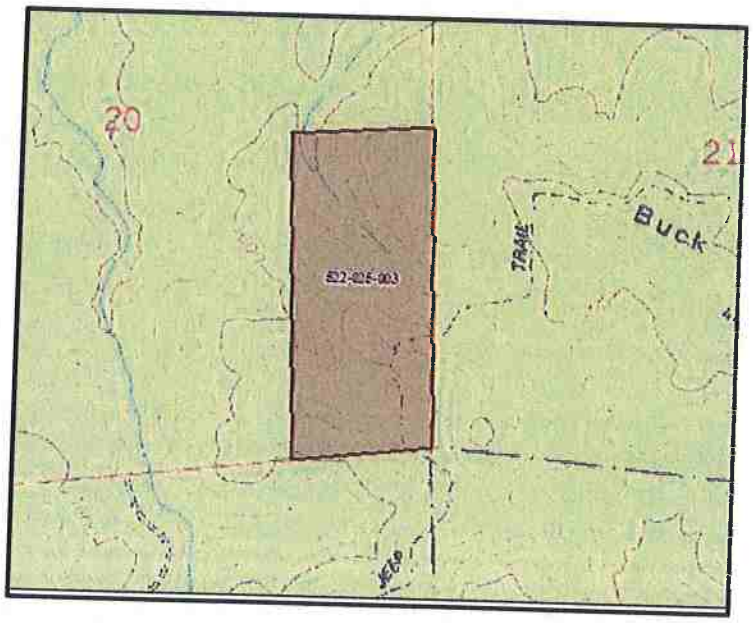
Restoration Plan and Documentation of Environmental Superiority

Three Creeks Farms LLC

APN 522-025-003

December, 2018



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Restoration Plan and Documentation of Environmental Superiority

Three Creeks Farms LLC (APN 522-025-003), Cultivation Area #5

Background

This Restoration Plan (RP) and Documentation of Environmental Superiority (DES) summarizes proposed corrective and restoration actions and an environmental assessment of two cultivation areas located on Humboldt County APN #522-025-003 located off New Three Creeks Road near Willow Creek, California, hereafter known as the "Project Site." This RP and DES has been requested by the Humboldt County Planning and Building Department (HCPBD) in response to a planning meeting with Mr. Steve Santos held on September 12, 2018 as part of the Humboldt County Cannabis permitting process. This RP and DES addresses proposed corrective actions and restoration work for an abandoned cannabis cultivation area and justification for previous relocation of cultivation to an environmentally superior cannabis cultivation area on the same parcel.

An initial site inspection was conducted on June 13, 2016 by PWA Certified Engineering Geologist Thomas H. Leroy and Staff Geologist Jack Skeahan to document current conditions at the landslide site, formerly known as Cultivation Area #5 (CA #5; see Figure 2). A second site inspection was conducted by PWA Staff Geologist Jack Skeahan on June 15, 2016 to document site conditions as relevant to the North Coast Regional Water Quality Control Board's (NCRWQCB) Waiver of Waste Discharge (WOWD) program. A third site inspection was conducted by PWA Staff Geologists Jack Skeahan and Michelle Robinson on August 22, 2018 to document and survey site conditions and relevant activities to develop a Lake or Streambed Alteration Agreement (LSAA) as required by the California Department of Fish and Wildlife (CDFW).

Figure 2 provides an overview of the Project Site and areas of interest. This map has been modified from the WOWD Water Resource Protection Plan (WRPP) Site Map previously developed for this Project Site. Attachment A - Photo Pages provides photo documentation of the areas of interest addressed in this RP. Attachment B provides typical Best Management Practices (BMPs) and PWA Typical Drawings proposed for implementation of short and long-term erosion control and revegetation measures as needed to mitigate fine-grained sediment generation and delivery to surface waters and the protection of water quality. Attachment C provides a Site Inspection and Monitoring Log Sheet to document site inspections, effectiveness of implemented treatments and photographs taken of the areas described below.

Proposed Corrective Actions and Erosion Control Practices to Remediate Cultivation Area #5

Cultivation Area #5 is composed of two relict spur roads, the lower of which may be an abandoned segment of New 3 Creeks Road as labeled on Google Earth, associated with historic logging activities which were conducted prior to the current landowner's ownership of the property. The short roads traverse the hillside for approximately 250 to 400 feet and are currently configured with a relatively flat to insloped geometry. The geometry of the lower road resulted in concentrated road runoff discharging near the terminal part of the road which, combined with sidecasting from road opening occurring between 2010 and 2012 (Photo 5-1A - 5-1B) and possible over-irrigation of potted cannabis plants, led to hillslope instability below the discharge point. The unstable hillside is manifest as a recent, relatively shallow debris slide with the head scarp exhibiting cracking and vertical displacement at the road edge, and hummocky debris slide deposits extending below the road for about 400 feet. It

appears that the debris slide terminated on the hillside without ever reaching or discharging to a watercourse. The original landslide occurred sometime between 2014 and 2016 (Photo 5-1C - 5-1D) and has since stabilized with significant vegetative regrowth within the slide body (Photos 2-5B and 2-5C). No significant slide movement appears to have occurred since it first failed. Also see Attachment A Photo 1-5A - 1-5C, Photo 2-5A - 2-5C, Photo 3-5A - 3-5C and Photo 4-5A. Aerial Photos 5-1A - 5-1D obtained from Google Earth Pro.

The proposed corrective actions and restoration activities to be taken at CA #5 include:

(1) Remove all cultivation-related materials and infrastructure from the cultivation area within close proximity to the failed outboard fillslope landslide and either reuse viable materials at other environmentally superior cultivation areas operated by Three Creeks Farms, LLC, or properly dispose of these materials at an appropriate waste disposal facility. These materials include, but may not be limited to, spent potting soil, pots, irrigation tubing and related components, irrigation timers, fencing materials, bamboo stakes, and other cultivation-related garbage and refuse (Photo 3-5A - 3-5C). If the portion of CA #5 located on the Project Site is determined to be stable and not an environmental threat to the watershed this area may be reused for cultivation following receipt of all applicable permits and if all regulatory requirements are met (Photo 4-5A). If cultivation activities at this location are proposed in the future any potting soil remaining at this location should be properly covered or have native cover crops planted over the wet season to contain any residual nutrients.

(2) If future cultivation activities are proposed at this location a Cross Road Drain (CRD) should be installed approximately 20-30 feet right of the right edge of the landslide to ensure no road surface runoff reaches the landslide.

(3) If future cultivation activities are not proposed at this location the existing road surfaces should be ripped to de-compact the road bed and CRDs should be installed at 50-75 foot intervals following the PWA Typical Drawings in Attachment B to disconnect any concentrated surface runoff, increase infiltration and direct any flow off the road bed and onto the heavily vegetated native hillslope.

(4) Regardless of whether cultivation activities resume at this location, if excessive hillslope or spring runoff is observed from the area upslope of the outboard fillslope landslide or at the base of the cutslope PWA recommends installation of an Inboard Ditch (IBD) to redirect this flow away from the landslide. The IBD should be installed along the base of the cutslope at the inboard edge of the road upslope of the outboard fillslope landslide. The IBD should begin directly left of the closest CRD to the landslide and extend along the base of the cutslope to the forested area at the southeast edge of the terminal landing. This IBD should be installed to collect and convey surface runoff from the cutslope and any area upslope of the outboard fillslope landslide away from the landslide and discharge into the heavily vegetated area to the southeast. The IBD will also need to be regularly monitored to ensure the flow pathway is functioning as intended and collected flow is not being obstructed.

(5) Install effective erosion control measures outlined below in the Erosion and Sediment Control Plan. These erosion control measures should be implemented following the approved RP, as recommended in the Water Resource Protection Plan (WRPP) developed by PWA and delivered to the landowner, and at any other locations as needed to sufficiently protect water quality, reduce erosion, contain fine-grained sediment and dewater the landing fillslope failure as much as possible.

(6) During and after restoration work, perform regular monitoring of all fillslopes, restoration activities, erosion control measures and revegetation areas along the roads in CA #5, as recommended in the Monitoring Plan below.
(7) Provide regular updates following the monitoring schedule below regarding implementation and completion of the tasks listed above to PWA and HCPBD staff to verify restoration treatments and erosion control measures are in place and functioning effectively.

Documentation of Environmental Superiority of Cultivation Area #4

Cultivation Area #4 on the same parcel (Figure 2) is an environmentally superior site compared to CA #5 (see Photos 4-4A and 4-4B). It is the preferred location for moving CA #5 cultivation activities for the following reasons:

- Cultivation Area #4 is located on a broad, stable ridge with abundant room for cultivation. No signs of outboard fillslope instability were observed at the time of the PWA site inspections at CA #4
- The slope of the graded pad at CA #4 is nearly flat while the road approach to the landing fillslope failure at CA #5 conveys surface flow to the steep, previously unstable outboard fillslope.
- Aside from the access road entering from the south (Access Road #6), there is a wide and heavily vegetated buffer around CA #4.
- No surface waters were observed in close proximity to CA #4 during PWA site inspections and the nearest documented watercourse is located approximately 400 feet to the southwest.
- The available area at CA #4 for cultivation is wider, longer and more uniform than the two tiered area at CA #5, which utilized two legacy logging road beds.
- Due to the wider, gentler and more uniform area at CA #4 available for cultivation, more efficient cultivation methods and less irrigation infrastructure may be needed at this location.
- The surrounding native hillslopes at CA #4 are of a shallower gradient than the areas around CA #5, leading to a very low likelihood of slope instability.
- Cultivation Area #4 is located close to a broad ridge nose and farther from surface waters than CA #5 which reduces the likelihood of potentially threatening or discharging sediment or runoff to surface waters. In contrast, the southeast edge of CA #5 is slightly over 200 feet away from a drainage swale which may contain an ephemeral watercourse.

Erosion and Sediment Control Plan

Heavy equipment restoration work on the Project Site will be conducted during dry weather periods during the summer/fall of 2019, when all work, erosion control, and site stabilization measures will be implemented prior to winter rainfall. Short-term erosion control measures (such as seeding, mulching, or installation of fiber rolls and silt fencing, if needed) will be utilized to reduce surface erosion of disturbed areas at CA #5. Long-term erosion control treatments will be implemented as needed based on site conditions and effectiveness of existing erosion control treatments. All of the short and long-term erosion control measures will be monitored on a regular basis (see schedule, below) for effectiveness and amended or replaced as needed to mitigate surface erosion and revegetate and stabilize disturbed areas.

Short-Term Erosion Control Measures - The following short-term erosion control measures will be implemented immediately after excavation activities have been completed:

Disturbed Areas - Surface erosion control Best Management Practices (BMPs) will be applied to all areas of disturbed soil to prevent surface erosion from rainfall impact and runoff. All bare mineral soil areas will be seeded with erosion control seed at the rate of 50lb/acre and mulched with rice straw or other weed-free straw at a rate of 4,000#/acre or using native-derived slash material to reduce surface erosion from rainfall. Application of rice straw and seed will be in conformance with Best Management Practice EC-6 of the 2009 California Stormwater BMP Handbook issued by the California Stormwater Quality Association (CASQA). A silt fence or fiber rolls (straw wattles) may be installed as needed along the downslope edge of the landing fillslope failure, at the outlet of the CRDs, or at any other areas as needed to intercept and contain any fine-grained sediment. Installation and spacing of fiber rolls, if and where they are needed, will be in conformance with Best Management Practice SE-5 of the 2009 California Stormwater BMP Handbook issued by the California Stormwater Quality Association (CASQA). In addition PWA recommends the planting of willow trees, if the soil holds enough water all year to sustain this species, or conifer and/or hardwood species at 5-10 foot spacing intervals on the excavated landing fillslope failure to improve dewatering of the landslide and increase root structure and slope stability.

Long-Term Erosion Control Measures - The following long-term erosion control measures will be implemented prior to the next wet season as needed:

Disturbed Areas - Surface erosion control BMPs will be reapplied as necessary to all areas of disturbed soil to prevent surface erosion from rainfall impact and runoff. Application of rice straw and seed will be in conformance with Best Management Practice EC-6 of the 2009 California Stormwater BMP Handbook issued by the California Stormwater Quality Association (CASQA). If decommissioning of the road beds at CA #5 is implemented the de-compacted road surface should be replanted with willows, native conifers and/or hardwoods to enhance restoration, improve slope stability and increase dewatering of these areas. Cross Road Drains should also be installed as described above on the decommissioned road beds to disconnect any concentrated road surface runoff. In addition the installation of the IBD along the base of the cutslope upslope of the outboard fillslope landslide will collect and convey surface runoff from the cutslope, the road bed upslope and any other areas that may flow to this area away from the landslide.

Note: Reapplication of short-term erosion control measures will be conducted as needed, based on the results of regular monitoring, and appropriate long-term erosion control measures will be implemented as necessary to mitigate sediment transport, enhance dewatering and protect water quality until the landslide area is stabilized or sufficiently revegetated.

Proposed Monitoring Plan

To assure protection of water quality and the effectiveness of restoration, erosion control, and revegetation techniques, a Monitoring Plan has been developed and will be implemented throughout 2018 and 2019, and ongoing as needed, to ensure the restored CA #5 landslide area is stable and is not a threat to surface waters. Monitoring will be conducted by approved representatives of Three Creeks Farms, LLC, under technical oversight by PWA. The areas where monitoring will be conducted (CA #5 upper and lower) are shown on the attached Site Map (Figure 2). In addition all areas requiring relocation and/or restoration work should be monitored as recommended in the WRPP. At a minimum the following locations will be monitored for performance of erosion control and water quality protection BMPs and to assure the erosion control BMPs are functioning as designed:

(1) The road beds at CA #5, the IBD once installed and any other disturbed areas at this location;

(2) The previously failed outboard fillslope material below the road bench;
(3) All seeded and mulched areas;
(4) All areas and features where revegetation areas or other short and/or long term erosion control techniques have been implemented; and
(5) Property wide observations will be performed to identify any location where soil erosion, nutrient or sediment delivery, or potential water quality impacts are occurring as discussed in the WRPP developed for this Project Site.

If any BMPs are not performing to expected standards (e.g. erosion control measures do not remain in place or do not contain or control erosion as designed and/or intended) or excessive erosion is observed, PWA will be informed and a qualified staff member will conduct a site visit, characterize the identified problem, and develop a plan of action to remediate the issue. Appendix C provides a Site Inspection and Monitoring Log Sheet can be used to document each site inspection with observations and photos. At a minimum, PWA personnel will be onsite to conduct an evaluation of the restoration, erosion control and revegetation work shortly after remediation is complete and may conduct additional site visits as needed to verify adequate performance of the above treatments and BMPs. In addition, PWA staff can be available to provide heavy equipment and implementation oversight and provide additional guidance on erosion control and revegetation measures.

Monitoring guidelines and reporting standards are modeled after the North Coast Regional Water Quality Control Board (NCRWQCB) Waiver of Waste Discharge (WOWD) Program. Monitoring of the Project Site includes visual inspection and photographic documentation of CA #5 and any additional potential sediment delivery areas as outlined in the WRPP developed for this Project Site, with new photographic documentation recorded with any notable changes to these areas.

Site inspection schedule – Periodic monitoring will include visual inspection of all restoration sites, including any management measures/practices needed to ensure they are being implemented correctly and are functioning as expected. Inspection methods include photographic documentation of any erosion and controllable sediment discharge sites and a visual inspection and documentation of those locations on the Project Site where runoff from roads or developed areas drains into or towards streams or wetlands.

At a minimum, CA #5 shall be inspected at the following times to ensure timely identification of changed site conditions and to determine whether implementation of additional management measures are necessary to prevent or minimize discharges of sediment to surface waters:

1) Before and after any significant alteration to the restoration site or any other controllable sediment discharge site. Inspection should include photographic documentation with photo records to be kept onsite as well as provided to PWA staff at regular intervals.
2) Prior to November 5th to evaluate restoration site preparedness for storm events and stormwater runoff.
3) Following the accumulation of 3 inches cumulative precipitation by November 15th, if this occurs.
4) Following any rainfall event with an intensity of 3 inches of precipitation in 24 hours. Precipitation data will be obtained from the National Weather Service at https://www.weather.gov/ by entering the Project Site zip code (or the nearest or most relevant zip code) and then the 3-day history showing precipitation totals will be analyzed.

Note: Site inspections following the schedule listed above may not be possible as the Project Site experiences snowfall during the winter months which limits access. In addition vehicle travel during the wet season on the roadways leading into the Project Site may lead to degradation of the road surface and the potential for increased sediment mobilization and delivery. As the landing fillslope failure at CA #5 has a relatively low potential for future sediment delivery and additional negative impacts on the environment, monitoring of this area prior to, during (as feasible) and following the wet season should be sufficient to ensure any winterization measures are in place and functioning effectively.

Conclusions

The concerns brought forth by the HCPBD will be addressed in this RP and erosion control and revegetation plan. Thank you for the opportunity to assist with remediating potential water quality impact on the Project Site. If you have any questions and/or concerns, please contact Tom Leroy or Jack Skeahan at (707) 839-5130.

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Figures:
Figure 1 - Location Map
Figure 2 - Site Map

Attachments:
Attachment A - Photo Pages
Attachment B - Erosion Control Measures/BMPs and Typical Drawings
Attachment C - Site Inspection and Monitoring Log Sheet

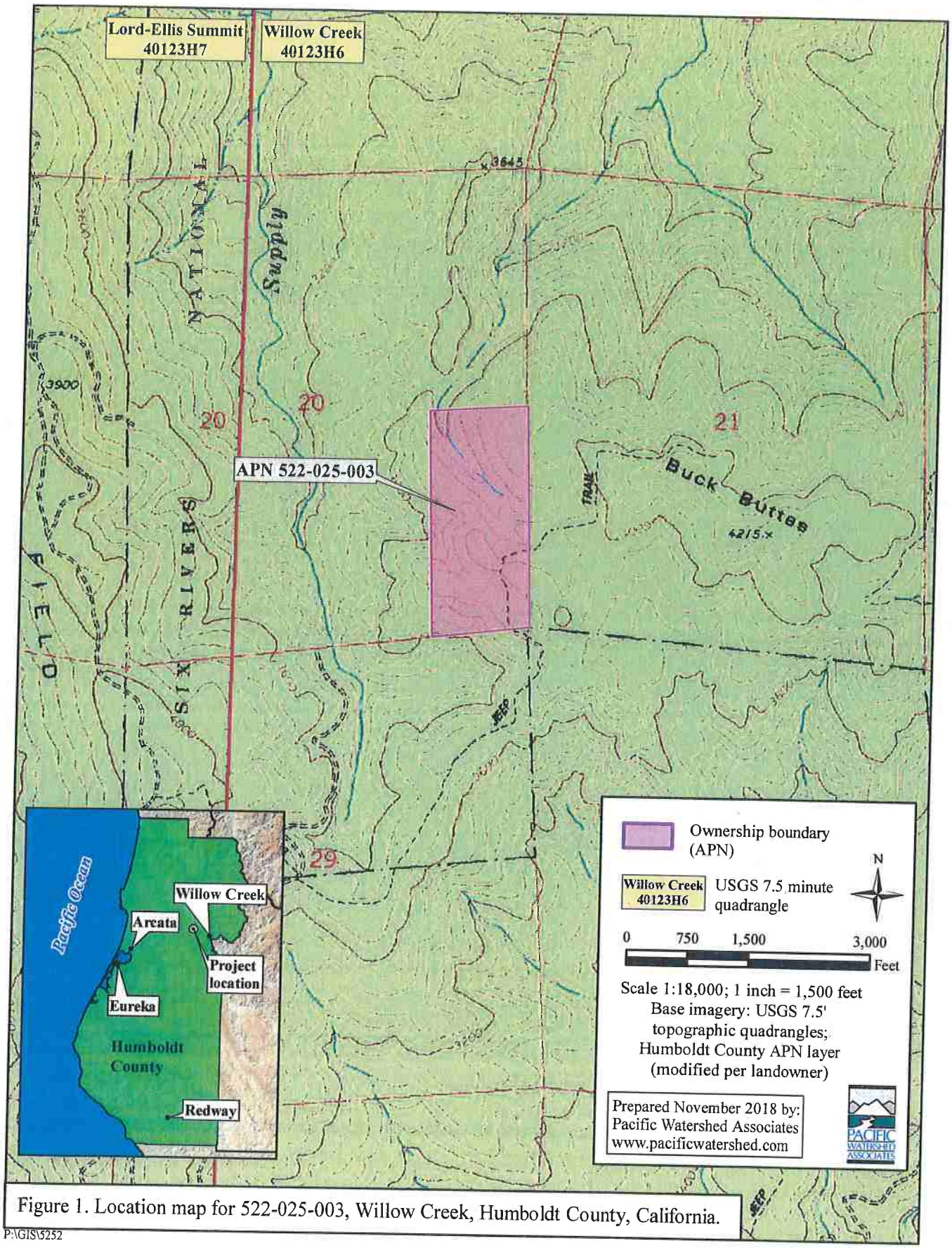

Figure 1. Location map for 522-025-003, Willow Creek, Humboldt County, California.

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Attachment A

Photo Pages

Three Creeks Farms LLC
APN 522-025-003

Cultivation Area #5 - Outboard fillslope failure

Photo 1-5A: Outboard landing fillslope failure looking southeast from the right edge of head scarp. (Photo taken June 13, 2016).

Photo 1-5B: Outboard landing fillslope failure looking northwest from the left edge of head scarp. (Photo taken June 13, 2016).

Photo 1-5C: Outboard landing fillslope failure looking downslope from near the center of feature. (Photo taken June 13, 2016).

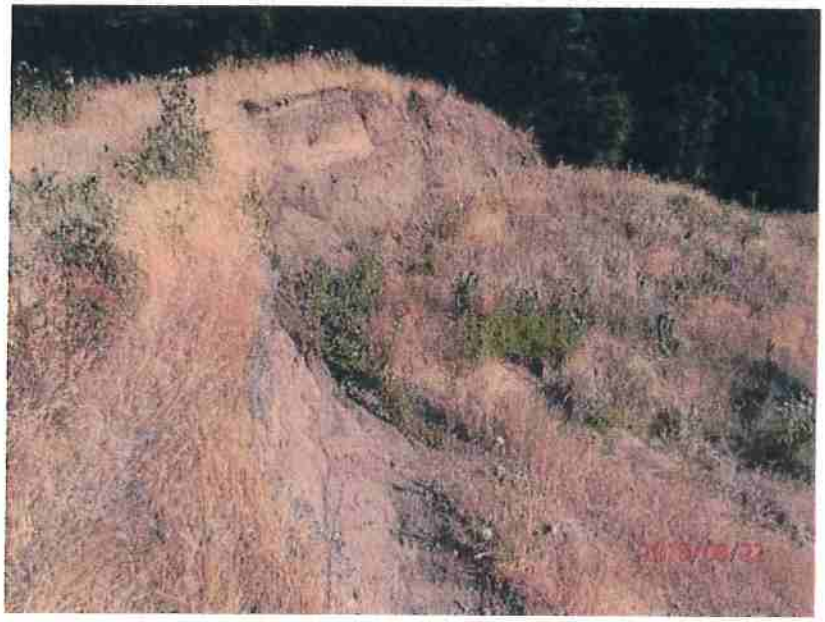


Photo 2-5A: Outboard landing fillslope failure looking southeast from the right edge of head scarp. Note natural revegetation of bare soil areas as compared to 2016 photos. (Photo taken August 22, 2018).

Photo 2-5B: Outboard landing fillslope failure looking southeast from the right edge of landslide head scarp.
(Photo taken August 22, 2018).

Photo 2-5C: Outboard landing fillslope failure looking downslope from near the right center of feature. Note natural revegetation of bare soil areas as compared to 2016 photos.
(Photo taken August 22, 2018).

Cultivation Area #5 - Cultivation-related materials

Photo 3-5A: Spent potting soil and cultivation-related materials located at Cultivation Area #5 (CA #5). View is from the right road approach looking southeast toward the outboard fillslope landslide. (Photo taken June 13, 2016)

Photo 3-5B: Spent potting soil and cultivation-related materials located at Cultivation Area #5 (CA #5). View is from the right road approach looking southeast toward the outboard fillslope landslide. The proposed inboard ditch (IBD) will be installed along the base of the cutbank (left side of the frame). (Photo taken June 13, 2016)

Photo 3-5C: Potting soil and cultivation-related materials located at CA #5. View is from the left edge of the landslide head scarp looking up the right road approach.
(Photo taken June 13, 2016)

Cultivation Area #5 - Previous cultivation area

Photo 4-5A: View of the northern portion of the lower road bench at CA #5 looking south in the direction of the outboard fillslope failure (not shown) from the intersection with Access Road #8.
(Photo taken June 13, 2016)

Cultivation Area #4 - Environmentally superior cultivation location

Photo 4-4A: View of the environmentally superior cultivation location at CA #4 looking north from the southern edge of the landing. Note the low gradient and mostly uniform cultivation area and vegetated boundaries at this location.
(Photo taken June 13, 2016)

Photo 4-4B: View of the environmentally superior cultivation location at CA #4 looking slightly upslope from the southeast corner of the landing.
(Photo taken June 13, 2016)

Photo 5-1A: 2010 Google Earth aerial imagery pre-road opening.

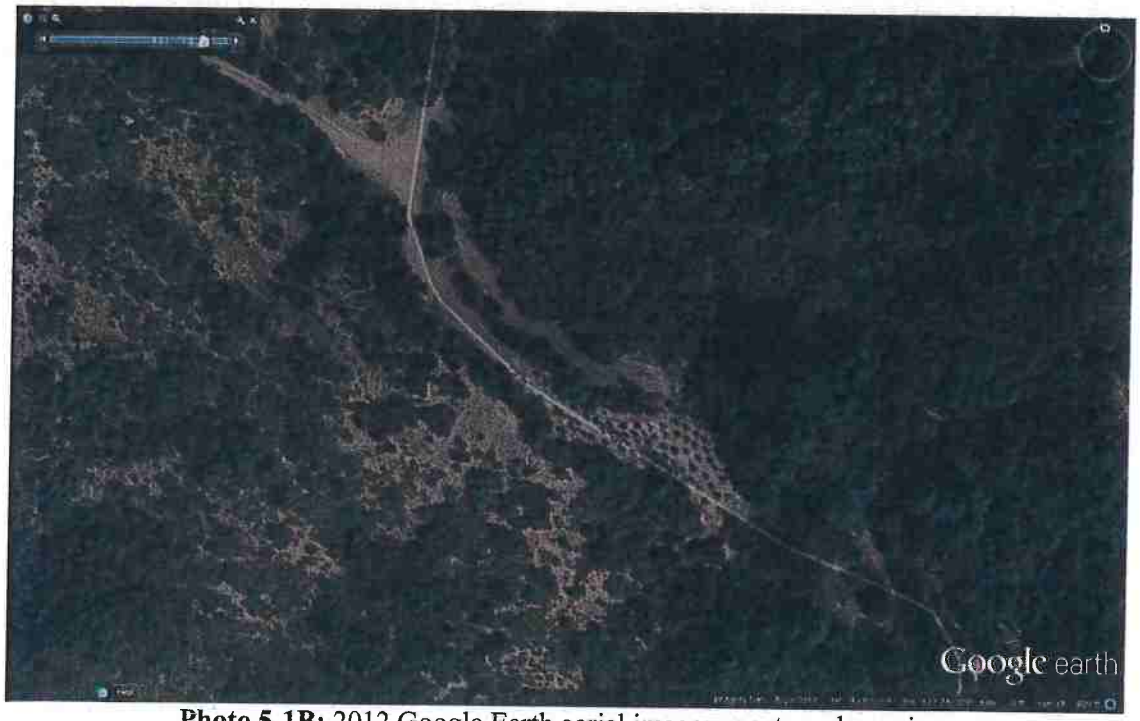


Photo 5-1B: 2012 Google Earth aerial imagery post-road opening.

Photo 5-1C: 2014 Google Earth aerial imagery pre-outboard landing fillslope failure.

Photo 5-1D: 2014 Google Earth aerial imagery post-outboard landing fillslope failure.

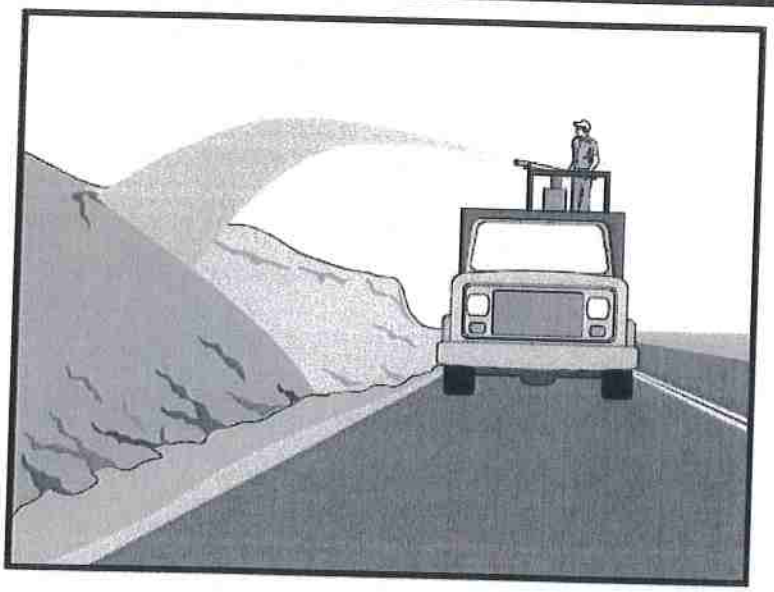
Attachment B

Erosion Control Measures and Typical Drawings

Three Creeks Farms LLC
APN 522-025-003

Straw Mulch

EC-6



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 Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-5 Soil Binders
EC-7 Geotextiles and Mats
EC-8 Wood Mulching
EC-14 Compost Blanket

Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or crimper, or anchoring it with a tackifier or stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

Suitable Applications

Straw mulch is suitable for disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch can be specified for the following applications:

- As a stand-alone BMP on disturbed areas until soils can be prepared for permanent vegetation. The longevity of straw mulch is typically less than six months.
- Applied in combination with temporary seeding strategies
- Applied in combination with permanent seeding strategies to enhance plant establishment and final soil stabilization
- Applied around containerized plantings to control erosion until the plants become established to provide permanent stabilization

Limitations

- Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.

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- There is a potential for introduction of weed seed and unwanted plant material if weed-free agricultural straw is not specified.
- Straw mulch applied by hand is more time intensive and potentially costly.
- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.
- Potential fugitive dust control issues associated with straw applications can occur. Application of a stabilizing emulsion or a water stream at the same time straw is being blown can reduce this problem.
- Use of plastic netting should be avoided in areas where wildlife may be entrapped and may be prohibited for projects in certain areas with sensitive wildlife species, especially reptiles and amphibians.

Implementation

- Straw should be derived from weed-free wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw should be used.
- Use tackifier to anchor straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking can be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier should not be applied during or immediately before rainfall.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Application Procedures

- When using a tackifier to anchor the straw mulch, roughen embankment or fill areas by rolling with a crimping or punching-type roller or by track walking before placing the straw mulch. Track walking should only be used where rolling is impractical.
- Apply straw at a rate of between 3,000 and 4,000 lb/acre, either by machine or by hand distribution and provide 100% ground cover. A lighter application is used for flat surfaces and a heavier application is used for slopes.
- Evenly distribute straw mulch on the soil surface.
- Anchoring straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating) can be used in lieu of a tackifier.

- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.
  - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier should be selected based on longevity and ability to hold the fibers in place. A tackifier is typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.
  - On very small areas, a spade or shovel can be used to punch in straw mulch.
  - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper."

Costs

Average annual cost for installation and maintenance is included in the table below. Application by hand is more time intensive and potentially more costly.

BMP	Unit Cost per Acre
Straw mulch, crimped or punched	$2,458-$5,375
Straw mulch with tackifier	$1,823-$4,802

Source: Caltrans Soil Stabilization BMP Research for Erosion and Sediment Controls, July 2007

Inspection and Maintenance

- BMPs must be inspected 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.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives. Straw mulch as a stand-alone BMP is temporary and is not suited for long-term erosion control.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

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

Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

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.

Non-Vegetative Stabilization EC-16

Categories		
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 Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

Non-vegetative stabilization methods are used for temporary or permanent stabilization of areas prone to erosion and should be used only where vegetative options are not feasible; examples include:

- Areas of vehicular or pedestrian traffic such as roads or paths;
- Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
- Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
- Areas where vegetation will not grow adequately within the construction time frame.

There are several non-vegetative stabilization methods and selection should be based on site-specific conditions.

Decomposed Granite (DG) is a permanent erosion protection method that consists of a layer of stabilized decomposed granite placed over an erodible surface.

Degradable Mulches of various types (see EC-3, EC-6, EC-8) can be used for temporary non-vegetative stabilization; examples include straw mulch, compost, wood chips or hydraulic mulch.

Geotextiles and Mats can be used for temporary non-vegetative stabilization (see EC-7). These BMPs are typically manufactured

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from degradable or synthetic materials and are designed and specified based on their functional longevity, i.e., how long they will persist and provide erosion protection. All geotextiles and mats should be replaced when they exceed their functional longevity or when permanent stabilization methods are instituted.

Gravel Mulch is a non-degradable erosion control product that is composed of washed and screened coarse to very coarse gravel, 16 mm to 64 mm (0.6" - 2.5"), similar to an AASHTO No. 3 coarse aggregate.

Rock Slope Protection consists of utilizing large rock or rip-rap (4"- 24") to stabilize slopes with a high erosion potential and those subject to scour along waterways.

Soil Binders can be used for temporary non-vegetative stabilization (see EC-5). The key to their use is functional longevity. In most cases, the soil binder will need to be routinely monitored and re-applied to maintain an erosion-resistant coverage.

Suitable Applications

Non-vegetated stabilization methods are suitable for use on disturbed soil areas and on material stockpiles that need to be temporarily or permanently protected from erosion by water and wind. Non-vegetated stabilization should only be utilized when vegetation cannot be established in the required timeframe, due to soil or climactic conditions, or where vegetation may be a potential fire hazard.

Decomposed Granite (DG) and Gravel Mulch are suitable for use in areas where vegetation establishment is difficult, on flat surfaces, trails and pathways, and when used in conjunction with a stabilizer or tackifier, on shallow slopes (i.e., 10:1 [H:V]). DG and gravel can also be used on shallow rocky slopes where vegetation cannot be established for permanent erosion control.

Degradable Mulches can be used to cover and protect soil surfaces from erosion both in temporary and permanent applications. In many cases, the use of mulches by themselves requires routine inspection and re-application. See EC-3 Hydraulic Mulch, EC-6 Straw Mulch, EC-8 Wood Mulch, or EC-14 Compost Blankets for more information.

Geotextiles and Mats can be used as a temporary stand-alone soil stabilization method. Depending on material selection, geotextiles and mats can be a short-term (3 mos – 1 year) or long-term (1-2 years) temporary stabilization method. For more information on geotextiles and mats see EC-7 Geotextiles and Mats.

Rock Slope Protection can be used when the slopes are subject to scour or have a high erosion potential, such as slopes adjacent to flowing waterways or slopes subject to overflow from detention facilities (spillways).

Soil Binders can be used for temporary stabilization of stockpiles and disturbed areas not subject to heavy traffic. See EC-5 Soil Binders for more information.

Limitations

General

- Refer to EC-3, EC-6, EC-8, and EC-14 for limitations on use of mulches. Refer to EC-7 for limitations on use of geotextiles and mats. Refer to EC-5 for limitations on use of Soil Binders.

Decomposed Granite

- Not available in some geographic regions.
- If not tackified, material may be susceptible to erosion even on slight slopes (e.g., 30:1 [H:V]).
- Installed costs may be more expensive than vegetative stabilization methods.

Gravel Mulch

- Availability is limited in some geographic regions.
- If not properly screened and washed, can contain fine material that can erode and/or create dust problems.
- If inadequately sized, material may be susceptible to erosion on sloped areas.
- Pore spaces fill with dirt and debris over time; may provide a growing medium for weeds.

Rock Slope Protection

- Installation is labor intensive.
- Installed costs can be significantly higher than vegetative stabilization methods.
- Rounded stones may not be used on slopes greater than 2:1 [H:V].

Implementation

General

Non-vegetated stabilization should be used in accordance with the following general guidance:

- Should be used in conjunction with other BMPs, including drainage, erosion controls and sediment controls.
- Refer to EC-3, EC-6, EC-8, and EC-14 for implementation details for mulches. Refer to EC-7 for implementation details for geotextiles and mats. Refer to EC-5 for implementation details for soil binders.
- Non-vegetated stabilization measures should be implemented as soon as the disturbance in the areas they are intended to protect has ceased.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Decomposed Granite Stabilization

- If used for a road or path should be installed on a prepared base.

- Should be mixed with a stabilizer if used for roads or pathways, or on slope applications.
- Though porous it is recommended to prevent standing water on or next to a decomposed granite road or pathway.

Gravel Mulch

- Should be sized based on slope, rainfall, and upgradient run-on conditions. Stone size should be increased as potential for erosion increases (steeper slopes, high intensity rainfall).
- If permanent, a weed control fabric should be placed prior to installation.
- Should be installed at a minimum 2" depth.
- Should completely cover all exposed surfaces.

Rock Slope Protection

- Rock slope protection installation should follow Caltrans Standard Specification 72-2: Rock Slope Protection. Refer to the specification for rock conformity requirements and installation methods.
- When using rock slope protection, rock size and installation method should be specified by an Engineer.
- A geotextile fabric should be placed prior to installation.

Costs

- Costs are highly variable depending not only on technique chosen, but also on materials chosen within specific techniques. In addition, availability of certain materials will vary by region/location, which will also affect the cost. Costs of mulches, geotextiles and mats, and soil binders are presented in their respective fact sheets. Costs for decomposed granite, gravel mulch stabilization and rock slope protection may be higher depending on location and availability of materials. Caltrans has provided an estimate for gravel mulch of \$10 - \$15/yd^2 in flat areas and \$11 - \$23/yd^2 on side slopes.

Inspection and Maintenance

General

- BMPs must be inspected 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.
- For permanent installation, require inspection periodically and after major storm events to look for signs of erosion or damage to the stabilization.
- All damage should be repaired immediately.
- Refer to EC-3, EC-6, EC-8, and EC-14 for inspection and maintenance requirements for mulches. Refer to EC-7 for inspection and maintenance requirements for geotextiles and mats. Refer to EC-5 for inspection and maintenance requirements for soil binders.

Decomposed Granite and Gravel Mulch Stabilization

- Rake out and add decomposed granite or gravel as needed to areas subject to rill erosion. Inspect upgradient drainage controls and repair/modify as necessary.
- Should remain stable under loose surface material. Any significant problem areas should be repaired to restore uniformity to the installation.

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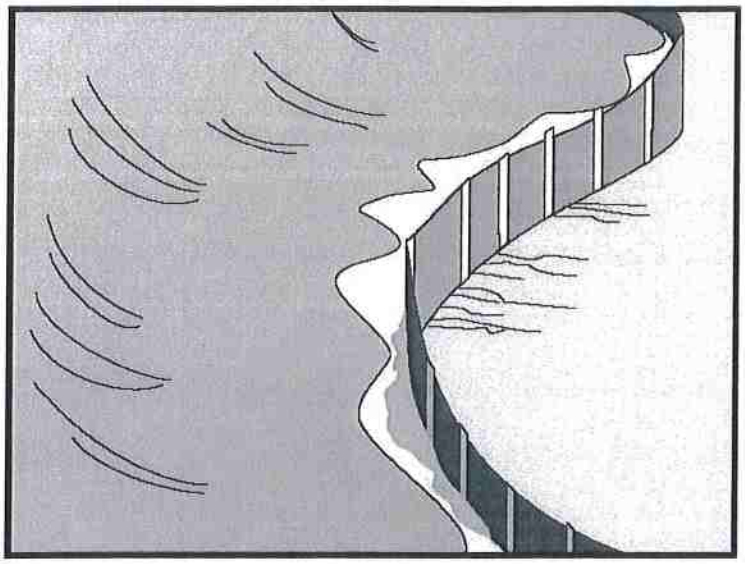
Silt Fence SE-1



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 Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier
SE-10 Storm Drain Inlet Protection
SE-14 Biofilter Bags

Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (SE-10). Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

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Silt Fence SE-1

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard. Runoff typically ponds temporarily on the upstream side of silt fence.
- Do not use silt fence to divert water flows or place across any contour line. Fences not constructed on a level contour, or fences used to divert flow will concentrate flows resulting in additional erosion and possibly overtopping or failure of the silt fence.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Not effective unless trenched and keyed in.
- Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.
- The maximum slope perpendicular to the fence line should be 1:1.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.

- Silt fences should remain in place until the disturbed area is permanently stabilized, after which, the silt fence should be removed and properly disposed.
- Silt fence should be used in combination with erosion source controls up slope in order to provide the most effective sediment control.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Woven geotextile material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the slope of area draining to the silt fence is 4:1 (H:V) or less.
- Used for shorter durations, typically 5 months or less
- Area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Use is generally limited to 8 months or less.
- Area draining to fence produces moderate sediment loads.
- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
  - Fence fabric has higher tensile strength.
  - Fabric is reinforced with wire backing or additional support.
  - Posts are spaced closer than pre-manufactured, standard silt fence products.
  - Posts are metal (steel or aluminum)

Materials

Standard Silt Fence

- Silt fence material should be woven geotextile with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The

reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 sec^{-1} and 0.15 sec^{-1} in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts or bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement for health and safety purposes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench.

- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.

- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with native material and compacted.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where, due to specific site conditions, a 3 ft setback is not available, the silt fence may be constructed at the

toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and more difficult to maintain.

- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of $^1/_3$ and a maximum of ½ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the gerotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
    - Ease of installation (most often done with a 2 person crew). In addition, installation using static slicing has been found to be more efficient on slopes, in rocky soils, and in saturated soils.
    - Minimal soil disturbance.
    - Greater level of compaction along fence, leading to higher performance (i.e. greater sediment retention).
    - Uniform installation.
    - Less susceptible to undercutting/undermining.

Costs

- It should be noted that costs vary greatly across regions due to available supplies and labor costs.
- Average annual cost for installation using the traditional silt fence installation method (assumes 6 month useful life) is $7 per linear foot based on vendor research. Range of cost is $3.50 - $9.10 per linear foot.
- In tests, the slicing method required 0.33 man hours per 100 linear feet, while the trenched based systems required as much as 1.01 man hours per linear foot.

Inspection and Maintenance

- BMPs must be inspected 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.
- Repair undercut silt fences.

- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.
- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

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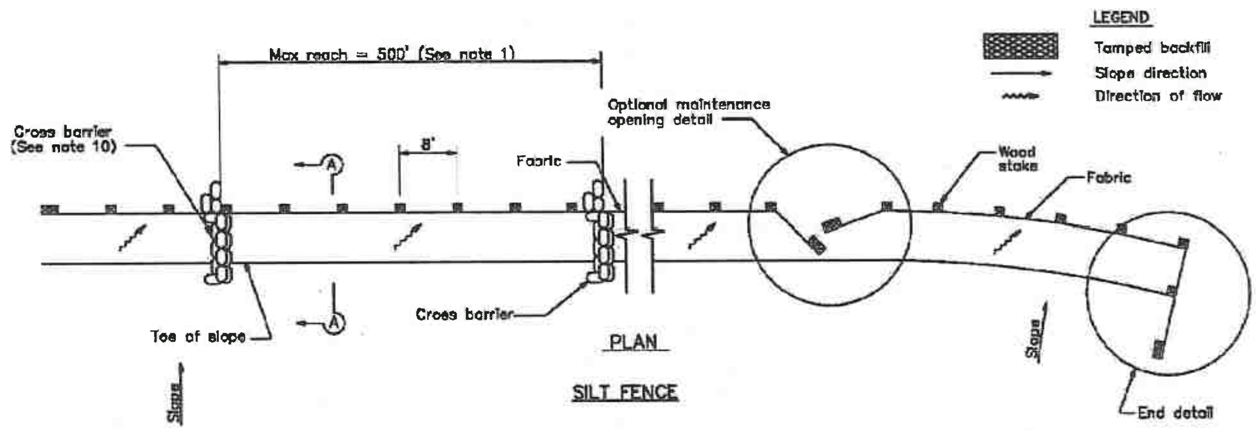
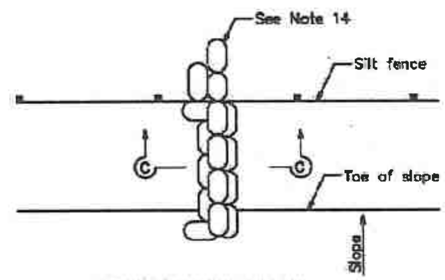
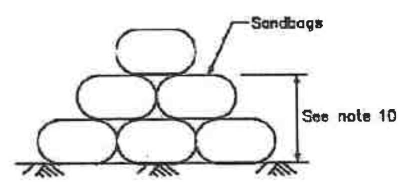


PLAN

SILT FENCE



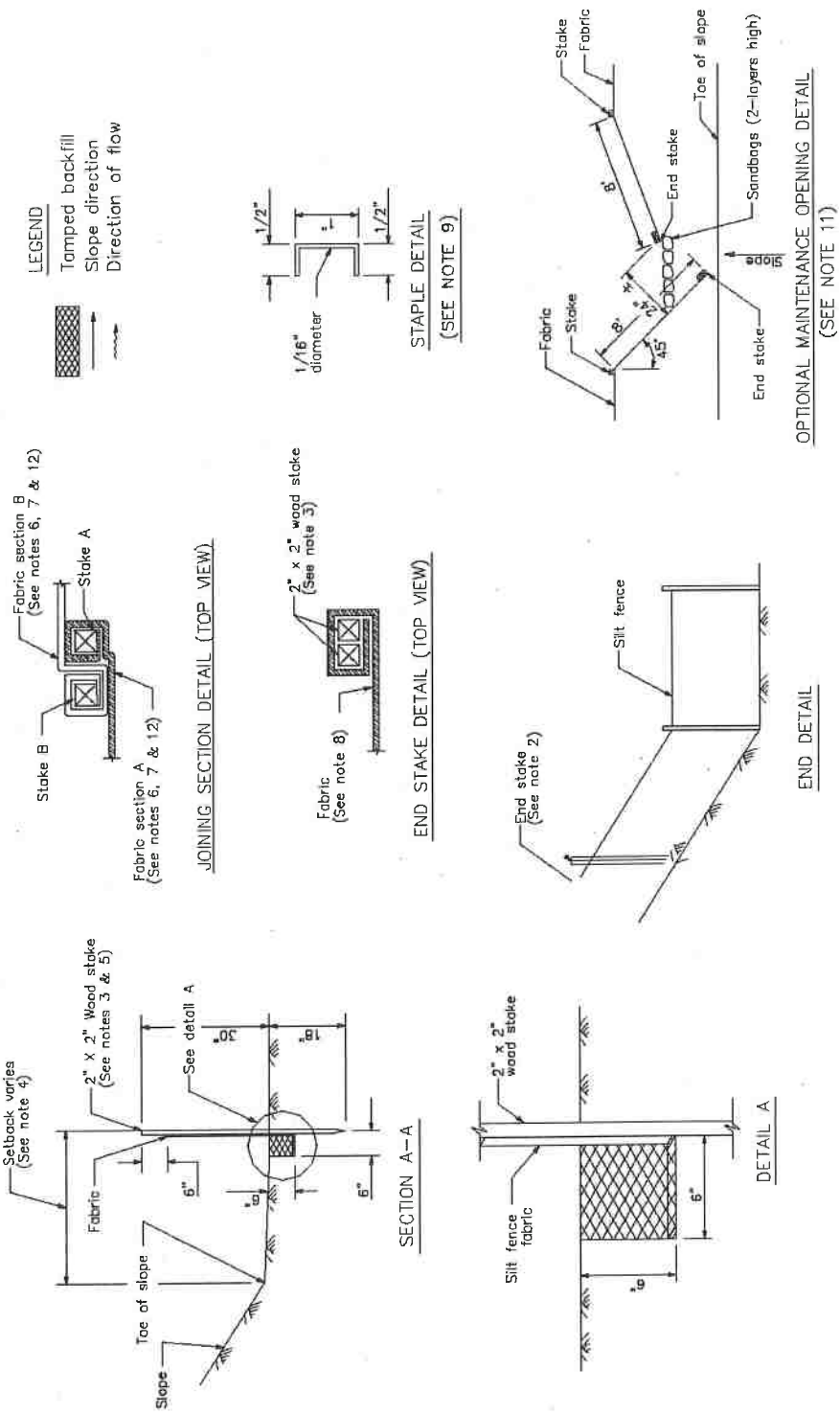
CROSS BARRIER DETAIL



SECTION C–C

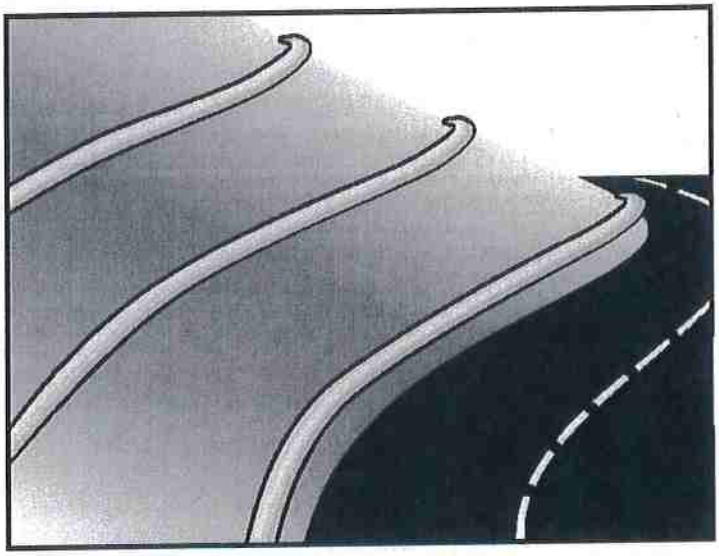
NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow–through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3–4 bags to cross barrier on downgradient side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.


LEGEND
Tamped backfill
Slope direction
Direction of flow
1/2"
1"
1/2"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
8"
End stake
Toe of slope
Sandbags (2-layers high)
Slope
Fabric
Stake
8"
4"
12"
45°
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Fabric section B
(See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A
(See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake
(See note 3)
Fabric
(See note 8)
END STAKE DETAIL (TOP VIEW)
Silt fence
End stake
(See note 2)
END DETAIL
Setback varies
(See note 4)
2" X 2" Wood stake
(See notes 3 & 5)
See detail A
30"
18"
Fabric
6"
6"
6"
Toe of slope
Slope
SECTION A-A
2" x 2"
wood stake
Silt fence
fabric
6"
6"
DETAIL A

Fiber Rolls

SE-5



Description and Purpose

A fiber roll consists of straw, coir, or other biodegradable materials bound into a tight tubular roll wrapped by netting, which can be photodegradable or natural. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight when staking the rolls are not feasible (such as use as inlet protection). When fiber rolls are placed at the toe and on the face of slopes along the contours, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.
- At operational storm drains as a form of inlet protection.

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 Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

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- Around temporary stockpiles.

Limitations

- Fiber rolls are not effective unless trenched in and staked.
- Not intended for use in high flow situations.
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.
- Rolls typically function for 12-24 months depending upon local conditions.

Implementation

Fiber Roll Materials

- Fiber rolls should be prefabricated.
- Fiber rolls may come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll. Fiber rolls impregnated with PAM provide additional sediment removal capabilities and should be used in areas with fine, clayey or silty soils to provide additional sediment removal capabilities. Monitoring may be required for these installations.
- Fiber rolls are made from weed free rice straw, flax, or a similar agricultural material bound into a tight tubular roll by netting.
- Typical fiber rolls vary in diameter from 9 in. to 20 in. Larger diameter rolls are available as well.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth should be ¼ to 1/3 of the thickness of the roll, and the width should equal the roll diameter, in order to provide area to backfill the trench.

- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- It is recommended that pilot holes be driven through the fiber roll. Use a straight bar to drive holes through the roll and into the soil for the wooden stakes.
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into the trench.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.
- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or removed depending on the type of fiber roll and application (temporary vs. permanent installation). Typically, fiber rolls encased with plastic netting are used for a temporary application because the netting does not biodegrade. Fiber rolls used in a permanent application are typically encased with a biodegradeable material and are left in place. Removal of a fiber roll used in a permanent application can result in greater disturbance.
- Temporary installations should only be removed when up gradient areas are stabilized per General Permit requirements, and/or pollutant sources no longer present a hazard. But, they should also be removed before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.

Costs

Material costs for regular fiber rolls range from $20 - $30 per 25 ft roll.

Material costs for PAM impregnated fiber rolls range between 7.00-$9.00 per linear foot, based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected 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.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP should be periodically removed

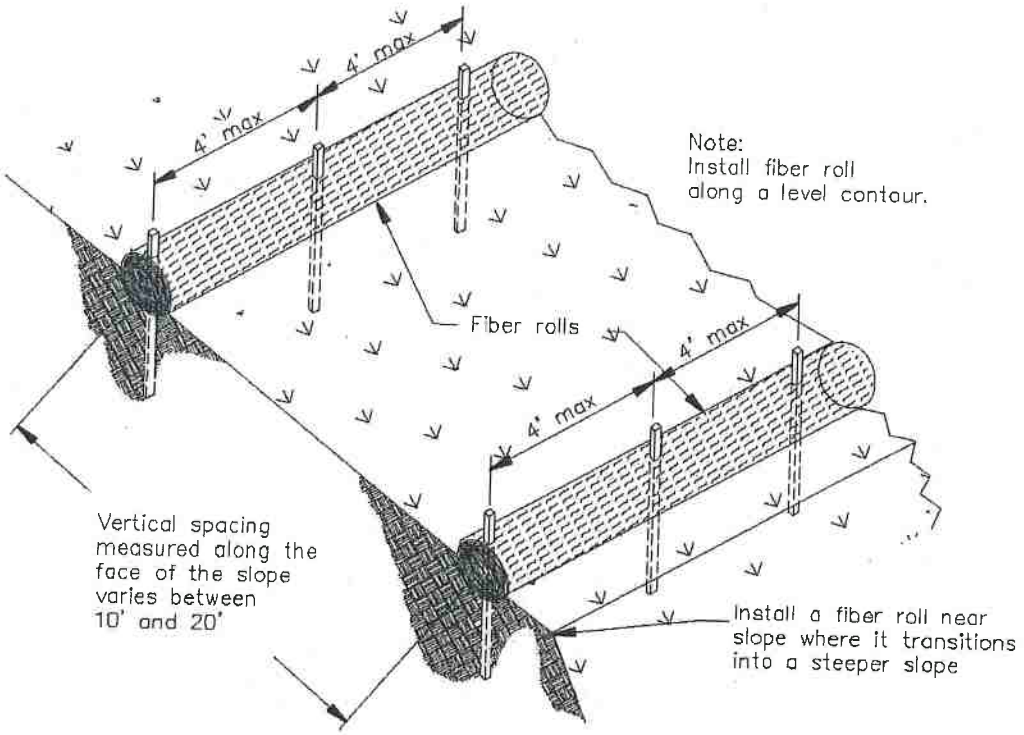
in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-third the designated sediment storage depth.

- If fiber rolls are used for erosion control, such as in a check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.
- Repair any rills or gullies promptly.

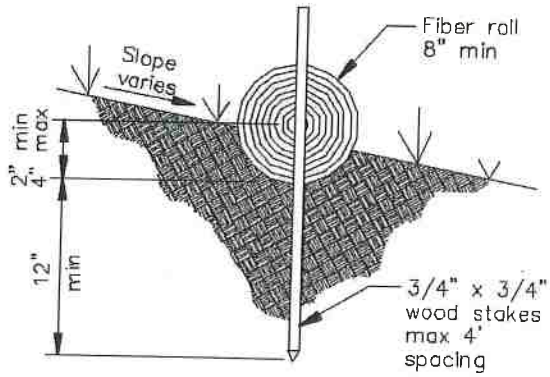
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

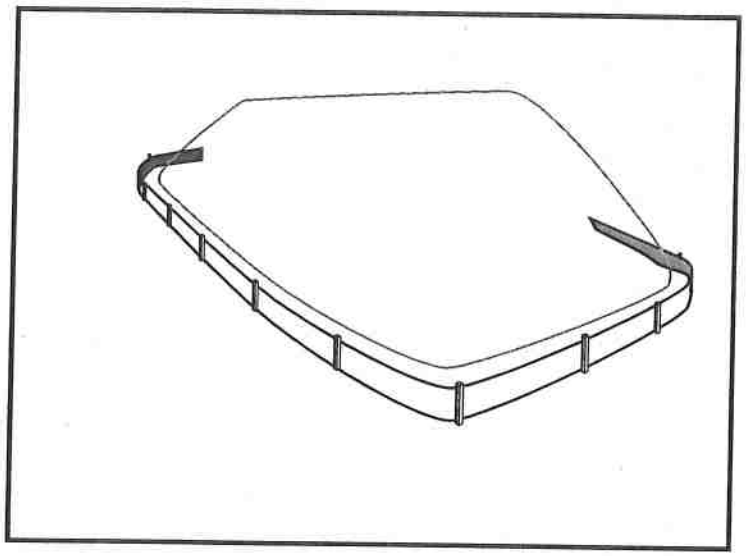


TYPICAL FIBER ROLL INSTALLATION
N.T.S.



ENTRENCHMENT DETAIL
N.T.S.

Stockpile Management WM-3



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 Category**
☒ **Secondary Category**

Description and Purpose

Stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, soil amendments, sand, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Suitable Applications

Implement in all projects that stockpile soil and other loose materials.

Potential Alternatives

None

Limitations

- Plastic sheeting as a stockpile protection is temporary and hard to manage in windy conditions. Where plastic is used, consider use of plastic tarps with nylon reinforcement which may be more durable than standard sheeting.
- Plastic sheeting can increase runoff volume due to lack of infiltration and potentially cause perimeter control failure.
- Plastic sheeting breaks down faster in sunlight.
- The use of plastic materials should be avoided when feasible and photodegradable plastics should not be used.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- On larger sites, a minimum of 50 ft separation from concentrated flows of stormwater, drainage courses, and inlets is recommended.
- All stockpiles are required to be protected immediately if they are not scheduled to be used within 14 days.
- Protect all stockpiles from stormwater run-on using temporary perimeter sediment barriers such as compost berms (SE-13), temporary silt dikes (SE-12), fiber rolls (SE-5), silt fences (SE-1), sandbags (SE-8), gravel bags (SE-6), or biofilter bags (SE-14). Refer to the individual fact sheet for each of these controls for installation information.
- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.
- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Some plastic covers withstand weather and sunlight better than others. Select cover materials or methods based on anticipated duration of use.

Protection of Non-Active Stockpiles

Non-active stockpiles of the identified materials should be protected further as follows:

Soil stockpiles

- Cover and project soil stockpiles with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- Consider temporary vegetation for topsoil piles that will be stockpiled for extended periods.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- Provide covers and protect these stockpiles with a temporary perimeter sediment barrier at all times.

Stockpiles of "cold mix"

- Cover cold mix stockpiles and place them on plastic sheeting (or comparable material) and surround the stockpiles with a berm all times.

Stockpiles of fly ash, stucco, hydrated lime

- Cover stockpiles of materials that may raise the pH of runoff (i.e., basic materials) with plastic and surround the stockpiles with a berm at all times.

Stockpiles/Storage of wood (Pressure treated with chromated copper arsenate or ammoniacal copper zinc arsenate)

- Cover treated wood with plastic sheeting (or comparable material) and surround with a berm at all times.

Protection of Active Stockpiles

Active stockpiles of the identified materials should be protected as follows:

- All stockpiles should be covered and protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" and treated wood, and basic materials should be placed on and covered with plastic sheeting or comparable material and surrounded by a berm prior to the onset of precipitation.
- The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm and runoff should be diverted around or away from the stockpile on the upstream perimeter.

Costs

For cost information associated with stockpile protection refer to the individual erosion or sediment control BMP fact sheet considered for implementation (For example, refer to SE-1 Silt Fence for installation of silt fence around the perimeter of a stockpile.)

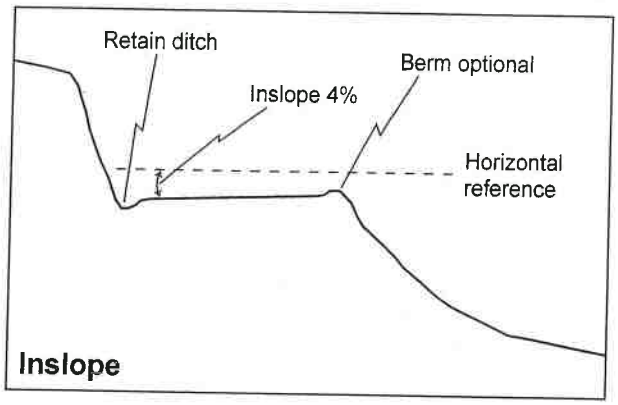
Inspection and Maintenance

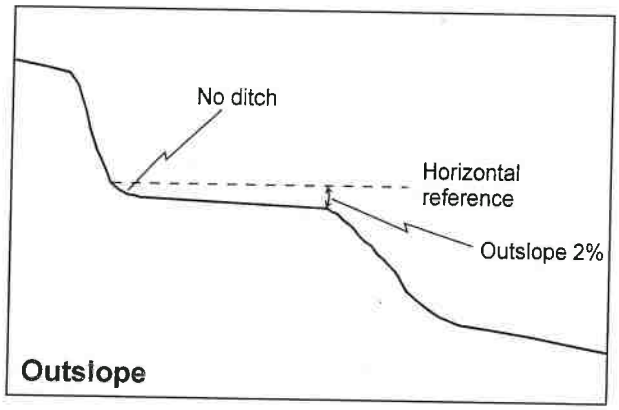
- Stockpiles must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during certain conditions (for example, high winds or extreme heat).
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.
- Sediment shall be removed when it reaches one-third of the barrier height.

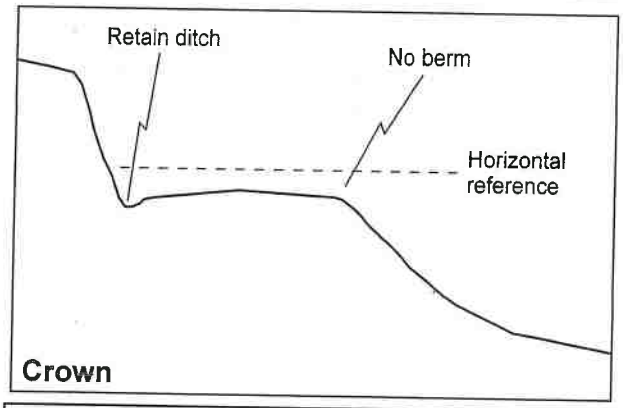
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Typical Designs for Using Road Shape to Control Road Runoff







Outsloping Pitch for Roads Up to 8% Grade		
Road grade	**Unsurfaced roads**	**Surfaced roads**
4% or less	3/8" per foot	1/2" per foot
5%	1/2" per foot	5/8" per foot
6%	5/8" per foot	3/4" per foot
7%	3/4" per foot	7/8" per foot
8% or more	1" per foot	1 1/4" per foot

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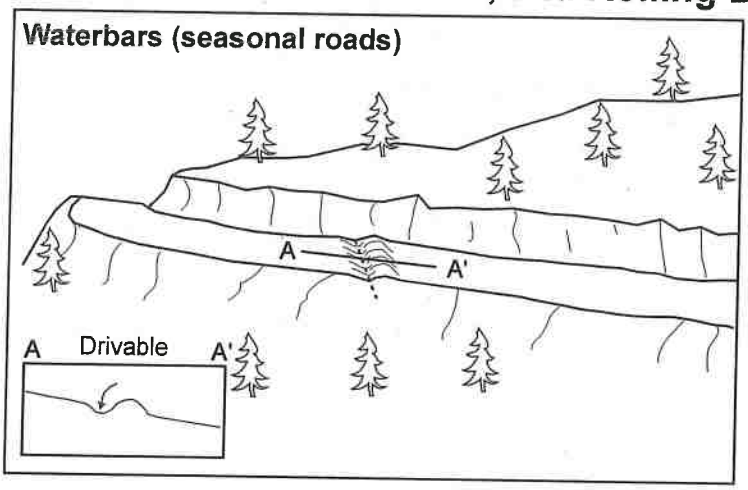
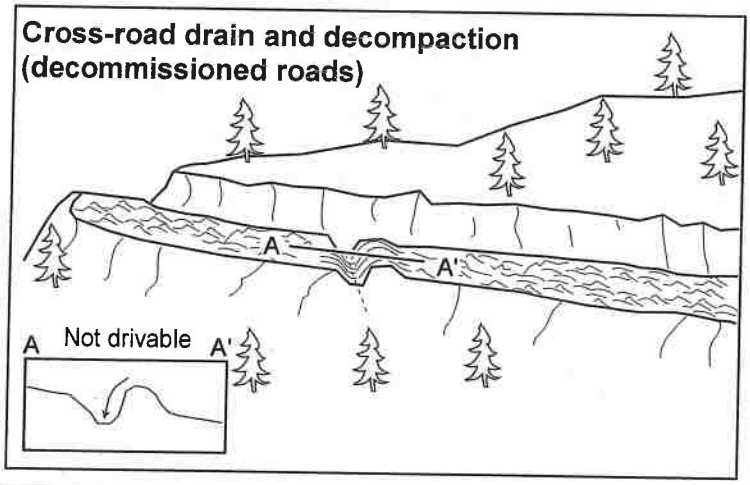
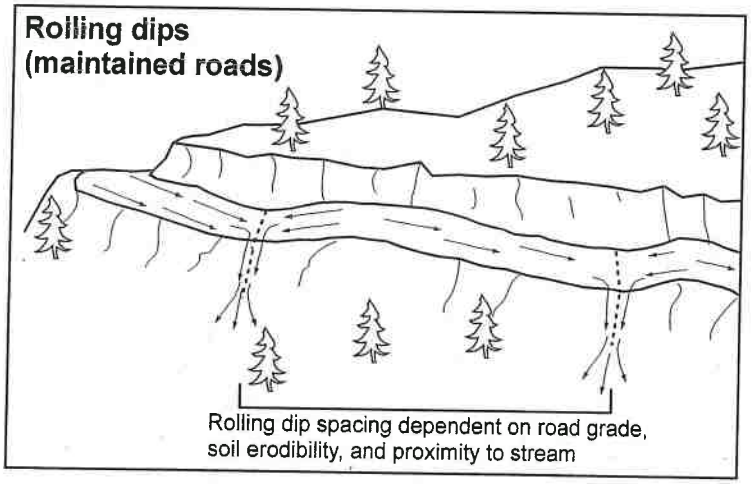
Typical Drawing #9

Typical Methods for Dispersing Road Surface Runoff with Waterbars, Cross-road Drains, and Rolling Dips







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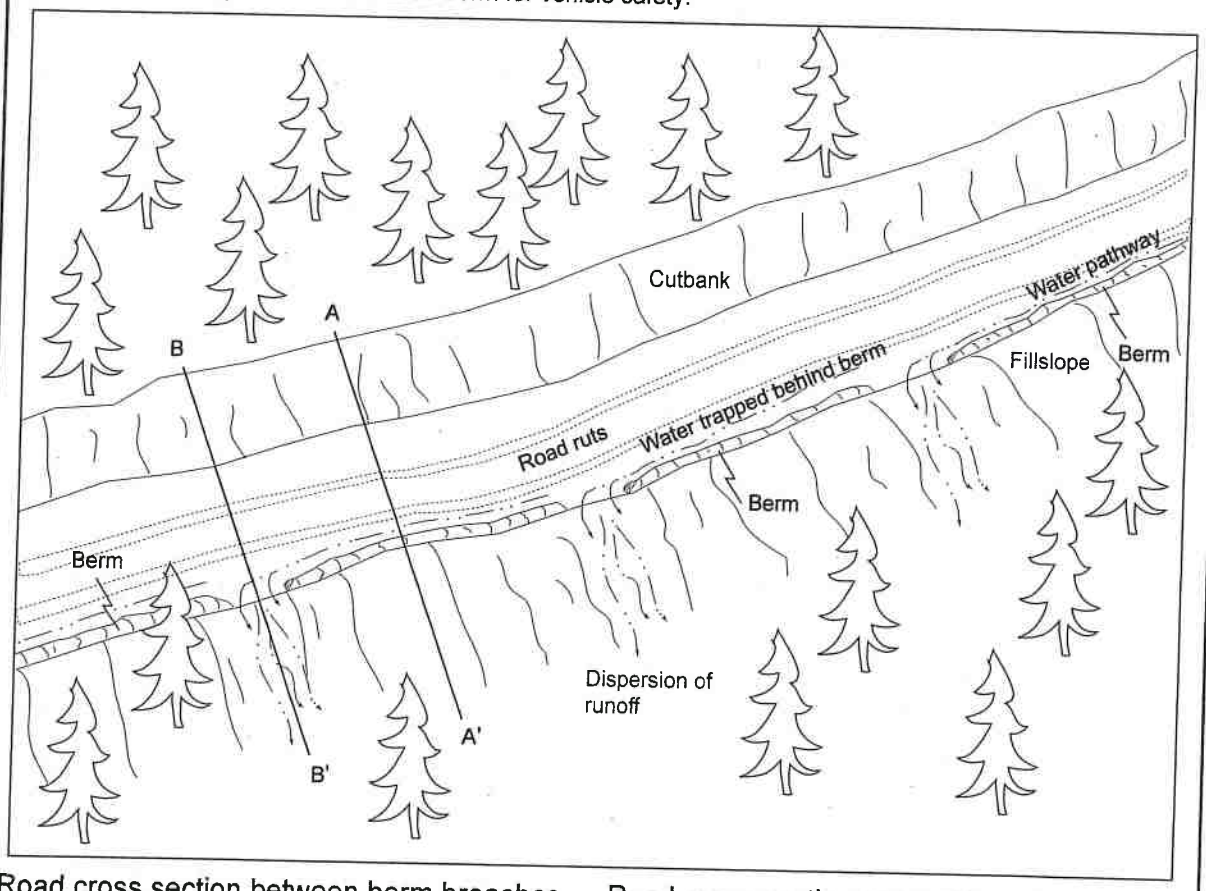
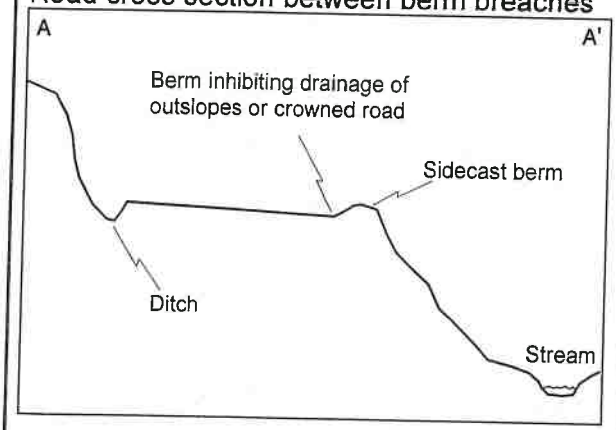
Typical Drawing #10

Typical Sidecast or Excavation Methods for Removing Outboard Berms on a Maintained Road

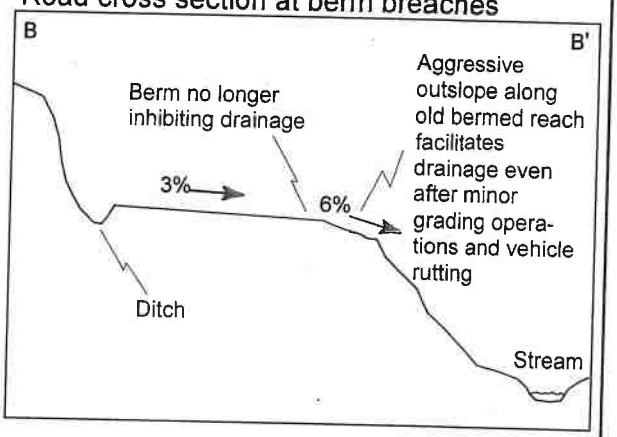
1. On gentle road segments berms can be removed continuously (see B-B').
2. On steep road segments, where safety is a concern, the berm can be frequently breached (see A-A' & B-B') Berm breaches should be spaced every 30 to 100 feet to provide adequate drainage of the road system while maintaining a semi-continuous berm for vehicle safety.



Road cross section between berm breaches



Road cross section at berm breaches



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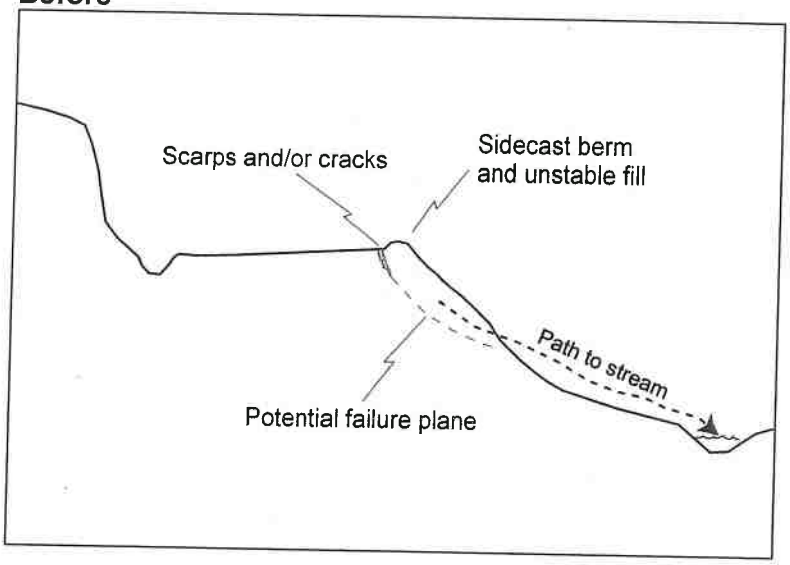
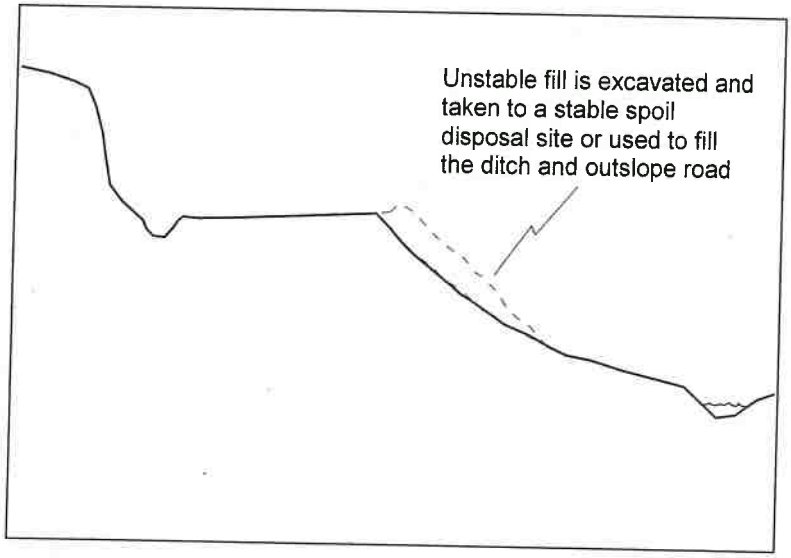
Typical Drawing #12

Typical Excavation of Unstable Fillslope on an Upgraded Road

Before



After



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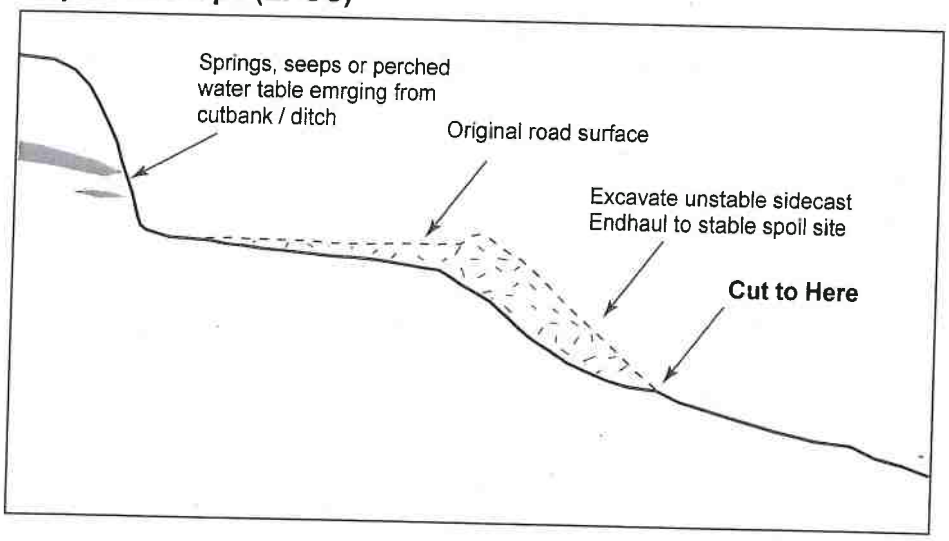
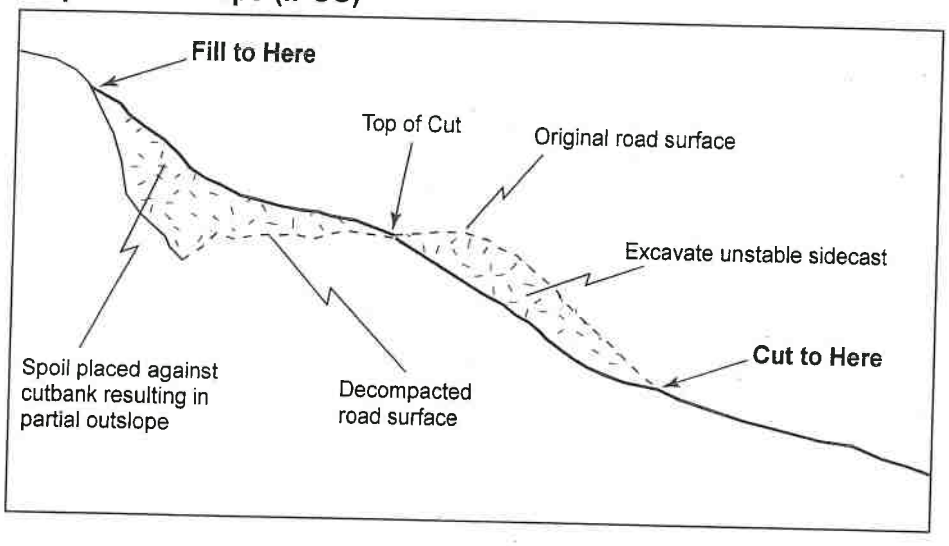
Typical Drawing #13

Typical Design for Road Decommisioning Treatments Employing Export and In-Place Outsloping Techniques

Export outslope (EPOS)



In-place outslope (IPOS)



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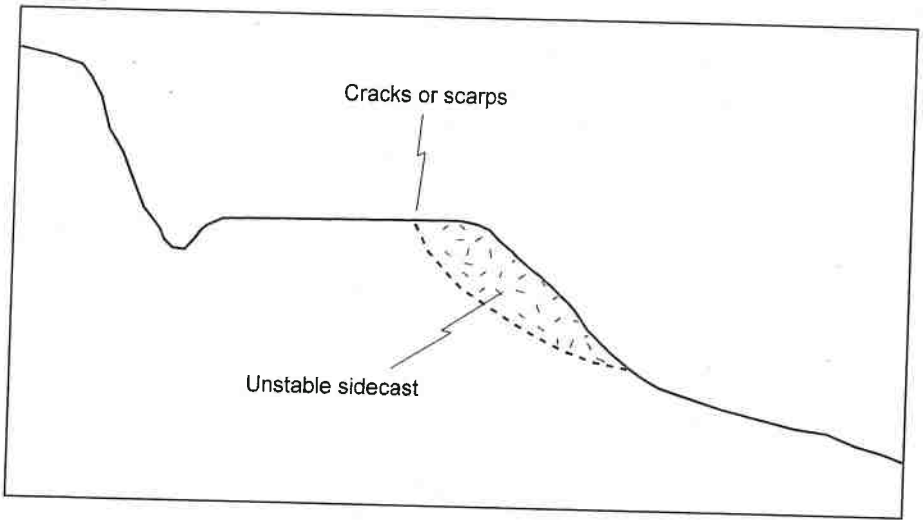
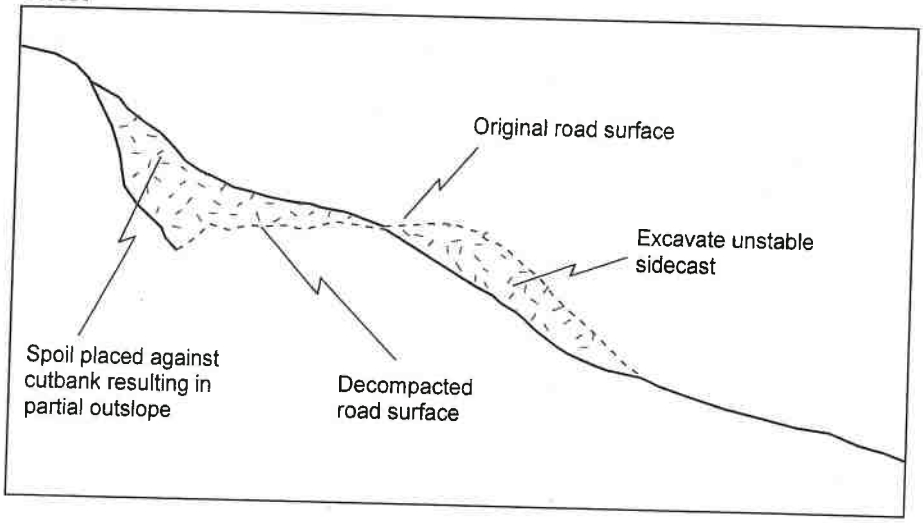
Typical Drawing #15

Typical Excavation of Unstable Fillslope on a Decommissioned Road

Before



After



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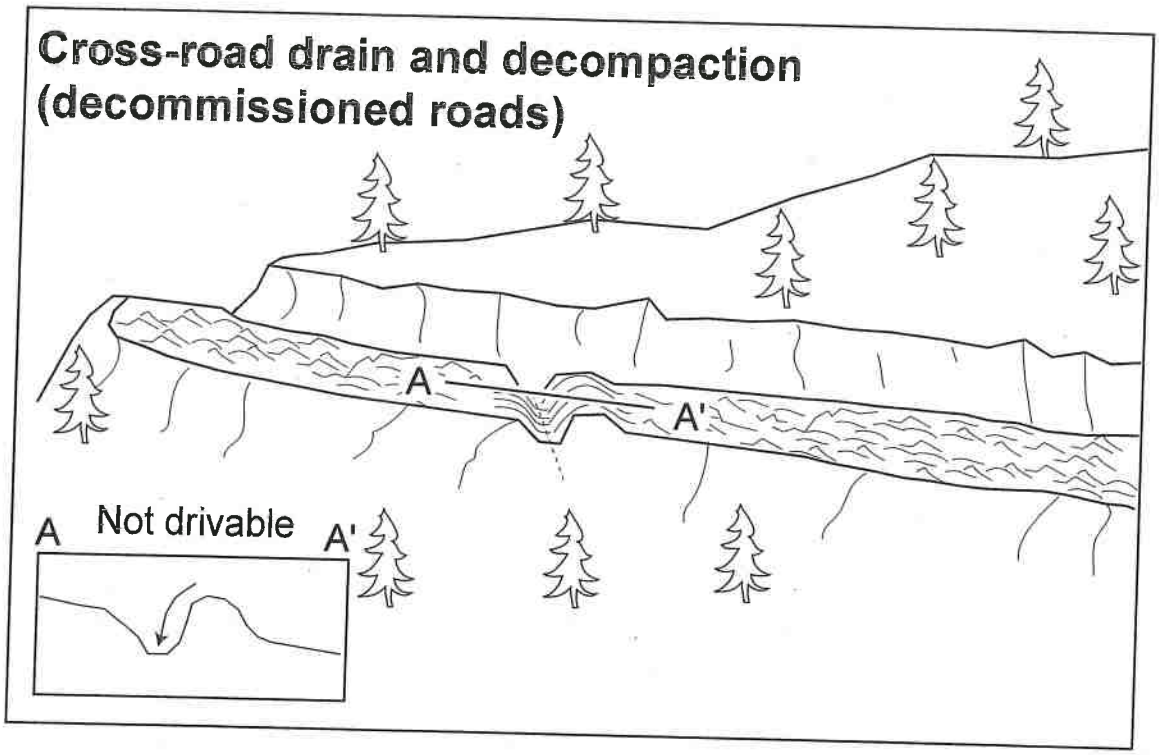
Typical Drawing #16

Cross-road drain and decompaction (decommissioned roads)



Cross road drain construction will ensure gullies, springs, road runoff and other concentrated flow will no longer collect over long lengths of road causing gully erosion and sediment delivery to streams. Cross road drains will be constructed at approximately 75 ft spacing intervals and these cross road drains will direct road surface runoff off the road onto stable hillslope locations.

Ripping the road surface 16 to 24 inches deep will increase road surface infiltration rates, decompact the road surface, and prevent concentrated runoff. Road ripping will also pulverize the compacted road surface or hardpan and allow for vegetation to establish and recover naturally.

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PWA Typical Drawing #17

Attachment C

Site Inspection and Monitoring Log Sheet

Three Creeks Farms LLC
APN 522-025-003

APPENDIX C: SITE INSPECTION AND MONITORING LOG SHEET

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**
#1234	CA #5 (lower road)	Landslide material below road	1/13/18	Pre-treatment	View of naturally revegetated material not showing additional movement since last inspection.
Example given in first row above.					

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**

Site Inspection and Monitoring Log for Cultivation Area #5 and any other features of interest before, during, and/or after treatment					
Photo frame # (or other unique identifier)	**Location**	**Feature of interest**	**Date of inspection**	**Pre-, during, or post-treatment**	**Description/observations**

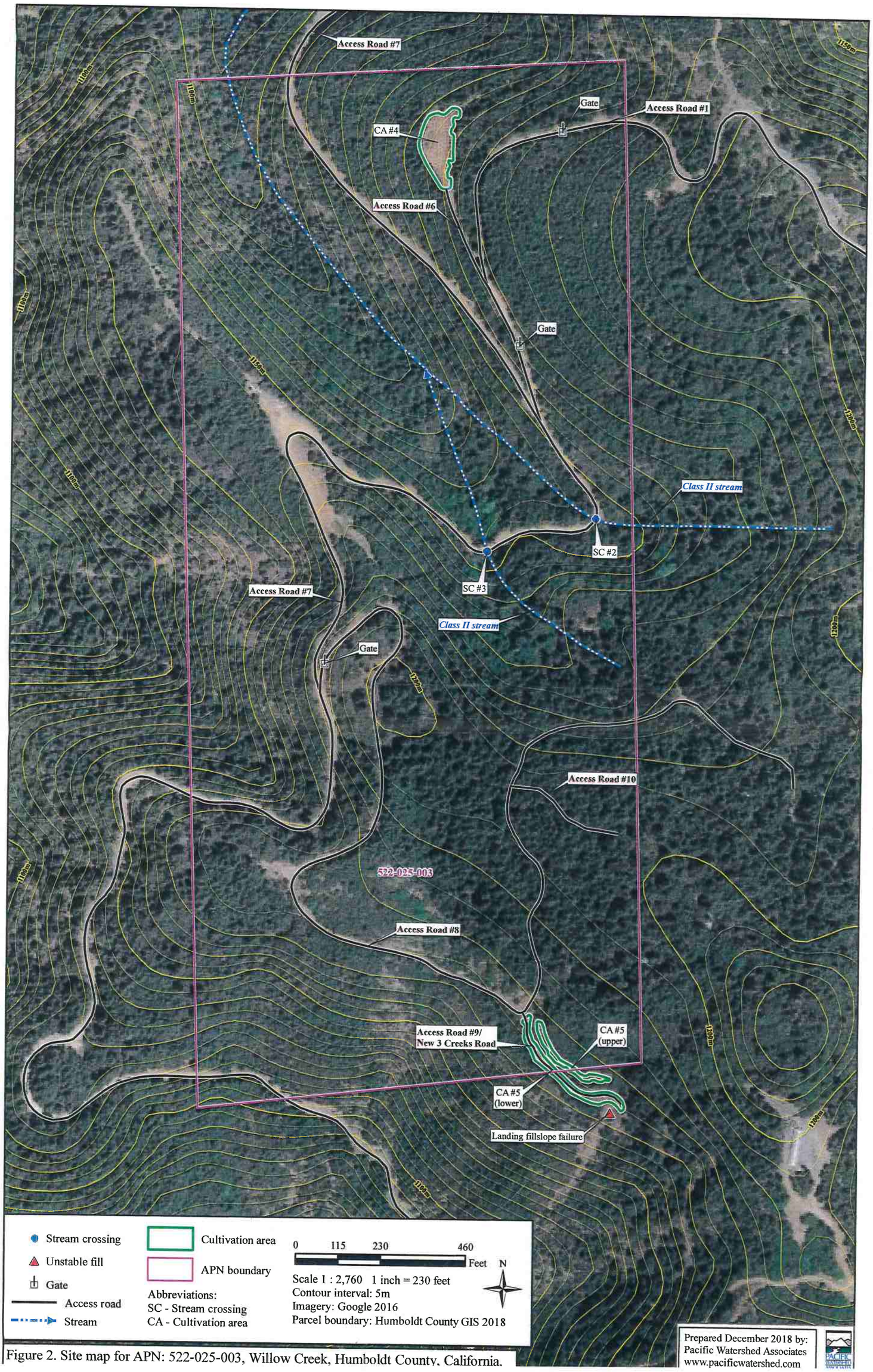

Figure 2. Site map for APN: 522-025-003, Willow Creek, Humboldt County, California.