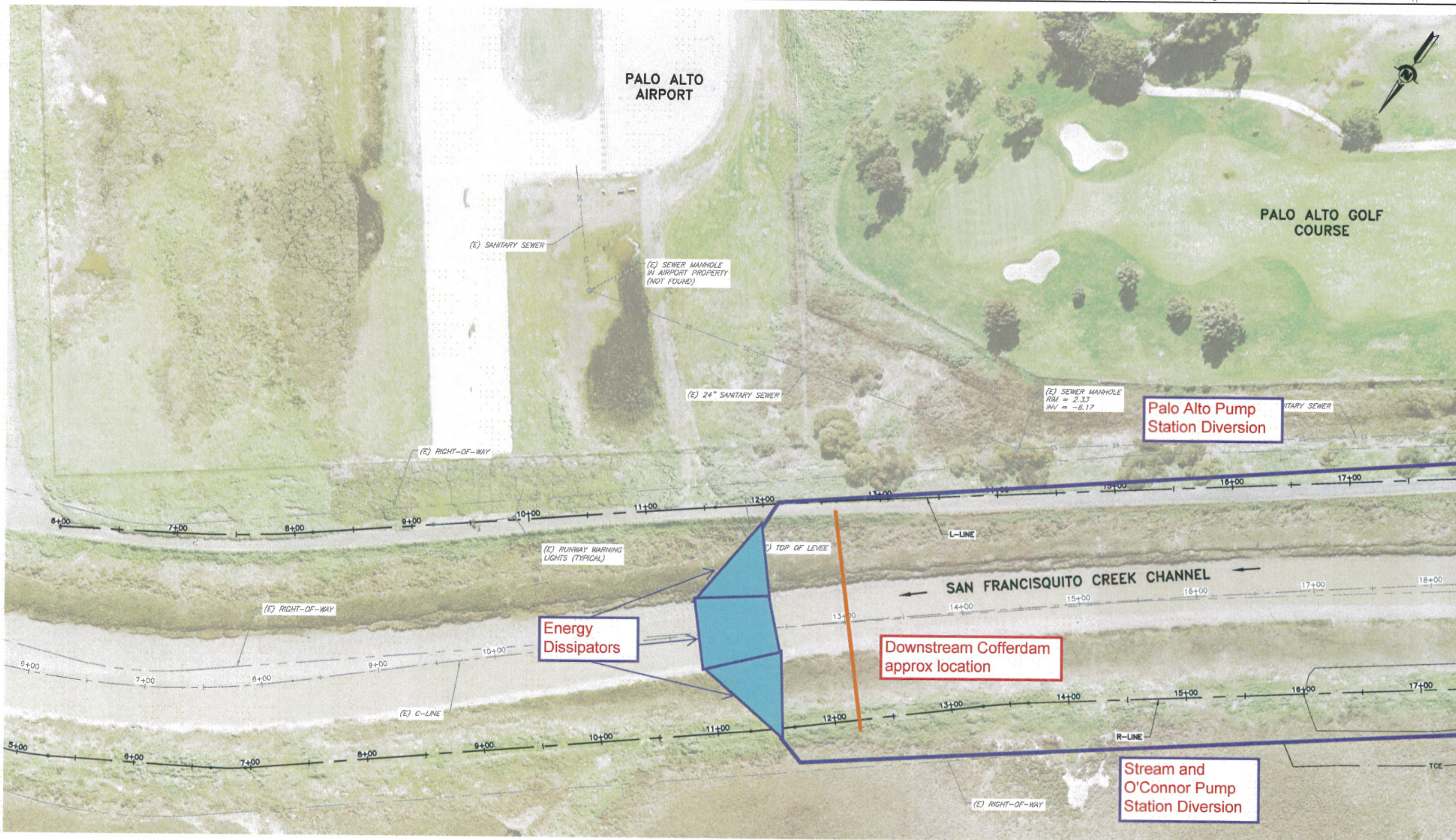

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE 09-30-12
DESIGN L. JONES
DRAWN H. SUAREZ
CHECKED P. HRADILEK

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY

ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
Temporary Water Diversion Plan
STA 6+00 TO STA 18+00 (C-LINE)

SCALE 1" = 40'
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 26284002
SHEET CODE: C-32
SHEET NUMBER: 45 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

USERNAME: BillShed Tue 08 Jul 2008 09:32am
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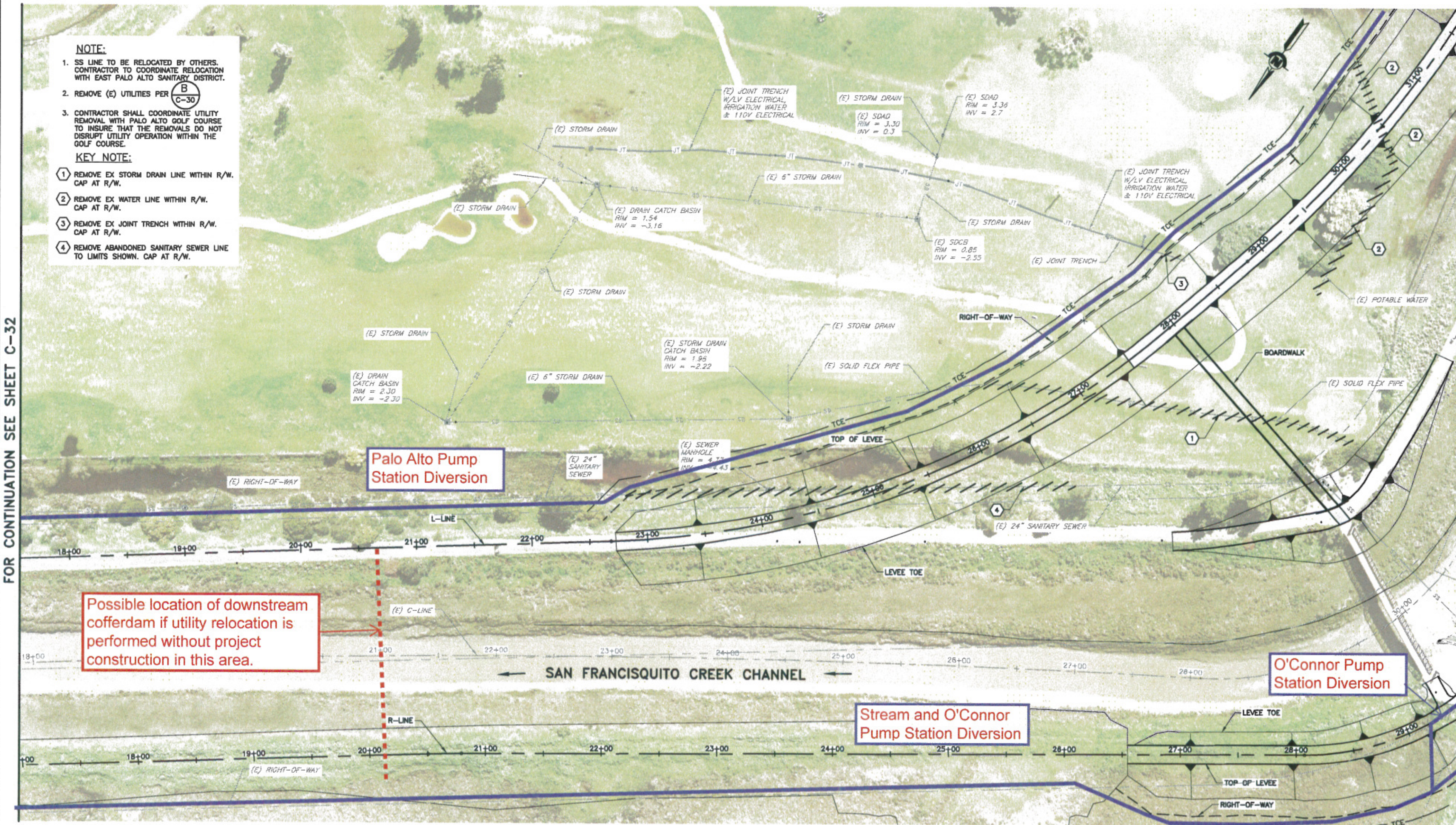
FOR CONTINUATION SEE SHEET C-32

FOR CONTINUATION SEE SHEET C-34


Palo Alto Pump Station Diversion
Possible location of downstream cofferdam if utility relocation is performed without project construction in this area.
SAN FRANCISQUITO CREEK CHANNEL
O'Connor Pump Station Diversion
Stream and O'Connor Pump Station Diversion
L-LINE
R-LINE
(E) C-LINE
TOP OF LEVEE
LEVEE TOE
RIGHT-OF-WAY
(E) RIGHT-OF-WAY
BOARDWALK
TCE
(E) STORM DRAIN
(E) 6" STORM DRAIN
(E) SOLID FLEX PIPE
(E) POTABLE WATER
(E) 24" SANITARY SEWER
(E) JOINT TRENCH
(E) JOINT TRENCH W/LV ELECTRICAL, IRRIGATION WATER & 110V ELECTRICAL
(E) DRAIN CATCH BASIN RIM = 1.54 INV = -3.16
(E) DRAIN CATCH BASIN RIM = 2.30 INV = -2.30
(E) STORM DRAIN CATCH BASIN RIM = 1.95 INV = -2.22
(E) SDAD RIM = 3.36 INV = 2.7
(E) SDAD RIM = 3.30 INV = 0.3
(E) SDCB RIM = 0.85 INV = -2.55
(E) SEWER MANHOLE

NOTE:

1. SS LINE TO BE RELOCATED BY OTHERS. CONTRACTOR TO COORDINATE RELOCATION WITH EAST PALO ALTO SANITARY DISTRICT.
2. REMOVE (E) UTILITIES PER B/C-30
3. CONTRACTOR SHALL COORDINATE UTILITY REMOVAL WITH PALO ALTO GOLF COURSE TO INSURE THAT THE REMOVALS DO NOT DISRUPT UTILITY OPERATION WITHIN THE GOLF COURSE.

KEY NOTE:

1. REMOVE EX STORM DRAIN LINE WITHIN R/W. CAP AT R/W.
2. REMOVE EX WATER LINE WITHIN R/W. CAP AT R/W.
3. REMOVE EX JOINT TRENCH WITHIN R/W. CAP AT R/W.
4. REMOVE ABANDONED SANITARY SEWER LINE TO LIMITS SHOWN. CAP AT R/W.

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE 09-30-12
DESIGN L. JONES
DRAWN H. SUAREZ
CHECKED P. HRADILEK

ENGINEERING CERTIFICATION — PROJECT ENGINEER — DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY

ACCEPTED BY DISTRICT — PROJECT ENGINEER — DATE

PROJECT NAME AND SHEET DESCRIPTION:

SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT

Temporary Water Diversion Plan

STA 18+00 TO STA 31+00 (C-LINE)

SCALE 1" = 40'
VERIFY SCALES: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 26284002
SHEET CODE: C-33
SHEET NUMBER: 46 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

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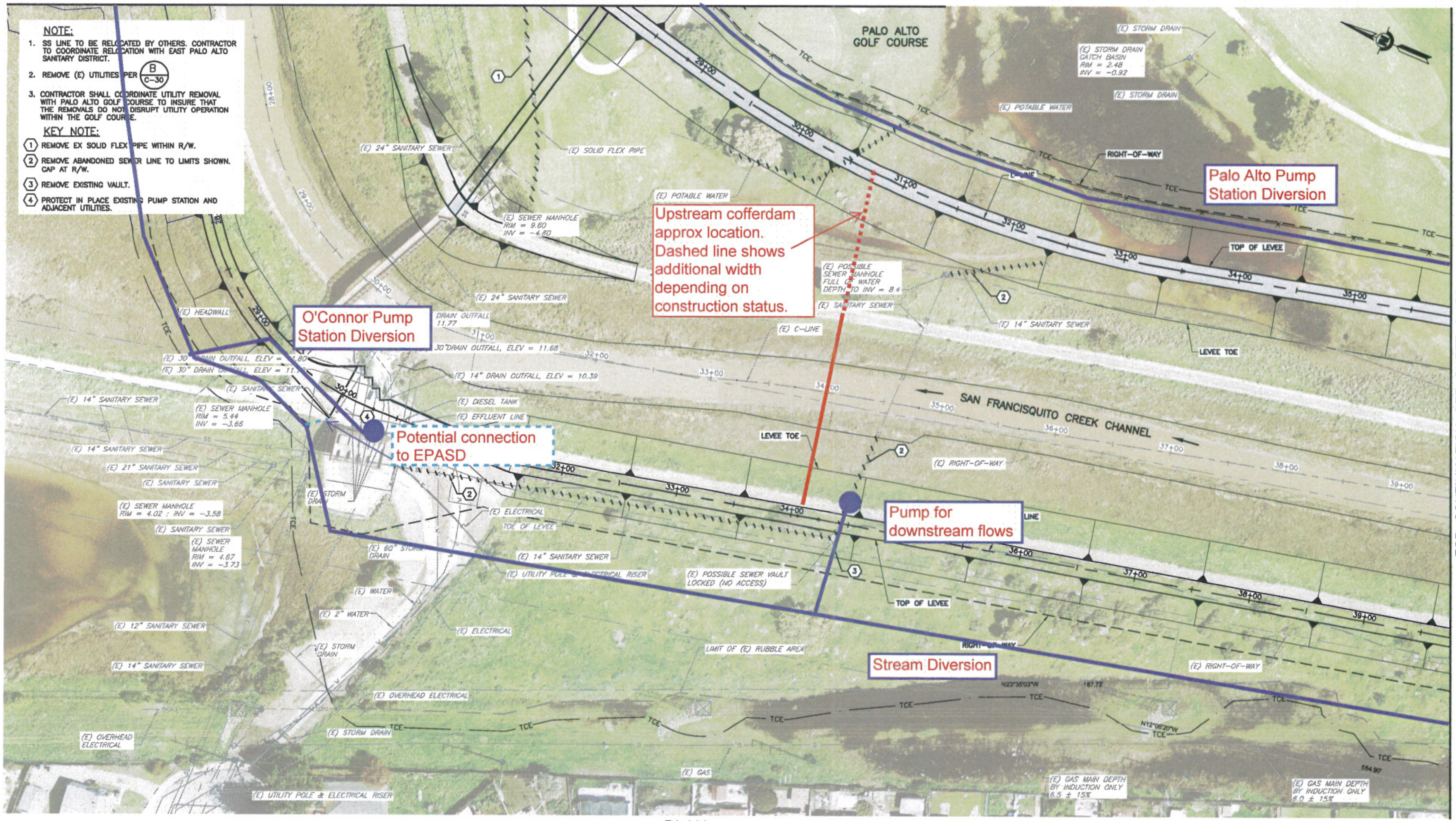
FOR CONTINUATION SEE SHEET C-33


PALO ALTO GOLF COURSE
Palo Alto Pump Station Diversion
O'Connor Pump Station Diversion
Upstream cofferdam approx location. Dashed line shows additional width depending on construction status.
Potential connection to EPASD
Pump for downstream flows
Stream Diversion
SAN FRANCISQUITO CREEK CHANNEL
LEVEE TOE
TOP OF LEVEE
RIGHT-OF-WAY
(E) POSSIBLE SEWER VAULT LOCKED (NO ACCESS)
LIMIT OF (E) RUBBLE AREA
(E) 14" SANITARY SEWER
(E) 24" SANITARY SEWER
(E) POTABLE WATER
(E) SOLID FLEX PIPE
(E) STORM DRAIN
(E) OVERHEAD ELECTRICAL
(E) UTILITY POLE & ELECTRICAL RISER
(E) GAS MAIN DEPTH BY INDUCTION ONLY 6.5 ± 15%
(E) GAS MAIN DEPTH BY INDUCTION ONLY 6.0 ± 15%

NOTE:

1. SS LINE TO BE RELOCATED BY OTHERS. CONTRACTOR TO COORDINATE RELOCATION WITH EAST PALO ALTO SANITARY DISTRICT.
2. REMOVE (E) UTILITIES PER B / C-30
3. CONTRACTOR SHALL COORDINATE UTILITY REMOVAL WITH PALO ALTO GOLF COURSE TO INSURE THAT THE REMOVALS DO NOT DISRUPT UTILITY OPERATION WITHIN THE GOLF COURSE.

KEY NOTE:

(1) REMOVE EX SOLID FLEX PIPE WITHIN R/W.
(2) REMOVE ABANDONED SEWER LINE TO LIMITS SHOWN. CAP AT R/W.
(3) REMOVE EXISTING VAULT.
(4) PROTECT IN PLACE EXISTING PUMP STATION AND ADJACENT UTILITIES.

FOR CONTINUATION SEE SHEET C-35

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE 09-30-12 | DESIGN L. JONES | DRAWN H. SUAREZ | CHECKED P. HRADILEK

ENGINEERING CERTIFICATION — PROJECT ENGINEER — DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY

ACCEPTED BY DISTRICT — PROJECT ENGINEER — DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
Temporary Water Diversion Plan
STA 30+00 TO STA 39+00 (C-LINE)

SCALE 1" = 40'
VERIFY SCALES: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER 26284002
SHEET CODE: C-34
SHEET NUMBER: 47 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

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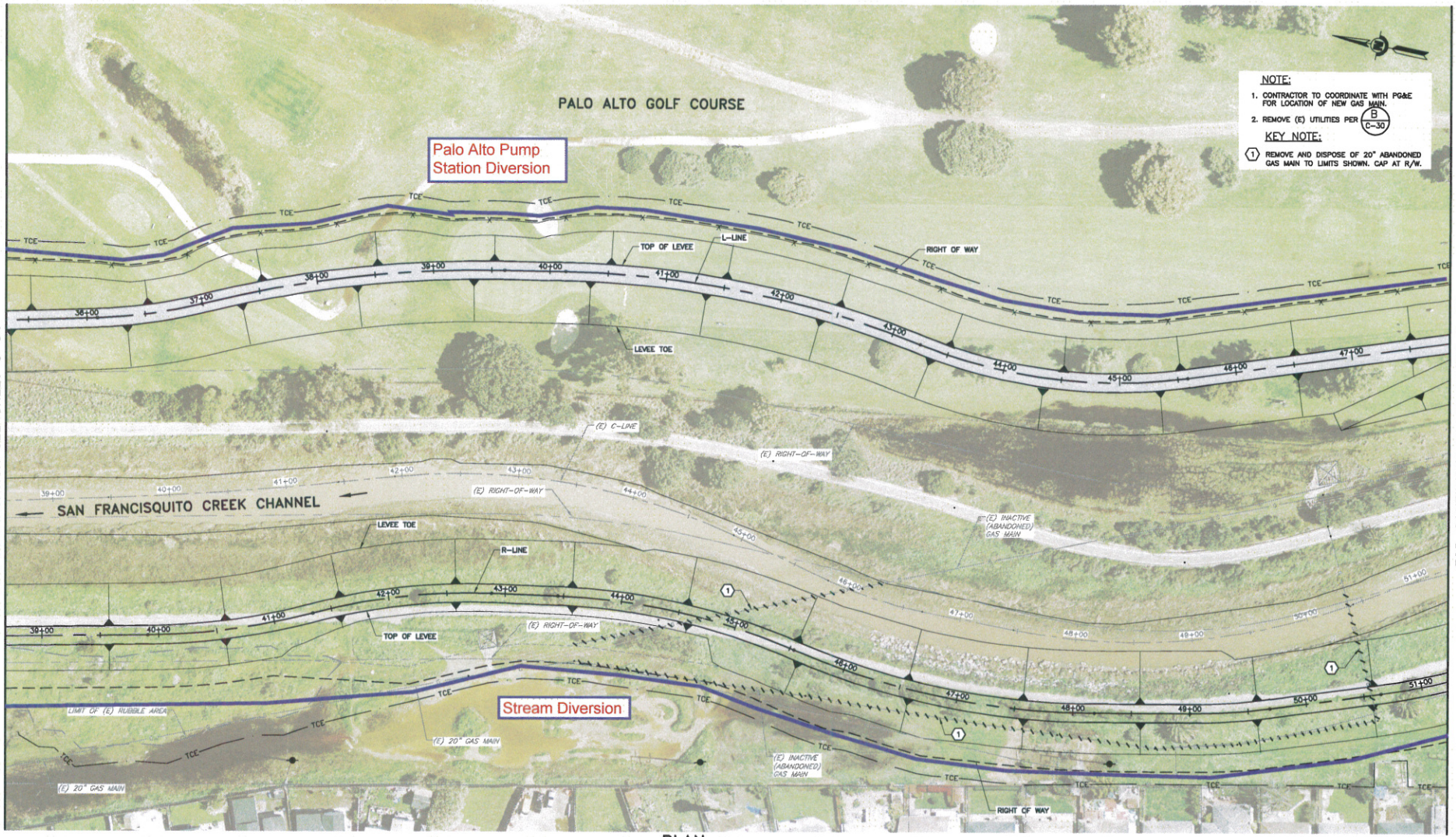

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE	09-30-12
DESIGN	L. JONES
DRAWN	H. SUAREZ
CHECKED	P. HRADILEK

ENGINEERING CERTIFICATION — PROJECT ENGINEER — DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY

ACCEPTED BY DISTRICT

PROJECT ENGINEER — DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
Temporary Water Diversion Plan
STA 39+00 TO STA 51+00 (C-LINE)

SCALE	1" = 40'
VERIFY SCALES	BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	26284002
SHEET CODE:	C-35
SHEET NUMBER:	48 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

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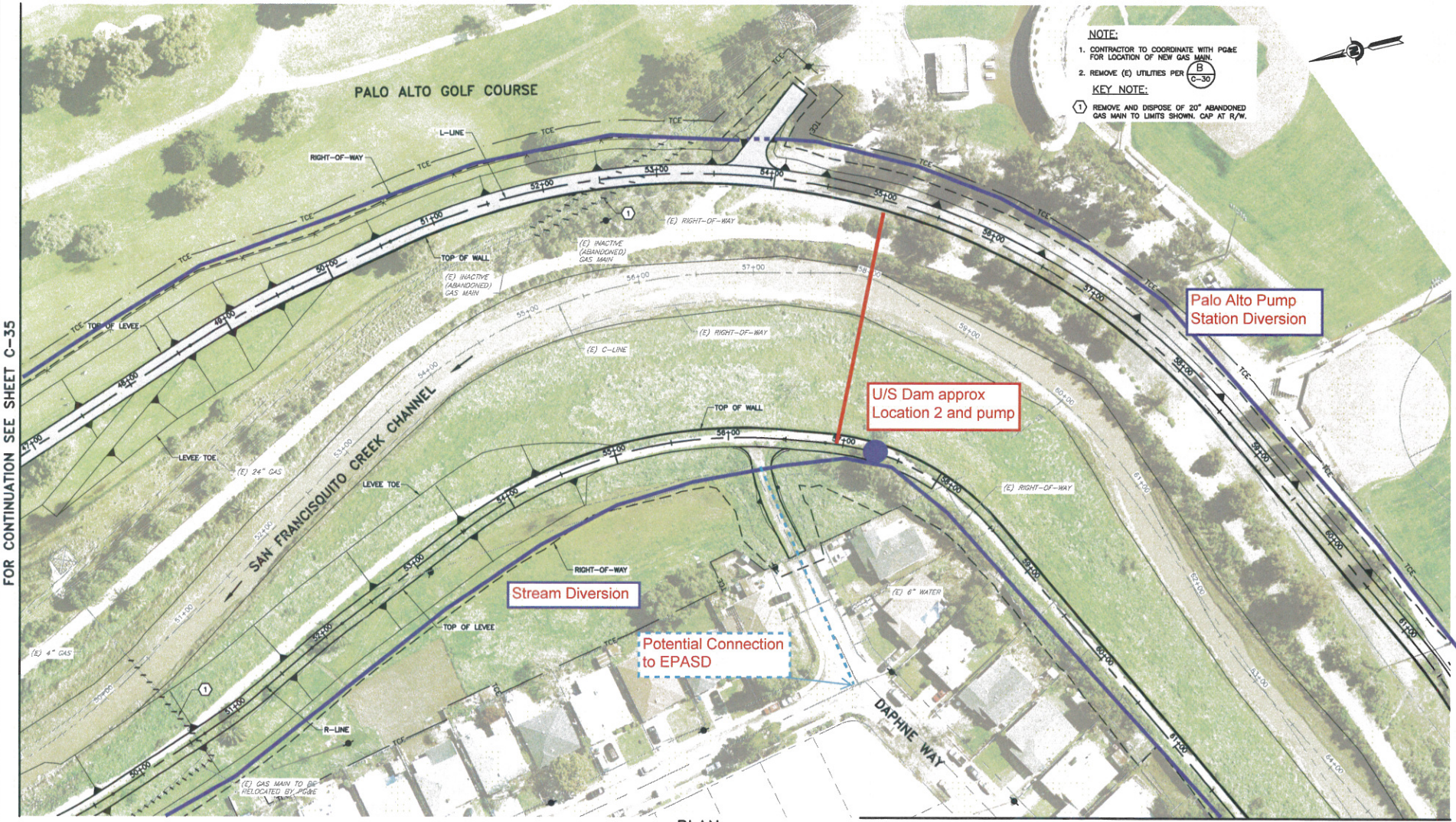

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE	09-30-12
DESIGN	L. JONES
DRAWN	H. SUAREZ
CHECKED	P. HRADILEK

ENGINEERING CERTIFICATION — REGISTERED PROFESSIONAL ENGINEER — PROJECT ENGINEER DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
Temporary Water Diversion Plan
STA 51+00 TO STA 63+00 (C-LINE)

SCALE	1" = 40'
VERIFY SCALES	0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	
PROJECT NUMBER	26284002
SHEET CODE:	C-36
SHEET NUMBER:	49 OF 107

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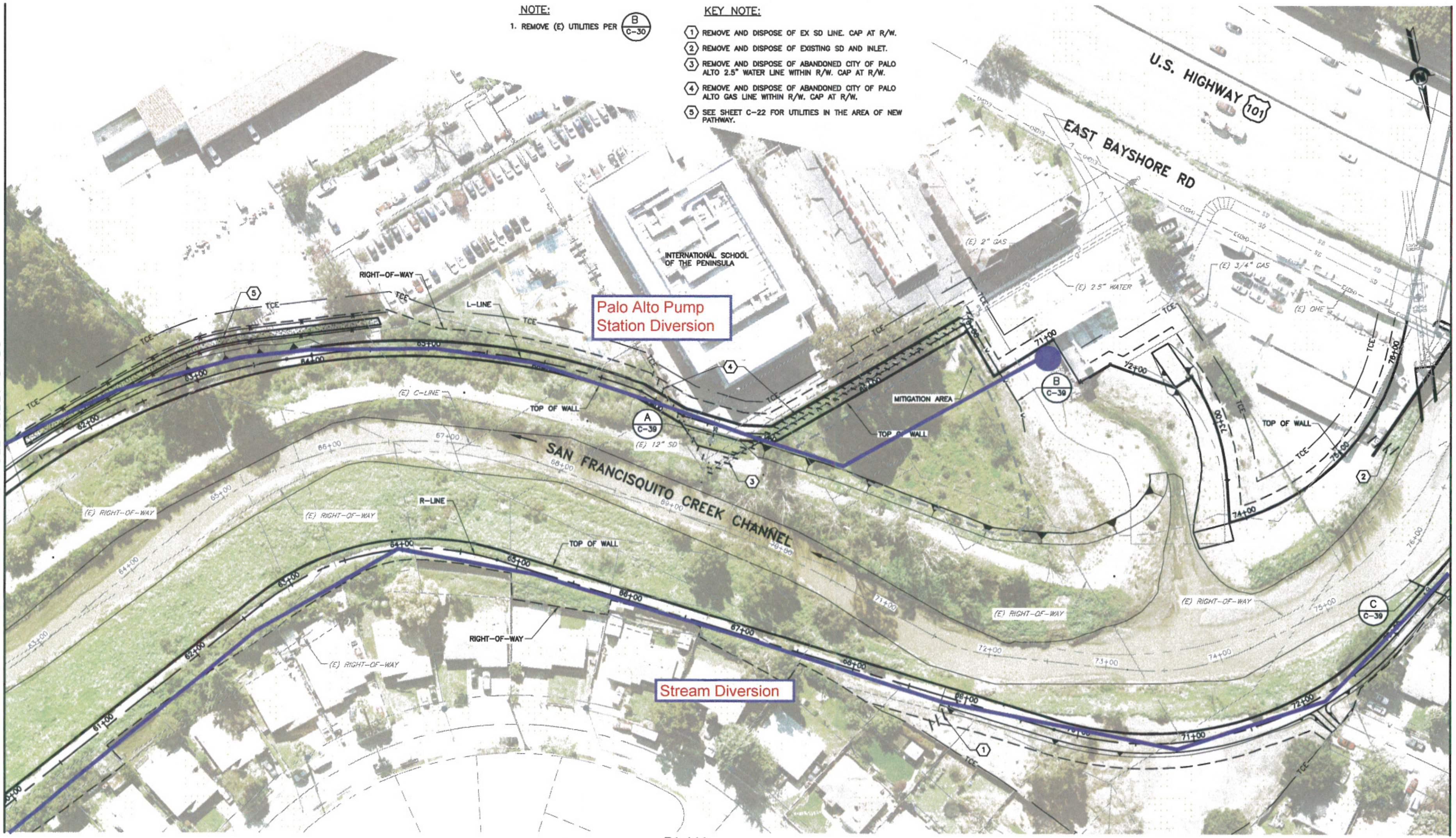
NOTE:

1. REMOVE (E) UTILITIES PER B/C-30

KEY NOTE:

1. REMOVE AND DISPOSE OF EX SD LINE. CAP AT R/W.
2. REMOVE AND DISPOSE OF EXISTING SD AND INLET.
3. REMOVE AND DISPOSE OF ABANDONED CITY OF PALO ALTO 2.5" WATER LINE WITHIN R/W. CAP AT R/W.
4. REMOVE AND DISPOSE OF ABANDONED CITY OF PALO ALTO GAS LINE WITHIN R/W. CAP AT R/W.
5. SEE SHEET C-22 FOR UTILITIES IN THE AREA OF NEW PATHWAY.



PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR.
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE 09-30-12; DESIGN L. JONES; DRAWN H. SUAREZ; CHECKED P. HRADILEK

ENGINEERING CERTIFICATION — PROJECT ENGINEER — DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY

ACCEPTED BY DISTRICT — PROJECT ENGINEER — DATE

PROJECT NAME AND SHEET DESCRIPTION:

SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT

Temporary Water Diversion Plan

STA 63+00 TO STA 76+00 (C-LINE)

SCALE 1" = 40'

VERIFY SCALES: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 26284002

SHEET CODE: C-37

SHEET NUMBER: 50 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

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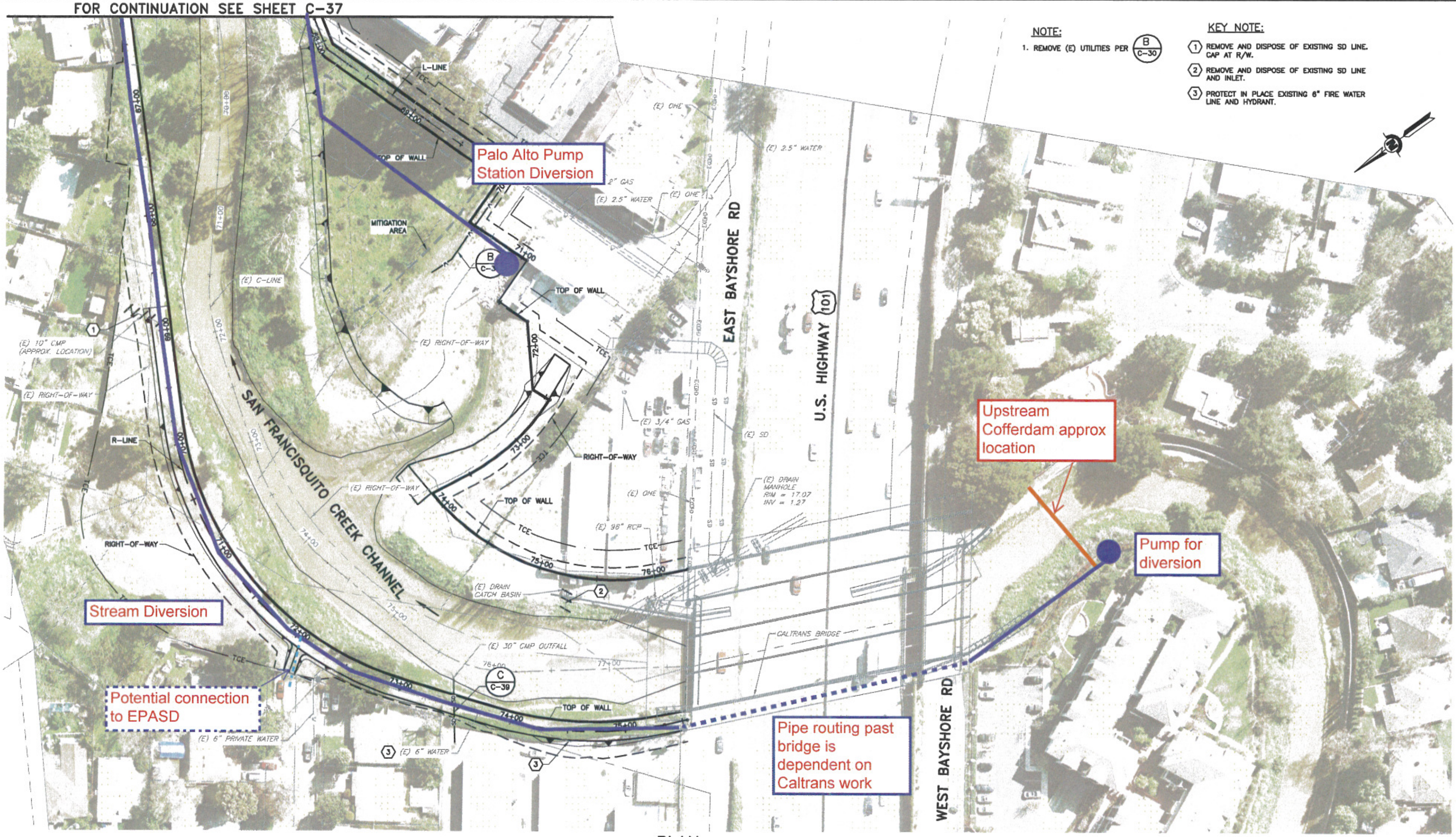
FOR CONTINUATION SEE SHEET C-37


Palo Alto Pump Station Diversion
Upstream Cofferdam approx location
Pump for diversion
Stream Diversion
Potential connection to EPASD
Pipe routing past bridge is dependent on Caltrans work
SAN FRANCISQUITO CREEK CHANNEL
EAST BAYSHORE RD
WEST BAYSHORE RD
U.S. HIGHWAY 101
CALTRANS BRIDGE
MITIGATION AREA
TOP OF WALL
RIGHT-OF-WAY
(E) RIGHT-OF-WAY
L-LINE
R-LINE
(E) C-LINE
(E) DRAIN CATCH BASIN
(E) 30" CMP OUTFALL
(E) DRAIN MANHOLE RIM = 17.07 INV = 1.27
(E) 6" PRIVATE WATER
(E) 6" WATER
(E) 10" CMP (APPROX. LOCATION)
(E) 2.5" WATER
(E) 3/4" GAS
(E) 98" RCP
(E) OHE
(E) SD
2" GAS
TCE

NOTE:

1. REMOVE (E) UTILITIES PER B/C-30

KEY NOTE:

1. REMOVE AND DISPOSE OF EXISTING SD LINE. CAP AT R/W.
2. REMOVE AND DISPOSE OF EXISTING SD LINE AND INLET.
3. PROTECT IN PLACE EXISTING 6" FIRE WATER LINE AND HYDRANT.

PLAN
SCALE: 1"=40'

REV	DESCRIPTION	DATE	APPR
	95% PRELIMINARY 11-14-2012		

HDR Engineering, Inc.

DATE 09-30-12
DESIGN L. JONES
DRAWN H. SUAREZ
CHECKED P. HRADILEK

ENGINEERING CERTIFICATION
PRELIMINARY
PROJECT ENGINEER / DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY
ACCEPTED BY DISTRICT
PROJECT ENGINEER / DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
Temporary Water Diversion Plan
STA 70+00 TO STA 77+50 (C-LINE)

SCALE 1" = 40'
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 26284002
SHEET CODE: C-38
SHEET NUMBER: 51 OF 107

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

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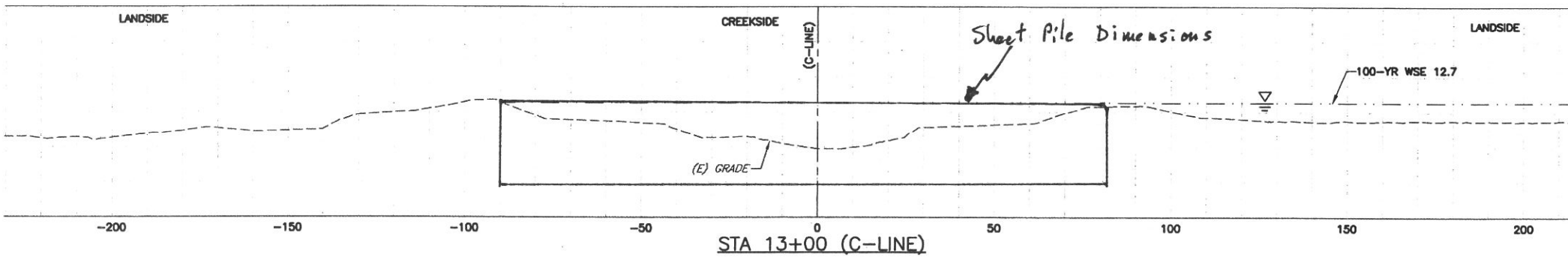
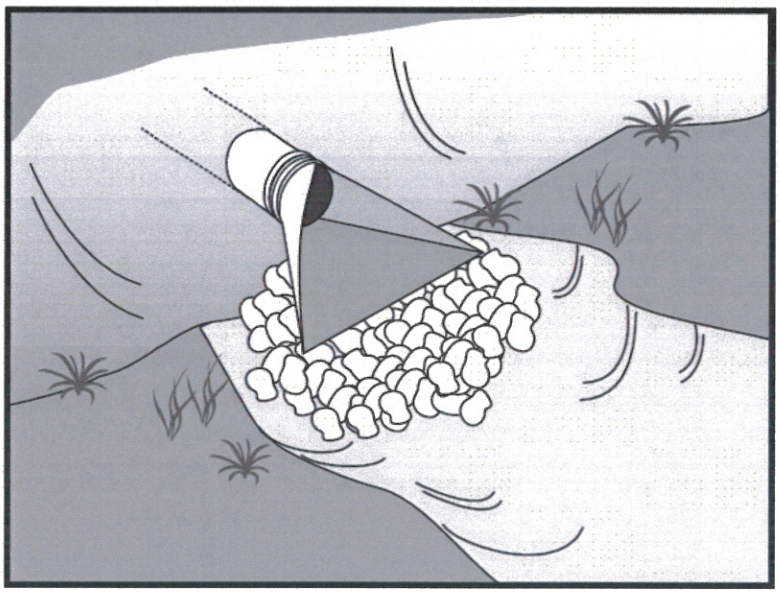


STA 13+00 (C-LINE)

Velocity Dissipation Devices EC-10



Objectives

EC	Erosion Control	☑
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

Implementation

General

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

Design and Layout

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.
  - Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.
  - Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the D_{50} rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

References

County of Sacramento Improvement Standards, Sacramento County, May 1989.

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursztynsky, P.E., McGraw Hill Book Company, 1986.

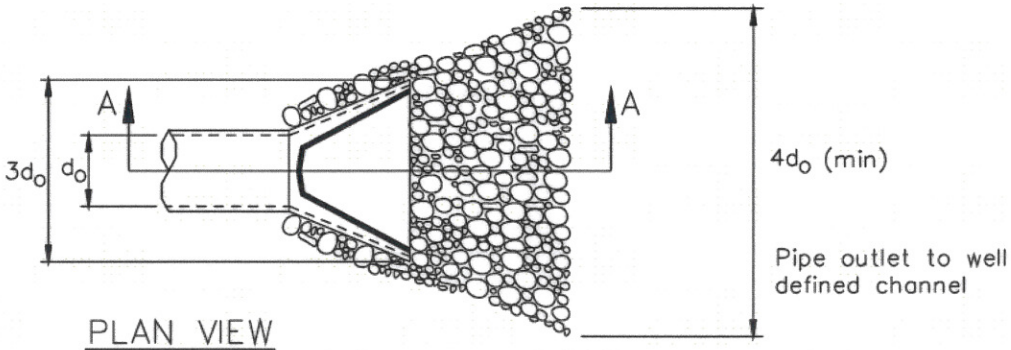
Handbook of Steel Drainage & Highway Construction, American Iron and Steel Institute, 1983.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

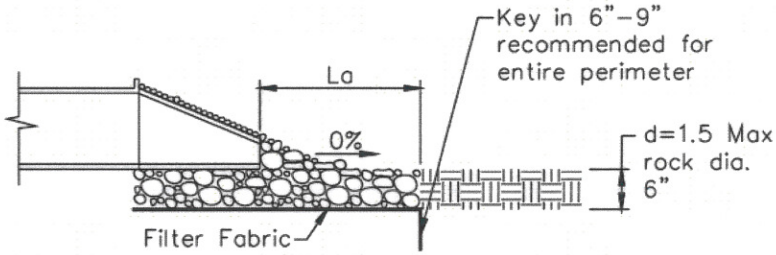
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, state of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



PLAN VIEW

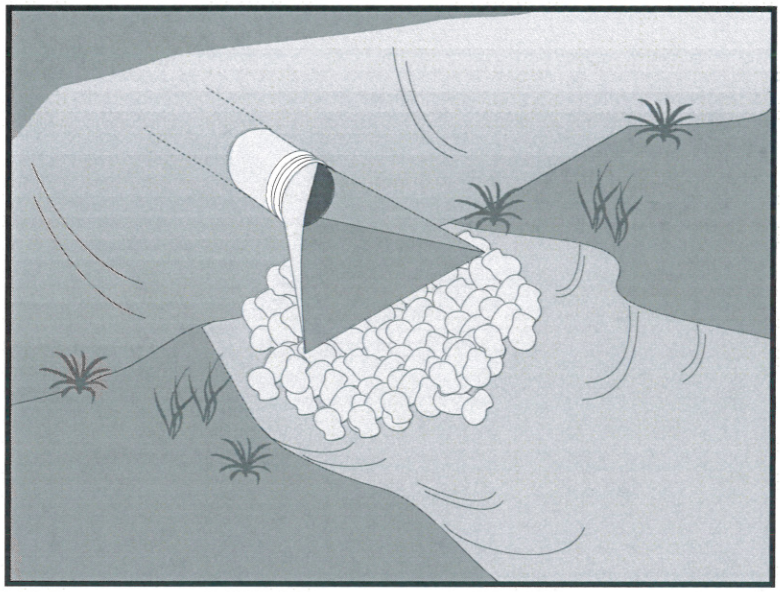


SECTION A–A

Pipe Diameter inches	Discharge ft³/s	Apron Length, La ft	Rip Rap D_{50} Diameter Min inches
12	5	10	4
	10	13	6
18	10	10	6
	20	16	8
	30	23	12
	40	26	16
24	30	16	8
	40	26	8
	50	26	12
	60	30	16

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS

Velocity Dissipation Devices EC-10



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in velocity dissipation devices.

Implementation

General

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

Design and Layout

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.

- Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.

- Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the D_{50} rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

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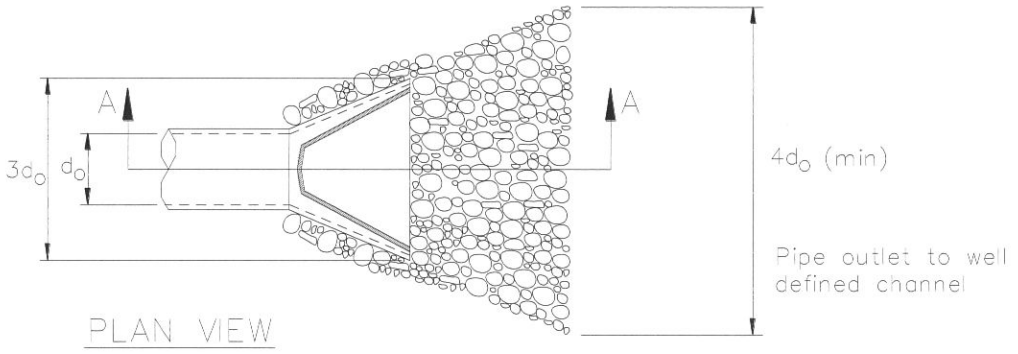
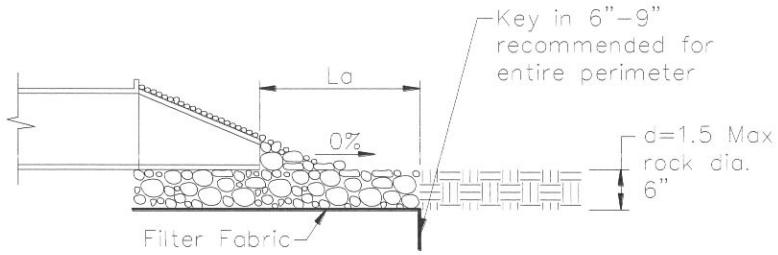


PLAN VIEW



SECTION A–A

Pipe Diameter inches	Discharge ft^3/s	Apron Length, La ft	Rip Rap D_{50} Diameter Min inches
12	5	10	4
	10	13	6
18	10	10	6
	20	16	8
	30	23	12
	40	26	16
24	30	16	8
	40	26	8
	50	26	12
	60	30	16

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS