

# Water Resource Protection Plan

APN 217-244-008

180101050601TRC297

1B170491CHUM



*Prepared by:*

**Timberland Resource Consultants**

**165 South Fortuna Blvd**

**Fortuna, California 95540**

**10/22/2017**

**Revision Date – 11/01/2017**

**Purpose**

This Water Resource Protection Plan (WRPP) has been prepared on behalf of the property owner, for the Humboldt County property identified as parcel number 217-244-008 by agreement and in response to the California Water Code Section 13260(a), which requires that any person discharging waste or proposing to discharge waste within any region that could affect the quality of the waters of the state, other than into a community sewer system, shall file with the appropriate regional water board a Report of Waste Discharge (ROWD) containing such information and data as may be required by the Regional Water Board. The Regional Water Board may waive the requirements of Water Code section 13260 for specific types of discharges if the waiver is consistent with the Basin Plan and in the public interest. Any waiver is conditional and may be terminated at any time. A waiver should include monitoring requirements to verify the adequacy and effectiveness of the waiver's conditions. California Regional Water Quality Control Board, North Coast Region, Order R1-2015-0023, conditionally waives the requirement for the property owner to file an ROWD for discharges and associated activities described in Finding-4.

**Scope of Report**

Order No. R1-2015-0023 states that "Tier 2 Dischargers and Tier 3 Dischargers who intend to cultivate cannabis before, during, or following site cleanup activities shall develop and implement a water resource protection plan that contains the elements listed and addressed below. Dischargers must keep this plan on site, and produce it upon request by Regional Water Board staff. Management practices shall be properly designed, installed, and assessed periodically for effectiveness. If a management measure is found to be ineffective, the plan must be adapted and implemented to incorporate new or additional management practices to meet standard conditions. Dischargers shall certify annually to the Regional Water Board individually or through an approved third party program that the plan is being implemented and is effectively protecting water quality, and report on progress in implementing site improvements intended to bring the site into compliance with all conditions of this Order."

**Methods**

The methods used to develop this WRPP include both field and office components. The office component consisted of aerial photography review and interpretation, existing USGS quad map review, GIS mapping of field data, review of on-site photography points, streamflow calculations, and general planning. The field component included identifying and accurately mapping all watercourses, wet areas, and wetlands located downstream of the cultivation areas, associated facilities, and all appurtenant roads accessing such areas. An accurate location of the Waters of the State is necessary to make an assessment of whether potential and existing erosion sites/pollution sites have the potential to discharge waste to an area that could affect Waters of the State (including groundwater). All cultivation areas, associated facilities, and all appurtenant roads accessing such areas were assessed for discharges and related controllable water quality factors from the activities listed in Order R1-2015-0023, Finding 4a-j. The field assessment also included an evaluation and determination of compliance with the Standard Conditions per Provision I.B of Order No. R1-2015-0023. The water resource protection plans required under Tier 2 are meant to describe the specific measures a discharger implements to achieve compliance with standard conditions. Therefore, all required components of the water resource protection plan per Provision I.B of Order No. R1-2015-0023 were physically inspected and evaluated. A comprehensive summary of each Standard Condition as it relates to the subject property is appended.

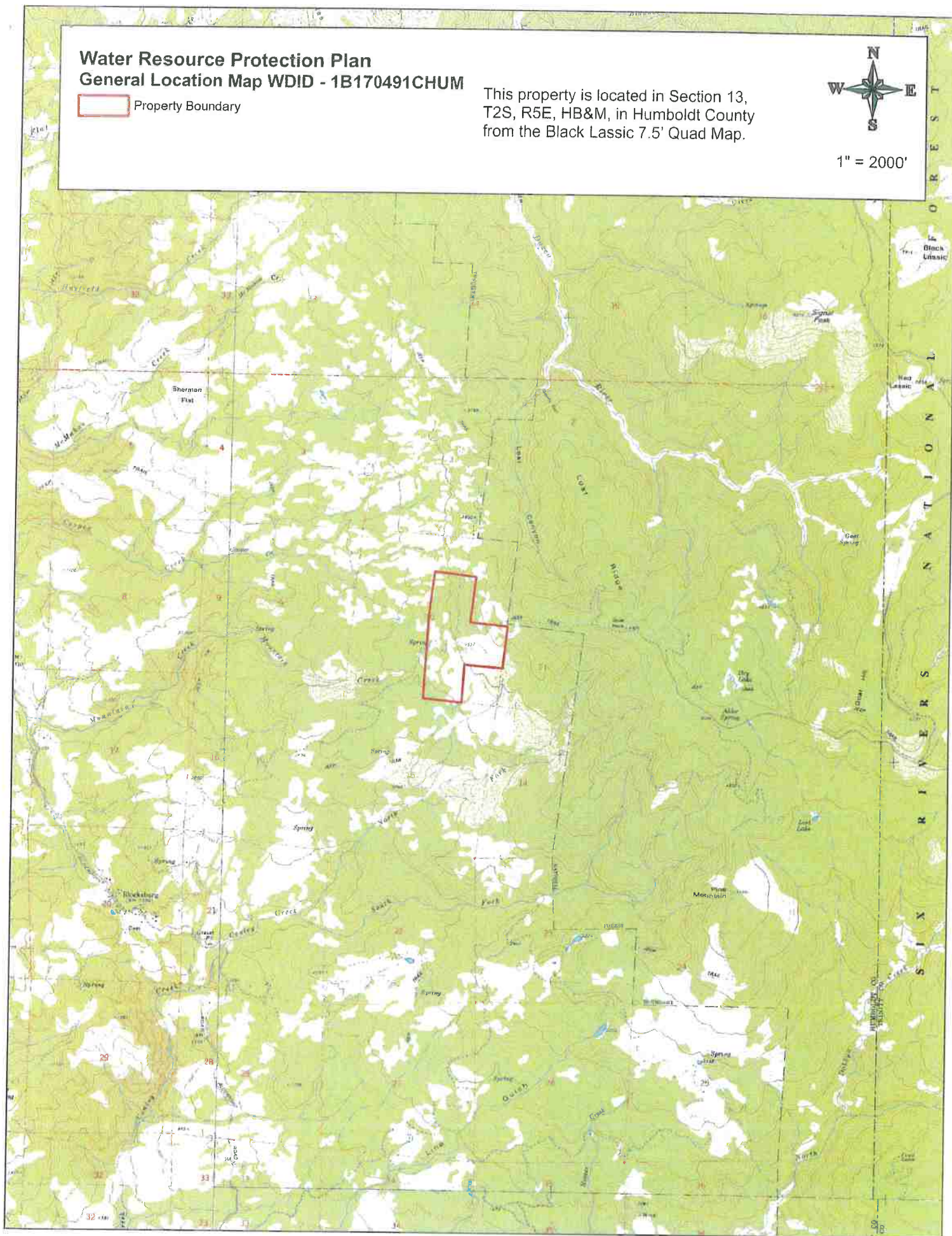
# Water Resource Protection Plan General Location Map WDID - 1B170491CHUM

 Property Boundary

This property is located in Section 13,  
T2S, R5E, HB&M, in Humboldt County  
from the Black Lassic 7.5' Quad Map.



1" = 2000'



**Property Description**

The property assessed consists of one 187-acre parcel with vegetation consisting primarily of conifer timberlands and grasslands. Slopes on the ownership average 28% with cultivation areas and roads averaging 15%. The property is located in Section 13, T2S, R5E, HB&M, in Humboldt County from the Black Lassic 7.5' Quad Map. This property is located approximately 2.5 miles northwest of Blocksburg, CA, California accessed via private roads off Alderpoint Road. This property has four unnamed Class III watercourses and two unnamed Class II watercourses that converge with the Cooper Creek.

**Project Description**

Cultivation on the property is comprised of three cultivation areas, referenced as Cultivation Area A, B, and C. Cultivation Area A consists of 13,950ft<sup>2</sup> with three 100X20ft greenhouses. Cultivation B consists of 3,222ft<sup>2</sup> of outdoor above ground potted plants. Cultivation Area C consists of 1,621ft<sup>2</sup> outdoor above ground potted plants. This equates to a total of 18,793ft<sup>2</sup> of cultivation area. All areas are accessed by a well-established road network with seasonal, permanent, and trail types.

**Monitoring Plan**

Tier 2 Dischargers shall include a monitoring element in the Water Resource Protection Plan that at a minimum provides for periodic inspection of the site, checklist to confirm placement and efficacy of management measures and document progress on any plan elements subject to a time schedule. Tier 2 Dischargers shall submit an annual report (Appendix C) by March 31 of each year that documents implementation and effectiveness of management measures during the previous year. Tier 2 annual reporting is a function that may be provided through an approved third party program.

Monitoring of the site includes visual inspection and photographic documentation of each feature of interest listed on the site map, with new photographic documentation recorded with any notable changes to the feature of interest. At a minimum, all site features must be monitored annually, to provide the basis for completion of the annual re-certification process. Additionally, sites shall be monitored 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, minimize, and mitigate discharges of waste to surface water: 1) just prior to October 15 to evaluate site preparedness for storm events and storm water runoff, 2) following the accumulation of 3" total precipitation or by November 15, whichever is sooner, and 3) following any rainfall event with an intensity of 3" precipitation in 24 hours. Precipitation data can be obtained from the National Weather Service Forecast Office (e.g. by entering the zip code of the parcel location at <http://www.srh.noaa.gov/forecast>). Sites requiring monitoring are indicated as such within the WRPP Mitigation report in the follow pages.

**Monitoring Plan Reporting Requirements**

Order No. R1-2015-0023, Appendix C must be submitted to the Regional Water Board or approved third party program upon initial enrollment in the Order (NOI) and annually thereafter by March 31. Forms submitted to the Regional Water Board shall be submitted electronically to [northcoast@waterboards.ca.gov](mailto:northcoast@waterboards.ca.gov). If electronic submission is infeasible, hard copies can be submitted to North Coast Regional Water Quality Control Board, 5550 Skylane Boulevard, Suite A, Santa Rosa, CA 95403.

### Assessment of the Standard Conditions

Assessment of Standard Conditions consisted of field examinations in the winter of 2016 and spring of 2017. The examination evaluated areas near, and areas with the potential to directly impact, watercourses for sensitive conditions including, but not limited to, existing and proposed roads, skid trails and landings, unstable and erodible watercourse banks, unstable upslope areas, debris, jam potential, inadequate flow capacity, changeable channels, overflow channels, flood-prone areas, and riparian zones. Field examinations also evaluated all roads and trails on the property, developed areas, cultivation sites, and any structures and facilities appurtenant to cultivation on the property. Anywhere the Standard Conditions are not met on the property, descriptions of the assessments and the prescribed treatments are outlined in the Mitigation Report to follow.

### Summary of Standard Conditions Compliance

1. Site maintenance, erosion control, and drainage features Y/N
2. Stream crossing maintenance Y/N
3. Riparian and wetland protection and management Y/N
4. Spoils management Y/N
5. Water storage and use Y/N
6. Irrigation runoff Y/N
7. Fertilizers and soil amendments Y/N
8. Pesticides and herbicides Y/N
9. Petroleum products and other chemicals Y/N
10. Cultivation-related wastes Y/N
11. Refuse and human waste Y/N

#### 1. Site maintenance, erosion control, and drainage features

Roads are being classified as "permanent" (being used year-round), "seasonal" (being used primarily during summer months), and "trail" (being rarely used for occasional access to features on the property). This property has approximately 0.5 miles of road with grades ranging 0-20%.

The rocky permanent roads on the property are used to access one cultivation area and a residence. The seasonal use road is used to access a pond, and various locations throughout the property. The trails are used to access two cultivation areas, water tanks, and two points of diversion.

The permanent road had sufficient surface rock with appropriate and adequately spaced drainage structures. This portion of road was primarily drained by an inside ditch with appropriately spaced ditch relief culverts. Some of these drainage features require maintenance and or re-establishment. These sites are referenced in the mitigation report and site map as Sites 01, 03, 04, 05, and 07. Grades on the permanent roads ranged from 0-15%.

The seasonal roads were stable due to sufficient surface rock and appropriately spaced drainage structures. These sections of roads are primarily drained by an out-sloping of the road surface with multiple push outs. The seasonal sections of roads are seldom used. The overall condition of the seasonal roads was in good condition with no site-specific actions identified at the time of survey. There are two locations with bank seeps that shall be monitored to ensure that the road surface is not eroding, these sites are referenced as Sites 10 and 11. Grades on the seasonal roads ranged from 0-20%.

## Assessment of the Standard Conditions (Cont.)

The trails on the property were stable with no signs of erosion. These trails consist of foot paths through a well vegetated forest with leaf litter, shrubs and grasses. No locations were determined to be lacking drainage or requiring maintenance on the trails. Grades on the trails ranged from 5-25%.

Cultivation on the property consists of four areas totaling 18,793ft<sup>2</sup>.

Cultivation Area A consists of 13,950ft<sup>2</sup> located on a graded area that appears to be a legacy log landing. At the time of survey this graded flat was stable with no signs of erosion or failure. All of the exposed soils were mulched at the time of survey. Slopes within this cultivation area range from 0-5%; slopes of the surrounding landscape range from 10-30%. No erosion or site maintenance issues were observed at this location.

Cultivation B consists of 3,222ft<sup>2</sup> of outdoor above ground potted plants located on a mid-slope terrace located adjacent to a Class III watercourse. Due to close proximity to a Class III watercourse this cultivation will require removal with remediation of the cultivation area. Post removal of cannabis related materials, the site maintenance and erosion control recommendations for this area will consist of seeding and mulching of the area that was used for cultivation. This site is referenced as Site 21.

Cultivation Area C consists of 1,986ft<sup>2</sup> of outdoor above ground potted plants located on a mid-slope terrace located adjacent to a Class II watercourse. The discharger has relayed plans to remove this cultivation area and relocate to a more central location. Post removal of cannabis related materials, the site maintenance and erosion control recommendations for this area will consist of seeding and mulching of the area that was used for cultivation. This site is referenced as Site 20.

A proposed cultivation relocation site was investigated in the field with a suitable location found near Cultivation Area A. The slope within the cultivation area ranges from 0-5% with surrounding slope ranging from 10-30%. This area is surrounded by well vegetated forest with the nearest watercourse being approximately 200 feet away. Based on the conditions of the California Regional Water Quality Control Board's Order, this proposed location appears to be an appropriate site.

## 2. Stream crossing maintenance

Two watercourse crossings occur on this property and are referenced as Sites 16 and 17. Of these, the watercourse crossing at Site 16 will require installation of a new structure. Site 16 consists of an 18" culvert that is too short resulting in an eroding outlet. This culvert is not adequately sized for a 100-year storm event and will eventually require replacement with a 24" culvert. Site 17 consists of a temporary crossing that has since been pulled. This site is functioning as a dirt ford. If a culvert is to be installed in this location, a 24" culvert would be an appropriate size.

Rational Method for 100-year flood flow (A < 200 acres)				APN 217-244-008				existing	proposed	Undersized?
$T_c = 60((11.9 \times L^3)/H)^{0.385}$				$Q_{100} = CIA$						
Crossing	Channel length (to top of basin) (mi)	Elevation difference (ft.)	Concentration time (min)	Runoff coefficient	100-year Return-Period Precipitation (in/hr)	Area (acres)	100-yr flood flow (cfs)			
	L	H	T <sub>c</sub>	C	I <sup>*</sup>	A	Q <sub>100</sub>			
16				0.4	3.32	11.89	15.8	18.0	24.0	Yes
17				0.4	3.32	5.9	7.8	ns	24	Yes
HW/D	CU18	CU24	CU30	CU36	CU42	CU48	CU54	CU60	CU72	CU84
1.0	5.6	11.6	20	32	47	66	89	115	180	265

## **Assessment of the Standard Conditions (Cont.)**

### **3. Riparian and wetland protection and management**

Cultivation Area A is 170 feet from a Class III watercourse. The peripheries of this cultivation area were fenced and all of the exposed soils were mulched. This cultivation area is outside of the riparian buffer defined by California's Regional Water Quality Control Board's Order.

Cultivation Area B has a Class III watercourse bisecting the center of the cultivation area. The discharger was informed of the close proximity to a watercourse and that cultivation activities must cease at this location. It is being recommended to remove all cultivation related materials and treat the disturbed soils with the attached erosion control BMP's.

Cultivation Area C is approximately 390ft away from a Class II watercourse. The discharger has relayed plans to remove this cultivation area due to an effort to consolidate cultivation areas to one location. It is being recommended to remove all cultivation related materials and treat the disturbed soils with the attached erosion control BMP's.

Due to a cultivation area requiring removal, a relocation site was assessed during the field inspection. This area next to Cultivation Area A, was found to be a suitable location due to being a level, well drained, and stable area, that is over 200 feet from the nearest watercourse.

There is a pit privy/ outhouse located within 10 feet of a Class III watercourse. This outhouse shall be removed. The discharger was informed of this in the field and use of this pit privy has ceased. The landowner relayed plans to install a B&B portable toilet on the property with future plans to install a septic system off of the agricultural storage building.

### **4. Spoils management**

During initial inspection, no spoils piles were located on the property. If spoiling material is required, such as from stream crossing installation or other grading, the discharger shall follow the BMPs in Appendix B or the Order, under Spoil Management. Spoil sites shall be located outside any standard width riparian area (50' for Class III and 100' for Class II) and shall be stabilized and contained as per the BMPs. This standard condition is being met at this time.

### **5. Water storage and use**

All agricultural water is sourced from one well and a spring point of diversion. Domestic water is sourced from two spring diversions. There is one 1,000-gallon tank located above Cultivation Area A where well water is pumped to. This property has a total of 1,000 gallons of water storage. There are no surface water diversion utilized for agricultural irrigation. Water metering device(s) shall be installed prior to any cultivation operation, 2018, to meter water used for the irrigation of cannabis.

A general recommendation has been made to implement water conservation techniques at the discretion of the discharger. Water conservation technique options include drip systems, mulching base of plant, watering early in the morning (before 10a.m) or later in the evening (after 6 p.m.), repairing leaky pipes and fittings, and utilizing water conserving soil amendments such as bio-char. These options further described in Appendix B of the order under Water Storage and Use BMPs.

**Assessment of the Standard Conditions (Cont.)****Water Use Estimates (gallons) from the Well: Agricultural Irrigation**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4650	4200	4650	4500	13950	13500	13950	13950	13500	13950	4500	4650	109,950

**Water Use Estimates (gallons) from the Spring Point of Diversion (Site 12): Domestic Use**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	36,000

**6. Irrigation runoff**

During the field assessments, no evidence of irrigation runoff was observed, nor was there evidence that it had occurred in the past. Recommendations were made to the property owner about proper winterization of the gardens including storing greenhouse plastics and covering of exposed soils.

**7. Fertilizers and soil amendments**

Fertilizers, potting soils, compost, and other soils and soil amendments are stored appropriately on the property in a manner in which they will not enter or be transported into surface waters and so that nutrients or other pollutants will not be leached into groundwater. Fertilizers and soil amendments are applied and used per the manufacturers guidelines. Cultivation areas are currently maintained so as to prevent nutrients from leaving the site during the growing season and post-harvest.

**8. Pesticides and herbicides**

All pesticides are stored in an agricultural storage structure. Products used are applied at rates based on the manufacturer's specifications. This standard condition is being met.

**9. Petroleum products and other chemicals**

Currently, no fuel storage or petroleum products are present on the property. Should the discharger at any point in the future obtain fuel storage or petroleum products, any/all future petroleum products and other liquid chemicals, including but not limited to diesel, biodiesel, gasoline, and oils shall be stored so as to prevent their spillage, discharge, or seepage into receiving waters. Storage tanks and containers shall be of suitable material and construction to be compatible with the substance(s) stored and conditions of storage such as pressure and temperature.

**10. Cultivation-related wastes**

During inspection, no accumulations of cultivation waste were found at the time of inspection. The discharger has been informed of the proper techniques of disposing of organic matter, including burning or composting.

**11. Refuse and human waste**

This property currently utilizes a pit privy for human waste disposal. This pit privy is within the riparian buffer and will require removal. The landowner was informed and has ceased use of this outhouse. It is the responsibility of the landowner to comply with the requirements set forth under Humboldt County Health and Human Services, Department of Public Health: Sewage Disposal Regulations, Appendix VII, 1984. Currently a permitted septic system is the only permissible method of human waste disposal under Humboldt County's Sewage disposal regulations.



**Assessment of the Standard Conditions (Cont.)****12. Remediation/Cleanup/Restoration**

Currently, four of the Standard Conditions are not being met; 1. Site maintenance, erosion control, and drainage features, 2. Stream crossing maintenance, 3. Riparian and wetland protection and management, and 11. Refuse and human waste. These sites will be treated in accordance with regulations, following approval of any and/or all necessary permits, and done in accordance with the BMP's listed in Appendix B of the Order. Additionally, several other general recommendations have been made as follows:

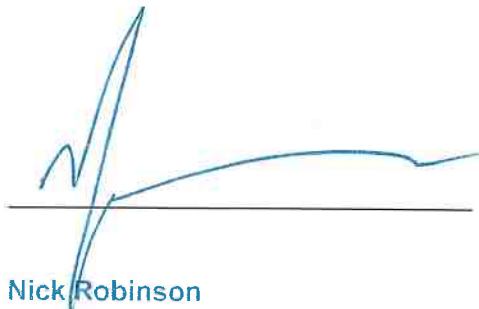
**General Recommendations:**

- In-organic cultivation related wastes should be removed and disposed of properly at a landfill transfer station or stored in an appropriate location greater than 200' from a watercourse where it cannot be transported by wind or rain, see Appendix B, BMP 137 of the Order. Organic cultivation related waste can either be composted or burned in the winter.
- Water use shall be designed and metered such that water used for the irrigation of cannabis will be recorded. Water use for the irrigation of cannabis is to be recorded monthly for annual reporting.
- Fertilizer, soil amendments, and pesticide use it to be recorded in such a manner that cumulative annual totals are recorded for annual reporting.
- Frequent use of un-surfaced roads should be avoided, particularly when road surfaces are soft/saturated.
- All culverts should be inspected regularly during the winter months to check for plugging, blockage, or other issues.
- Road surfaces should be maintained via grading, as needed, to prevent road surface runoff from being trapped in and eroding wheel tracks.

**STATEMENT OF CONTINGENT AND LIMITING CONDITIONS CONCERNING THE PREPARATION AND  
USE OF WATER RESOURCE PROTECTION PLAN**

**Prepared by Timberland Resource Consultants**

1. This Water Resource Protection Plan has been prepared for the property within APN 217-244-008 in Humboldt County at the request of the Client.
2. Timberland Resource Consultants does not assume any liability for the use or misuse of the information in this Water Resource Protection Plan.
3. The information is based upon conditions apparent to Timberland Resource Consultants at the time the inspection was conducted. Changes due to land use activities or environmental factors occurring after this inspection have not been considered in this Water Resource Protection Plan.
4. Maps, photos, and any other graphical information presented in this report are for illustrative purposes. Their scales are approximate, and they are not to be used for locating and establishing boundary lines.
5. The conditions presented in this Water Resource Protection Plan may differ from those made by others or from changes on the property occurring after the inspection was conducted. Timberland Resource Consultants does not guarantee this work against such differences.
6. Timberland Resource Consultants did not conduct an investigation on a legal survey of the property.
7. Persons using this Water Resource Protection Plan are advised to contact Timberland Resource Consultants prior to such use.
8. Timberland Resource Consultants will not discuss this report or reproduce it for anyone other than the Client named in this report without authorization from the Client.



**Nick Robinson**  
Timberland Resource Consultants

## Photographs



This photograph references Site 09 a 24" ditch relief culvert. Cultivation Area A is in the background.



Site 09 – 24" ditch relief culvert. Functioning adequately.





**Point of diversion. 5 gallon bucket burried with a 1" poly line gravity fed to holding tank.  
Utilized for domestic use.**







**Site 12 the point of diversion and Site 11 a dirt ford. Bank seep drains across legacy hunting road. It is being recommended to install a water bar at Site 11 to ensure the bank seep does not drain down the road surface.**

# Water Resource Protection Plan Site Map WDID - 1B161048CHUM

-  Property Boundary
-  Cultivation Area
-  Proposed Relocation Area
-  Structure
-  Pond

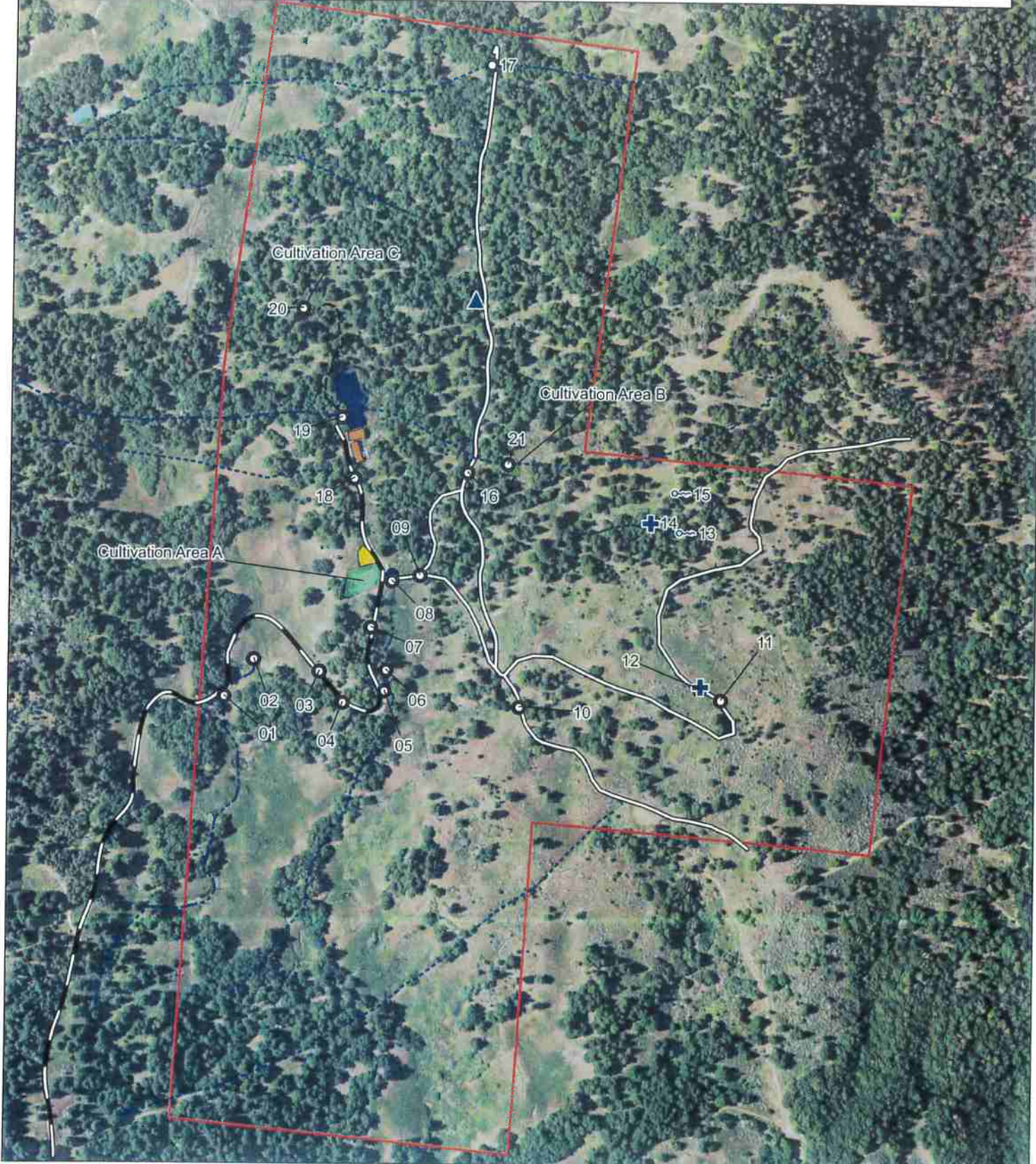
-  Site
-  Tank
-  Point of Diversion
-  Well

- ### Road
-  Permanent
  -  Seasonal
  -  Trail

- ### Watercourse
-  Class II
  -  Class III



1" = 450'



# Water Resource Protection Plan Site Map WDID - 1B161048CHUM

- Property Boundary
- Structure
- Pond
- Cultivation Area
- Proposed Relocation Area

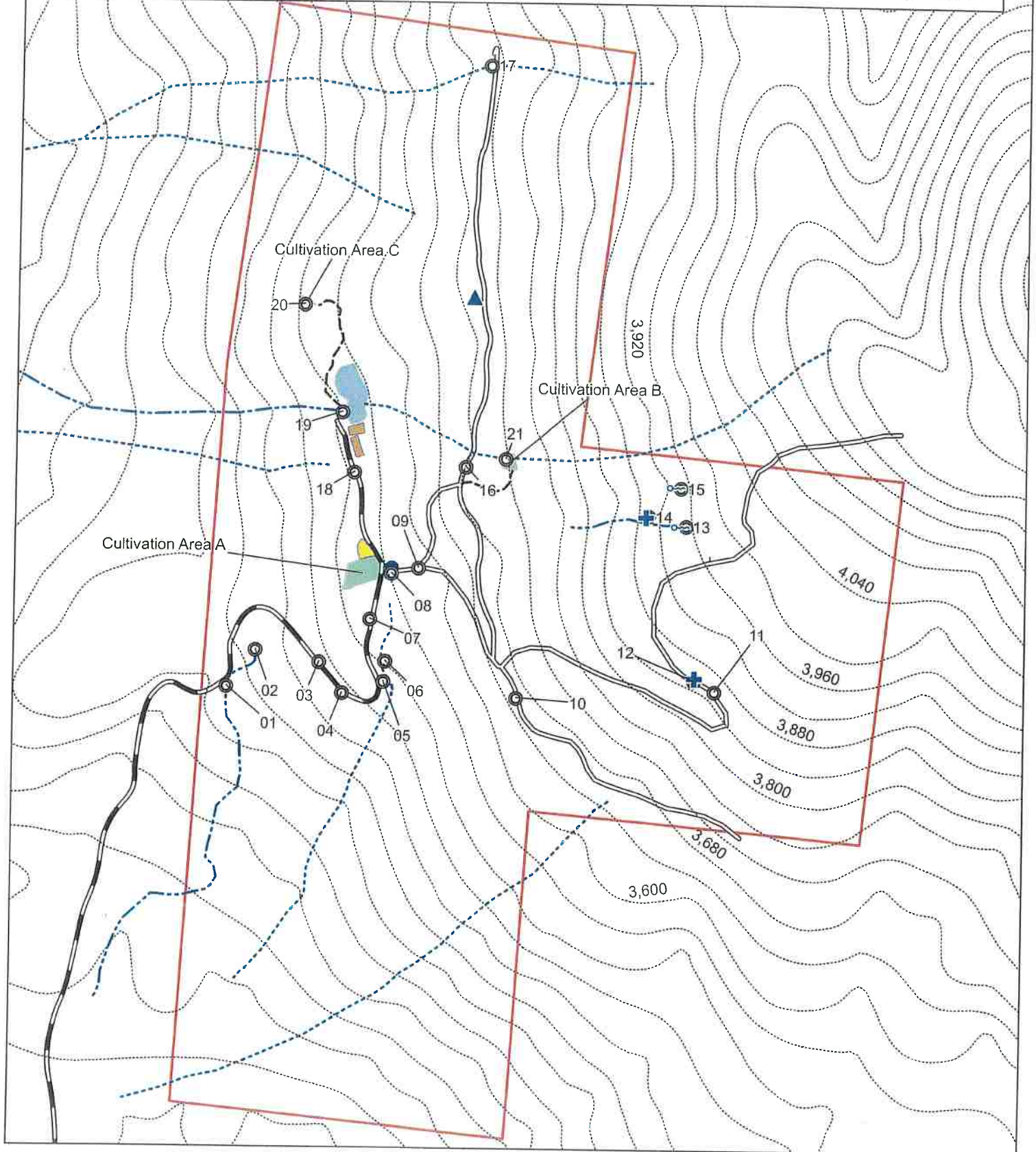
- Site
- Tank
- Point of Diversion
- Well

- Road**
- Permanent
  - Seasonal
  - Trail

- Watercourse**
- Class II
  - Class III



1" = 450'







**Timberland  
Resource  
Consultants**

## WRPP - Mitigation Report

APN# -217-244-008

180101050601TRC297

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
1	-123.601 40.3014	Permanent		X		A.1.		
Current Condition: Erosion control point consisting a watercourse that diverts into an inboard ditch. This diverted watercourse eventually returns to its original course by a push out.						Proposed Action : Return watercourse to the original channel prior to the diversion into the inside ditch. It is being recommended to build up a berm to prevent this watercourse from deviating from its natural course. The push out in this location will require re-establishment.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
2	-123.601 40.3018			X				
Current Condition: Spatial reference for a stock pond. This pond is not used for cultivation purposes.						Proposed Action : None.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
3	-123.6 40.3016			X		A.1.	Prior to 10/15/18 pending approval of applicable permits	
Current Condition: Section of inside ditch that is not drained adequately.						Proposed Action : Install 18" ditch relief culvert in this location per the specifications of the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
4	-123.599 40.3013	Permanent		X		A.1.		
Current Condition: Existing push out that drains an inside ditch. Requires re-establishment.						Proposed Action : Re-establish the pushout and section of inside ditch.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
5	-123.599 40.3014	Permanent		X		A.1.		
Current Condition: The natural channel of a Class III watercourse has diverted in the past.						Proposed Action : Install a berm in this location to ensure that the watercourse stays in the original channel.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
6	-123.599 40.3017	Permanent		X		A.1.		
Current Condition: Spatial reference for a stock pond on the property. This pond is not used for cannabis cultivation purposes.						Proposed Action : None.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
7	-123.599 40.3026	Permanent	X	X		A.1.	Prior to 10/15/18 pending approval of applicable permits	
Current Condition: Section of road that is not adequately drained.						Proposed Action : Install a type 1 rolling dip in this location.		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
8	-123.599 40.3021	Seasonal		X		A.1.		
Current Condition: Water runoff from an inside ditch was diverted at some point. This has been corrected and water runoff now runs clear and infiltrates into the adjacent grassland.						Proposed Action : None.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
9	-123.598 40.3027	Seasonal		X		A.1.		
Current Condition: 24" ditch relief culvert. Good installation. Functioning adequately.						Proposed Action : None.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
10	-123.598 40.3027	Seasonal		X		A.5.		
Current Condition: Road side bank seep. Appears to have been used as a point of diversion in the past. This bank seep is not currently used as a point of diversion.						Proposed Action : None.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
11	-123.597 40.3013	Seasonal	X	X		A.1.		
Current Condition: Location of a bank seep located on a legacy road. Spatial reference for monitoring.						Proposed Action : Bank seep pools on the road surface. It is being recommended to install a water bar at this location to ensure the bank seep does not drain down the road surface.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
12	-123.594 40.3015	Seasonal		X		A.1.		
Current Condition: Five gallon bucket buried in a bank seep, used as a point of diversion for domestic use.						Proposed Action: This point of diversion will require a Lake and Streambed Alteration Agreement.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
13	-123.594 40.3015			X		A.5.		
Current Condition: This point references the location of a spring.						Proposed Action: None.		



# WRPP - Mitigation Report

APN# -217-244-008

180101050601TRC297

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
14	-123.594 40.3032			X		A.5.		

Current Condition: This point references the location of the point of diversion for the spring referenced as Site 13. Proposed Action: None.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
15	-123.595 40.3033	Trail		X		A.5.		

Current Condition: This point references where the head of a spring is located. Proposed Action: None.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
16	-123.594 40.3036	Seasonal	X	X	X	A.2.	Prior to 10/15/18 pending approval of applicable permits	

Current Condition: Class III watercourse crossing, 18" culvert. This crossing is too short and not to grade resulting in an eroding outlet. Inadequately sized for a 100 year storm event. Proposed Action: A 24" culvert shall be installed in this location per the specifications of the attached BMP's.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
17	-123.597 40.3039	Seasonal		X		A.2.		

Current Condition: Temporary Class III watercourse crossing that last used in fire fighting efforts in 2015. This crossing was abandoned by Cal fire post firefighting efforts. Proposed Action: None.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
18	-123.599 40.3037	Seasonal	X	X		A.11. & A.3.	Prior to 10/15/18 pending approval of applicable permits	

Current Condition: Location of an outhouse. This outhouse is within the riparian buffer zone of a Class III watercourse. Discharger was informed of this and has ceased use of this outhouse. Proposed Action: Remove the outhouse from this location.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
19	-123.597 40.3075	Trail		X		A.2.		

Current Condition: Overflow for a pond. Rocked overflow that drains into a Class II watercourse. Functioning adequately. This pond is not used for cannabis cultivation purposes. This overflow functions as a Class II watercourse crossing. Proposed Action: None.



# WRPP - Mitigation Report

APN# -217-244-008

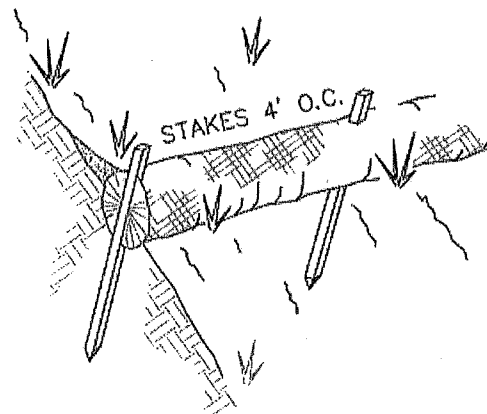
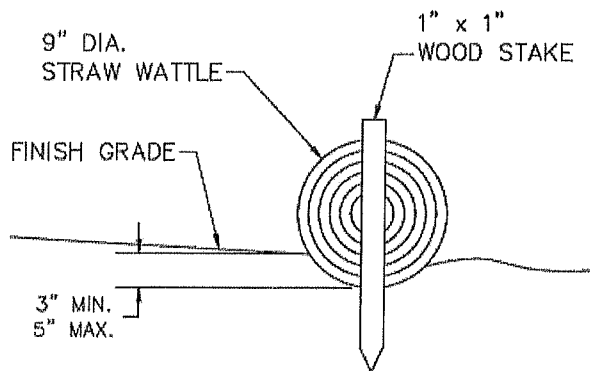
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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
20		Trail	X	X		A.1.	Prior to 10/15/18 pending approval of applicable permits	
Current Condition: Discharger has relayed plans to consolidate cultivation areas and relocate this cultivation area to the proposed flat near Cultivation Area A.						Proposed Action: This cultivation shall be removed and relocated prior to the growing season of 2018. Post removal of cultivation related materials it is being recommended to treat all disturbed areas with the erosion control BMP.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
21		Trail	X	X		A.1. & A.3.	Prior to 10/15/18 pending approval of applicable permits	
Current Condition: This cultivation area is within the riparian buffer for a Class III watercourse.						Proposed Action: This cultivation shall be removed and relocated prior to the growing season of 2018. Post removal of cultivation related materials it is being recommended to treat all disturbed areas with the erosion control BMP.		

## Project Best Management Practices (BMP)

### BMP: Erosion Control

- Erosion control and sediment detention devices and materials shall be incorporated into the cleanup/restoration work design and installed prior to the end of project work and before the beginning of the rainy season. Any continuing, approved project work conducted after October 15 shall have erosion control works completed up-to-date and daily.
- Erosion control materials shall be, at minimum, stored on-site at all times during approved project work between May 1 and October 15.
- Approved project work within the 5-year flood plain shall not begin until all temporary erosion controls (straw bales or silt fences that are effectively keyed-in) are installed downslope of cleanup/restoration activities.
- Non-invasive, non-persistent grass species (e.g., barley grass) may be used for their temporary erosion control benefits to stabilize disturbed slopes and prevent exposure of disturbed soils to rainfall.
- Upon work completion, all exposed soil present in and around the cleanup/restoration sites shall be stabilized within 7 days.
- Soils exposed by cleanup/restoration operations shall be seeded and mulched to prevent sediment runoff and transport.
- Straw Wattles (if used) shall be installed with 18 or 24 inch wood stakes at four feet on center. The ends of adjacent straw wattles shall be abutted to each other snugly or overlapped by six inches. Wattles shall be installed so that the wattle is in firm contact with the ground surface.



**BMP: Crossing Abandonment**

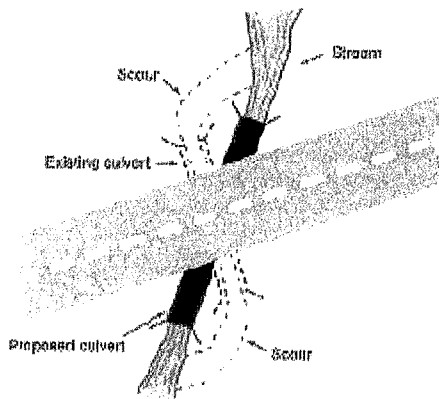
- When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade, orientation, and a width that is wider than the natural channel.
- Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- Temporary crossings shall be removed by November 15.
- Any temporary culvert crossing left in after October 15 or installed between October 15 and May 1, shall be sized to accommodate the estimated 100-year flow.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Road approaches leading to the crossing to be abandoned shall be hydrologically disconnect.
- The abandonment of a watercourse crossing shall not prevent equipment access to existing watercourse crossings not also being abandoned.

**BMP: Permanent Culvert Crossing**

- New culvert installations shall be sized to accommodate flows associated with a 100-year storm event.
- If the new culvert is replacing a poorly installed old culvert, the crossing may need to be abandoned to the following standard:
- When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade and orientation, and that is wider than the natural channel.
- Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- New culverts shall be placed at stream gradient, or have downspouts, or have energy dissipaters at outfall.
- Align culverts with the natural stream channel orientation to ensure proper function, prevent bank erosion, and minimize debris plugging. See Figure 97 below.
- Place culverts at the base of the fill and at the grade of the original streambed or install a downspout past the base of the fill. Downspouts should only be installed if there are no other options.
- Culverts should be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
- Culvert beds should be composed of rock-free soil or gravel, evenly distributed under the length of the pipe.
- Compact the base and sidewall material before placing the pipe in its bed.
- Lay the pipe on a well-compacted base. Poor basal compaction will cause settling or deflection in the pipe and can result in separation at a coupling or rupture in the pipe wall.
- Backfill material should be free of rocks, limbs, or other debris that could dent or puncture the pipe or allow water to seep around the pipe.
- Cover one end of the culvert pipe, then the other end. Once the ends are secure, cover the center.
- Tamp and compact backfill material throughout the entire process, using water as necessary for compaction.
- Backfill compacting will be done in 0.5 – 1.0 foot lifts until 1/3 of the diameter of the culvert has been covered.

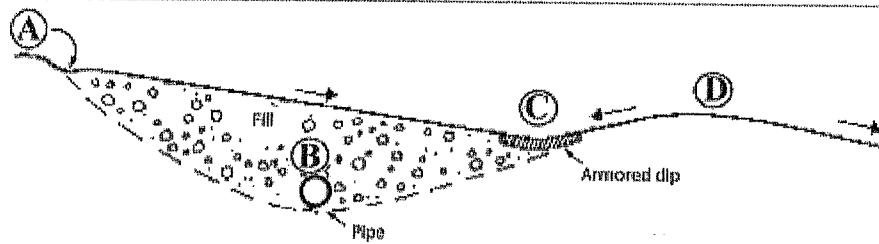
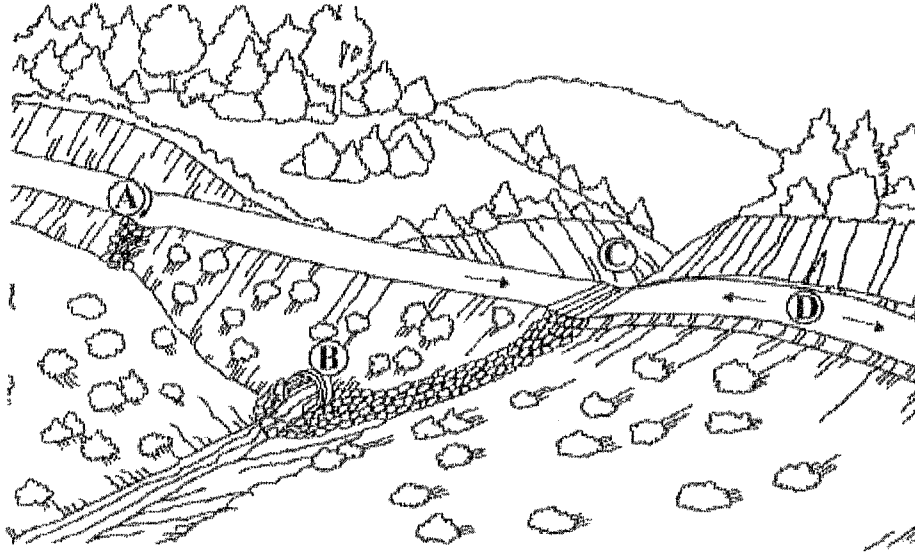
### Project Best Management Practices (Cont.)

- Push layers of fill over the crossing to achieve the final design road grade, road fill above the culvert should be no less than one-third to one-half the culvert diameter at any point on the drivable surface.
- Critical dips shall be installed on culvert crossings to eliminate diversion potential. Refer to Figure 84 below.
- Road approaches to crossings shall be treated out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment.
- Road surfaces and ditches shall be disconnected from streams and stream crossings to the greatest extent feasible. Ditches and road surfaces that cannot be feasible disconnected from streams or stream crossings shall be treated to reduce sediment transport to streams.
- If downspouts are used, they shall be secured to the culvert outlet and shall be secure on fill slopes.
- Culverts shall be long enough so that road fill does not extend or slough past the culvert ends.
- Inlet of culverts, and associate fill, shall be protected with appropriate measures that extend at least as high as the top of the culvert.
- Outlet of culverts shall be armored with rock if road fill sloughing into channel can occur.
- Armor inlets and outlets with rock, or mulch and seed with grass as needed (not all stream crossings need to be armored).
- Where debris loads could endanger the crossing, a debris catchment structure shall be constructed upstream of the culvert inlet.
- Bank and channel armoring may occur, when appropriate, to provide channel and bank stabilization.



**FIGURE 97.** Culvert alignment should be in relation to the stream and not the road. It is important that the stream enters and leaves the culvert in a relatively straight horizontal alignment so streamflow does not have to turn to enter the inlet or discharge into a bank as it exits. This figure shows a redesigned culvert installation that replaces the bending alignment that previously existed. Channel turns at the inlet increase plugging potential because wood going through the turn will not align with the inlet. Similarly, channel turns at the inlet and outlet are often accompanied by scour against the channel banks (Wisconsin Transportation Information Center, 2004).

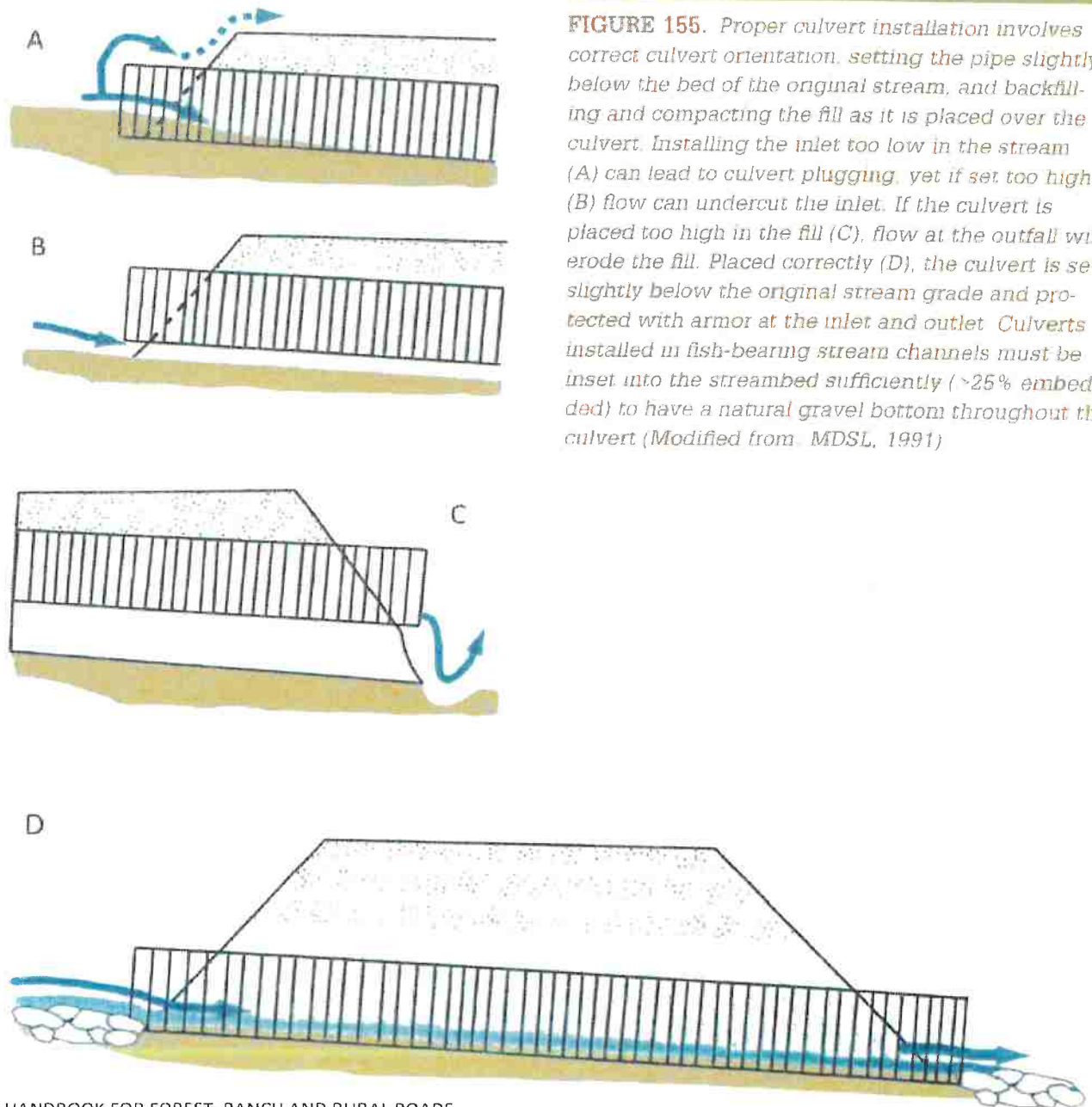
**BMP: Permanent Culvert Crossing (Cont.)**



**FIGURE 84.** Critical dips or dipped crossing fills should be centered near a stream crossing's down-road hingeline, not over the centerline of the crossing where overtopping could cause washout or severe erosion of the fill. If the stream crossing culvert (B) plugs, water will pond behind the fill until reaching the critical dip or low point in the crossing (C) and flowing back down into the natural stream channel. The down-road ditch must be plugged to prevent streamflow from diverting down the ditch line. For extra protection in this sketch, nprap armor has been placed at the critical dip outfall and extending downslope to the stream channel. This is only required or suggested on stream crossings where the culvert is highly likely to plug and the crossing fill overtopped. The dip at the hinge line is usually sufficient to limit erosional damage during an overtopping event. Road surface and ditch runoff is disconnected from the stream crossing by installing a rolling dip and ditch relief culvert just up-road from the crossing (A) (Keller and Sharar, 2003).



**BMP: Permanent Culvert Crossing (Cont.)**

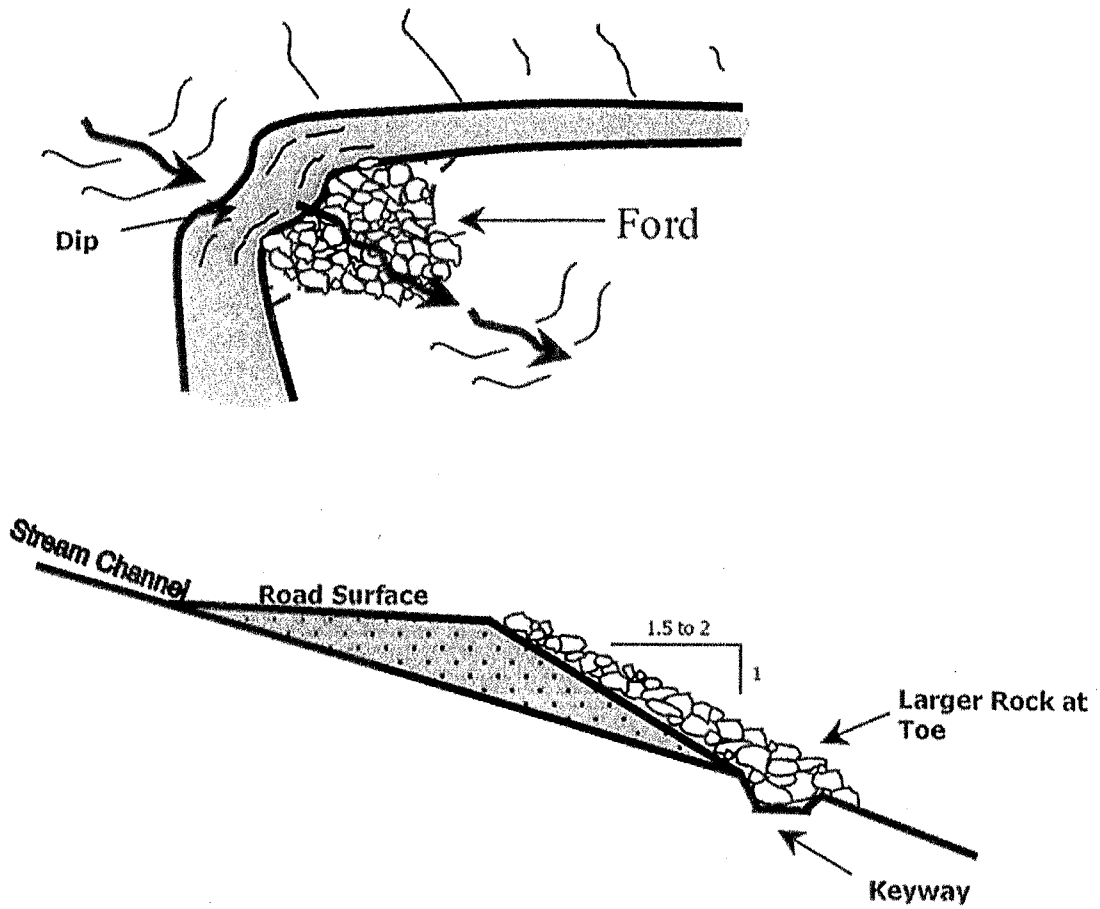


**FIGURE 155.** Proper culvert installation involves correct culvert orientation, setting the pipe slightly below the bed of the original stream, and backfilling and compacting the fill as it is placed over the culvert. Installing the inlet too low in the stream (A) can lead to culvert plugging, yet if set too high (B) flow can undercut the inlet. If the culvert is placed too high in the fill (C), flow at the outfall will erode the fill. Placed correctly (D), the culvert is set slightly below the original stream grade and protected with armor at the inlet and outlet. Culverts installed in fish-bearing stream channels must be inset into the streambed sufficiently (~25% embedded) to have a natural gravel bottom throughout the culvert (Modified from MDSL, 1991)

- **BMP: Rocked Ford**
- Rocked fords are drainage structures designed to carry watercourses across roads with little to no erosion of the road surface or fill.
- Fords constructed in-channel shall be of appropriately sized material that shall withstand erosion or displacement by expected velocities and placed in a broad, U-shaped channel to create a drivable crossing.
- The road shall dip into and out of the rocked ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the ford shall be constructed with clean rock. The rock shall be applied to a minimum depth of 6 inches.
- A range of interlocking rock armor sizes should be selected and sized so that peak flows will not pluck or transport the armor off the roadbed or the sloping fill face of the armored fill.
- The ford's outlet shall be rock armored to resist down cutting and erosion.
- Excavate the keyway and armored area - Excavate a two to three foot deep "bed" into the dipped road surface and adjacent fill slope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
- Armor the basal keyway - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
- Armor the fill - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
- Armor the top of the fill - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- Road approaches to rocked fords shall be rock surfaced out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment using rock.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Road approach rock and rock ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

**BMP: Rocked Ford (Cont.)**

**FORD:** A large dip is graded into the road at the axis of the stream channel. The outside fill face is dished out to form a spillway with large rock. On large watercourses, rock is keyed several feet into firm native soils. The road surface is rocked with 6" of minus rock .



- **BMP: Armored Ford [Fill]**

- Armored fords are watercourse crossing fills comprised primarily of rock and designed to carry watercourses across roads without erosion or displacement of installed fill material.
- Armored fords shall have a U-shaped channel to create a drivable crossing.
- The road shall dip into and out of the armored ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the armored ford shall consist of rock small enough to be easily passable by vehicle, but large enough to not be transported during high flow storm events.
- The ford's inlet shall be rock armored if a threat of head cutting exists.
- Excavate the keyway - Excavate a one to three foot deep "bed" into the inboard edge of the road
- Armor the basal keyway - place various sized rock in the constructed keyway to prevent head cutting. Use the largest rock armor to fill the keyway trench and create a buttress along the inboard edge of the road. This should have a "U" shape to it and it will define the inlet where flow leaves the natural channel and enters the road.
- The ford's outlet shall be rock armored to resist down cutting and erosion.
- Excavate the keyway and armored area - Excavate a two to three foot deep "bed" into the dipped road surface and adjacent fill slope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
- Armor the basal keyway - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
- Armor the fill - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
- Armor the top of the fill - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- Road approaches to armored fords shall surface rocked out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment using rock.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Armored ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

**BMP: Armored Ford [Fill] (Cont.)**



**FIGURE 120.** This armored fill crossing of a steep, ephemeral stream was constructed to provide a low maintenance crossing. The crossing has been deeply dipped to reduce the volume of road fill and to eliminate the potential for stream diversion. The fill slope has been heavily armored through the axis of the crossing to contain flood flows and prevent down-cutting. Armored fills cannot be used on fish bearing streams.

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS



**FIGURE 121D.** Well graded rock armor is then backfilled into the structure and spread across the breadth of the U-shaped stream crossing, and about one-third the way up the roadbed, so that streamflow will only flow over or come in contact with resistant armor material. The armor must be spread and compacted across the design width of the expected flood flow channel width so peak flows will not flank the armored structure.



**FIGURE 121E.** Two weeks after this armored fill was constructed, a storm flow event occurred and the structure maintained its function and integrity. The road approaches had not yet been compacted or surfaced with road rock.

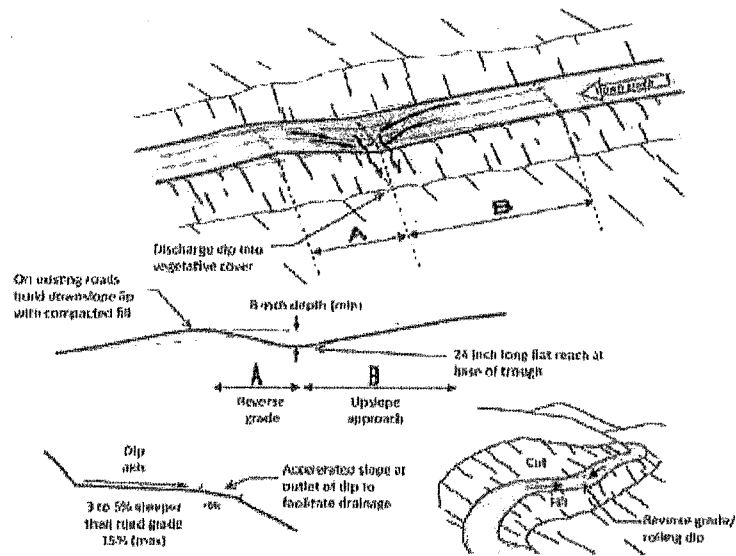


**FIGURE 121F.** The same armored fill as it appeared after the first winter flood flows. No maintenance was required to reopen the road. It is also clear that no stream diversion is possible at this stream crossing site, and the volume of fill within the crossing has been reduced to the minimum amount needed to maintain a relatively smooth driving surface on this low volume road.

- Rolling dips are drainage structures designed to capture and discharge surface water collected on road surfaces and in inside ditches at a specific location.
- The road shall dip into and out of the rolling dip to eliminate the possibility of water flowing along the road surface or in an inside ditch to bypass the dip structure.
- The rolling dip shall be constructed with clean native materials.
- The rolling dips outlet may be armored to resist down cutting and erosion.
- Do not discharge rolling dips into swales that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill.

**BMP: Rocked Rolling Dip**

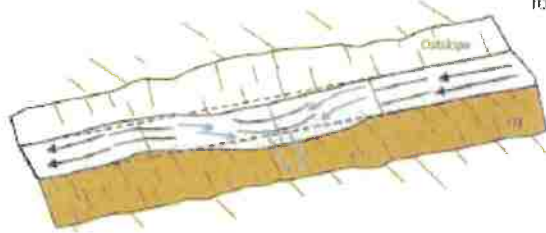
- Rocked Rolling dips are drainage structures designed to capture and discharge surface water collected on road surfaces and in inside ditches at a specific location.
- The road shall dip into and out of the rolling dip to eliminate the possibility of water flowing along the road surface or in an inside ditch to bypass the dip structure.
- The rocked rolling dips inlet and outlet shall be armored to resist down cutting and erosion.
- The entire length of the rocked rolling dip shall be rock armored to a minimum of 5-feet from the centerline of the dip.
- If a keyway is necessary, the rocked rolling dip keyway shall be constructed at the base of the dip and shall be of sufficient size, depth, and length to support materials used in the rocked rolling dip construction back up to the road crossing interface.
- Do not discharge rolling dips into swales that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill.
- The rolling dip must be drivable and not significantly inhibit traffic and road use.



**FIGURE 34.** A classic Type I rolling dip, where the excavated up-road approach (B) to the rolling dip is several percent steeper than the approaching road and extends for 60 to 80 feet to the dip axis. The lower side of the structure reverses grade (A) over approximately 15 feet or more, and then falls down to rejoin the original road grade. The dip must be deep enough that it is not obliterated by normal grading, but not so deep that it is difficult to negotiate or a hazard to normal traffic. The outward cross-slope of the dip axis should be 3% to 5% greater than the up-road grade (B) so it will drain properly. The dip axis should be out-sloped sufficiently to be self-cleaning, without triggering excessive downcutting or sediment deposition in the dip axis (Modified from: Best, 2013).

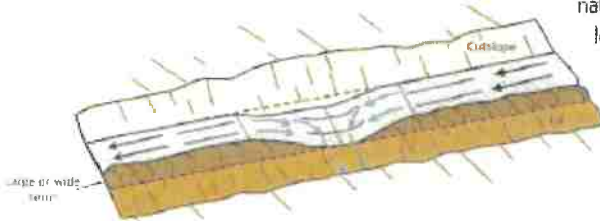


Type 1 Rolling Dip  
(Standard)



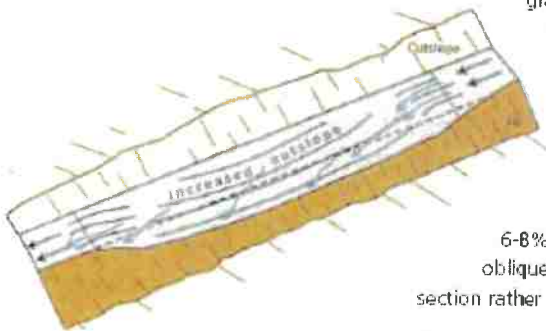
Type 1 rolling dips are used where road grades are less than about 12-14% and road runoff is not confined by a large through cut or berm. The axis of the dip should be perpendicular to the road alignment and sloped at 3-4% across the road tread. Steep roads will have longer and more abrupt dip dimensions to develop reverse grade through the dip axis. The road tread and/or the dip outlet can be rocked to protect against erosion, if needed.

Type 2 Rolling Dip  
(Through-cut or thick berm road reaches)



Type 2 rolling dips are constructed on roads up to 12-14% grade where there is a through cut up to 3 feet tall, or a wide or tall berm that otherwise blocks road drainage. The berm or native through cut material should be removed for the length of the dip, or at least through the axis of the dip, to the extent needed to provide for uninterrupted drainage onto the adjacent slope. The berm and slope material can be excavated and endhauling, or the material can be sidecast onto native slopes up to 45%, provided it will not enter a stream.

Type 3 Rolling Dip  
(Steep road grade)



Type 3 rolling dips are utilized where road grades are steeper than about 12% and it is not feasible to develop a reverse grade that will also allow passage of the design vehicle (steep road grades require more abrupt grade reversals that some vehicles may not be able to traverse without bottoming out).

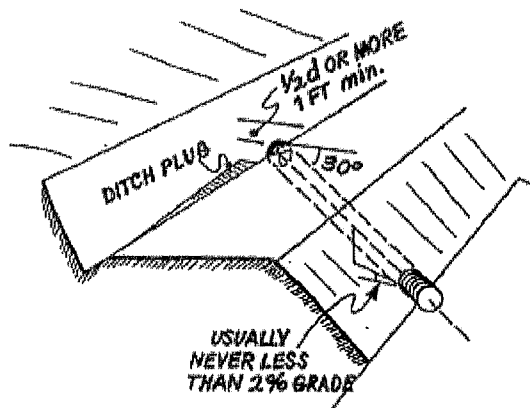
Instead of relying on the dip's grade reversal to turn runoff off the roadbed, the road is built with an exaggerated outslope of 6-8% across the dip axis. Road runoff is deflected obliquely across the dip axis and is shed off the outsloped section rather than continuing down the steep road grade.

FIGURE 36. Rolling dip types

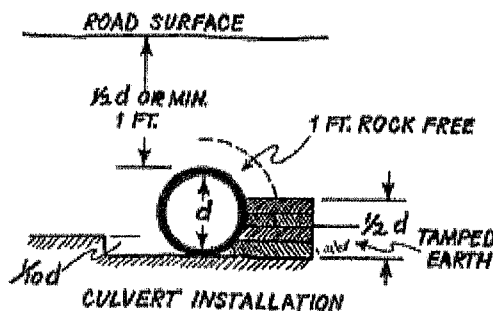
**BMP: Rolling Dip and Rocked Rolling Dip (Cont.)**

BMP: Ditch Relief Culvert

- Install ditch relief culverts at an oblique (typically 30 degree) angle to the road so that ditch flow is not forced to make a sharp angle turn to enter the pipe. On low gradient roads (<5%), where ditch flow is slow, ditch relief culverts can be installed at right angles to the road.
- Install ditch relief culverts (DRC) to outlet at, and drain to, the base of the fill.
- If it cannot be installed at the base of the fill, install the DRC with a grade steeper than the inboard ditch draining to the culvert inlet, and install a downspout on the outlet to carry the culvert flow to the base of the fillslope.
- Downspouts longer than 20 feet should be secured to the hillslope for stability.
- Ditch relief culverts should not carry excessive flow such that down cutting of the ditch line or gullying below the outlet occurs.
- Do not discharge flows from ditch relief culverts onto unstable fill or active landslides.
- If the ditch is on an insloped or crowned road, consider using outsloping to drain the road surface. The ditch and the ditch relief culvert would then convey only spring flow from the cutbanks and hillslope runoff, and not turbid runoff from the road surface.



**FIGURE 48.** The elements of a properly installed ditch relief culvert. The culvert is angled at about 30 degrees to the road alignment to help capture flow and prevent culvert plugging or erosion of the inlet area. It is set at the base of the fill (ideally) or with a grade slightly steeper than the grade of the contributing ditch (but never with a grade less than 2 percent) (USDA-SCS, 1983). At a minimum, the grade of the ditch relief culvert should be sufficient to prevent sediment accumulation at the inlet or deposition within the culvert itself (it should be self-cleaning) (USDA-SCS, 1983).



**BMP: Ditch Relief Culvert (Cont.)**



**FIGURE 39.**

*Waterbars are often used to drain surface runoff from seasonal, unsurfaced roads. Because they are easily broken down by vehicles, waterbars are only used on unsurfaced roads where there is little or no wet weather traffic. In this photo, a waterbar and ditch relief culvert are used to drain all road surface and ditch runoff from the insloped road prism.*



**FIGURE 238.** Traffic and surface runoff from graveled roads often produces surface erosion, turbid runoff and fine sediment transport that can be delivered to streams. Where ditches can't be eliminated, sediment traps and roadside settling basins can be installed to capture and remove most of the eroded sediment. This settling basin has been constructed along the inside ditch just before a stream crossing culvert inlet (see arrow). Eroded sediment from the road and ditch are deposited in the basin before flow is released to the stream. Fine sediments have filled about 1/3 of this basin and vegetation is now growing. Sediment basins require periodic maintenance to maintain their storage capacity.

**BMP: Inlet and Outlet Armoring**

- Inlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert.
- Outlets of culverts shall be provided a rocked energy dissipater at the outfall of the culvert.
- Outlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert if road fill sloughing into channel can occur.
- Prior to inlet and outlet rocking, the inlet and outlets shall be prepared. Preparation will include removal of vegetation and stored materials from the inlet and outlet.
- Inlets may require construction of an inlet basin.
- Slopes at the outlet should be shaped to a 2:1 or natural slope prior to placing rock armor.
- Rock used at culvert inlets and outlets should be a matrix of various sized rocks and rip-rap that range from a 3" dia. to a 2' dia.
- The largest rocks should be places at the base of the culvert or fill. Incrementally smaller rocks shall be placed over the larger rocks at the armoring extend up the slope. Voids and spaces shall be back filled with smaller gravels and rocks.

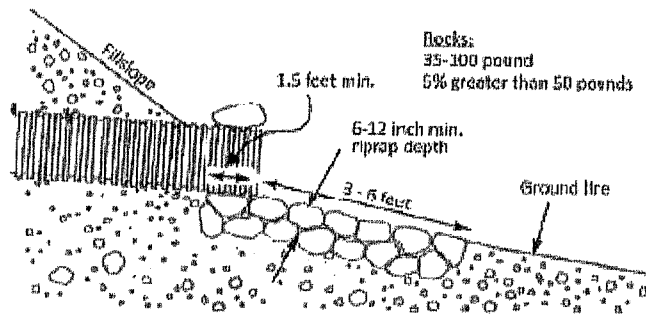


FIGURE 107A. Riprap armor at culvert outlet (Modified from: Keller et al., 2011).

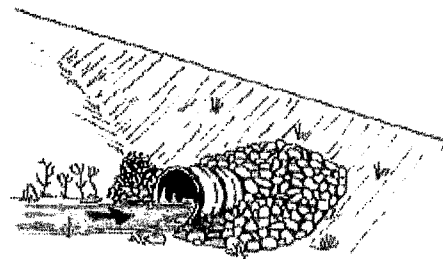


FIGURE 107B. Riprap armor at culvert inlet (Keller and Sherat, 2003).