehicle is 1 s.
6. If a passing maneuver is aborted, the passing vehicle will use a deceleration rate of 3.4 m/s^2 [11.2 ft/s^2], the same deceleration rate used in stopping sight distance criteria.
7. For a completed or aborted pass, the space headway between the passing and passed vehicles is 1 s.
8. The minimum clearance between the passing and opposed vehicles at the point at which the passing vehicle returns to its normal lane is 1 s.

The application of the passing sight distance models using these assumptions is presented in NCHRP Report 605 (*34*).

The passing sight distance for use in design should be based on a single passenger vehicle passing a single passenger vehicle. While there may be occasions to consider multiple passings, where two or more vehicles pass or are passed, it is not practical to assume such conditions in developing minimum design criteria. Research has shown that longer sight distances are often needed for passing maneuvers when the passed vehicle, the passing vehicle, or both are trucks (*30*). Longer sight distances occur in design, and such locations can accommodate an occasional multiple passing maneuver or a passing maneuver involving a truck.

Frequency and Length of Passing Sections

Sight distance adequate for passing should be encountered frequently on two-lane highways. Each passing section along a length of roadway with sight distance ahead equal to or greater than the minimum passing sight distance should be as long as practical. The frequency and length of passing sections for highways principally depend on the topography, the design speed of highway, and the cost. For streets, the spacing of intersections is the principal consideration.

It is not practical to directly indicate the frequency with which passing sections should be provided on two-lane highways due to the physical constraints and cost limitations. During the course of normal design, passing sections are provided on almost all highways and selected streets, but the designer's appreciation of their importance and a studied attempt to provide them can usually enable others to be provided at little or no additional cost. In steep mountainous terrain, it may be more economical to build intermittent four-lane sections or passing lanes with stopping sight distance on some two-lane highways, in lieu of two-lane sections with passing sight distance. Alternatives are discussed in "Passing Lanes" of Section 3.4.4.

The passing sight distances shown in Table 3-4 are sufficient for a single or isolated pass only. Designs with infrequent passing sections may not provide enough passing opportunities for efficient traffic operations. Even on low-volume roadways, a driver desiring to pass may, on reaching the passing section, find vehicles in the opposing lane and thus be unable to use the passing section or at least may not be able to begin to pass at once.

The importance of frequent passing sections is illustrated by their effect on the level of service of a two-lane, two-way highway. The procedures in the *Highway Capacity Manual* (HCM) (*62*) to analyze two-lane, two-way highways base the level-of-service criteria on two measures of effectiveness—percent time spent following and average travel speed. Both of these criteria are affected by the lack of passing opportunities. The HCM procedures show, for example, up to a 19 percent increase in the percent time spent following when the directional split is 50/50 and no-passing zones comprise 40 percent of the analysis length compared to a highway with similar traffic volumes and no sight restrictions. The effect of restricted passing sight distance is even more severe for unbalanced flow and where the no-passing zones comprise more than 40 percent of the length.

There is a similar effect on the average travel speed. As the percent of no-passing zones increases, there is an increased reduction in the average travel speed for the same demand flow rate. For example, a demand flow rate of 800 passenger cars per hour incurs a reduction of 3.1 km/h [1.9 mph] when no-passing zones comprise 40 percent of the analysis length compared to no reduction in speed on a route with unrestricted passing.

The HCM procedures indicate another possible criterion for passing sight distance design on two-lane highways that are several miles or more in length. The available passing sight distances along this length can be summarized to show the percentage of length with greater-than-minimum passing sight distance. Analysis of capacity related to this percentage would indicate whether or not alignment and profile adjustments are needed to accommodate the design hourly volume (DHV). When highway sight distances are analyzed over the whole range of lengths within which passing maneuvers are made, a new design criterion may be evaluated. Where high traffic volumes are expected on a highway and a high level of service is to be maintained, frequent or nearly continuous passing sight distances should be provided.

The HCM procedures and other traffic models can be used in design to determine the level of service that will be provided by the passing sight distance profile for any proposed design alternative. The level of service provided by the proposed design should be compared to the highway agency's desired level of service for the project and, if the desired level of service is not achieved, the feasibility and practicality of adjustments to the design to provide additional passing sight distance should be considered. Passing sections shorter than 120 to 240 m [400 to 800 ft] have been found to contribute little to improving the traffic operational efficiency of a two-lane highway. In determining the percentage of roadway length with greater-than-minimum passing sight distance, passing sections shorter than the minimum lengths shown in Table 3-5 should be excluded from consideration.

Height of Object

For stopping sight distance and decision sight distance calculations, the height of object is considered to be 0.60 m [2.00 ft] above the road surface. For passing sight distance calculations, the height of object is considered to be 1.08 m [3.50 ft] above the road surface.

Stopping sight distance object—The selection of a 0.60-m [2.00-ft] object height was based on research indicating that objects with heights less than 0.60 m [2.00 ft] are seldom involved in crashes (*17*). Therefore, it is considered that an object 0.60 m [2.00 ft] in height is representative of the smallest object that involves risk to drivers. An object height of 0.60 m [2.00 ft] is representative of the height of automobile headlights and taillights. Using object heights of less than 0.60 m [2.00 ft] for stopping sight distance calculations would result in longer crest vertical curves without a documented decrease in the frequency or severity of crashes (*17*). Object height of less than 0.60 m [2.00 ft] could substantially increase construction costs because additional excavation would be needed to provide the longer crest vertical curves. It is also doubtful that the driver's ability to perceive situations involving risk of collisions would be increased because recommended stopping sight distances for high-speed design are beyond most drivers' capabilities to detect objects less than 0.60 m [2.00 ft] in height (*17*).

Passing sight distance object—An object height of 1.08 m [3.50 ft] is adopted for passing sight distance. This object height is based on a vehicle height of 1.33 m [4.35 ft], which represents the 15th percentile of vehicle heights in the current passenger car population, less an allowance of 0.25 m [0.85 ft], which represents a near-maximum value for the portion of the vehicle height that needs to be visible for another driver to recognize a vehicle as such (*32*). Passing sight distances calculated on this basis are also considered adequate for night conditions because headlight beams of an opposing vehicle generally can be seen from a greater distance than a vehicle can be recognized in the daytime. The choice of an object height equal to the driver eye height makes passing sight distance design reciprocal (i.e., when the driver of the passing vehicle can see the opposing vehicle, the driver of the opposing vehicle can also see the passing vehicle).

Intersection sight distance object—As in the case of passing sight distance, the object to be seen by the driver in an intersection sight distance situation is another vehicle. Therefore, design for intersection sight distance is based on the same object height used in design for passing sight distance, 1.08 m [3.50 ft].

Decision sight distance object—The 0.60-m [2.00-ft] object-height criterion adopted for stopping sight distance is also used for decision sight distance. The rationale for applying this object height for decision sight distance is the same as for stopping sight distance.

Sight Obstructions

On a tangent roadway, the obstruction that limits the driver's sight distance is the road surface at some point on a crest vertical curve. On horizontal curves, the obstruction that limits the driver's sight distance may be the road surface at some point on a crest vertical curve or it may be some physical feature outside of the traveled way, such as a longitudinal barrier, a bridge-approach fill slope, a tree, foliage, or the backslope of a cut section. Accordingly, all highway construction plans should be checked in both the vertical and horizontal plane for sight distance obstructions.

Measuring and Recording Sight Distance

The design of horizontal alignment and vertical profile using sight distance and other criteria is addressed in Sections 3.3 through 3.5, including the detailed design of horizontal and vertical curves. Sight distance should be considered in the preliminary stages of design when both the horizontal and vertical alignment are still subject to adjustment. By determining the available sight distances graphically on the plans and recording them at frequent intervals, the designer can review the overall layout and produce a more balanced design by minor adjustments in the plan or profile. Methods for scaling sight distances on plans are demonstrated in Figure 3-2, which also shows a typical sight distance record that would be shown on the final plans.

Because the view of the highway ahead may change rapidly in a short travel distance, it is desirable to measure and record sight distance for both directions of travel at each station. Both horizontal and vertical sight distances should be measured and the shorter lengths recorded. In the case of a two-lane highway, passing sight distance should be measured and recorded in addition to stopping sight distance.

Sight distance information, such as that presented in Figures 3-41 and 3-43, may be used to establish minimum lengths of vertical curves. Charts similar to Table 3-28 are useful for determining the radius of horizontal curve or the lateral offset from the traveled way needed to provide the design sight distance. Examining sight distances along the proposed highway may be accomplished by direct scaling. Sight distance can be easily determined where plans and profiles are drawn using computer-aided design and drafting (CADD) systems. The following discussion presents a method for scaling sight distances.

Horizontal sight distance on the inside of a curve is limited by obstructions such as buildings, hedges, wooded areas, high ground, or other topographic features. These are generally plotted on the plans. Horizontal sight is measured with a straightedge, as indicated in the upper left portion of Figure 3-2. The cut slope obstruction is shown on the worksheets by a line representing the proposed excavation slope at a point 0.84 m [2.75 ft] above the road surface (i.e., the approximate average of 1.08 and 0.60 m [3.50 and 2.00 ft] for stopping sight distance and a point about 1.080 m [3.50 ft] above the road surface for passing sight distance. The position of this line with respect to the centerline may be scaled from the plotted highway cross sections. Preferably, the stopping sight distance should be measured between points on one traffic lane and passing sight distance from the middle of the other lane.

Such refinement on two-lane highways generally is not needed and measurement of sight distance along the centerline or traveled-way edge is suitable. Where there are changes of grade coincident with horizontal curves that have sight-limiting cut slopes on the inside, the line-of-sight intercepts the slope at a level either lower or higher than the assumed average height. In measuring sight distance, the error in use of the assumed 0.84- or 1.08-m [2.75- or 3.50-ft] height usually can be ignored.

Vertical sight distance may be scaled from a plotted profile by the method illustrated at the right center of Figure 3-2. A transparent strip with parallel edges 1.08 m [3.50 ft] apart and with a scratched line 0.60 m [2.00 ft] from the upper edge, in accordance with the vertical scale, is a useful tool. The lower edge of the strip is placed on the station from which the vertical sight distance is desired, and the strip is pivoted about this point until the upper edge is tangent to the profile. The distance between the initial station and the station on the profile intersected by the 0.60-m [2.00-ft] line is the stopping sight distance. The distance between the initial station and the station on the profile intersected by the lower edge of the strip is the passing sight distance.

A simple sight distance record is shown in the lower part of Figure 3-2. Sight distances in both directions are indicated by arrows and figures at each station on the plan and profile sheet of the proposed highway. To avoid the extra work of measuring unusually long sight distances that may occasionally be found, a selected maximum value may be recorded. In the example shown, all sight distances of more than 1 000 m [3,000 ft] are recorded as 1 000 m+ [3,000 ft+], and where this occurs for several consecutive stations, the intermediate values are omitted. Sight distances less than 500 m [1,500 ft] may be scaled to the nearest 10 m [50 ft] and those greater than 500 m [1,500 ft] to the nearest 50 m [100 ft]. The available sight distances along a proposed highway also may be shown by other methods. Several states use a sight distance graph, plotted in conjunction with the plan and profile of the highway, as a means of demonstrating sight distances.

Sight distance records for two-lane highways may be used effectively to tentatively determine the marking of no-passing zones in accordance with criteria given in the MUTCD (*22*). Marking of such zones is an operational rather than a design responsibility. No-passing zones thus established serve as a guide for markings when the highway is completed. The zones so determined should be checked and adjusted by field measurements before actual markings are placed.

Sight distance records also are useful on two-lane highways for determining the percentage of length of highway on which sight distance is restricted to less than the passing minimum, which is important in evaluating capacity. With recorded sight distances, as in the lower part of Figure 3-2, it is a simple process to determine the percentage of length of highway with a given sight distance or greater.

3.3 HORIZONTAL ALIGNMENT

3.3.1 Theoretical Considerations

To achieve balance in highway design, all geometric elements should, as far as economically practical, be designed to operate at a speed likely to be observed under the normal conditions for that roadway for a vast majority of motorists. Generally, this can be achieved through the use of design speed as an overall design control. The design of roadway curves should be based on an appropriate relationship between design speed and curvature and on their joint relationships with superelevation (roadway banking) and side friction. Although these relationships stem from the laws of mechanics, the actual values for use in design depend on practical limits and factors determined more or less empirically. These limits and factors are explained in the following discussion.

When a vehicle moves in a circular path, it undergoes a centripetal acceleration that acts toward the center of curvature. This acceleration is sustained by a component of the vehicle's weight related to the roadway superelevation, by the side friction developed between the vehicle's tires and the pavement surface, or by a combination of the two. Centripetal acceleration is sometimes equated to centrifugal force. However, this is an imaginary force that motorists believe is pushing them outward while cornering when, in fact, they are truly feeling the vehicle being accelerated in an inward direction. In horizontal curve design, "lateral acceleration" is equivalent to "centripetal acceleration"; the term "lateral acceleration" is used in this policy as it is specifically applicable to geometric design.

at its junction with the major road. For simple unchannelized intersections involving low design speeds and stop or signal control, it may be desirable to warp the crowns of both roads into a plane at the intersection; the appropriate plane depends on the direction of drainage and other conditions. Changes from one cross slope to another should be gradual. Intersections at which a minor road crosses a multilane divided highway with a narrow median on a superelevated curve should be avoided whenever practical because of the difficulty in adjusting grades to provide a suitable crossing. Gradelines of separate turning roadways should be designed to fit the cross slopes and longitudinal grades of the intersection legs.

The alignment and grades are subject to greater constraints at or near intersections than on the open road. At or near intersections, the combination of horizontal and vertical alignment should provide traffic lanes that are clearly visible to drivers at all times, clearly understandable for any desired direction of travel, free from the potential for conflicts to appear suddenly, and consistent in design with the portions of the highway just traveled.

The combination of vertical and horizontal curvature should allow adequate sight distance at an intersection. As discussed in Section 3.5 on "Combinations of Horizontal and Vertical Alignment," a sharp horizontal curve following a crest vertical curve is undesirable, particularly on intersection approaches.

9.5 INTERSECTION SIGHT DISTANCE

9.5.1 General Considerations

Each intersection has the potential for several different types of vehicular conflicts. The possibility of these conflicts actually occurring can be greatly reduced through the provision of proper sight distances and appropriate traffic controls. The avoidance of conflicts and the efficiency of traffic operations still depend on the judgment, capabilities, and response of each individual driver.

Stopping sight distance is provided continuously along each highway or street so that drivers have a view of the roadway ahead that is sufficient to allow drivers to stop. The provision of stopping sight distance at all locations along each highway or street, including intersection approaches, is fundamental to intersection operation.

Vehicles are assigned the right-of-way at intersections by traffic-control devices or, where no traffic-control devices are present, by the rules of the road. A basic rule of the road, at an intersection where no traffic-control devices are present, requires the vehicle on the left to yield to the vehicle on the right if they arrive at approximately the same time. Sight distance is provided at intersections to allow drivers to perceive the presence of potentially conflicting vehicles. This should occur in sufficient time for a motorist to stop or adjust their speed, as appropriate, to avoid colliding in the intersection. The methods for determining the sight distances needed by drivers approaching intersections are based on the same principles as stopping sight distance, but incorporate modified assumptions based on observed driver behavior at intersections.

The driver of a vehicle approaching an intersection should have an unobstructed view of the entire intersection, including any traffic-control devices, and sufficient lengths along the intersecting highway to permit the driver to anticipate and avoid potential collisions. The sight distance needed under various assumptions of physical conditions and driver behavior is directly related to vehicle speeds and to the resultant distances traversed during perception-reaction time and braking.

Sight distance is also provided at intersections to allow the drivers of stopped vehicles a sufficient view of the intersecting highway to decide when to enter the intersecting highway or to cross it. If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, a major-road vehicle may need to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.

9.5.2 Sight Triangles

Specified areas along intersection approach legs and across their included corners should be clear of obstructions that might block a driver's view of potentially conflicting vehicles. These specified areas are known as clear sight triangles. The dimensions of the legs of the sight triangles depend on the design speeds of the intersecting roadways and the type of traffic control used at the intersection. These dimensions are based on observed driver behavior and are documented by space-time profiles and speed choices of drivers on intersection approaches (*12*). Two types of clear sight triangles are considered in intersection design—approach sight triangles and departure sight triangles.

Approach Sight Triangles

Each quadrant of an intersection should contain a triangular area free of obstructions that might block an approaching driver's view of potentially conflicting vehicles. The length of the legs of this triangular area, along both intersecting roadways, should be such that the drivers can see any potentially conflicting vehicles in sufficient time to slow or stop before colliding within the intersection. Figure 9-15A shows typical clear sight triangles to the left and to the right for a vehicle approaching an uncontrolled or yield-controlled intersection.

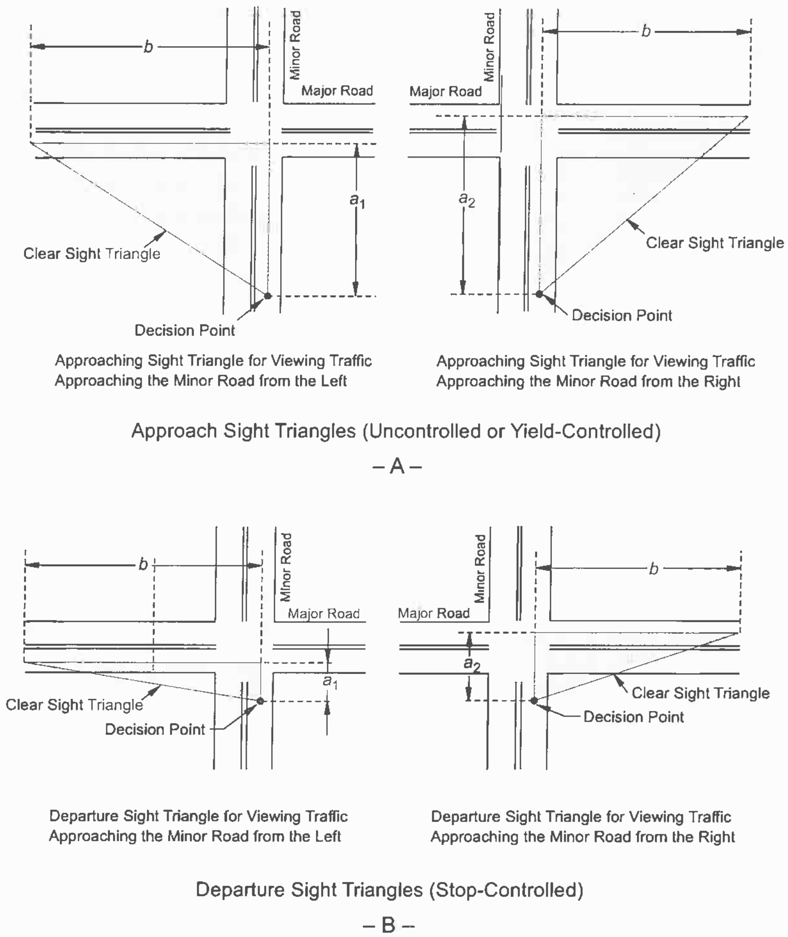

Figure 9-15. Intersection Sight Triangles

The vertex of the sight triangle on a minor-road approach (or an uncontrolled approach) represents the decision point for the minor-road driver (see Figure 9-15A). This decision point is the location at which the minor-road driver should begin to brake to a stop if another vehicle is present on an intersecting approach. The distance from the major road, along the minor road, is illustrated by the distance a_1 to the left and a_2 to the right as shown in Figure 9-15A. Distance a_2 is equal to distance a_1 plus the width of the lane(s) departing from the intersection on the major road to the right. Distance a_2 should also include the width of any median present on the major road unless the median is wide enough to permit a vehicle to stop before entering or crossing the roadway beyond the median.

The geometry of a clear sight triangle is such that when the driver of a vehicle without the right-of-way sees a vehicle that has the right of way on an intersecting approach, the driver of that potentially conflicting vehicle can also see the first vehicle. Distance b illustrates the length of this leg of the sight triangle. Thus, the provision of a clear sight triangle for vehicles without the right-of-way also permits the drivers of vehicles with the right-of-way to slow, stop, or avoid other vehicles, if needed.

Although desirable at higher volume intersections, approach sight triangles like those shown in Figure 9-15A are not needed for intersection approaches controlled by stop signs or traffic signals. In that case, the need for approaching vehicles to stop at the intersection is determined by the traffic control devices and not by the presence or absence of vehicles on the intersecting approaches.

Departure Sight Triangles

A second type of clear sight triangle provides sight distance sufficient for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. Figure 9-15B shows typical departure sight triangles to the left and to the right of the location of a stopped vehicle on the minor road. Departure sight triangles should be provided in each quadrant of each intersection approach controlled by stop or yield signs. Departure sight triangles should also be provided for some signalized intersection approaches (see Case D in Section 9.5.3 on "Intersection Control"). Distance a_2 in Figure 9-15B is equal to distance a_1 plus the width of the lane(s) departing from the intersection on the major road to the right. Distance a_2 should also include the width of any median present on the major road unless the median is wide enough to permit a vehicle to stop before entering or crossing the roadway beyond the median. The appropriate measurement of distances a_1 and a_2 for departure sight triangles depends on the placement of any marked stop line that may be present and, thus, may vary with site-specific conditions.

The recommended dimensions of the clear sight triangle for desirable traffic operations where stopped vehicles enter or cross a major road are based on assumptions derived from field observations of driver gap-acceptance behavior (*12*). The provision of clear sight triangles like those shown in Figure 9-15B also allows the drivers of vehicles on the major road to see any vehicles stopped on the minor-road approach and to be prepared to slow or stop, if needed.

Identification of Sight Obstructions within Sight Triangles

The profiles of the intersecting roadways should be designed to provide the recommended sight distances for drivers on the intersection approaches. Within a sight triangle, any object at a height above the elevation of the adjacent roadways that would obstruct the driver's view should be removed or lowered, if practical. Such objects may include buildings, parked vehicles, highway structures, roadside hardware, hedges, trees, bushes, unmowed grass, tall crops, walls, fences, and the terrain itself. Particular attention should be given to the evaluation of clear sight triangles at interchange ramp/crossroad intersections where features such as bridge railings, piers, and abutments are potential sight obstructions.

The determination of whether an object constitutes a sight obstruction should consider both the horizontal and vertical alignment of both intersecting roadways, as well as the height and position of the object. In making this determination, it should be assumed that the driver's eye is 1.08 m [3.50 ft] above the roadway surface and that the object to be seen is 1.08 m [3.50 ft] above the surface of the intersecting road.

This object height is based on a vehicle height of 1.33 m [4.35 ft], which represents the 15th percentile of vehicle heights in the current passenger car population less an allowance of 250 mm [10 in.]. This allowance represents a near-maximum value for the portion of a passenger car height that needs to be visible for another driver to recognize it as the object. The use of an object height equal to the driver eye height makes intersection sight distances reciprocal (i.e., if one driver can see another vehicle, then the driver of that vehicle can also see the first vehicle).

Where the sight-distance value used in design is based on a single-unit or combination truck as the design vehicle, it is also appropriate to use the eye height of a truck driver in checking sight obstructions. The recommended value of a truck driver's eye height is 2.33 m [7.6 ft] above the roadway surface.

9.5.3 Intersection Control

The recommended dimensions of the sight triangles vary with the type of traffic control used at an intersection because different types of control impose different legal constraints on drivers and, therefore, result in different driver behavior. Procedures to determine sight distances at intersections are presented below according to different types of traffic control, as follows:

- Case A—Intersections with no control
- Case B—Intersections with stop control on the minor road
  - Case B1—Left turn from the minor road
  - Case B2—Right turn from the minor road
  - Case B3—Crossing maneuver from the minor road
- Case C—Intersections with yield control on the minor road
  - Case C1—Crossing maneuver from the minor road
  - Case C2—Left or right turn from the minor road
- Case D—Intersections with traffic signal control
- Case E—Intersections with all-way stop control
- Case F—Left turns from the major road

Case A—Intersections with No Control

For intersections not controlled by yield signs, stop signs, or traffic signals, the driver of a vehicle approaching an intersection should be able to see potentially conflicting vehicles in sufficient time to stop before reaching the intersection. The location of the decision point (driver's eye) of the sight triangles on each approach is determined from a model that is analogous to the stopping sight distance model, with slightly different assumptions.

While some perceptual tasks at intersections may need substantially less time, the detection and recognition of a vehicle that is a substantial distance away on an intersecting approach, and is near the limits of the driver's peripheral vision, may take up to 2.5 s. The distance to brake to a stop can be determined from the same braking coefficients used to determine stopping sight distance in Table 3-1.

Field observations indicate that vehicles approaching uncontrolled intersections typically slow to approximately 50 percent of their midblock running speed. This occurs even when no potentially conflicting vehicles are present (*12*). This initial slowing typically occurs at deceleration rates up to 1.5 m/s^2 [5 ft/s^2]. Deceleration at this gradual rate has been observed to begin even before a potentially conflicting vehicle comes into view. Braking at greater deceleration rates, which can approach those assumed in stopping

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CALIFORNIA STATE TRANSPORTATION AGENCY

CHAPTER 4F. PEDESTRIAN HYBRID BEACONS

Section 4F.01 Application of Pedestrian Hybrid Beacons

Support:

01 A pedestrian hybrid beacon is a special type of hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk.

01a A conventional traffic control signal operation with a standard signal face displaying green, yellow and red (steady and/or flashing red) indications, at a mid-block crosswalk is an alternative to the pedestrian hybrid beacon.

Option:

02 A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants (see Chapter 4C), or at a location that meets traffic signal warrants under Sections 4C.05 and/or 4C.06 but a decision is made to not install a traffic control signal.

Standard:

03 If used, pedestrian hybrid beacons shall be used in conjunction with signs and pavement markings to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon shall only be installed at a marked crosswalk.

Guidance:

04 If one of the signal warrants of Chapter 4C is met and a traffic control signal is justified by an engineering study, and if a decision is made to install a traffic control signal, it should be installed based upon the provisions of Chapters 4D and 4E.

05 If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit pedestrians to cross, or if the speed for vehicles approaching on the major street is too high to permit pedestrians to cross, or if pedestrian delay is excessive, the need for a pedestrian hybrid beacon should be considered on the basis of an engineering study that considers major-street volumes, speeds, widths, and gaps in conjunction with pedestrian volumes, walking speeds, and delay.

06 For a major street where the posted or statutory speed limit or the 85th-percentile speed is 35 mph or less, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-1 for the length of the crosswalk.

07 For a major street where the posted or statutory speed limit or the 85th-percentile speed exceeds 35 mph, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-2 for the length of the crosswalk.

08 For crosswalks that have lengths other than the four that are specifically shown in Figures 4F-1 and 4F-2, the values should be interpolated between the curves.

Section 4F.02 Design of Pedestrian Hybrid Beacons

Standard:

01 Except as otherwise provided in this Section, a pedestrian hybrid beacon shall meet the provisions of Chapters 4D and 4E.

02 A pedestrian hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications (see Figure 4F-3).

03 When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:

A. At least two pedestrian hybrid beacon faces shall be installed for each approach of the major street,
B. A stop line shall be installed for each approach to the crosswalk,
C. A pedestrian signal head conforming to the provisions set forth in Chapter 4E shall be installed at each end of the marked crosswalk, and
D. The pedestrian hybrid beacon shall be pedestrian actuated.

Guidance:

04 When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:

A. The pedestrian hybrid beacon should be installed at an intersection, or at the junction of a roadway with a driveway, or at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs,

B. Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk, or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance,

C. The installation should include suitable standard signs and pavement markings, and

D. If installed within a signal system, the pedestrian hybrid beacon should be coordinated.

05 On approaches having posted or statutory speed limits or 85th-percentile speeds in excess of 35 mph and on approaches having traffic or operating conditions that would tend to obscure visibility of roadside hybrid beacon face locations, both of the minimum of two pedestrian hybrid beacon faces should be installed over the roadway.

06 On multi-lane approaches having a posted or statutory speed limits or 85th-percentile speeds of 35 mph or less, either a pedestrian hybrid beacon face should be installed on each side of the approach (if a median of sufficient width exists) or at least one of the pedestrian hybrid beacon faces should be installed over the roadway.

07 A pedestrian hybrid beacon should comply with the signal face location provisions described in Sections 4D.11 through 4D.16.

Standard:

08 A CROSSWALK STOP ON RED (symbolic circular red) (R10-23) sign (see Section 2B.53) shall be mounted adjacent to a pedestrian hybrid beacon face on each major street approach. If an overhead pedestrian hybrid beacon face is provided, the sign shall be mounted adjacent to the overhead signal face.

Option:

09 A Pedestrian (W11-2) warning sign (see Section 2C.50) with an AHEAD (W16-9P) supplemental plaque may be placed in advance of a pedestrian hybrid beacon. A warning beacon may be installed to supplement the W11-2 sign.

Guidance:

10 If a warning beacon supplements a W11-2 sign in advance of a pedestrian hybrid beacon, it should be programmed to flash only when the pedestrian hybrid beacon is not in the dark mode.

Standard:

11 If a warning beacon is installed to supplement the W11-2 sign, the design and location of the warning beacon shall comply with the provisions of Sections 4L.01 and 4L.03.

Section 4F.03 Operation of Pedestrian Hybrid Beacons

Standard:

01 Pedestrian hybrid beacon indications shall be dark (not illuminated) during periods between actuations.

02 Upon actuation by a pedestrian, a pedestrian hybrid beacon face shall display a flashing CIRCULAR yellow signal indication, followed by a steady CIRCULAR yellow signal indication, followed by both steady CIRCULAR RED signal indications during the pedestrian walk interval, followed by alternating flashing CIRCULAR RED signal indications during the pedestrian ~~clearance~~ change interval (see Figure 4F-3). Upon termination of the pedestrian clearance interval, the pedestrian hybrid beacon faces shall revert to a dark (not illuminated) condition.

03 Except as provided in Paragraph 4, the pedestrian signal heads shall continue to display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are either dark or displaying flashing or steady CIRCULAR yellow signal indications. The pedestrian signal heads shall display a WALKING PERSON (symbolizing WALK) signal indication when the pedestrian hybrid beacon faces are displaying steady CIRCULAR RED signal indications. The pedestrian signal heads shall display a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are displaying alternating flashing CIRCULAR RED signal indications. Upon termination of the pedestrian clearance interval, the pedestrian signal heads shall revert to a steady UPRAISED HAND (symbolizing DONT WALK) signal indication.