

Landscape Inspection Training

For Landscape Architects, Construction Inspectors
and Resident Engineers



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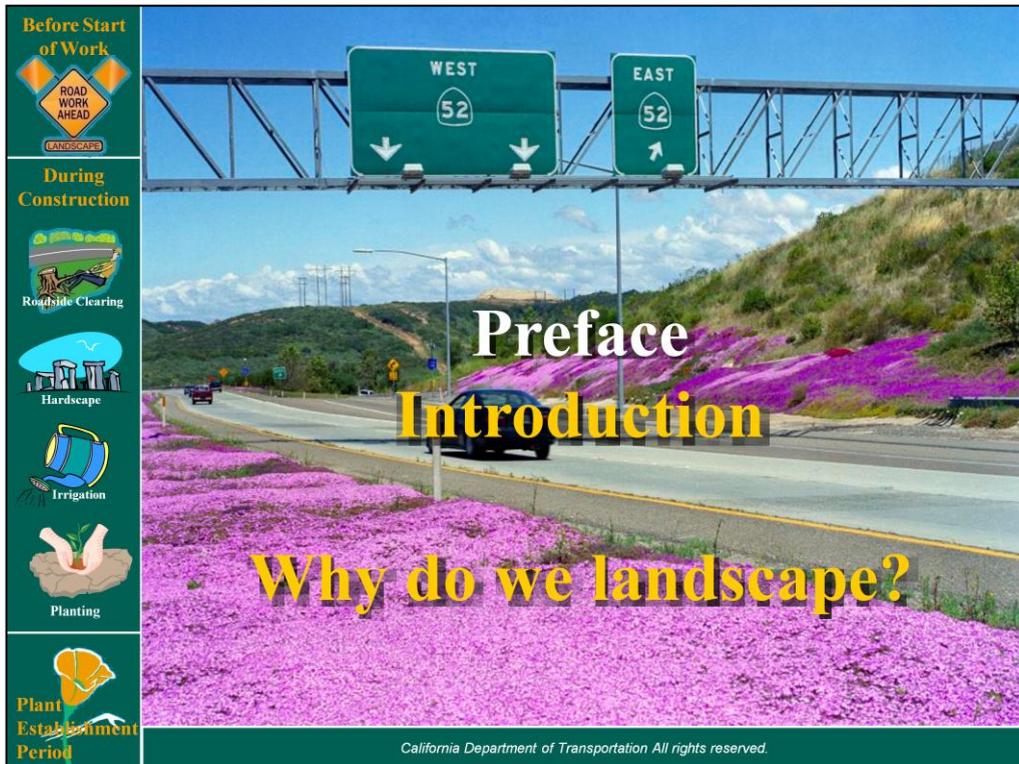
This training has been adopted from the classroom training Landscape Inspection (G100007) that was developed for Construction and delivered in 2009. It has been modified to be compatible with an on-line format rather than a classroom setting.

The training has been updated to reflect current practices and standards as necessary.

This training module includes the PowerPoint presentation slides and speaker notes from the classroom training. This presentation condenses the information presented in the accompanying Landscape Inspection Manual. As you proceed, follow along in the Manual for more detailed training information.

<p>Before Start of Work</p> 	<h1 style="text-align: center;">Landscape Inspection</h1> <ul style="list-style-type: none"> •Preface •Chapter 1 •Chapter 2-1 •Chapter 2-2 •Chapter 2-3 •Chapter 2-4 •Chapter 3 •Chapter 4 <div style="float: right; text-align: right;"> <ul style="list-style-type: none"> <u>Introduction</u> <u>Before Start of Work</u> <u>Roadside Clearing</u> <u>Hardscape</u> <u>Irrigation</u> <u>Planting</u> <u>Plant Establishment</u> <u>Plant Identification</u> </div>	
<p>During Construction</p>  <p>Roadside Clearing</p>		
 <p>Hardscape</p>		
 <p>Irrigation</p>		
 <p>Planting</p>		
 <p>Plant Establishment Period</p>	<p><small>California Department of Transportation All rights reserved.</small></p>	

This training module follows the same construction sequence as in the Landscape Inspection Manual. An optional section is included on the identification of plants commonly planted along the state's roadsides. This Plant ID section was part of the original classroom training but was not included in the Manual.

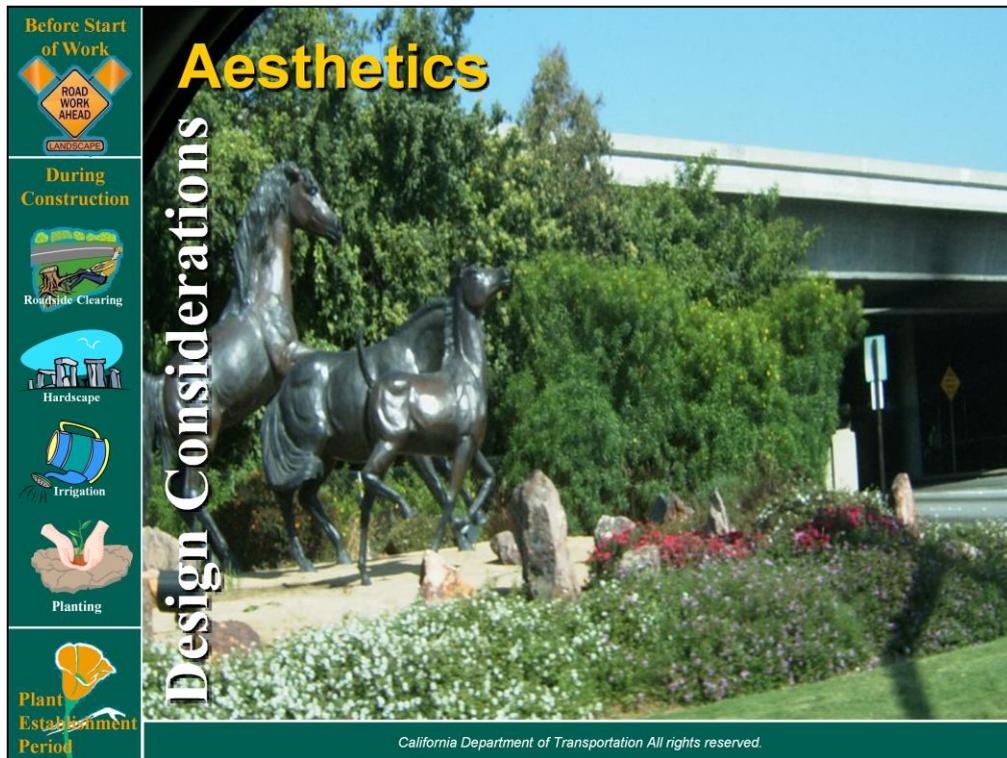


Highway planting is vegetation placed for safety, environmental mitigation, aesthetic, storm water pollution prevention, or erosion control purposes, and includes necessary irrigation systems, inert materials, wood mulches, and design for safety features. In addition, highway planting is used to satisfy the need for headlight glare reduction, fire retardant, windbreak protection, or graffiti reduction on retaining walls and noise barriers.

The public expects Caltrans to provide aesthetically pleasing highways that are integrated into surrounding communities and the natural environment. Landscaping is one of the tools Caltrans uses to effectively meet the desires and expectations of local communities. The public understands that landscaping can boost the image of their community, protect property values, and improve their overall quality of life.

We will briefly go over some landscape considerations:

- Aesthetics
- Traveler & Worker Safety
- Environmental Mitigation
- Functional

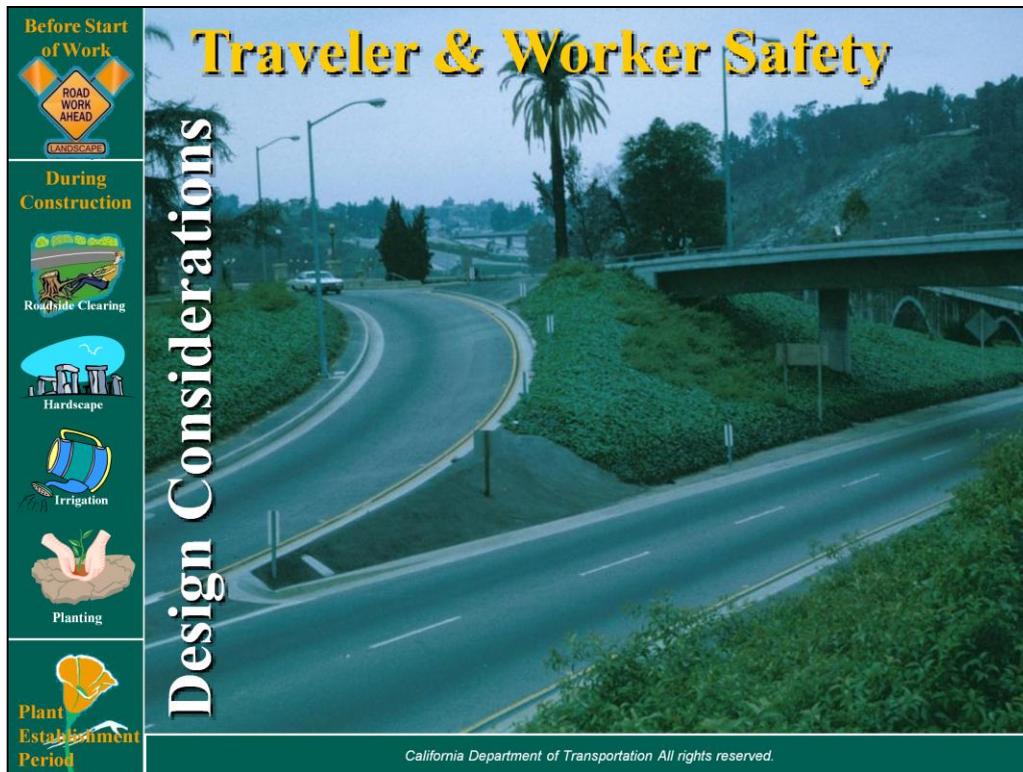


Freeway exits and entrances are no longer just thought of as on- and off-ramps but as *gateways* to the adjacent community. Aesthetics helps to integrate the highway facility into the context of the adjacent community or the natural environment. The consideration of a community’s aesthetic and scenic values during the planning and design of a highway helps Caltrans to be a good neighbor and helps in getting highway improvement projects accepted by the community.

Landscaping is used to soften the impact of objectionable types of views to improve corridor aesthetics:

- Screen objectionable views such as toward dump sites or salvage yards.
- Screen distracting views towards airports, race tracks, etc.
- Screen objectionable views of the freeway from homes, schools, etc...

Replacement Planting replaces vegetation installed by Caltrans or others that has been damaged or removed due to roadway construction. Revegetation provides planting to replace native vegetation damaged or removed due to roadway construction. Planting materials and designs should be regionally appropriate and visually compatible with local indigenous plant communities or surrounding landscaping. Contour grading and careful preservation and enhancement of existing vegetation and natural features are other techniques used to integrate the highway facility into the surroundings.



Plants are selected to maintain sight distance and clear recovery zone setbacks. A clear recovery zone provides areas for errant vehicles to regain control. Planting must not interfere with the function of safety features such as shoulders, barriers, guardrail, traffic or regulatory devices, warning and guide signs or with motorists' view of the road. Planting and irrigation facilities are designed to ensure the safety of both maintenance workers and the public. Highway planting projects incorporate safety concepts that include, but are not limited to the following:

Access

- Access gates for maintenance workers from local streets and frontage roads.
- Maintenance access roads provide access to the center of interchange areas or other wide, flat areas.
- Paved maintenance vehicle pullouts located where access cannot be made from local streets and roads.

Minimize Worker Exposure to Traffic

- Irrigation system components and vegetation are located away from shoulder areas, gore areas, and narrow areas adjacent to traveled way to reduce the need for shoulder or lane closures.
- Irrigation components that require regular maintenance are placed outside the clear recovery zone or behind safety devices.
- Narrow dirt areas and areas beyond the gore are paved.

Automated Irrigation systems and remote control devices are used to minimize worker exposure and allow for effective water management. Irrigation components are clustered and located adjacent to access gates, maintenance vehicle pullouts, maintenance access roads or other areas away from traffic.

Environmental Mitigation

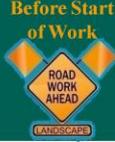
Design Considerations



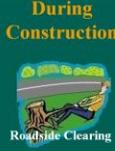
Streambed Restoration



Habitat Restoration



**Before Start
of Work**



**During
Construction**



Hardscape



Irrigation



Planting



**Plant
Establishment
Period**

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Mitigation provides planting and other work necessary to mitigate environmental impacts due to roadway construction. The work is necessary to comply with legally required environmental mitigation or permit requirements. Examples of work involved in mitigation planting may include:

- Creation, restoration, or enhancement of habitat such as wetlands, oak woodlands, etc.
- Planting trees in front of large structures to reduce their visual impacts.

Functional

Design Considerations

Before Start of Work
ROAD WORK AHEAD

During Construction
Roadside Clearing
Hardscape
Irrigation
Planting

Plant Establishment Period

Prevent Erosion

Eliminate Fire Hazards

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Functional landscapes:

- Reduce erosion, dust, and fire hazard (Well established planting will prevent weeds which presents a fire hazard.)
- Reduce headlight glare (median and ramp glare blocking)
- Delineate the traveled way - Maintain sight distances
- Provide wind breaks (sand and snow)
- Restore wildlife habitat (environmentally sensitive)
- Accomplish mitigation

<p>Before Start of Work</p> 	<h1>Site Distance & Clear Recover Zone</h1>
<p>During Construction</p>     <p>Plant Establishment Period</p>	<ul style="list-style-type: none"> • Sight Distance 50' setback > 2' height • Clear Recovery Zone 40' setback trees 4" diameter or >.  
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Safety is of primary importance, and is not subordinate to aesthetics. Two types of safety setbacks affect the placement of landscape elements:

- **Sight distance** setbacks keep the continuous length of highway ahead visible to the driver.

In interchange areas, generally, from the edge of traveled way, a 50-foot setback within the loops is considered as the sight distance setback for trees and shrubs that will grow above a 2-foot height.

- **Clear recovery zone** setbacks provide areas for errant vehicles to regain control. The policy along freeways and expressways, including interchange areas, is to strive for 40 feet or more of clearance between the edge of traveled way and large trees, but with a minimum clearance of 30 feet. The 30-foot distance is measured horizontally to the trunk of the tree. Large trees may be planted within the 30-foot minimum setback limit where they will not constitute a fixed object; for example, on cut slopes above a retaining wall or in areas behind guard railing which has been placed for reasons other than the tree planting.



Shortage of Water-How do we maximize this limited resource?

- Provide safe and even distribution of water: automatic irrigation systems and Remote Irrigation Control Systems (RICS)
- Minimize runoff and erosion
- Irrigate according to plant needs
- Irrigate at night
- Plant native or drought tolerant plants.
- Utilize reclaimed water whenever feasible. Reclaimed water regulations must be adhered to: signing, no cross connections to domestic water, no backflows, etc.
- Use of inert materials such as decomposed granite or crushed rock, wood mulch, etc.

Government Regulations

- Outdoor advertising act; No planting trees in front of existing signs.
- Pesticide reduction; Only pesticides listed in the specifications are to be used and the usage shall be monitored very closely. Environmental Protection Agency (EPA) is a very big concern for Caltrans.
- Safe Drinking Water Act (1986); Current commitment requires Caltrans to reduce herbicide usage. Reference is the CT Maintenance Manual, Chapter C2, Section C2.03 and the Caltrans Vegetation Control Policy
- Protection of endangered species
- Caltrans Storm Water Construction General Permit; No dumping of chemicals into drains, etc.

Types of Landscape Projects

- Stand-alone Landscaping
- Roadway Construction w/ Landscaping

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Stand-alone landscape projects:

- New Highway Planting w/Type I Plant Establishment (PE)
- Highway Planting Restoration w/ Type 1 PE
- Functional (headlight glare screening, wind breaks)
- Environmental mitigation
- Revegetation

Roadway Construction w/Landscape

- New freeways, widening, soundwalls, bridge rehabs, etc. w/ Type 2 PE.



Available Help

- Landscape Architect
- Landscape Specialist
- Maintenance Landscape Superintendant



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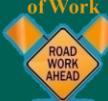
*We are all colored **ORANGE**.*

The only dumb question is the one you don't ask.

When questions concerning the landscaping arise during construction you should first contact the Landscape Architect who prepared the PS&E. The Landscape Architect's name can be found on the project plans.

Other helpful contacts will be the Landscape Specialist and the Maintenance Landscape Superintendent for the project. These Maintenance contacts should be listed in the Resident Engineer File provided by the Landscape Architect.

Before Start of Work



During Construction






Plant Establishment Period



Maintenance Resources

- **29,380 Landscaped Acres**
- **Caltrans Average PYs**
 - 1970: 1 PY / 20 Acres
 - 2007: 1 PY / 51 Acres
 - 2011: 1 PY / 62 Acres
- **3-Year Plant Establishment Period**



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Caltrans currently has 29,380 acres (2009 data) of irrigated landscaping that requires on-going maintenance. The amount of acreage that one maintenance worker is responsible for has been steadily increasing over the years. It becomes more difficult year after year to meet the public's expectations for clean and maintained roadsides.

Caltrans has determined that a 3-year Plant Establishment Period is required to adequately establish new plantings. Plants that are well established require less attention from Maintenance once they take over the maintenance responsibilities from the contractor at the end of the PE period.

That is why it is **CRITICAL** that the plantings and irrigation systems be installed properly and the requirements of the plant establishment period is strictly enforced according to the plans and specifications.

<p>Before Start of Work</p> 	<h1 style="text-align: center;">Review Questions</h1> <ol style="list-style-type: none"> 1. Name 4 reasons why we provide landscaping on a highway. 2. Name 3 safety concepts used to improve maintenance workers 3. What policies maximize our limited water resources? 4. What government regulations are needed to be aware of? 5. What are the 2 general types of landscape projects?
<p>During Construction</p>  <p>Roadside Clearing</p>	
 <p>Hardscape</p>	
 <p>Irrigation</p>	
 <p>Planting</p>	
<p>Plant Establishment Period</p> 	

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1. Aesthetics; safety; environmental mitigation; storm water pollution control; erosion control; head light glare reduction; fire retardant; wind break; graffiti reduction.
2. Provide safe access (gates, roads, MVPs); Minimize maintenance worker exposure (locate irrigation components away from the traveled way and outside the clear recovery zone); Use automated irrigation systems.
3. Use water efficient or native plants; utilize reclaimed water and irrigate at night (minimize demand during peak water usage); use of inert materials and wood chips; provide safe & even distr. of water w/ auto. controllers and RICS
4. Outdoor advertising act; Pesticide reduction; Safe drinking water act; Protection of endangered species; Storm Water Construction General Permit.
5. Stand-alone landscaping projects; Roadway Construction with landscaping included.



Before Start of Work



Plant Establishment Period

MEMORANDUM

To: Landscape Inspection Trainee
FROM: T. Rex, Resident Engineer
SUBJECT: First Commandment



“Thou shall know the plans, special provisions, *Standard Specifications* and *Standard Plans* better than ANY Contractor”

Before Start of Work

During Construction

Roadside Clearing

Hardscape

Irrigation

Planting

Plant Establishment Period

Chapter 1 Before Start of Work

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Review the Project Plans and Special Provisions and prepare for the following to be done before the start of the Construction period:

- Review Job Site
- Service Installations
- Pre-Construction Meeting
- Pre-job Submittals
- Standard Contract Change Order

 **Before Start of Work**

Project Review

- **Field Review (Take lots of Photos!):**
 1. Existing plants and irrigation
 2. Fences and drainage facilities
 3. Signs, markers for irrigation crossover
 4. Erosion
 5. Weeds
 6. Pests: Gophers, rats, & ground squirrels
- **Internal Kick-Off Meeting**
 1. Attendees
 2. Bidders Questions
 3. RE File



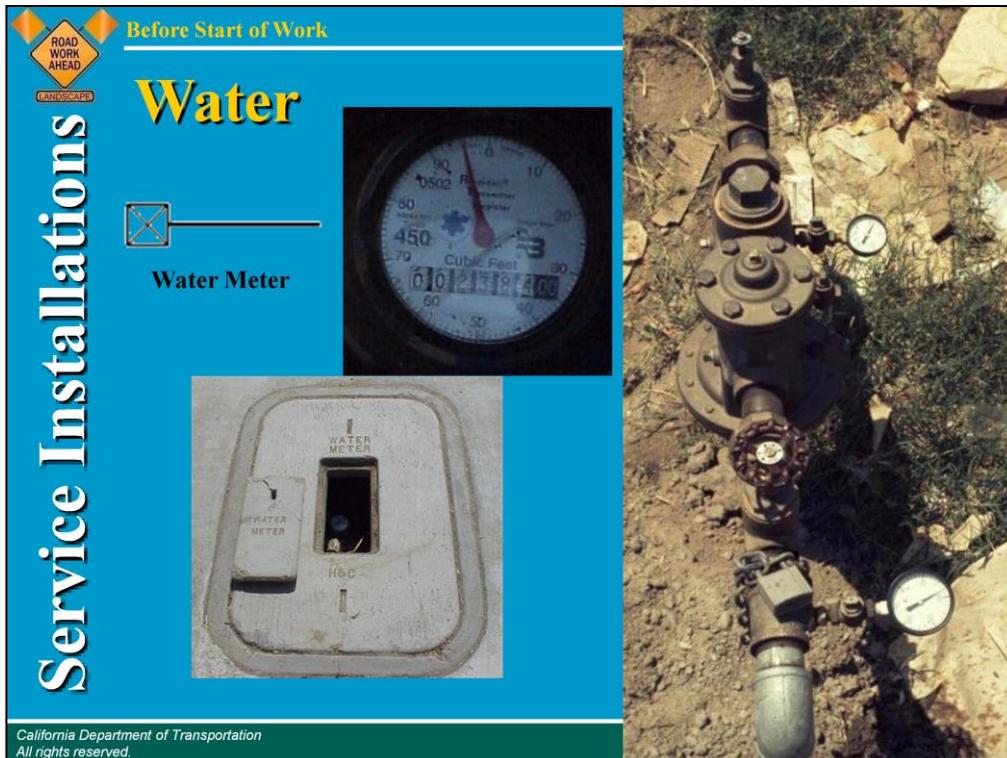
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Field Review

- Review the project to visualize the desired finished product.
- Utilize contract plans to identify potential problem areas.
- Take photos of existing conditions. Identify time and location of all photos. Keep photos in project files.

Internal Kick-off Meeting:

- An in-house meeting for Caltrans staff to review bidder's questions and any potential problems. Attendees include: Landscape Architect, Construction Landscape Specialist and Maintenance Supervisor.
- This meeting is important so that there are no surprises or disagreements at the pre-construction meeting held with the contractor.
- Transfer of RE Pending File from Design. Review commitments made to adjacent properties and/or communities.

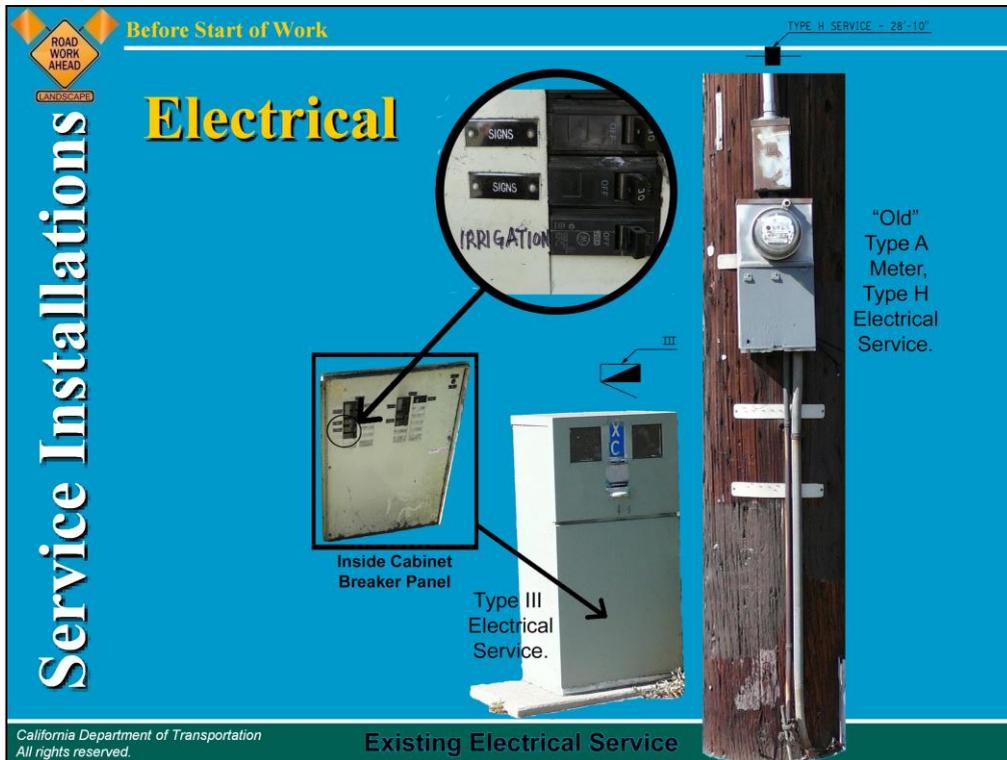


Water Meters are USUALLY installed by the water company but sometimes the contractor installs. Special provisions identify who installs.

Test water pressure at backflow preventer to see if it matches the design pressure noted on the plans.

If higher or lower, contact the Landscape Architect. Generally if:

- HIGHER - a pressure reducing valve may be needed.
- LOWER - a booster pump may be needed.



Landscape projects, in general, will use the existing electrical service available on the project. If a new electrical service is required, contact the Construction Electrical Specialist for assistance.

For existing electrical services, verify;

- Location shown on the plans.
- Cabinet is energized (voltage is still being supplied).
- Available space for the additional circuit breaker.

Contractor should test for voltage at the electrical service cabinet.



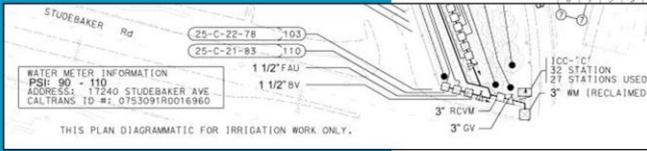
Before Start of Work

Water "Sample"

Service Installations

Responsibilities

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
UTILITY SERVICE REQUEST
 FA2134 (NEW 7/2005) Copy Form for Billing



WATER METER INFORMATION
 PSH: 90 + 110
 ADDRESS: 17240 STUDEBAKER AVE
 CALTRANS 10 #1: 0753091R0016960

THIS PLAN DIAGRAMMATIC FOR IRRIGATION WORK ONLY.

- Turn-On Notice
- Monitor Expenditures
- Transfer Notice
- Termination Notice

HIGHWAY UTILITY INFORMATION ONLY														
18	Dist. Dist.	Unit	Chg. Dist.	EA	EA	Class	Spec. Dist.	Approved By:	Phone					
CONST.	07	300	07	002963	2	300		I. R. Engineer	(562) 555-1234					
MAINT. 26														
21. SERVICE TYPE EXISTING <input type="checkbox"/> METERED <input type="checkbox"/> FLAT RATE <input type="checkbox"/> VOLTAGE <input checked="" type="checkbox"/> ELECTRICAL <input type="checkbox"/> POTABLE <input type="checkbox"/> WATER														
LUMINAIRES <input type="checkbox"/> RECLAIMED <input checked="" type="checkbox"/> OTHER <input type="checkbox"/>														
WATTS	75	150	175	180	200	250	300	350	400	700	1K	HPG	LPH	WV
EXISTING														
NEW														
REMOVE														
SIGN NUMBERS <input type="checkbox"/> WATTAGE <input type="checkbox"/> BILL BILLING TO: CALTRANS (562) 555-1234 (562) 555-1234 P.O. Box 18000 Sacramento, CA 95818-8520														
23. DISTRICT UTILITY COORDINATOR TELEPHONE: (213) 555-4321						24. UTILITY COMPANY REPRESENTATIVE TELEPHONE: (562) 555-3333								
D. I. Coordinator: Construction, Maintenance, Traffic/Electrical Design, Utility Coordinator, Utility Payment Section (316-227-4243)														
* Highway Utilities include: Street Lights, Ramp Meters, Traffic Signals, Irrigation Systems, etc.														
ADA NOTICE: For individuals with hearing disabilities, this document is available in alternate formats. For information call (916) 654-8410 or TDD (916) 654-3888 or Utility Records and Forms Management, 1125 N Street, MS-68, Sacramento, CA 95814.														

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- Service requests responsibilities include:
- Turn-on notice: contact service utility, providing Construction cost expenditure authorization (EA).
 - Monitor project utility service expenditures because utility billings come out of the project contingency funds.
 - Transfer notice: transfer utility billings from Construction EA to Maintenance EA.
 - Termination notice: shut off utility when service is no longer needed.

 **Before Start of Work**

Pre-Construction Meeting

- Attendees
- Safety
- Submittals
- Contract Time
- Contractor's Yard
- Equipment
- Progress Inspection



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Attendees should include:

- Representatives from Safety, Storm Water, and Labor Compliance who will make presentations.
- Maintenance Supervisor and the Landscape Architect to answer specific questions from the Contractor that the Resident Engineer cannot answer.

ROAD WORK AHEAD
LANDSCAPE

Before Start of Work

Safety

- Open Trench
- Shoulder Closures



Pre-Construction Meeting

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Safety is a primary objective in any construction job. Warning signs, equipment use, awareness, lane/shoulder closures, crossovers pits & trenches, and any pertinent Cal OSHA requirements are discussed at the pre-construction meeting.

- Based on traffic uniform codes, *Landscaping Ahead* signs, for temporary traffic control, are no longer permissible. Use of a *Right Shoulder Closed Ahead* sign will provide the traveling public with an awareness that work or workmen are off to the sides of the roadway and not on the roadway. A shoulder closure must be used if workers stop their vehicles on the shoulder within 6' of traveled way to do work.
- The Construction Manual states that construction warning signs should be removed at the start of plant establishment. Various districts keep them up during plant establishment for liability purposes.

ROAD WORK AHEAD
LANDSCAPE

Before Start of Work

Pre-Construction Meeting

Submittals

- **Plant Material Ordered**
- **Pesticide Program**
- **Booster Pump**
- **Solvent Cement**
- **Wiring Plans and Diagrams**

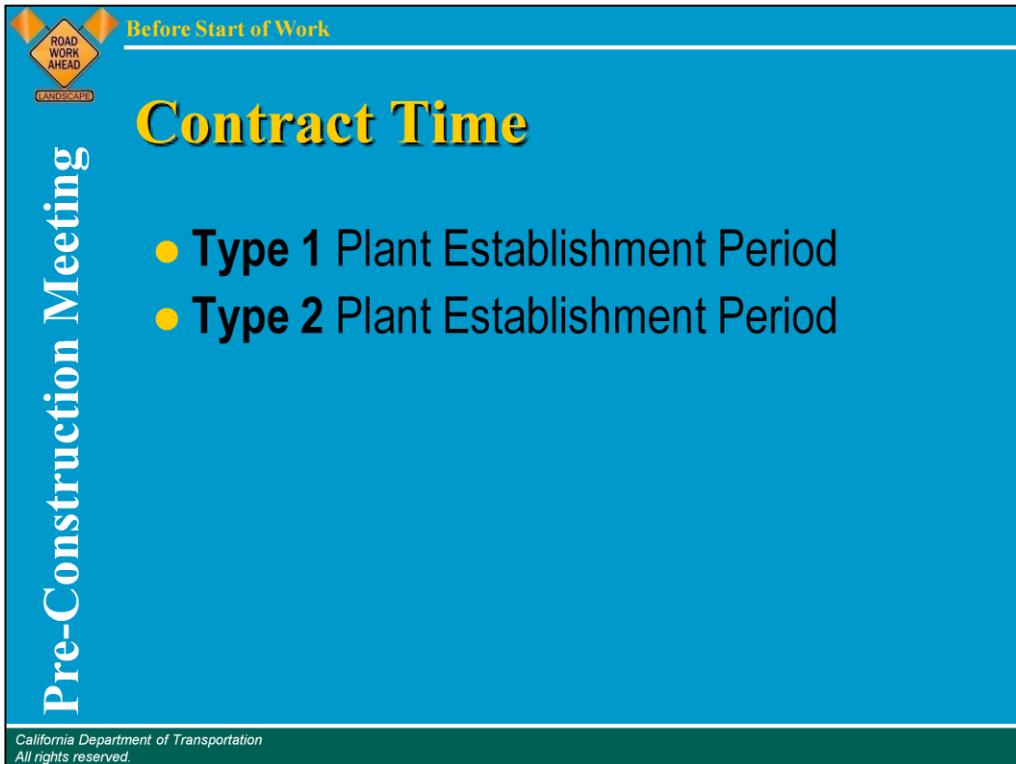


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Know what submittals are required by the project. Some of the submittals that are unique to Landscape projects include:

- Plant Materials ordered: Statement from vendor that plants have been ordered.
- Pesticide Program: Licensed Pest Control Advisor's recommendations.
- Booster Pump: Shop drawings, product data, maintenance and operations manual.
- Solvent Cement: Copy of printed instructions.
- Wiring Diagram & Sizing: Shop drawings for electrical components.

Some submittals require approval by the Engineer and others are for information only. The Specifications will tell you when an approval is required.



The slide features a blue background with a white border. In the top left corner, there is a diamond-shaped sign with the text 'ROAD WORK AHEAD' and 'LANDSCAPE' below it. To the right of the sign, the text 'Before Start of Work' is written in a small font. The main title 'Contract Time' is displayed in a large, bold, yellow font. Below the title, two bullet points are listed: 'Type 1 Plant Establishment Period' and 'Type 2 Plant Establishment Period'. On the left side, the text 'Pre-Construction Meeting' is written vertically in a white font. At the bottom left, the text 'California Department of Transportation' and 'All rights reserved.' is written in a small font.

ROAD WORK AHEAD
LANDSCAPE

Before Start of Work

Contract Time

- Type 1 Plant Establishment Period
- Type 2 Plant Establishment Period

Pre-Construction Meeting

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Review the contract time to determine the limits of the construction planting period and the plant establishment period (PEP). Plant establishment work is routine maintenance to ensure that the plants grow, the irrigation systems functions properly and weeds and trash are controlled.

Rain days during the construction planting period are usually considered non-working days. Rain, fog, wind, or snow days during the plant establishment period are work days, because these weather conditions do not stop the plants from growing.

For a **Type 1 PEP**, the contractor must complete all work except plant establishment before the PEP begins. Only plant establishment work may be in progress during the PEP.

Type 1 PEP usually applies on stand-alone landscape projects only.

Type 2 PEP is normally applied to roadway construction projects that includes landscape work. Two time periods are specified for projects with Type 2 PEP. An amount for liquidated damages is specified for each time period. The following are the two time periods:

- The number of working days for all work except plant establishment.
- The total number of working days for all contract work, including the PEP.

For Type 2 PEP the contractor must complete all highway planting work before the PEP begins. In addition to plant establishment work, other contract work may be in progress during the Type 2 PEP.

ROAD WORK AHEAD
CONSTRUCTION

Before Start of Work

Contractor's Yard?

Pre-Construction Meeting



I don't think so!!

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Contractor's Yard inside R/W?

The contractor may wish to establish a work yard within the State's R/W. Approval must be obtained from the RE. FIRST, check the special provisions and plans to see if it is allowed by the project. The Contractor must provide the RE with the proposed location marked on a set of plans, identifying ingress/egress, and a written plan addressing maintenance and removal of yard at completion of the contract. When this documentation is received, the Engineer will consider the request.

ROAD WORK AHEAD
LANDSCAPE

Before Start of Work

Pre-Construction Meeting

Equipment

- **Equipment on-site**
- **Contractor's vehicles**



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Work equipment must have required safety components: seat belts, roll-over bars, emergency stop bars for shredders, goggles, gloves, etc.

Work vehicles must display the contractor's name and/or logo. The equipment ID number must match the Contractor's Equipment List.

Personal vehicles are not allowed on the State R/W.



Before Start of Work

Progress Inspections

- During Pressure testing of pipe
- During testing low voltage connectors
- Before planting begins and after holes prepared
- Before plant establishment work begins
- Once a month during the Plant Establishment Period

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The RE performs progress inspections at these stages of the project. Do not progress beyond each stage of work until the inspection has been completed, corrective work has been performed, and the work accepted.



Before Start of Work

Review Questions

1. **What are the two preliminary construction meetings?**
2. **What are 4 contractor required submittals unique to Landscape Projects.**
3. **At what stages of construction are progress inspections performed?**

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Answers:

1. *In House* Kick-off & Pre-construction Meeting
2. Plant materials order, Pesticide program, Booster Pump installation and instructions, Electrical Irrigation Components (Low Voltage Wiring diagram/sizing)
3. -During Pressure testing of pipe
-During testing low voltage connectors
-Before planting begins and after holes prepared
-Before plant establishment work begins
-Once a month during the Plant Establishment Period



Before Start of Work

MEMORANDUM

TO: Landscape Inspection Trainee

FROM: T. Rex, Resident Engineer

SUBJECT: Second Commandment

“At all times when in the field doing inspection, thou shall have the project plans, special provisions, Standard Specifications and Standard Plans with thee”



Chapter 2-1: During Construction Roadside Clearing

Before Start of Work
ROAD WORK AHEAD
LANDSCAPE

During Construction
Roadside Clearing
Hardscape
Irrigation
Planting
Plant Establishment Period

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The first phase of work on a Landscape project is normally Roadside Clearing. Roadside Clearing work is to be done prior to beginning work on hardscape or the irrigation system.

Document existing conditions prior to any work being done:

Remember to take lots of PHOTOS!!

During Construction: Roadside Clearing

Review with Contractor

- ❑ **Limits of roadside clearing**
- ❑ **Slope Repair**
- ❑ **Sequence:**
 - **Trash Pick-up**
 - **Mowing**
 - **Pest Control**
 - **Pesticides**
 - **Maintain until start of PEP**

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The limits of Roadside Clearing should be delineated on the project plans.

Areas to be maintained within the job limits:

- New landscape areas
- Existing landscape areas
- Work areas with no landscape
- DSA -Disturbed Soil Areas
- ESA – Environmentally Sensitive Area

Areas to be maintained during construction phase and plant establishment phase shall be identified in the special provisions. Sometimes there are existing landscape areas where no work is to be done and either the Maintenance Branch maintains it or it may be done by the contractor.



Do NOT allow the contractor to denude slopes. Repairing of slopes damaged prior to contract is done by CCO, funds in Supplemental allocation.

Slope damage caused by the Contractor is repaired at HIS expense.



Mowing



Different types of mowing machinery may be used. The specifications will identify mowing height or other requirements.

 **During Construction: Roadside Clearing**

Pest Control



- **Rodents**
- **Insects**
- **Noxious Weeds**

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• **Rodents** have sharp incisors that they use to gnaw wood, break into food, and bite predators. Most eat seeds or plants, though some have more varied diets. Some species have historically been pests, eating human seed stores and spreading disease.

• Many **insects** are considered pests by humans. Insects commonly regarded as pests include those that are parasitic transmit diseases, damage structures, or destroy agricultural goods.

• **Noxious Weeds** are introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations.



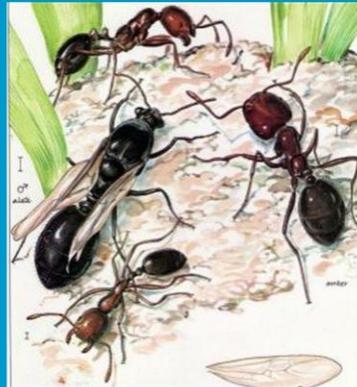
- For **gophers**, traps are the best method of control. When the first gophers are trapped and killed, leave the carcass in the covered hole, it will chase the rest from the area. Their burrows and tunnel systems lead to erosion. They eat the roots of plants and chew through low voltage conductors.
- Ground squirrels** eat the tops of plants and make burrows, but not tunnel systems. Control by trap or poison.
- Rats** will eat the cambium layer (bark) of shrubs and trees leading to eventual plant death. Control by trap or poison.



Insects

Pest Control

RIFA



Lerp Psyllid



Africanized Honey Bees

- **Red Imported Fire Ants (RIFA)** are more aggressive than most native ant species and have a painful sting. The sting of the RIFA has venom which causes both pain and the formation of white pustules which appear one day after the sting.
RIFA often travel from one area to another in turf, root balls of nursery stock, and other agricultural products. They are a pest, not only because of the physical pain they can inflict, but because their mound-building activity can damage plant roots. Their stings are rarely life-threatening to humans. RIFA can be controlled but not eradicated.
- **Africanized Honey Bee (AHB)** look the same as the more docile European Honey Bee, but the AHB is much more aggressive and territorial. Once agitated and in pursuit the AHB will respond in much greater numbers than the European Honey Bee. While the venom of the AHB is no more potent than the European Honey Bee, the greater number of stings can be dangerous. 500 or more stings can be life threatening.
- **Lerp Psyllid** are small insects (1/8 inch long), slender and pale-green. They are sucking insects that are hard to see. Adults and larvae feed primarily on Eucalyptus trees. Mostly, what is seen are the sugar-like 1/8 inch wide white cones called "lerps" found on the leaves. Larvae are found beneath these lerps. Both adults and larvae suck sap from the leaves and stems, weakening the Eucalyptus. Heavy infestations cause leaf drop, severe stress, and eventual death of the trees.



Insects

Pest Control



Glassy Winged Sharp-Shooter



Snails



APHIDS



WHITEFLIES



MEALY BUGS

- **Glassy-winged sharpshooter** is about ½ of an inch in length. Its color is dark brown to black with a black-and-yellow underside. It has yellow eyes, and the upper parts of the head and back are speckled with ivory or yellowish spots. The wings are transparent with reddish veins.
The glassy-winged sharpshooter feeds on a wide variety of plants, including grapes and oleanders. Once it feeds on an infected plant the sharpshooter carries the *Xylella fastidiosa* bacterium from plant to plant. This bacterium is linked to many plant diseases, including oleander leaf scorch and Pierce's disease in California.
- **Aphids** feed by sucking up plant juices through a food channel in their beaks. At the same time, they inject saliva into the host. This activity causes leaf curl, wilting, stunting of shoot growth, and delay in production of flowers and fruit, as well as a general decline in plant vigor.
- **Whiteflies** are tiny, soft bodied insects. Whiteflies can seriously injure plants by sucking juices causing wilting, stunting, or even death. Whitefly adults can also transmit several viruses from diseased to healthy plants.
- **Mealybugs** get their name from the white wax on their bodies, making them look like they were rolled in flour. They feed on plants by inserting long straw like mouthparts, called stylets, into plant tissue. Besides producing a white wax, mealybugs secrete a sticky honeydew that adheres to leaf surfaces attracting dust and molds.
- **Snails and slugs** feed on a variety of living plants as well as on decaying plant matter. They chew irregular holes with smooth edges in leaves and flowers.



Weeds

Pest Control



Bermuda grass



Castor bean

California Department of Transportation
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- **Bermuda Grass** is a very hardy, creeping perennial grass with a deep root system. It reproduces through seeds, runners, and rhizomes. It spreads quickly. It can put out seeds within three months of implantation, the seeds germinate when temperatures reach 68 degrees F., and will begin growing within two weeks. Though it prefers 16"+ of rain per year, once established it is highly resistant to drought (going into dormancy above-ground while its rhizomes extend toward the water table). It can spread in poor soils and it is strongly fire-adapted.
- **Castor bean** establishes easily. It has large leaves which are long-stalked, alternate and palmate with coarsely toothed segments. The fruit is a spiny, greenish capsule with large, oval, shiny, bean-like, highly poisonous seeds with brownish mottling. It is a fast-growing, suckering, perennial shrub, which can reach the size of a small tree.

Castor bean displaces native plant species in riparian areas and drainages. Its seeds are among the first to germinate following fire. Plants colonize disturbed areas and they grow rapidly, shading out native seeds and seedlings.

Pulling plants by hand when small or in wet sandy soils is a feasible technique for removal in most areas. The bulk of the root should be removed. Plants broken at the root crown will regenerate with multiple shoots. Gloves should be worn for hand pulling. A foliar-sprayed of 2 percent glyphosate can kill mature shrubs. Cut-stump treatment with 25 percent glyphosate can also be used to kill mature shrubs.



Weeds

Pest Control



Artichoke thistle

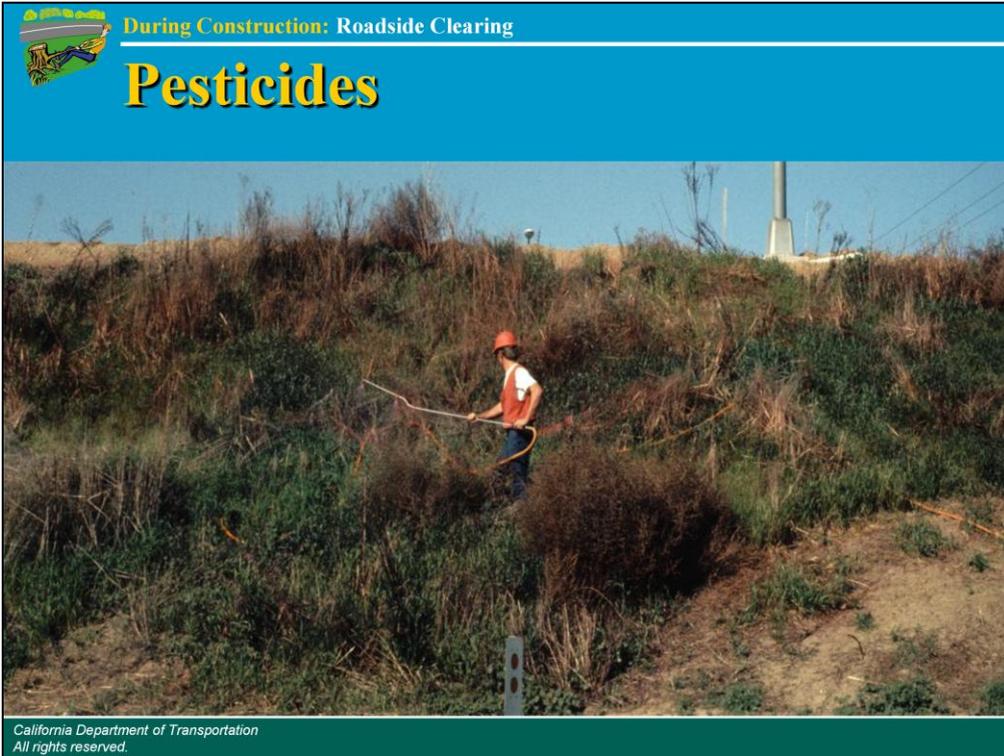


Arundo donax



Star thistle

- The typically large size and spiny nature of **Artichoke thistle** plants make physical removal very challenging. Grubbing is possible when plant densities are low but is impractical on large infestations. New shoots will emerge from the tap root and must be repeatedly removed. Completely digging out the tap root is extremely difficult since it may extend to a depth of eight feet. An alternative method is removing the seed heads to prevent seed dispersion. Large scale mechanical removal requires repeated plowing or cultivation. Heavy leather gloves and chainsaw chaps are generally recommended when doing hand removal.
- **Star thistle** is a grayish-green plant with multiple rigid stems that form a bushy-looking cluster that can reach 6 feet in height and more than that in diameter. It produces bright yellow flowers ringed with long, sharp spines. The plant grows quickly and is very competitive. It bears a taproot that can reach 3 feet deep allowing it to thrive during dry, hot summers.
- **Arundo donax** was introduced to California from the Mediterranean in the 1820s for erosion control in drainage canals in the Los Angeles area. It is among the fastest growing terrestrial plants in the world (nearly 4 inches/ day). It damages California's riparian ecosystems by out competing native species, such as willows, for water. Minor infestations can be removed manually, as long as the entire root mass and all rhizome parts are removed. Pull or dig plants, from seedlings to 6 feet tall, ideally after heavy rains loosen the soil. Cut the stems of larger plants and dig up the roots. Systemic herbicides may be applied after flowering as a cut-stump treatment or foliar spray to kill the root mass.



Pesticides are any chemical used for killing insects, rodents, or plants; includes herbicides, insecticides, fungicides, rodenticides, germicides, nematocides, bactericides, inhibitors, fumigants, defoliant, soil sterilants and repellants.

The pesticides that will be used in the field are:

Herbicides – agents used to destroy or inhibit plant growth.

Insecticides – any agent used to kill insects.



Herbicides

Pesticides

- Pre-emergent
- Contact
- Systemic
- Sterilant
- Fertilizer
- Fumigants (Highly Toxic)



The more common herbicides are:

- Pre-emergence – soil action – Use after planting to prevent weed growth through soil (surflan).
- Contact (Diquat) – non soil acting – Use for killing broad leaf weeds or grasses.
- Systemic (Glyphosate) – non soil acting – Use on Bermuda grass, kills from roots up.
- Sterilants – long lasting soil acting - Used under asphalt concrete or rock blanket areas; use only when specified in the special provisions..
- Fertilizer (Amonia Sulphate) – non soil acting – foilage burn – use only on edule.
- Fumigants: methyl bromide or vapam ... gas that is highly toxic – kills seeds and plants.

During Construction: Roadside Clearing

Labels and MSDS

Pesticides



MONSANTO COMPANY
Roundup Original MAXR Herbicide

Page: 1/9
Version: 1.1
Effective Date: 10/18/2006

MONSANTO COMPANY

Material Safety Data Sheet
Commercial Product

1. PRODUCT AND COMPANY IDENTIFICATION

Product name
Roundup Original MAXR Herbicide

EPA Reg. No.
252-279

Product use
Herbicide

Chemical name
not applicable

Synonyms
None

Company
MONSANTO COMPANY, 800 N. Lindbergh Blvd., St. Louis, MO, 63167
Telephone: 800.325.1111, Fax: 314.646.0157

Emergency numbers
FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT: Call CHEMREC - Day or Night - 1-800-424-9300 toll free in the continental U.S., Puerto Rico, Canada, or Virgin Islands. For calls originating elsewhere: 703-527-3887 (toll-free with access).

FOR MEDICAL EMERGENCY - Day or Night: +1 (314) 694-4000 (toll-free calls accepted).

2. COMPOSITION/INFORMATION ON INGREDIENTS

Active ingredient
Glycolic salt of N-(phosphonomethyl)glycine (Phosphonic salt of glyphosate)

Component	CAS No.	% by weight (approximate)
Phosphonic salt of glyphosate	1069-73-2	49
Color agent		1

The specific chemical identity is being withheld because it is trade secret information of Monsanto Company.

OSHA Status
This product is hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

3. HAZARDS IDENTIFICATION

International pictogram

Appearance and odor (color/form/odor) Amber / Liquid / Odorless, Slight

CAUTIONS
CAUTION: MODERATE EYE IRRITATION

Potential health effects
Likely routes of exposure
Skin contact, eye contact, inhalation
Eye contact, skin contact
May cause temporary eye irritation.

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The Construction Safety Orders require that Material Safety Data Sheets (MSDS) must be submitted for any hazardous materials stockpiled on the job site. Pesticide labels and their MSDS are the best source of information available and include:

- Product name.
- Active ingredients – total toxic material.
- Adequate directions how to use and for types of plants and pests.
- Method of application – spray, broadcast, etc.
- Recommended dosage rates.
- An adequate danger-caution, warning statement very important.
- Hazards of skin absorption, breathing of fumes or environmental contaminants, and oral ingestion (a study by the California Department of Health and the California Department of Food and Agriculture has revealed the most hazardous jobs to be the *mixer loader* and *ground applicators* and the most hazardous activity to be pouring the pesticide out of its original container).
- Label must list name and address of manufacturer and the registration number.

All persons handling pesticides should know what the term LD-50 means. LD-50 means lethal dose of the chemical in milligrams per kilograms of body weight that will kill 50% of a large population of test animals. A pesticide having a low LD-50 number is very poisonous. The higher the LD-50 number, the less poisonous.

Danger – Poison	0-50
Warning – Moderately toxic	50-500
Caution – Slightly toxic	500-5000

If illness occurs, supply product name and registration number to the doctor. Personnel can be exposed by dermal (skin), oral, or respiratory contact.



Submittals

Pesticides

Active
Landscape Insured
Landscape - Irrigation - Drainage - Playground Equipment

1417 East Third Street - Pomona, California 91766 - (714) 824-0724 - Contractor's Lic. No. C27-30288

State of California
Department of Transportation
758 No. Batavia, Suite A
Orange, CA 92668

Attention: Harvey Hopkins
Resident Engineer

Subject: Contract 907-050014 Pest Control Advisor

Dear Mr. Hopkins:

Enclosed please find the recommended pesticides and their application rates, suggested by our pest control advisor.

Don Fargoe, from Robinson's Fertilizer will be our pest control advisor, and will be advising us on any pesticides that are applied.

If you have any questions, please contact us.

Sincerely,

ACTIVE LANDSCAPING, INC.

Original signed by:

Larry Fox
President

L.F:mf

enclosure

ROBINSON FERTILIZER CO.
141 South Fourth Street
Anaheim, CA 92807

October 22, 1984

Active Services
1417 East Third Street
Pomona, CA 91766

Attention: Larry Fox

Subject: Weed control on Caltrans project, Contract No. 07-050114, freeway right-of-way, Route 405, 1 mi. South of MacArthur to Segerstrom Overhead, on Route 25 from 1 mi. South of Baker to Main

- 1) Pre-emergent weed control under pavement:
Treflan EC, 12 fluid ounces per 1,000 sq. ft., applied in 3 1/2 - 4 gal. Water; follow label instructions regarding equipment to use, site preparation, etc.
- 2) Non-selective weed control, stolon type weeds:
Roundup, applied as a 1 - 2% solution, depending upon the weed species involved, and the stage of growth at the time of application; follow label directions regarding name.
- 3) Non-selective weed control, weeds other than stolon type:
Diquat, plus an approved surfactant, used at the rate as indicated on the label for the particular situation on the project.
- 4) Weed control in established ice plant areas:
Magnesium chloride or Ammonium sulfate may be used providing the proper conditions and stage of weed growth are present. See the attached University of California leaflet No. 2782, Weed Control in Ground Covers.

Please contact us if there is any further information needed.

Sincerely,

Original Signed By:

Donald E. Fargoe
Advisor License No. 3104

Enclosures

Fifteen (15) days prior to use of pesticides the contractor must submit to the Resident Engineer for approval a **Recommendations of Pesticides Usage** signed by a licensed Pest Control Advisor with a copy of the Pest Control Advisor's license.



Chemical Storage

Pesticides



Correct



Incorrect

Check for any special County regulations. Some concerned agencies are Department of Agriculture, Environmental Protection Agency, Cal OSHA, Water Quality. Use of pesticides that are not in the Standard Specifications requires a headquarters approval and a contract change order. Pesticides must be stored in a secured structure or away from the jobsite.

During Construction: Roadside Clearing

Inspect/Verify

Pesticides



- Licensed applicator?
- Proper mix
- Photosensitive dyes
- Surfactant
- Application
- Cleaning

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The licensed Pest Control Advisor must be on project, but it is not always necessary for the spray applicator to be the licensed person. The most hazardous exposure time for the pesticides is during the mixing of the pesticides, so stay clear. The spray applicator should use a face shield, rubber gloves, boots, and protective clothing. To insure the use of proper rates, have the spray applicator explain what their plans for mixing are. Check the following for proper mixing:

- Photosensitive dyes of a contrasting color that disappears between 2 and 3 days.
- Surfactant: liquid agent added to chemical spray to enhance adherence of chemical to foliage
- Tank and equipment for leaks and cleanliness.
- Any chemicals not to be used on project.

Applications are influenced by:

- Wind – check for spray drift – 5-7 mph.
- Gun pressure affects drift.
- Spray drift to adjacent property.
- Re-check area to be covered by calculated amount in spray rig.

The contractor has to clean the tank when the spraying is completed in an area designated by the County Agriculture Department, per Proposition 65. Store equipment in safe place.



During Construction: Roadside Clearing

Weekly Report: LA-17

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
REPORT OF CHEMICAL SPRAY OPERATIONS
 LA - 17 (REV. 04/2001)

ADA Notice
 For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6419 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

Copy Form for Saving

REPORT OF CHEMICAL SPRAY OPERATIONS

CONTRACTOR	WEEK ENDING DATE	PROJECT DESCRIPTION	PROJECT NUMBER
CHEMICAL MIXTURE AND PERCENT ACTIVE MATERIAL	A	B	C
	D		
WATER RATE			
APPLICATION PER SQUARE FOOT OR ACRE			

DAY	CHECK PROPER BOX					PLANTING SPRAYED				PEST KILLED		DESCRIPTION OF AREA (STA., LOOP, ETC.)												
	WINDY	CALM	A.M.	P.M.	CLOUDY	SUNNY	A	B	C	D	TREES		SHRUBS	IVY	ICE PLANT	P.M.	GROUND COVER	GRASS	BROADLEAF	STOLONS	SCALE, MOTH, ETC.	DISEASE		
MON																								
TUE																								
WED																								
THU																								
FRI																								
SAT																								

RESIDENT ENGINEER COMMENTS: _____

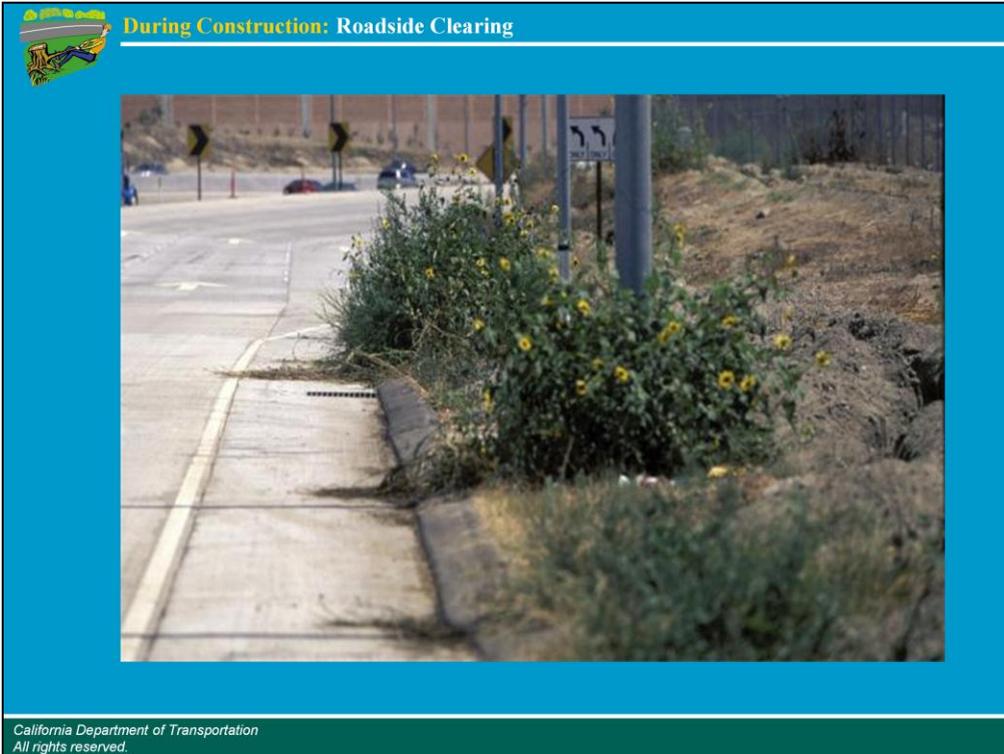
CONTRACTOR'S REPRESENTATIVE _____
 COPY TO: DISTRICT _____ MAINTENANCE FOR FILE _____

Pesticides

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The Contractor is required to notify the Resident Engineer at least 24 hours before each chemical application and fill out Form LA-17 *Report of Chemical Spray Operations* each week that applications are made.

Establish a separate file category in the project records for the Pest Control Recommendations and the Report of Chemical Spray Operations, LA-17. Include in the assistant Resident Engineer's daily report what chemical was used and where.



Weed Control Needed!!

Roadside Clearing areas must be maintained until start of the Plant Establishment Period.



Review Questions

1. List normal roadside clearing sequence (4).
2. What are the 6 basic types of chemicals used for weed control?
3. How long is roadside clearing performed?

1. List normal roadside clearing sequence:
 - Trash pick up
 - Mowing and weed pickup
 - Spraying weed for kill
 - Rodent control
2. What are the 6 basic types of chemicals used for weed control?
 - Pre-emergent
 - Contact
 - Systemic
 - Sterilant
 - Fertilizer
 - Fumigant
3. How long is roadside clearing work performed?
 - Until the start of plant establishment period



MEMORANDUM

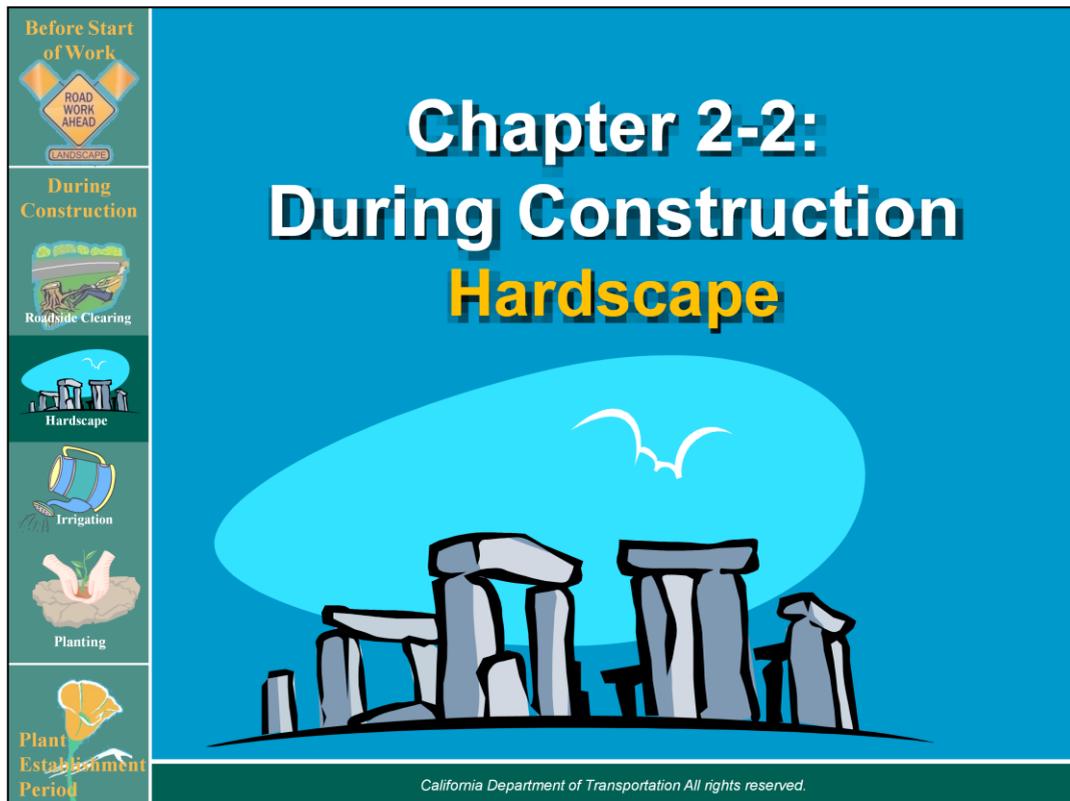
To: Landscape Inspection Trainee

FROM: T. Rex, Resident Engineer

SUBJECT: Fourth Commandment

**“Thou shall write a neat,
legible, accurate and
complete daily report and
properly follow all standard
procedures”**





Hardscape can be done at any time prior to PEP, but best immediately AFTER Roadside Clearing and before irrigation work begins.

Types of hardscape include:

1. Rock blanket
2. PCC areas, colored stamped concrete, hot mix asphalt areas colored/stamped AC.
3. Slope paving under structures
4. Air Blown Mortar (ABM), or shotcrete, on slopes/retaining walls.

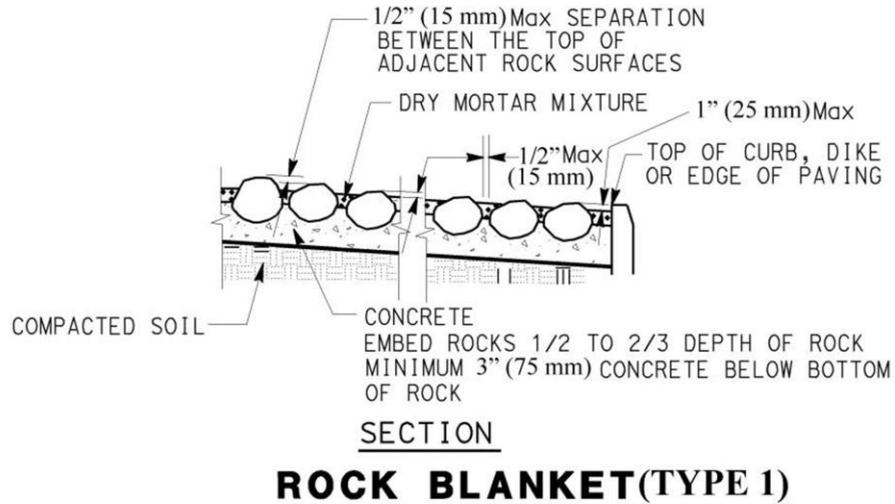
Evaluate constructability of the contract documents: Field check to make sure that the finished product is appropriate to the existing conditions of the site.

Hardscape areas may be approved for Relief of Maintenance.



Details

Rock Blanket



For safety reasons, Rock Blanket Type 1 is required at areas that may be traversed by a vehicle and where pedestrians will have easy access to it.

Review the SSPs and details to understand the requirements for:

- Materials: type of rock, color, sizes, samples submitted; source of materials; color.
- Site Preparation: Roadside clearing; 90% compaction
- Placement
- Weed fabric
- Soil preparation/sterilant



Type 1 Installation

Rock Blanket



Rock Blanket is a labor intensive, slow, and expensive item of work.

Rock Blanket Type 1 installation includes: Soil preparation (includes creating a smooth, even surface, scarifying soil and applying soil sterilants, compacting subgrade), set rocks/cobbles in the wet concrete, and spread dry mortar mix in joints between rocks and water in.

Rock Blanket Type 1 work should be scheduled so that the concrete work, rock placement, mortar, and application of any curing is completed in any section on the same day that the work is started in that section.



During Construction: Hardscape

Type 1 Termination

Rock Blanket



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Example of completed Rock Blanket Type 1 w/ smooth concrete order.



During Construction: Hardscape

Type 1 Termination

Rock Blanket



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Check details on plans for proper termination. Normally concrete banding or steel edging is required at termination edges.



During Construction: Hardscape

Problem----Gophers

Rock Blanket



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Lack of proper pest control prior to installation . They were there and pushed up thru the wet concrete before it cured. Gophers should have been eliminated from this area prior to installation.



During Construction: Hardscape

Why are there Weeds??

Rock Blanket



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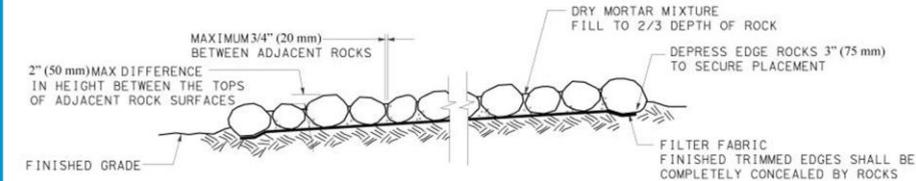
Problem: Weed invasion due to improper preparation.

Lack of proper pre-emergence/sterilization chemical before Rock Blanket installation.

During Construction: Hardscape

Rock Blanket

Type 2

2" (50 mm) MAX DIFFERENCE IN HEIGHT BETWEEN THE TOPS OF ADJACENT ROCK SURFACES

MAXIMUM 3/4" (20 mm) BETWEEN ADJACENT ROCKS

FINISHED GRADE

DRY MORTAR MIXTURE FILL TO 2/3 DEPTH OF ROCK

DEPRESS EDGE ROCKS 3" (75 mm) TO SECURE PLACEMENT

FILTER FABRIC FINISHED TRIMMED EDGES SHALL BE COMPLETELY CONCEALED BY ROCKS

- * FOR USE BEYOND 30' (9 m) FROM EDGE OF PAVEMENT, CURB OR DIKE
- * NO EXCAVATION REQUIRED
- * SEE PLANS FOR LOCATIONS

ROCK BLANKET (TYPE 2)

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Rock Blanket Type 2 can be placed on-grade without a concrete bed. A landscape fabric is needed to reduce weed growth. A soil sterilant may also be required. See the SSPs and details.

Rock Blanket Type 2 is allowed in areas outside of the clear recovery zone and where pedestrians will not have access to the rock.



Type 2 Installation

Rock Blanket



Spreading dry mix mortar

Prepare soil the same as for Type 1, spread rock as per the detail, spread dry mortar mix and water in. (faster than Type 1).



Rejected Material

Rock Blanket



The pile of rock in circle is rock rejected by Inspector. This material may be used on site at culverts and bridge drains, etc., to control erosion. The same concept applies on rock that has been brought to the surface during irrigation trenching.



Here's an example of stamped PCC. This has a natural color but the SSPs may specify a color treatment.

The same preparation treatments apply as for normal PCC paving.

This is at Rte 10/605 IC in District 7.



Trapped Posts



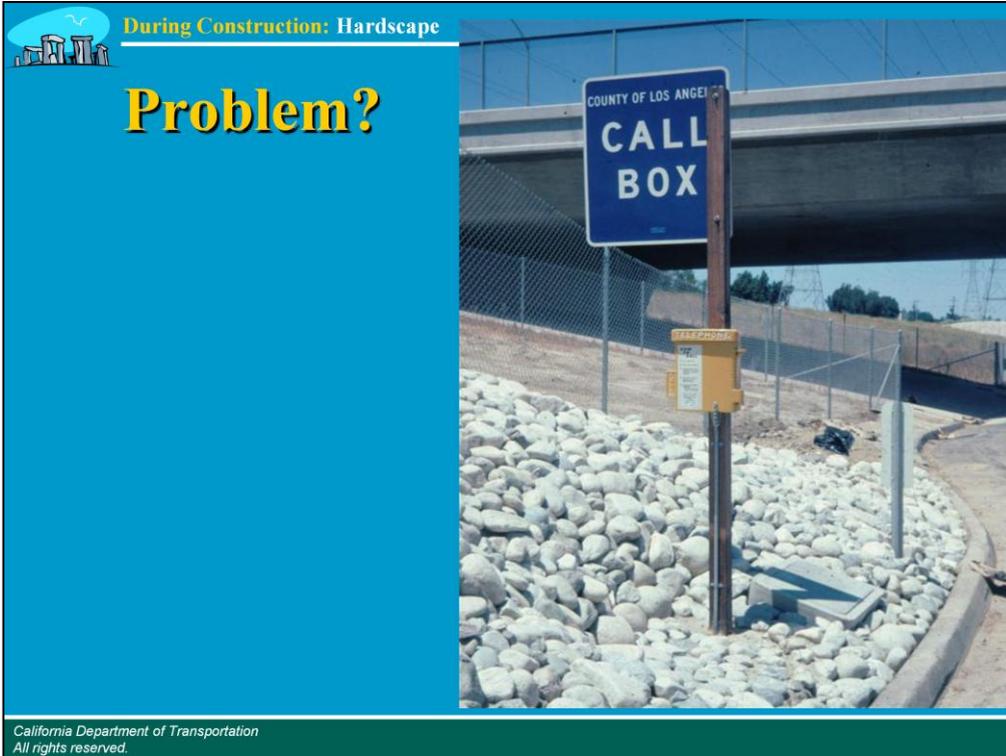
COLLAR DETAIL

This is a common hardscape problem: *trapped posts*.

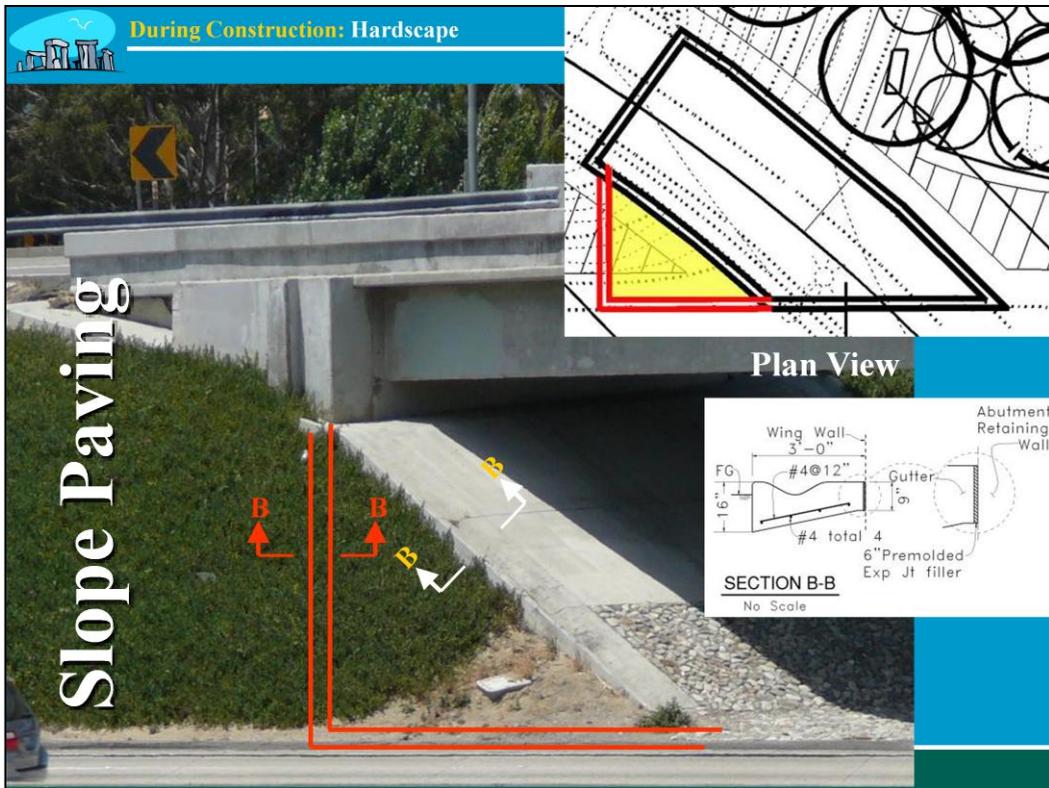
Much work is involved for Maintenance to replace the sign post on the left when it is knocked down by an errant vehicle. This work exposes them to traffic so they need to complete the work as quickly as possible and get out of there.

A better installation is to provide a post sleeve in the paving or rock blanket. Look for a post sleeve detail on the plans. If no detail, ask for one! You need to take the initiative to require a proper installation even if the plans don't show it.

Construction often has the last chance to make it right and make it safe for workers!



Safety concern—This call box is not accessible. An even concrete platform should have been provided for stranded motorists, not a irregular pile of rocks.



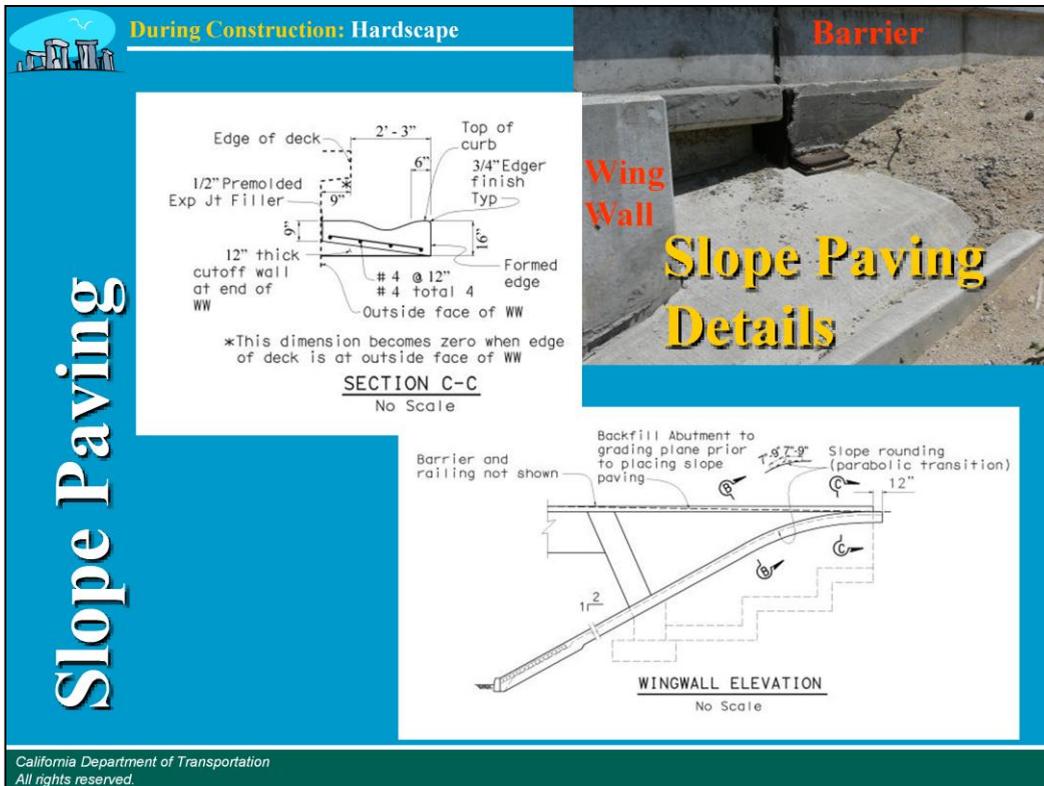
In this picture, water is running over the edge drain, causing erosion. Maintenance has been hauling away soil from the bottom of the slope after every rain event.

This problem could have been corrected during construction of the slope paving. Solve potential problems by reviewing the design before work starts. This slope paving is on a skew that allows the water to run over the edge drain. A CCO could increase the paving area as shown in red to make the edge drain perpendicular to the slope. This will keep water from running over the edge drain and it will also eliminate an acute angle in the planted area which will make the irrigation system more efficient.

Plan View:

Per Contract - Double black line.

What should have been done shown in red and yellow.



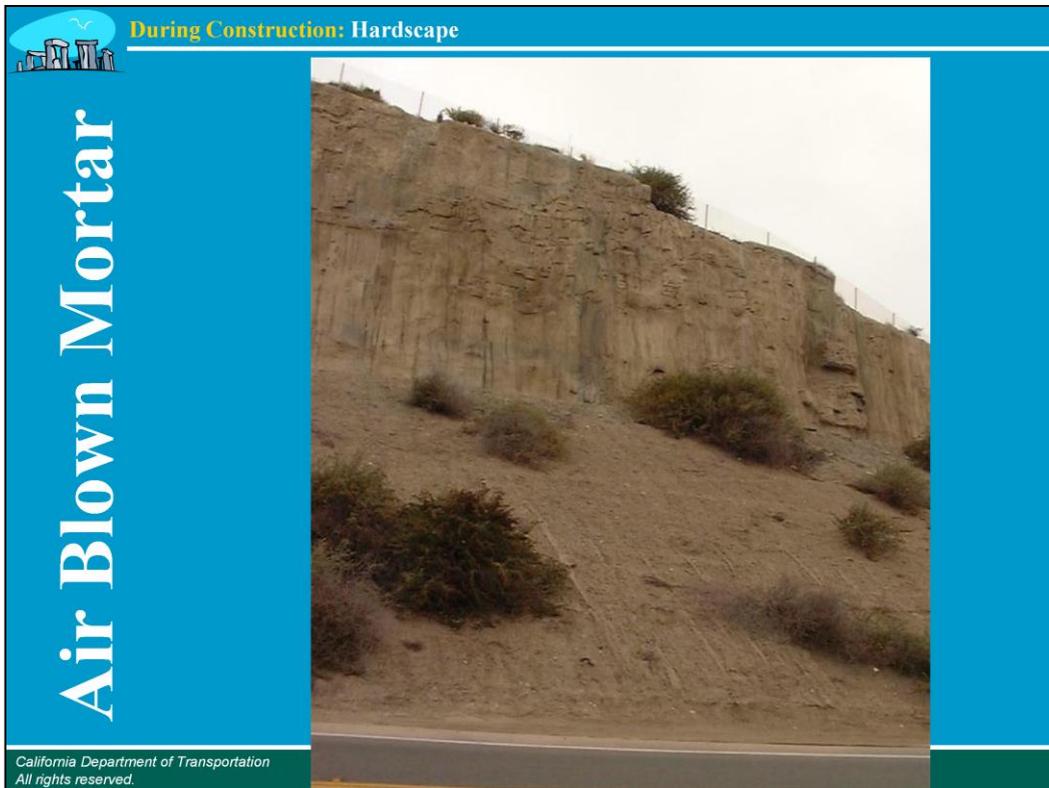
On this project, a MBGR replaced with concrete barrier.

Always check the detail at the top of bridge. The swale of the edge drain must begin beyond the end of the bridge rail to catch the run-off. The photo shows a concrete barrier was added but note there is still drainage through the joint.

The three most important items to check on slope paving at bridges:

- Slope paving and edge drains are located outside the bridge rail limits.
- Edge drains are perpendicular to the slopes on the downhill side of bridges on a skew.
- Edge drains extend beyond the edge of the bridge rail at the top of slope.

If necessary, extend the limits of slope paving by increasing items or by CCO.



ABM (shotcrete) is often used where scenic quality is an issue and retaining walls with simulated natural rock surface treatment is desired. This photo shows ABM on a vertical face above a slope. It simulates a natural cliff and successfully blends into the natural environment, minimizing visual impacts.

The installation of this type of wall system is nonstandard and requires specialized Contractors to sculpt the walls. Developing plans a specifications for this type of work can be challenging and direction of the Contractor by the inspector and Resident Engineer becomes critical for success. Communicate with the designer to make sure the design intent is correctly interpreted in the final execution of the work.



Review Questions

- 1. How many types of Rock Blanket are there and where is each type used?**
- 2. What is a good use for rejected/excavated Rock Blanket material?**
- 3. When a sign post is placed in a hardscape area, why should a post sleeve be provided?**
- 4. What are the 3 most important areas (limits) to check for on Slope Paving?**

1. TWO --Type 1 and Type 2. -- Type 1 adjacent to traveled way or where pedestrians have access. Type 2 in areas outside of the clear recovery zone and where pedestrians will not have access.
2. Use as an erosion control material (energy absorber at culvert) within job limits.
3. It helps Maintenance make a faster repair, reducing their exposure to traffic.
4. Check for:
 - Slope paving and edge drains are outside the bridge rail limits.
 - Edge drains are perpendicular to the slopes on the downhill side of bridges on a skew.
 - Edge drains extend beyond the edge of the bridge rail at the top of slope.



MEMORANDUM

To: Landscape Inspection Trainee

FROM: T. Rex, Resident Engineer

SUBJECT: Third Commandment

**“Thou shall conduct thyself
in a calm, professional, fair
and honest manner at all
times”**



Chapter 2-3: During Construction Irrigation



Before Start of Work
ROAD WORK AHEAD
DURING CONSTRUCTION

During Construction
Roadside Clearing
Hardscape
Irrigation
Planting
Plant Establishment Period

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Objective: The irrigation system will provide a cost effective, safe, even and appropriate distribution of water to the planted areas by incorporating automatic irrigation systems that accomplish the Department's water conservation goals.



During Construction: Irrigation

Manual Systems

Major Components

- Source of Water: Water meter (WM)
- Irrigation Conduits
- Backflow Preventer Assembly (BPA) w/ Wye Strainer (WS)
- Supply lines (Main & Lateral)
- Manual Control Valve (MCV)
- Quick Coupler Valve (QCV)
- Ball Valve (BV)
- Gate Valve (GV)
- Pressure Relief Valve (PRLV)
- Wye Strainer Assembly (WSA)
- Valve boxes
- Spray Heads (Sprinklers) and Emitters

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This is an over view of the major components of the irrigation systems , keep these definitions in mind as we will go into more detail on each item as we proceed:

A manual system must be turned on and off by a person and contains the following components:

See the **Landscape Inspector Manual Glossary** for detail notes on each component.



During Construction: Irrigation

Automatic Systems

Major Components

- + Manual System Components
- Booster Pump (BP)
- Flow Sensor (FS)
- Master Remote Control Valve (RCVM)
- Remote Control Valves (RCV)
- Irrigation Controllers (IC)
- Electrical Service
- Pull Boxes (PB)
- Low Voltage (LV) Conductors

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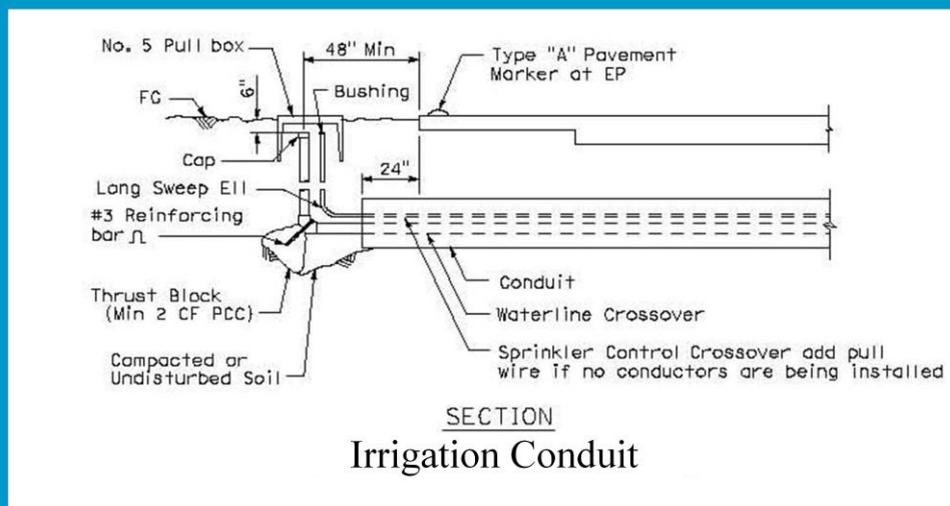
Automatic Systems, In addition to all items in a Manual system, Automatic systems use electrical devices that once properly installed and programmed will turn on and off the irrigation components without any human contact; and consist of:

See **Student Manual Glossary** for detail notes on each component.

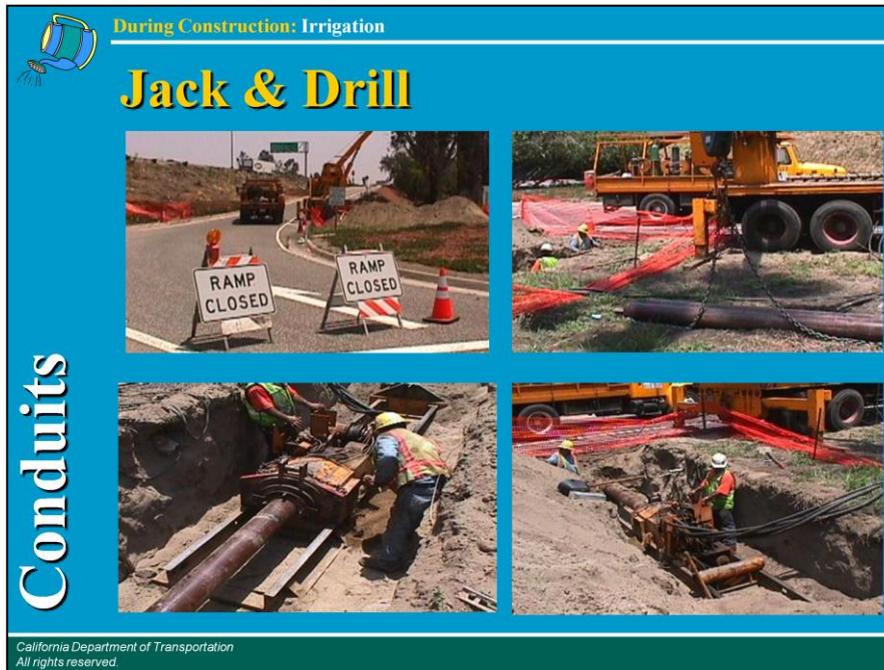


Irrigation Conduits

First Order of Work



- Prior to beginning irrigation work, the existing Irrigation Conduit (previously called Irrigation Crossover) should be located and verified that they are usable or if new need to be installed.
- Locate the existing irrigation conduits by looking for the Type A marker and its pull box.
- When installing new conduit according to SP H9:
 - Type A marker at the edge of pavement may be the only visible locator after a few years when the plant material grows over the pull box.
 - Waterline crossovers are PR 315 Pipe and schedule 80 fittings.
 - Long sweep elbows are for pulling future conductors. It is next to impossible to pull conductors through a 90 degree elbow.
 - thrust blocks to prevent movement of the water lines.
 - Bushing prevents the skinning of the insulation when pulling wires through.
 - Cap is to prevent debris from clogging the conduit.
 - Pull box will have a gate or ball valve that can be used to isolate the areas when repairs are necessary.



This is often one of the first items of work, along with locating existing irrigation conduits, even before Roadside Clearing has begun in the area (or project limits).

T.L. Photo- Ramp closure needed.

T.R. Photo- There is a drill extension on the truck bed and 8” Welded Steel Pipe (WSP) conduit on the ground. A crane is necessary for this work.

B.L. Photo- Note the mule and frame rails it rides on in the pit. A full length (10’) of WSP is on its way under the ramp. Spoil from the pipe is being shoveled by worker on right as the drill bit, which is inside the pipe, rotates and the mule pushes the pipe. After each section of pipe is pushed most of the way in, the mule is backed up and a new section, with drill bit extension inside, is lowered into place, welded to the previous pipe, and the process repeats for as many sections as necessary to cross the ramp.

B.R. Photo- Last section of WSP being pushed through. When done, the drill bit extensions are backed out, the water lines and sprinkler control conduit can be installed and the other details, as shown on the previous slide, is completed and the pit is backfilled.



During Construction: Irrigation

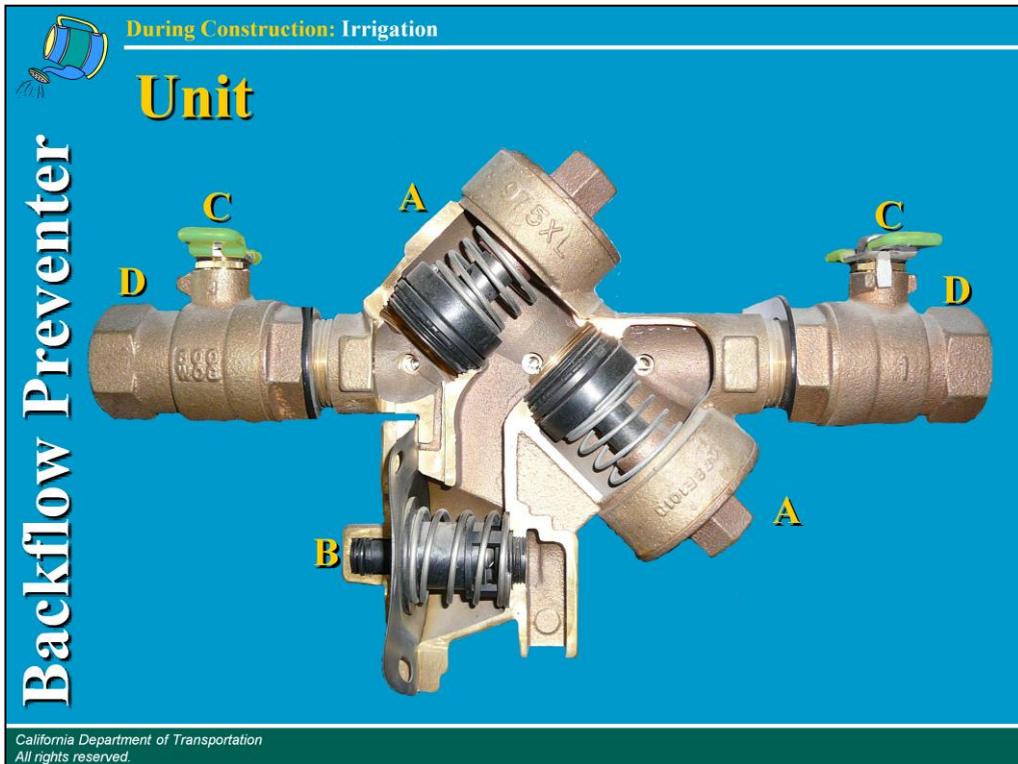
Jack & Drill

Conduits



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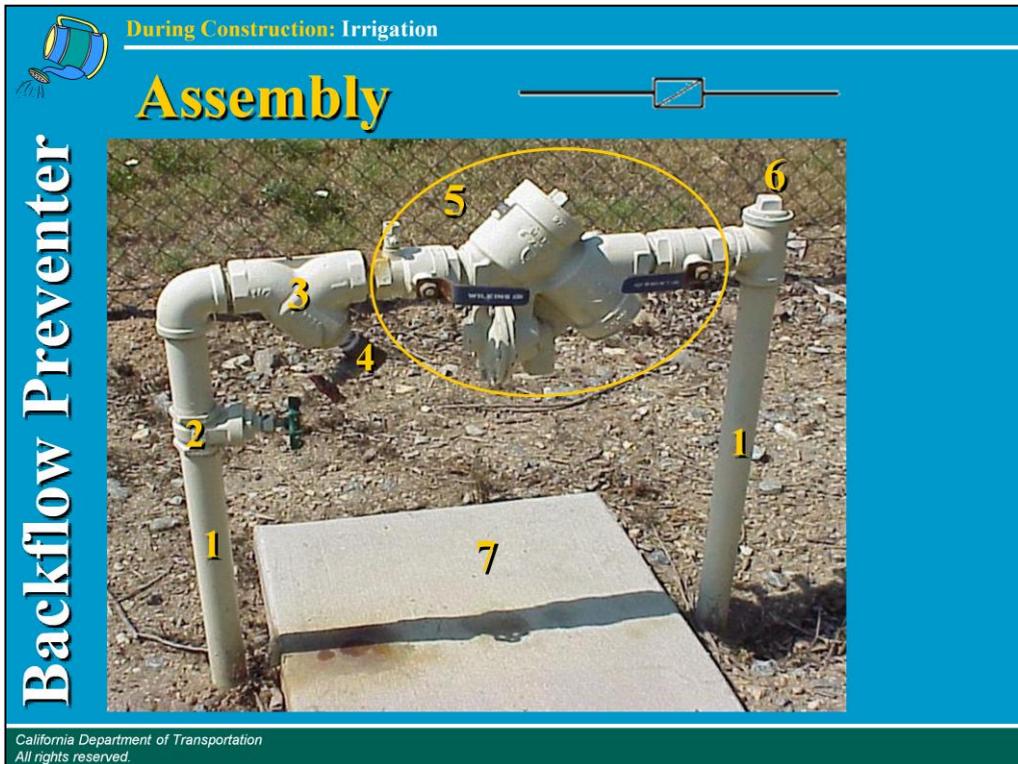
After all work to install an irrigation crossover is complete, it will look like this. Note that the ground cover is about to grow over the pull box, so the TYPE A marker will be the only way to quickly locate this crossover in the future.



Backflow Preventers shall be factory assembled.

- A. 2 check valves
- B. 1 pressure differential relief valve
- C. 2 shut-off valves, can be ball type as shown or gate valve type
- D. one union on one side of each shut-off valve.
- E. 4 test cocks (not shown - on back side)

Backflow Preventers must be tested when installed and YEARLY thereafter.



Backflow Preventers are designed to allow water to travel in only one direction (away from the source) and are required by the Department of Health Services.

Backflow Preventers can be:

- Vacuum or anti-siphon: Cheapest, 6” above the highest sprinkler.
- Double check valve: Can be below grade installation, but not on irrigation systems and not on Caltrans projects.
- Reduced pressure, installed minimum 12” above grade, and required by Caltrans.

1. Galvanized steel pipe from Water Meter to backflow preventer and above ground installation
2. Gate valve
3. Wye strainer (cast iron or all bronze, 150 psi, 20 mesh screen)
4. Gate valve for blow out. Must be field modified so no attachments can be made to this fitting.
5. Backflow Unit
6. Plug (for a future fire hydrant or stand pipe)
7. Concrete pad.

 **During Construction: Irrigation**

Wye Strainer

Backflow Preventer



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Photo shows a hose bib being field modified (cutting the threads off) so no attachments can be made to this fitting.



During Construction: Irrigation

Enclosure

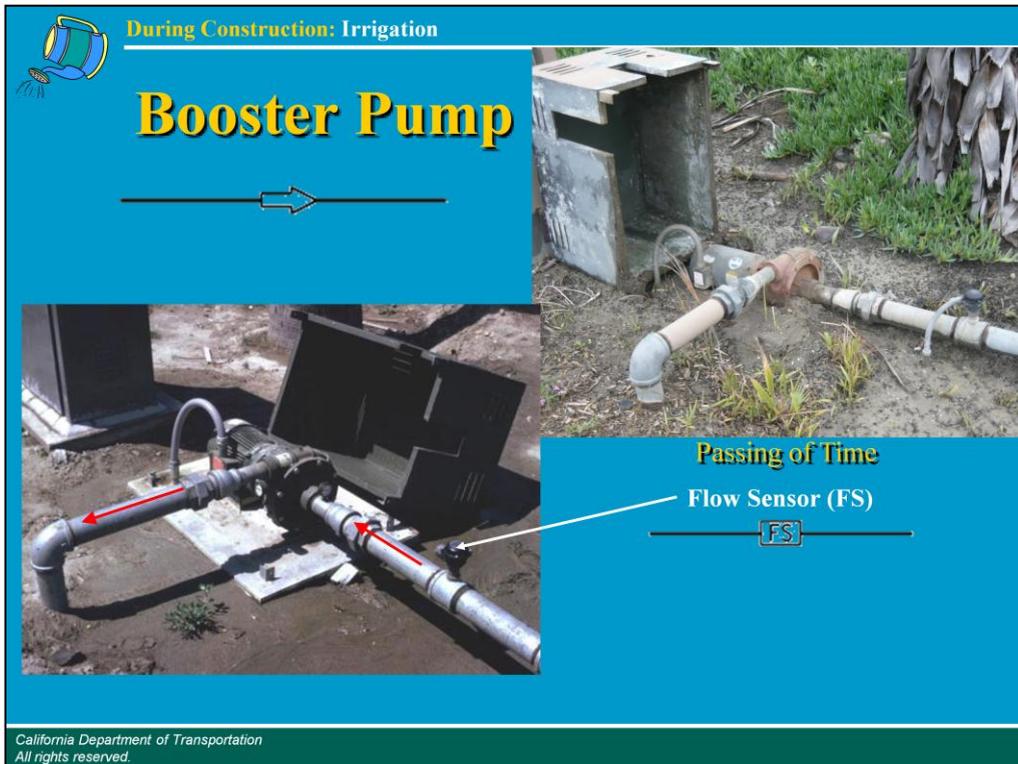


Backflow Preventer



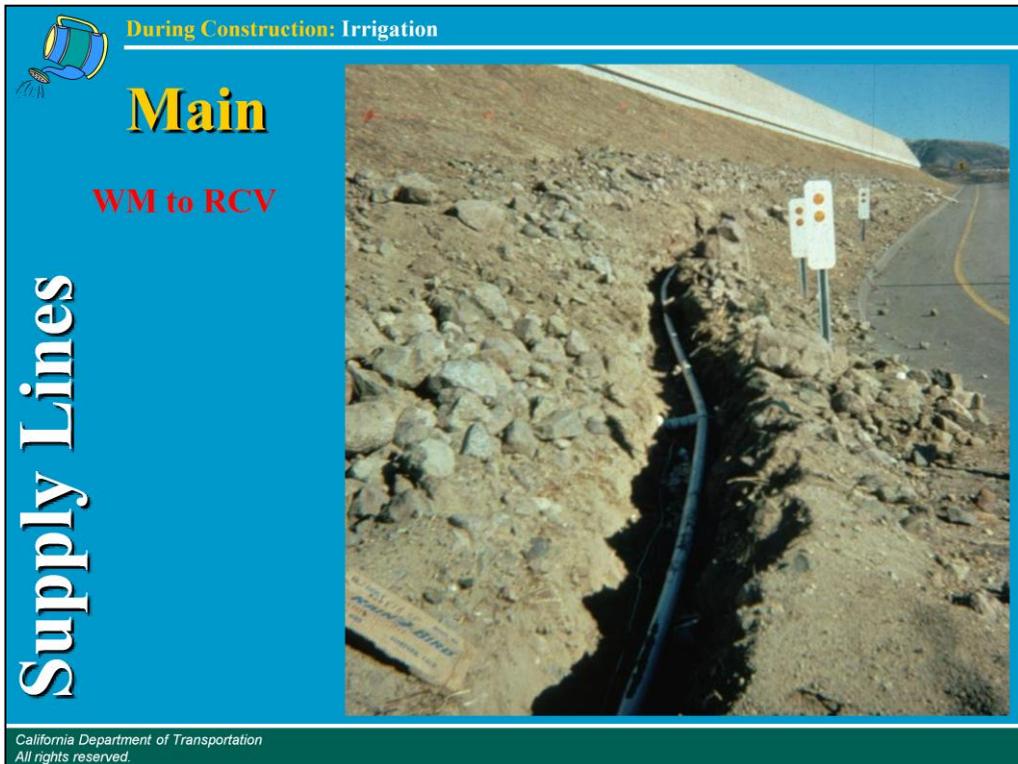
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When an enclosure is used, it is recommended to not use a solid concrete pad so as not to rust out the enclosure.



A housing unit is preferable to minimize vandalism and protection from the elements. The location of flow sensor is CRITICAL! Distance from any fitting is a set formula depending on size of pipe and design flow of pump. And the length of the paddle blade of the flow sensor must be the proper length to be in the proper location inside the pipe. Have the Contractors submittals reviewed by headquarters.

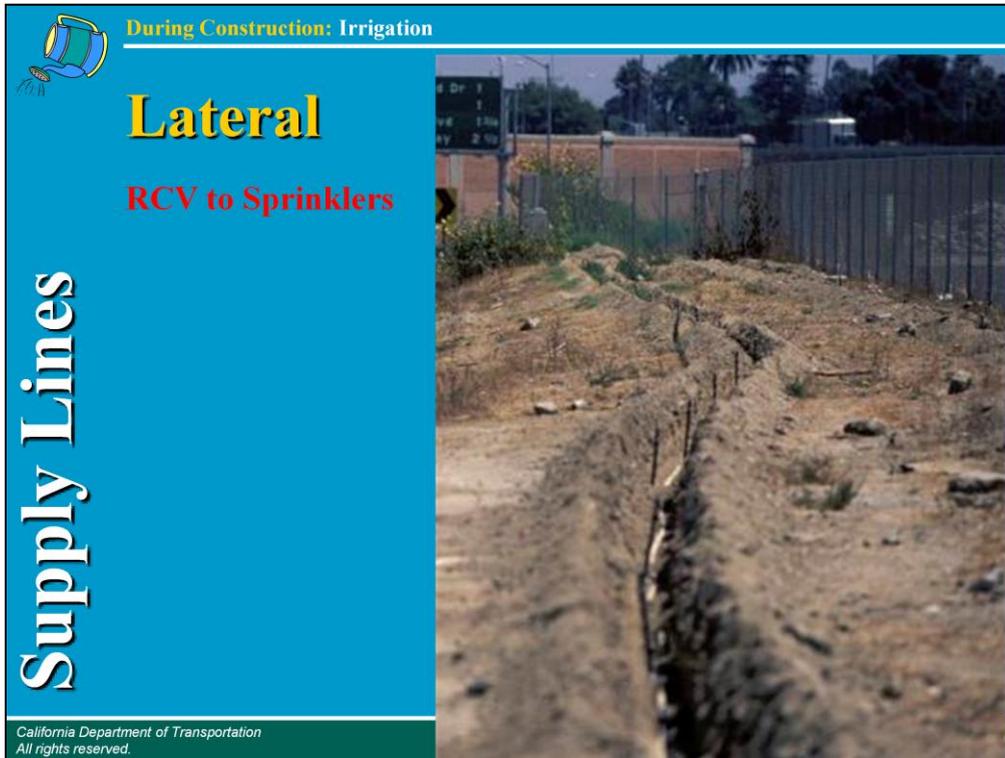
Note also that there are 3 axis of installation. INLET TO PUMP, OUTLET AND MOTOR TO PUMP. All 3 must be correct or pump will fail within a short time instead of 20+ years of service.



Main supply lines serve the entire system of valves and sprinklers from the water meter and is under pressure when any one of the valves is in operation. In other words, it is the water line between the water meter and the remote control valves.

Notice the rock removed during trenching. Removal of rock done under CCO. This rocky material is not suitable for backfilling trench.

Solvent weld pipe is snaked in trench to allow for expansion & contraction. Note 4-foot distance from curb/dikes/paved shoulders.



Lateral supply lines connect only the sprinklers of one remote control valve and is only under pressure when that valve is scheduled to operate. In other words, it is the water line from the remote control valve to all of the sprinklers.

Snaking of solvent weld pipe for laterals is required, same as the Main Supply Line (allow for expansion & contraction)

Layout is critical for plants with individual sprinklers, requiring you to look at both the irrigation plans and the planting plans. We will revisit layout of the irrigation lines and the plants at a later point in the training.



Trenching

Supply Lines

- Depth
- Width
- Setbacks
- Backfill
- Compaction



Refer to Standard Specifications 20-2.01C(2).

- Existing landscape area:
 1. Prune as necessary to allow for trench
 2. Clear ground cover as necessary ... no more than 6'.
 - Spray-kill-remove, then trench.
 3. Replant and apply pre-emergent if required ... refer to special provisions.
- Signing (Open Trench) in place.
- Rocks – must be brought to surface and removed when ordered.
- Depth - See Standard Specifications
- Width - 2x the pipe or conduit diameter.
- Setback requirements – 4 feet from curb, dikes, and paved shoulders.
- Backfilling – with suitable material from excavation of trench.
- Compaction – minimum relative compaction of 90%.



These are above grade installations of water line crossover with galvanized steel pipe and sprinkler control conduit and 110 V.

Structures approval required when over traffic requires.

Galvanized Steel Pipe:

- Tapered threads vs. non-tapered (elect.)

- Dielectric coupling needed if attached to any other type of metal (copper) pipes.

- Bonding to electrical conduit

- Comes in 21' lengths-usually for water and 10' lengths for electrical conduit

- Was used in Older Existing Conduits under the Roadway, now used only in above grade applications and between the water meter and 2 feet beyond the backflow preventer.

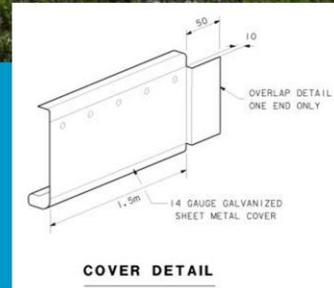
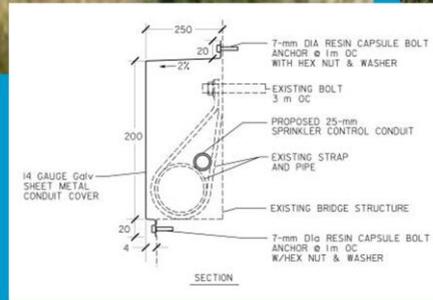
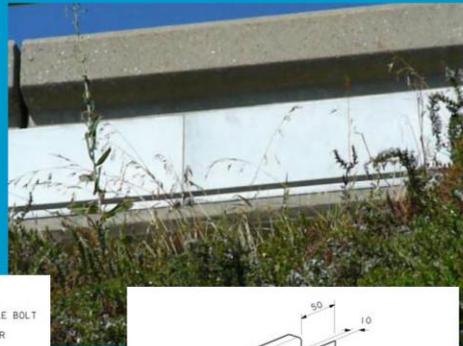
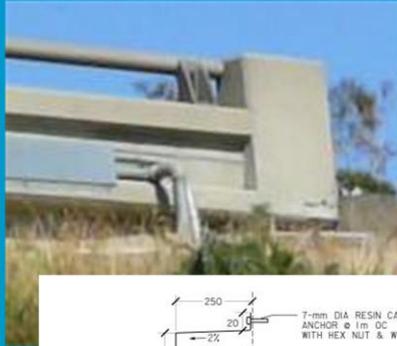
Photo on left is **old installation**: The pipes were ganged in the **Type I** pipe anchor bracket to minimize the intrusion of the galvanized steel water conduit, 120 V electrical conduit and the low voltage (LV) electrical conduit on the bridge rail.



During Construction: Irrigation

Galvanized Steel Pipe

Supply Lines



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Current installation: Galvanized steel water conduit and low voltage (LV) electrical conduit that are attached to the exterior of existing bridges are covered with a metal shield to improve the aesthetics of the bridge.

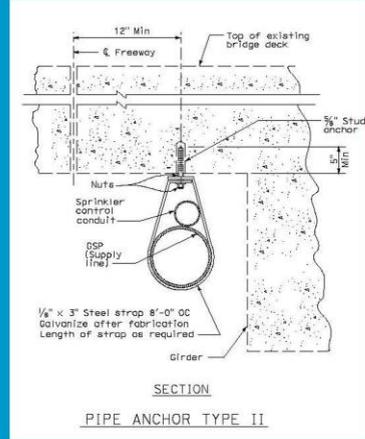
Note how the left photo shows the pipes and shield going almost to the end of the bridge rail where the embankment nears the roadway.



During Construction: Irrigation

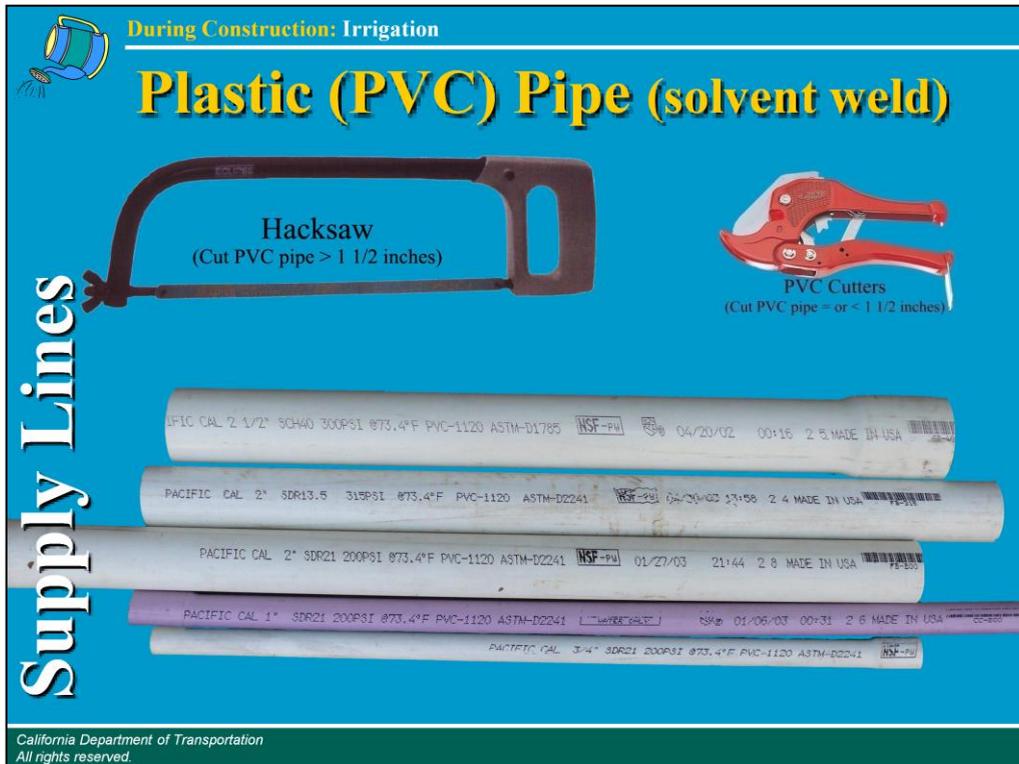
Galvanized Steel Pipe

Supply Lines



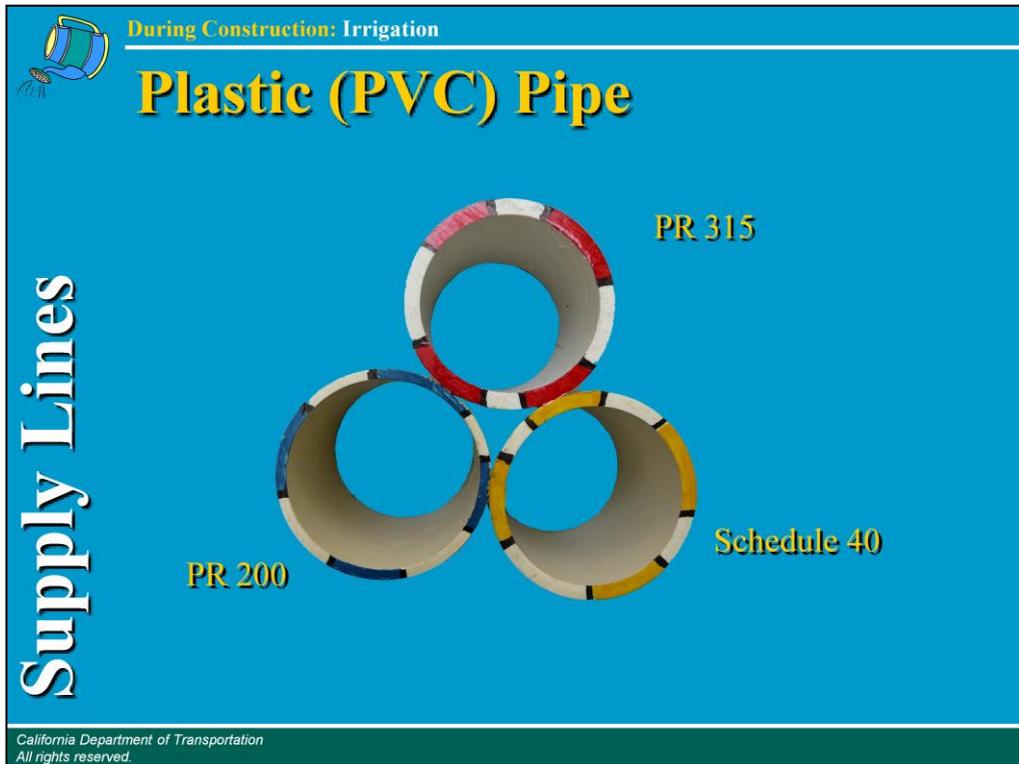
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This is a 3 inch GSP Water Line Crossover and a 2-1/2 inch Sprinkler Control Conduit Under a Bridge running parallel to the Freeway centerline in **Type II** pipe anchors.



Codes on the pipe indicate manufacturer name, size, schedule or PR rating, TYPE of PVC, ASTM Designation, Date of Mfg, time of mfg, where made, bar code for material lot.

- PVC Pipe comes in 20' or 10' lengths.
- PVC pipe can be either straight or bell end (one end only – top and bottom pipes shown above. Bell end pipe reduces the number of SxS (slip by slip) fittings required in long runs of pipe. But note that the bell end is deeper than a typical SxS fitting of the same size. This is because bell pipe is thinner than a Sch 40 or 80 fitting of the same size.
- PVC cutters are required for pipe 1½” or smaller ... no saw cutting allowed.
- Using a Hacksaw is the most common way to cut PVC > 1½”, however it creates PVC *sawdust* that must be flushed from the pipes so as not to clog the sprinkler nozzles in the future.
- Purple PVC pipe is used for reclaimed water systems. Purple reclaimed warning tape may be placed in the trench above white PVC pipe in lieu of the purple pipe.



Plastic (PVC) Pipe is rated by Schedule or Pressure Rated (PR).

Schedule refers to wall thickness, regardless of size of pipe the wall thickness is the same regardless of size of pipe so pressure rating declines as the size of the pipe increases. Types used by Caltrans -- Sch 40, Sch 80

Pressure rated (PR) is the allowable working pressure of the pipe, thus PR 200 will withstand 200 psi and PR 315 will withstand 315 psi. The wall thickness will vary on the different pipe sizes of the same pressure rating.

Fittings : Sch 40 (white) & Sch 80 (grey)

- Solvent cement fittings must be Schedule 40 fittings.
- Fittings for supply line in irrigation conduit must be Schedule 80.

During Construction: Irrigation

Plastic (PVC) Pipe (Glue)

Supply Lines

Follow these directions and those on the cans

EVEN IF YOU HAVE INSTALLED PVC PIPE BEFORE!

Typical field set-up

The image shows two cans of IPS WELD-ON products. The left can is PVC 2700 solvent cement, and the right can is P-68 primer. Below the cans is a photograph of a typical field set-up for PVC pipe installation, showing a pipe, a fitting, and a dauber.

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Solvent Cement (*glue) & Primer.

Manufacture's instructions must be submitted.

Primers are usually a light purple color and the solvent cement (glue) is either Clear, Blue or Grey and 2 to 3 shades darker than any of the primers on the market. Each is applied with a dauber or brush.

- First the primer is swabbed inside of the fitting and then to the pipe in a width slightly larger than the depth of the fitting.
- Then the solvent cement (glue) is applied to both surfaces.
- Insert the pipe into the fitting to it full depth (a stop ridge is inside each side of all fittings) and give a ¼ turn and hold pipe and fitting for 30 seconds or more depending on temperature. This is to prevent the pipe from “backing out” of the fitting and not being strong enough to withstand the designed pressure operating range. See mfg’s instructions - generally, when colder than the temperature listed on the instructions - the longer time is required for curing. There may be a warning in the instructions to not install when temperature is below XX degrees.

During Construction: Irrigation

Plastic (PVC) Pipe (Gasket Ring)

HARVEL
PLASTICS, INC.

PVC Gasket Pipe

Supply Lines

The QUALITY Line

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Thrust Blocks

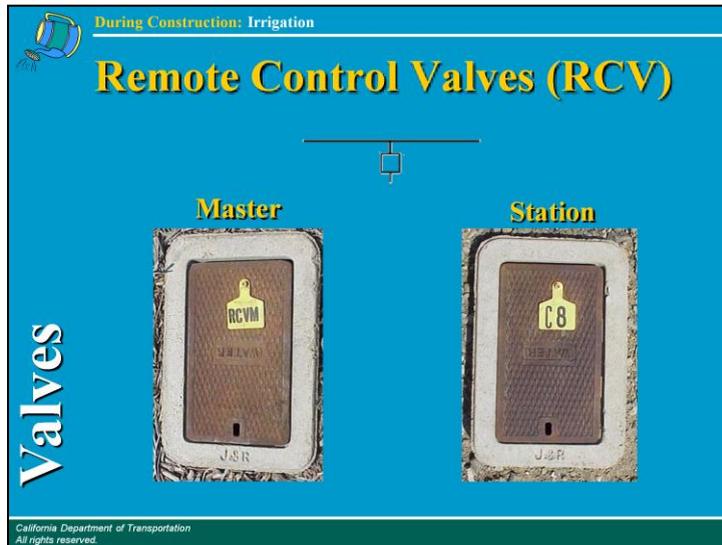
Figure 1 Thru line connection, tee
Figure 2 Direction change, elbow
Figure 3 Change line size, reducer

Thrust Restrainers

Figure 1 Thru line connection, cross used as tee
Figure 2 Direction change, elbow
Figure 3 Direction change, tee used as elbow

Supply line 2" & larger must be either rubber ring gasket or solvent cement types, except only solvent cement type when used in conduits.

Ring type needs more care to install. The lubricant needs to be kept clean, the pipe must be properly inserted to insure a proper seal, it must be installed deeper, more care taken in snaking and joining, and thrust blocks and restrainers are required. For these reasons it is more labor intensive and expensive - but may be superior in some applications to solvent weld. Designers will not normally specify it for supply lines.



The remote control valve (Master) (RCVM) is located downstream from the backflow preventer assembly. The RCVM controls the flow of water to supply lines so that they are not under constant pressure when irrigation is not taking place. The RCVM turns on the entire main supply line whenever any individual remote control value is scheduled for watering.

Individual remote control values (RCV) control the flow of water to the lateral water supply lines and sprinklers. They open and close when and for what period of time as directed by the irrigation controller (IC). They are one of many under one RCVM. Standard practice is to group clusters of RCVs at safe access locations away from the traveled way rather than having individual RCVs spread out across the roadside. This is done to reduce worker exposure to traffic.

STATION

Each remote control valve (RCV) and the spray heads it controls are called a station. Station numbers should start with all the valves with heads at the shoulders then to interior systems and lastly to the low flow systems (emitters). This is so that the shoulders are watered early in the day before winds come up, then to areas where wind has little or no chance of spray onto the traveled way. The numbering sequences may have to be adjusted due to wind or local water company restrictions. When changes are made to station sequencing, be sure that the irrigation controller (IC) plans are corrected before they are laminated.

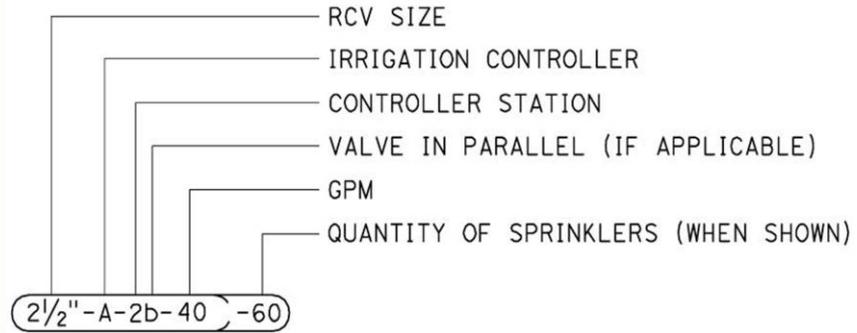
So this valve is controlled by IC C and is number 8 in sequence.



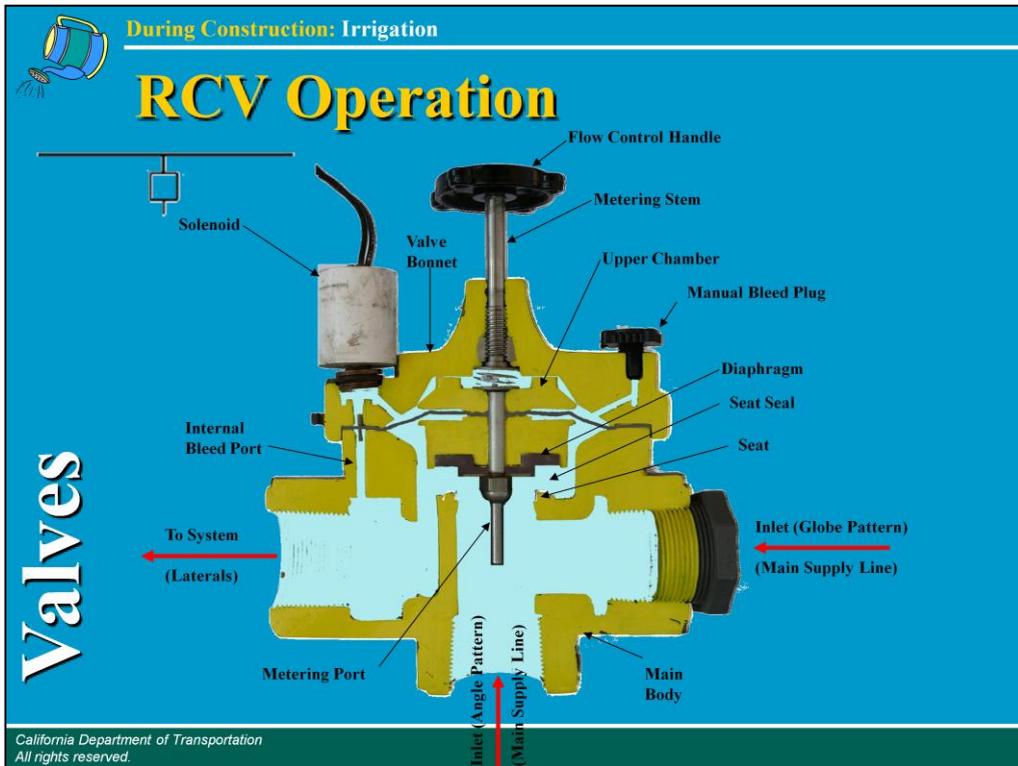
RCV Code

Valves

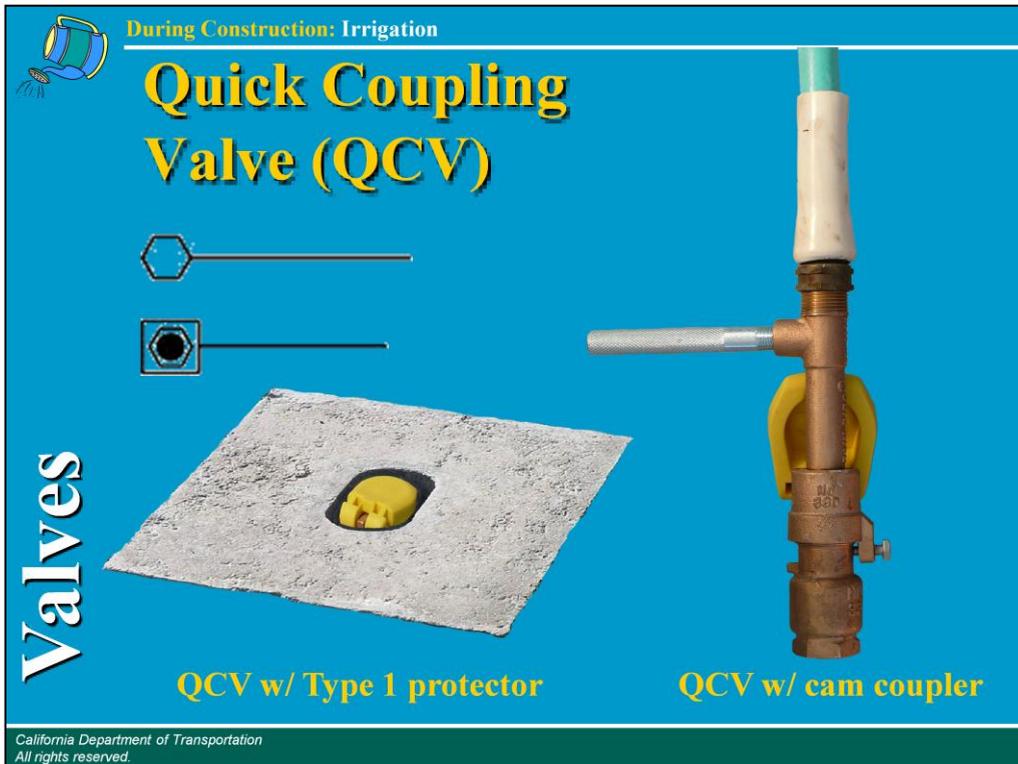
VALVE CODE



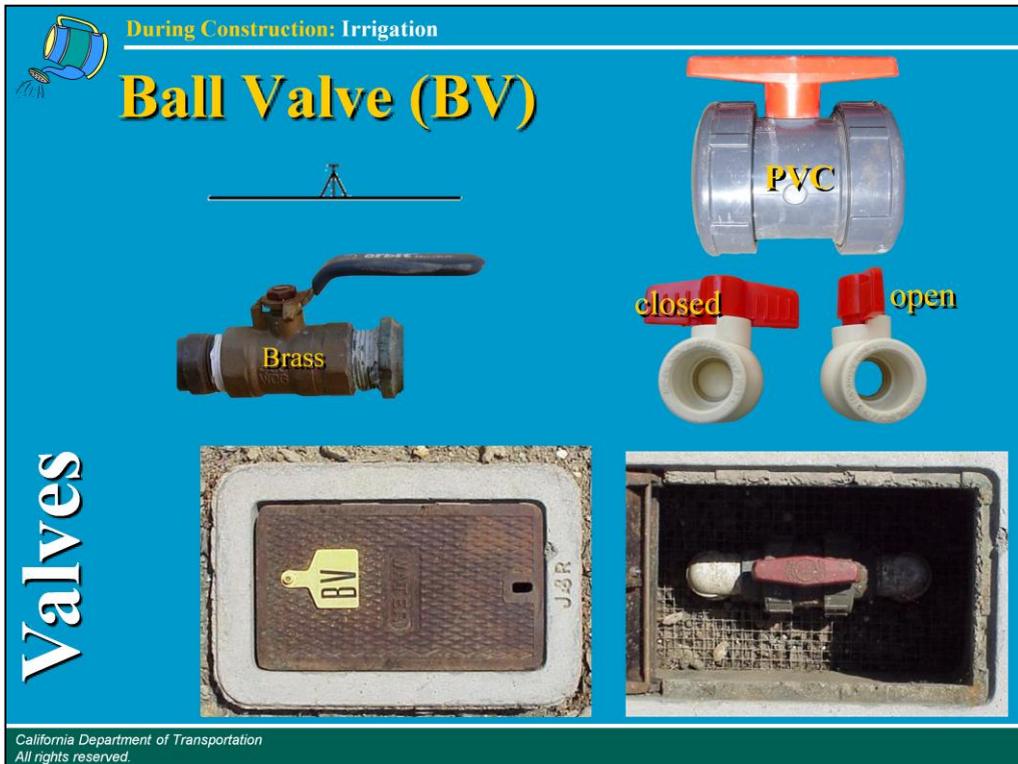
Each remote control valve is identified on the irrigation plans with this coded symbol. Here is a key to what those codes mean.



You should have a basic understanding of how a remote control valve works. A thorough explanation is provided in the Manual. This cutaway diagram identifies the major parts.



A quick coupler valve (QCV) is a manual device installed on the main supply line and used to attach a hose to the irrigation system. It usually requires a Sprinkler Protector Type I to protect the QCV from damage. A cam coupler is inserted into the QCV to operate. One QCV is normally placed at each grouping of RCVs or wherever a hose may be needed.



Ball Valve – 90 degree turn on/off. Very efficient with round ball with hole in center and Teflon seats. Narrow body fits well in systems. Mostly used to isolate valve clusters and Backflows. Handles indicate position of valve - inline means flow through the valve - perpendicular means no flow. Since water passes only through the center of the *ball* they are less likely to corrode than gate valves.

Use brass BV only at BPA and above grade applications.

For below grade inline applications can use PVC BV and unions. Place in valve box.

During Construction: Irrigation

Gate Valve (GV)




1/2 open Full open

Valves




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Gate valve – Installs inline and opens by an internal rising *gate*. Used most often at Irrigation Conduits and Backflow Preventers. The valve handle only turns, it does not rise or lower, SO unlike a Ball Valve, you cannot tell if the valve is open or closed just by looking at it. Debris/corrosion can build up in the gate area, preventing complete closure. Corrosion also causes these will eventually leak when closed. They often corrode to an immovable condition in either the completely open or closed position!! Why? Because water is running through the entire inner portion of valve stem, seat, etc.

 **During Construction: Irrigation**

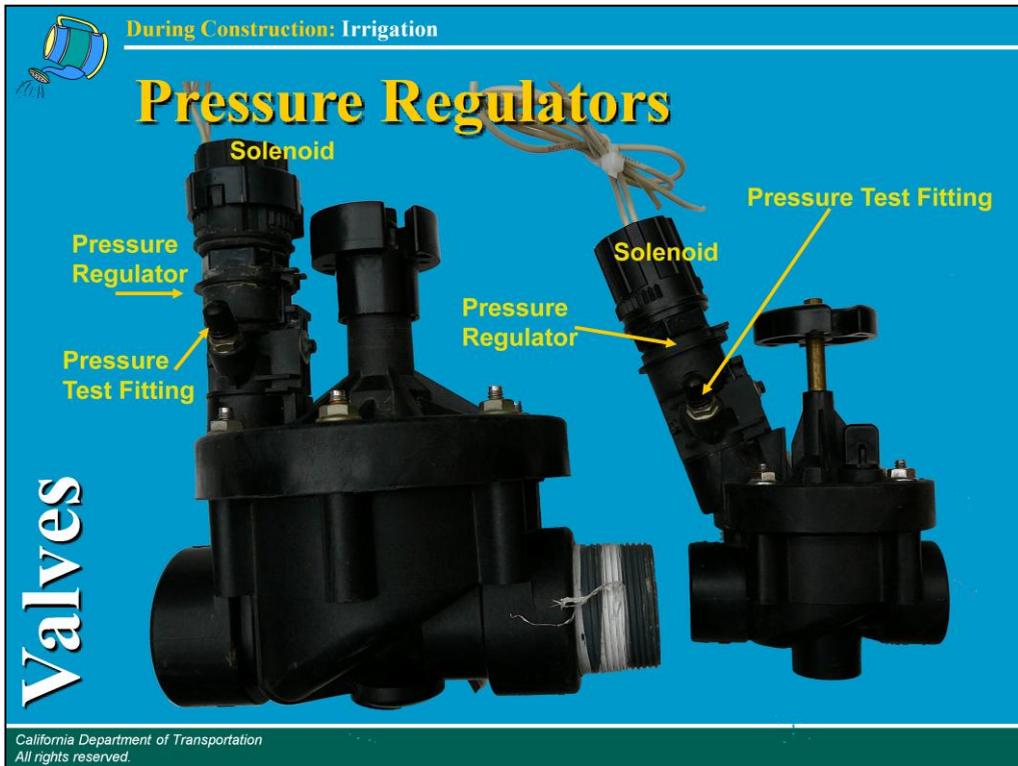
Pressure Reducing Valve (PRV)



Valves

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A Pressure Reducing Valve (PRV) does just that, reduces water pressure. They can be of any size, and are usually installed near the backflow preventer for systems with high static pressure.



Shown here are two Remote Control Valves w/ Pressure Regulators.

Pressure regulators are used on RCVs to reduce the pressure for the low flow sprinkler systems. High pressures in the low flow systems would cause excessive misting of the spray pattern of the sprinkler, an inefficient use of water, and results in eventual damage to the sprinklers.



WSAs are used for the low flow spray & drip systems to prevent clogging of the heads. Low flow heads have very small nozzle openings (often in microns) and are easily plugged. It is very important to flush the main supply lines and the lateral supply lines before the filters AND sprinkler heads are installed .

Various sizes of WSA - dependent upon gpm requirements of the system.

Unions are usually used at backflow preventers (brass) & filters (PVC) to allow removal. Fittings are Sch 40 or Sch 80 as recommended by manufacturer of filter.

During Construction: Irrigation

Pressure Relief Valve (PRLV)

Valves

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Pressure Relief Valves are preset protection devices that open at a PRESET pressure to prevent damage to the main and lateral supply lines. They are most commonly located at the end of the supply lines/lowest elevation -most common setting is 150 PSI.

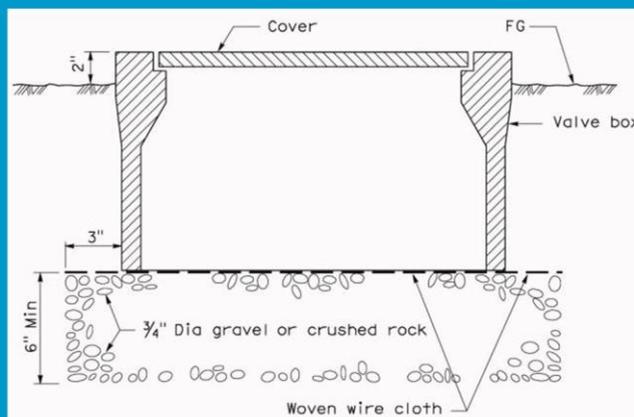
A PRV is generally not necessary in most urban areas as normal pressures are generally in the 40-60 PSI range, but they will be needed in high pressure areas – areas of great elevation changes or where there are high pressures at the water source point.



Boxes



Valves



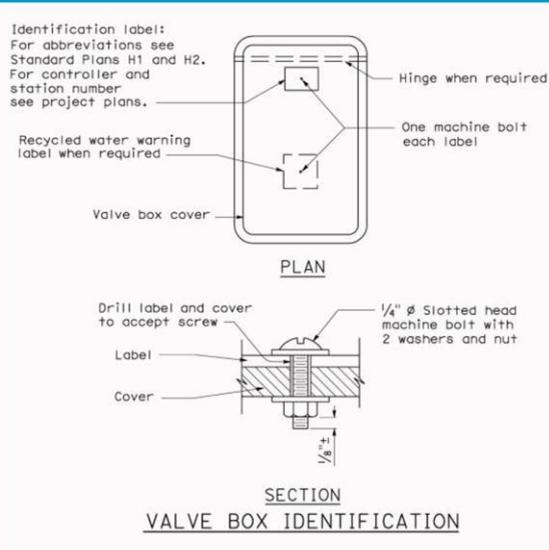
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- Valve boxes must be precast concrete and must be placed below grade as shown.
Lids for boxes must be concrete, steel, or cast iron and marked **WATER** in precast letters.
- The gravel bed provides a firm and stable base for the box to set on.
 - The wire mesh is required to keep gophers from filling up the boxes with dirt. Gophers like to make their tunnel runs along the water lines and when they reach a valve box, too much light gets into their tunnel. So, they have to block the light, aka fill up the box with dirt.



During Construction: Irrigation

Boxes – ID Tags



Valves

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The valve box covers must include a polyurethane label with the appropriate controller letter and station number as shown.

The purple tag is industry standard for reclaimed water.



During Construction: Irrigation

Locations



Valves

Valves should be clustered near safe access areas like access gates, Maintenance Vehicle Pullout(s) (MVP) or access roads.



Placing valve clusters away from the traveled way is required to reduce worker exposure and improve worker safety. At this location, a maintenance access road will allow a truck to be driven to the valves.

During Construction: Irrigation

Sprinklers

- **Type**
 - **Individual** (Radius < 4 ft)
 - **Overhead Spray** (Radius 5 ft – 50 ft)
- **Risers**
- **Materials**



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See Sprinkler Schedule for Sprinkler Type, Spray Pattern, Riser, Material, etc.

Individual sprinklers are for shrubs or trees and meant to supply water in small areas directly at plant root zone. Usually used as supplement system to insure growth of specific plants within large areas of ground covered by overhead spray heads and as a back-up for whenever the large area sprinklers fail or are turned off in drought conditions. Also used as the primary system for just tree/shrub plantings for water conservation.

- Bubblers (GPM)
- Emitters (Drip or Low Flow Spray) (GPH)

Overhead Spray (Radius 5 ft - 50 ft)

- Impact or gear driven (full circle & part circle)
- Fixed pattern Spray or Stream
- Pop-up (can be all of the above)

Riser: the pipe and fittings used to attach the sprinkler to the lateral pipe.

Swing Joints are installed between the riser and the lateral to allow movement.

Swing joints allow the sprinkler head location to be easily adjusted and they deflect to prevent breakage.

During Construction: Irrigation

Sprinklers - Individual

Bubblers



Fixed GPM



Adjustable GPM

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Bubblers usually have a flow in gallons per minute (gpm) – and usually require basins around the individual plants to retain the water.

Note the gallonage on the bubbler above - POINT 25 (1/4) gallons per minute. This is low flow.

Adjustable bubbler can generally go from 0.25 (1/4) to 5 GPM.

During Construction: Irrigation

Sprinklers - Individual

Emitters



Low Flow Spray



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Sprinklers with very low flow, in gallons per hour (GPH), are referred to as emitters. Emitters (low flow spray or drip) often have color coded inserts that determine the GPH. See Sprinkler Schedule and manufacturer's literature.

Drip & Low Flow Spray are very low gallonage, so it is usually not necessary for the plants to have a basin.

During Construction: Irrigation

Sprinklers - Overhead

Impact & Gear Driven

Both are adjustable in arch and radius, full or part circle.
Radius: 20 ft – 50 ft



Impact



Gear Driven

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Impact Sprinklers operate by the impact of water leaving the nozzle hitting *spoons* and *flappers* to drive the sprinkler. They have collars and spring mechanisms for radius and arc adjustment. A disadvantage is that there is backsplash to areas not meant to be watered. Since it uses an *impact* to drive through its arc they can go out of arc adjustment and spray unwanted areas such as the roadway and sidewalks. Usually constructed of brass, they are expensive and they are a target for theft for their scrap value.

Gear Driven are usually of plastic construction. They operate by water flowing through the internal gears of the sprinkler for arc and radius. Once arc and radius are set, they rarely go out of adjustment. Since plastic has NO SCRAP VALUE, they are generally left alone other than just malicious damage/vandalism.

During Construction: Irrigation

Sprinklers - Overhead

Fixed Pattern

Radius: 5 ft – 15 ft





Stream
Spray





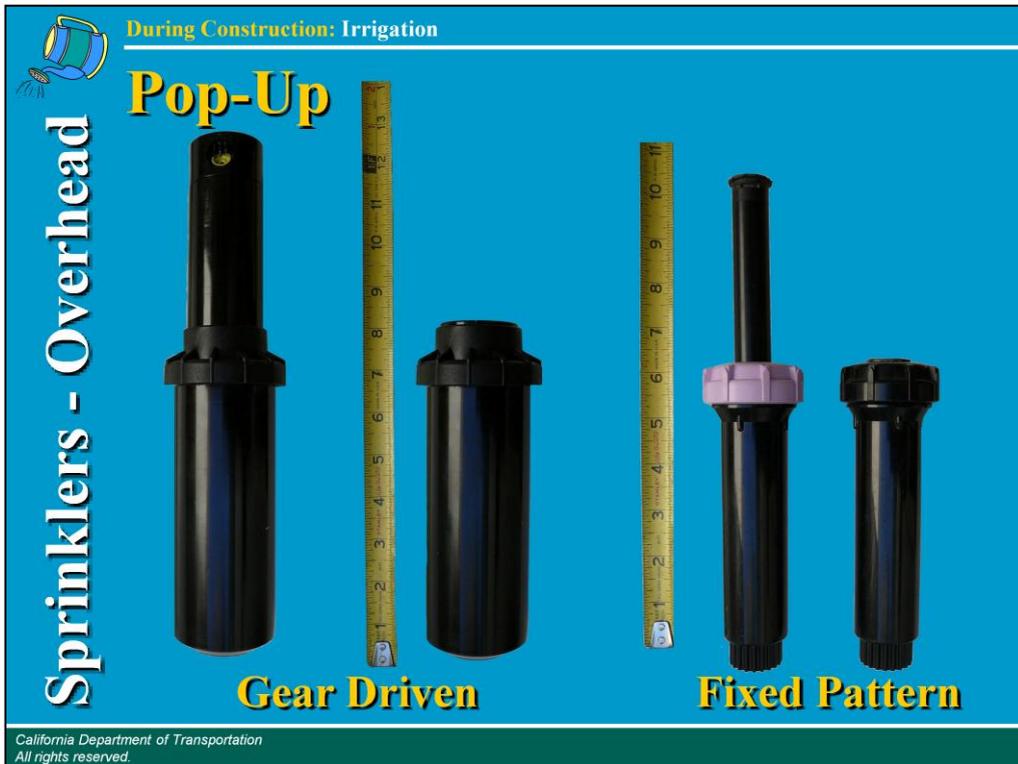
Fan
Spray

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Stream Spray: Note the nozzle holes. These stream sprays are less susceptible to wind. The code on top of the Stream Spray (22H-SS) indicates the pattern is a half circle and designated as **H** on the Sprinkler Schedule.

Fan sprays are more susceptible to wind. Note the shape of the nozzle and arc is indicated on top. The arc is set but the radius is adjustable. This is a quarter circle pattern and designated as **Q** on the Sprinkler Schedule.

Fan or spray would be designated in the Remarks section of the Sprinkler Schedule.



When not operating under pressure, pop-up sprinklers are flush with grade (out of sight) and only *pop up* and operate when under the design pressure for their particular size. When pressure is removed they should retreat back to flush grade.

Note: **Pop Up** would be listed under the remarks column on the Sprinkler Schedule along with the type of swing joint and riser required. A concrete protector is used for areas adjacent to pull-off areas (are often due to a high number of *hits* by traffic.)

Gear Driven are slimmer and less prone to malfunctioning and damage than an impact pop up sprinkler commonly referred to as a *Rainbird in a can*.

Fixed pattern are used for narrow areas adjacent to traffic (smaller radius). The purple cap is used for Reclaimed Water.

During Construction: Irrigation

Sprinkler Protector Type I

Sprinklers - Overhead



Type I

Poor Installation!

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Sprinkler Protector must be maximum 1" above grade. The installation on the right is a tripping/safety hazard.

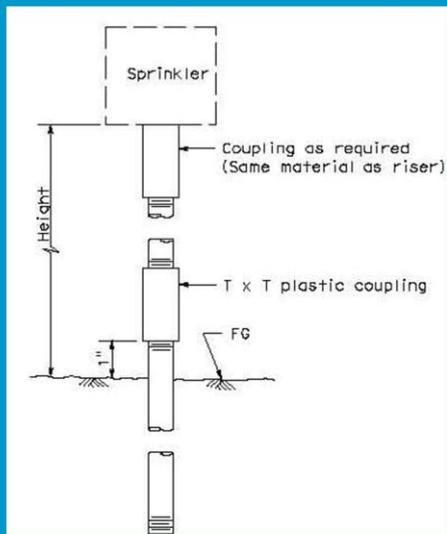
Sprinkler Protector Type II (See Standard Plan H6) has a 1" dome and the edges are flush with grade.



During Construction: Irrigation

Type I

Sprinklers - Risers



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Type I Riser

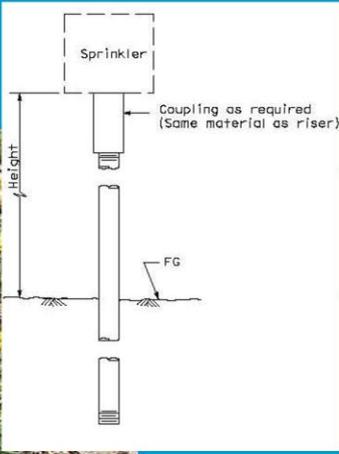
- Rigid, Plastic or Galvanized (See Sprinkler Schedule for riser material)
- Plastic Coupling 1" above ground

What type of sprinkler? (Fixed Spray)

During Construction: Irrigation

Type II

Sprinklers - Risers



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Type II Riser

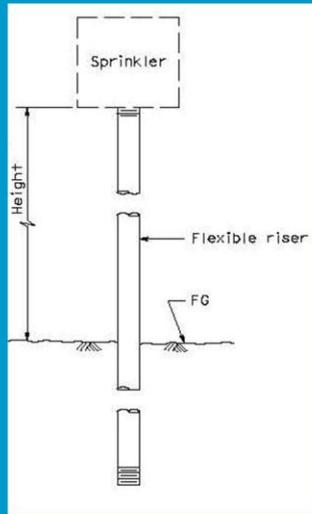
- Rigid, Plastic or Galvanized (See Sprinkler Schedule for riser material)
- No coupling

What type of sprinkler? (Gear Driven)



Type III

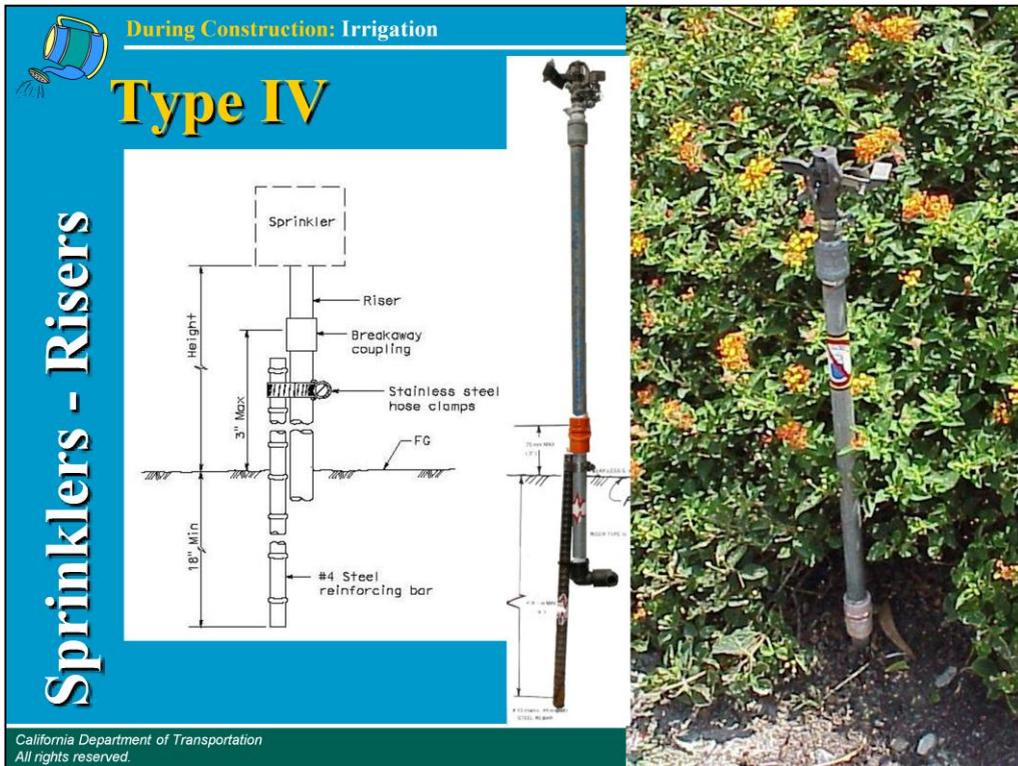
Sprinklers - Risers



Type III Riser

- Flexible
- No coupling

What type of sprinkler? (Emitter – Low Flow Spray)



Type IV Riser

- Plastic or Galvanized (See Sprinkler Schedule for riser material)
- Breakaway Coupling (Flow shutoff device)

What type of sprinkler? (Impact)



During Construction: Irrigation

Flow Shutoff Device

Sprinklers - Risers

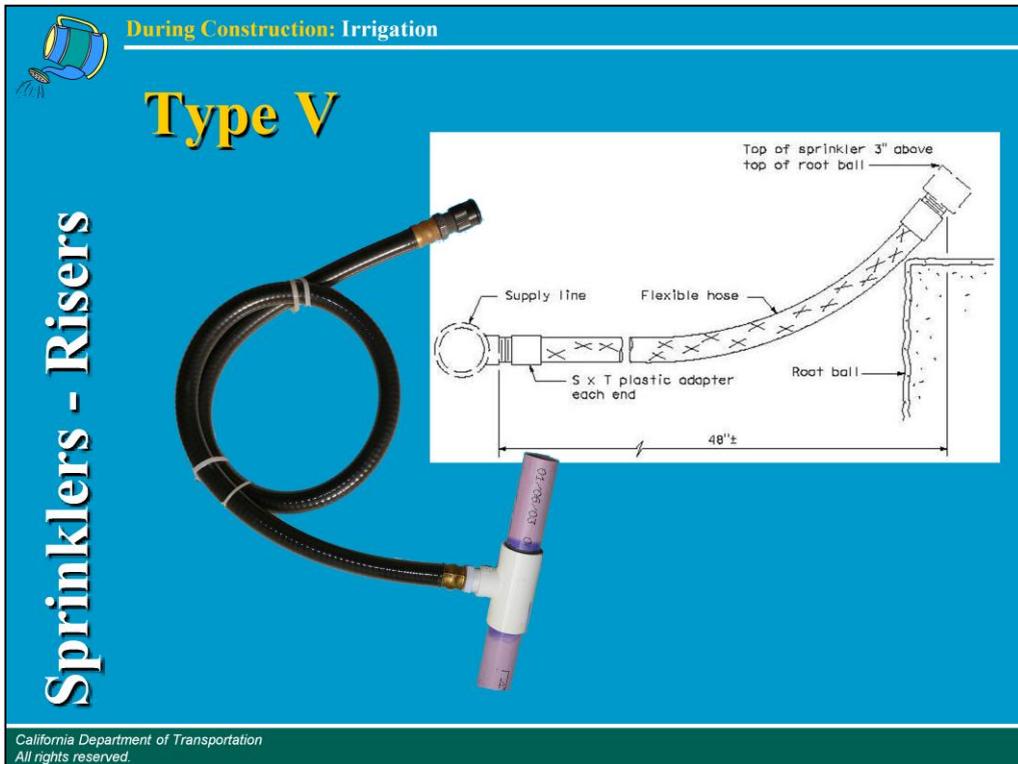


Flow



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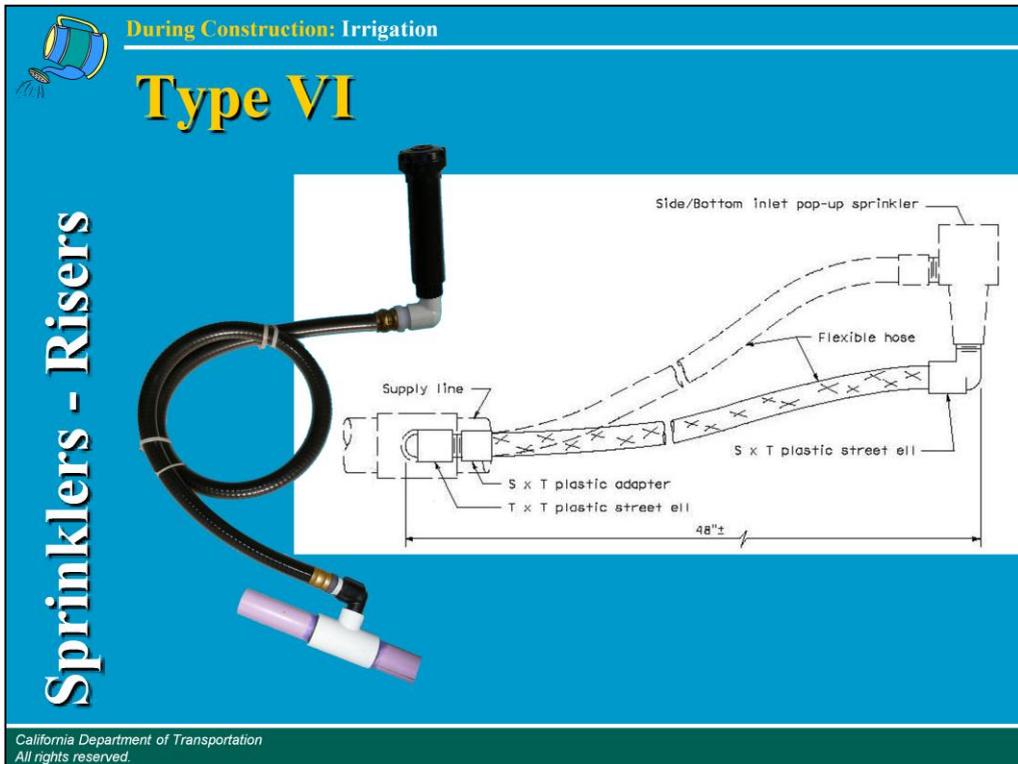
Proper installation depth is important for both sides of the riser to seat to allow the device to work properly. The metal band on bottom of coupling (see flow arrow) and the top part of the riser must be deep enough to prevent the black Y-Ball from rising enough to shut off the sprinkler until the top portion of the riser is broken away. When the water comes on, only a small squirt will shoot in the air, as the black stopper seats against the remaining portion of the device rather than a stream of water at 30 psi (= 15' high) and almost 10 gpm of water spraying onto the highway possibly causing an accident.



Type V Riser

- 48" Flexible Hose
- Straight off supply line to sprinkler

What type of sprinkler? (Bubbler)



Type VI Riser

- 48" Flexible Hose
- Street Ell off supply line
- Street Ell to sprinkler

What type of sprinkler? (Pop-up)

Either the Type VI riser or the Riser Type II are most commonly used with pop-up and other sprinklers that are adjacent to the traveled lanes. They allow for more flexibility to prevent broken sprinklers where they are not as visible - as those on higher risers needing a breakaway coupling.

Sprinklers – Swing Joint

During Construction: Irrigation

Type I

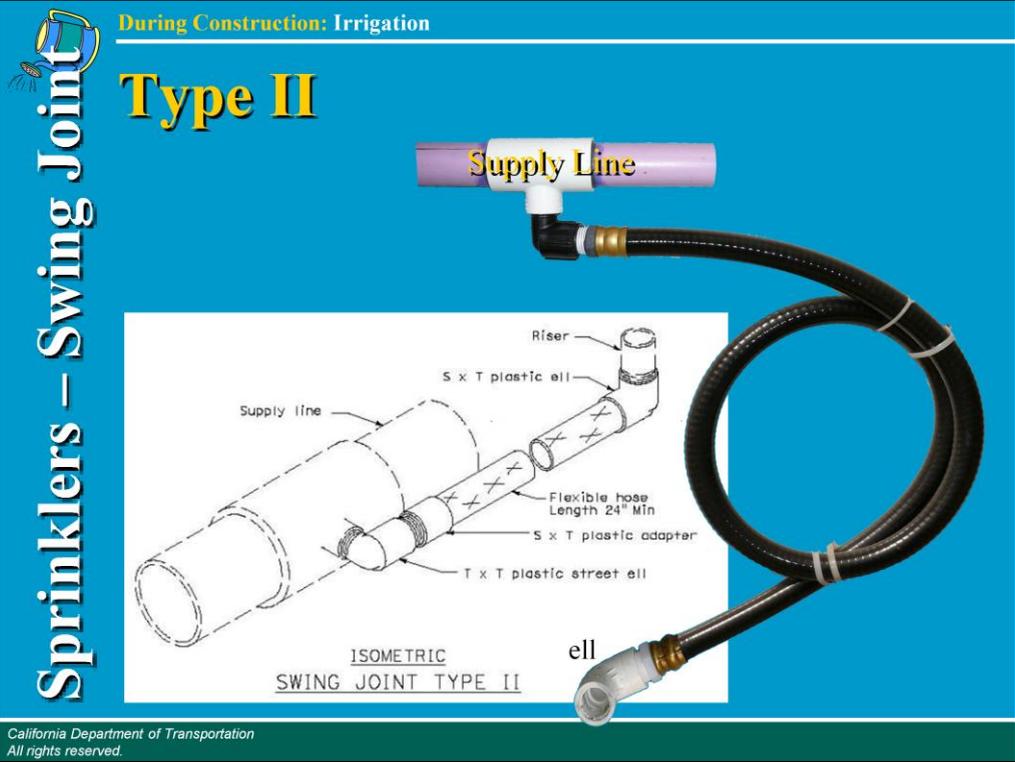
ISOMETRIC
SWING JOINT TYPE I

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STREET ELLS have 1 male end , 1 female end.

ELLS have 2 female ends.

This swing joint allows for placement of the sprinkler in relation to slopes.

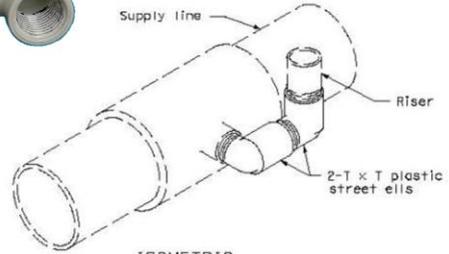


A swing joint Type II is the same as a Riser Type VI, except the flexible hose is 24" rather than 48".

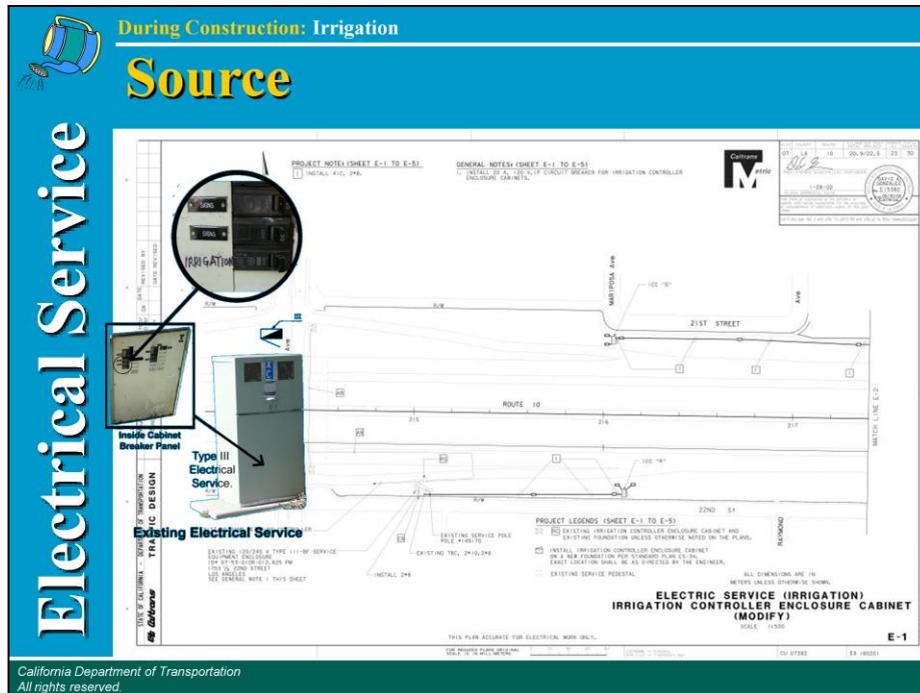
Sprinklers – Swing Joint

During Construction: Irrigation

Type III



ISOMETRIC
SWING JOINT TYPE III



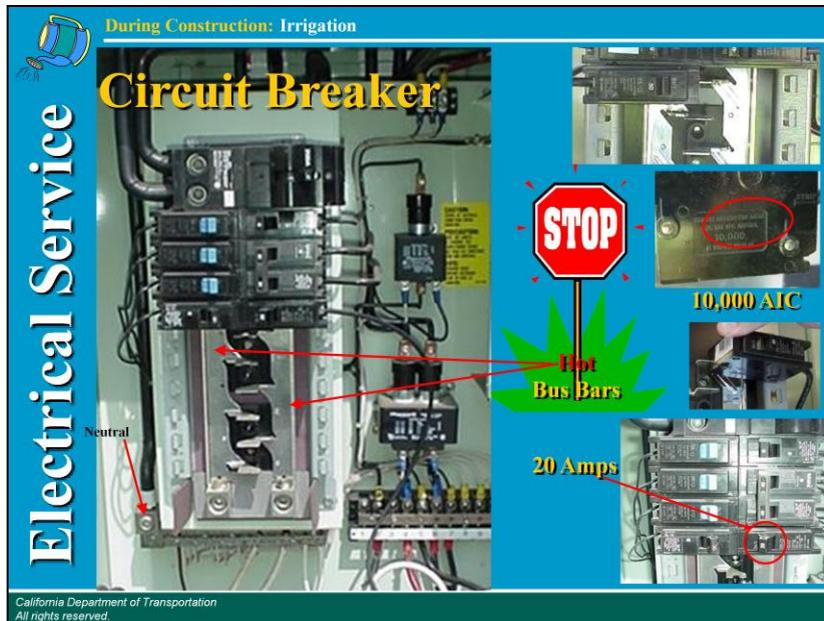
We have gone from the water meter to the sprinkles. Now that we have water, we now need to go over all the requirements to power the system. Electrical service must meet the requirements of the Electrical Section of the SS and SP, not the Landscape SS & SP's.

We will now be looking at:

- Electrical Project Plans.
- Section 86 of the Standard Specifications

Notice that the new circuit shown above has been labeled ***Irrigation***. Landscape is a guest in the Electrical Service Cabinets, therefore we need to take an extra effort to follow their specifications.

Note: This is a great example of why some districts only allow the Electrical Inspectors to inspect electrical.



Only qualified personnel should open up the breaker (dead front) panel due to the risk of electrocution. Electrical Service is the same as your house current, 120 V alternating current (AC) and it can kill you. So, touch nothing, ever! But, you, the inspector, needs to be present when the contractor installs the work. Especially if it is a Landscape project that doesn't have an electrician on staff. Even the most qualified electrician may try to take short cuts from the specifications, so lets pay attention!

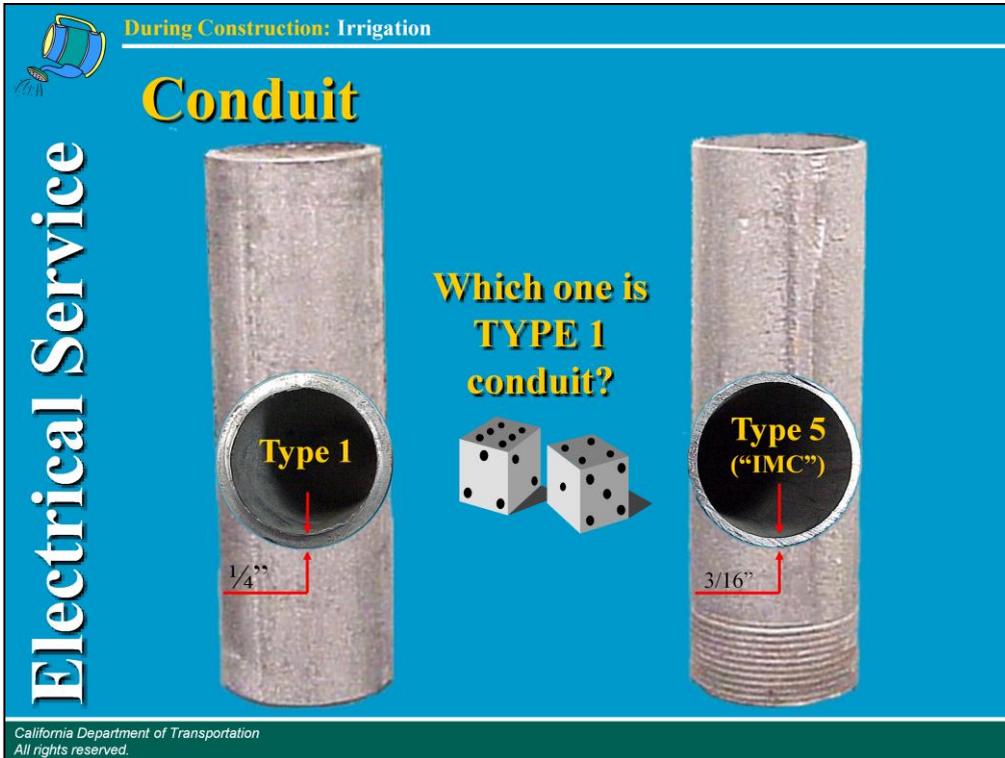
When you open up the breaker (dead front) panel you'll see something like this. Exposed bus bars are live and can kill you on contact. You really have no reason to touch anything here. If you need to inspect it, ask the contractor to show you around.

WARNING: Each of the bus bars are 120V to ground.!

In *Chapter 1, Before Start of Work*, we verified that there was space in the cabinet for an additional circuit breaker.

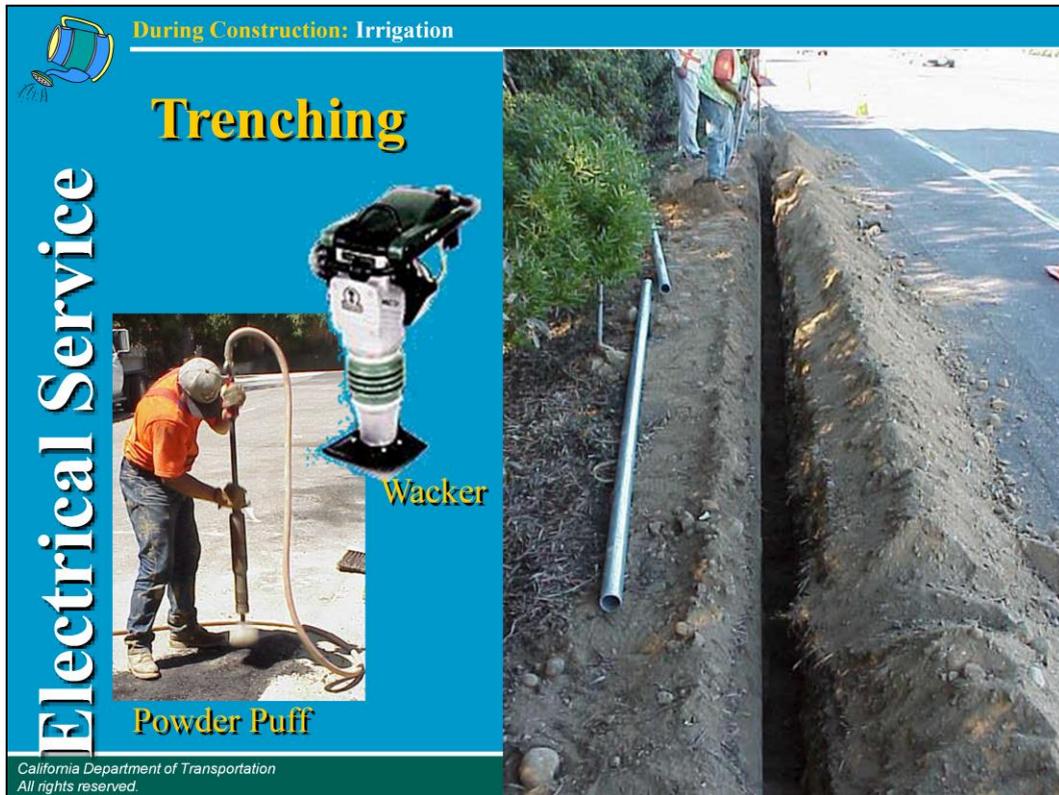
Is there room for more circuit breakers in the cabinet shown? Inserting one 20 amp - 120V - 1 pole circuit breaker (CB) takes up one slot. The amperage is printed at the end of the circuit breaker switch.

10,000 AIC (Average Interrupt Current) - The circuit breaker must be rated to handle the available fault current.



Refer to Standard Specifications 86-2.05 Conduit.

- Type 1, Hot Dip Galvanized, Rigid Metallic Conduit
- Minimum trade sizes - 1 ½ inch if unspecified.
- Installation SS 86-2.05C:
 - Cutting, Damage, Threaded Ends, Bends
- Properly connected sections of conduit will show NO threads between the coupling points.
- There shall not be more than four 90 degree angles or a total of 360 degrees of bends in a single conduit run. Conduit runs consist from pull box to pull box, pull box to cabinet or pull box to foundation. Any individual conduit run shall not exceed 200 feet. Install pull boxes to comply.

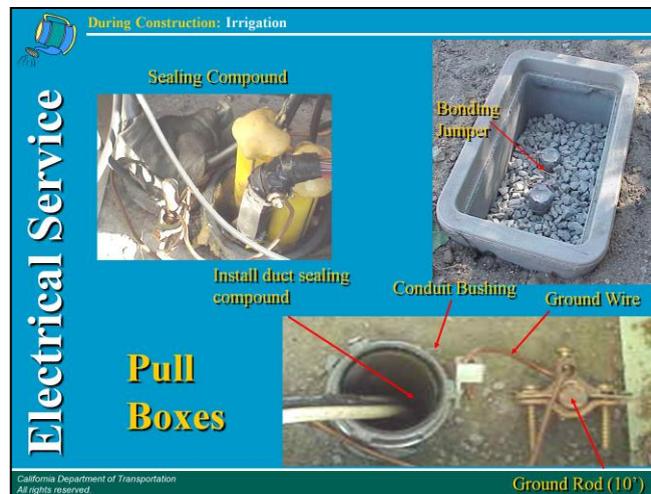


Refer to SS 86-2.05C for trenching for electrical conduit:

- Depth – not less than 30” below finish grade; at least 18” below sidewalk or curbed paved median.
 - In pavement: depth must not exceed the greater of 12” or conduit size plus 10”.
- Backfill & Compaction SS 86-2.01
 - Outside hinge point of slopes and not under pavement – 90% & native material
 - On slopes or under pavement – 95% & SE20 material
 - Conduit is to have 30 inches of cover. Type 1 conduit does not require slurry cement backfill in dirt areas.
- Compact with a *powder puff* or *wacker*. The contractor will try to sell you on wheel rolling or compacting the trench with a backhoe’s bucket, but this will not work as well as a trench compacted with a *powder puff* or *wacker*. Any uncompacted trenches up slopes will wash out during the next rainfall. When the contractor is trenching off of the paved shoulder, make sure to cover the drain inlets with plywood if there is a chance of dirt falling in.

What should you inspect on this view?

- a. Conduit Size
- b. Trench Depth
- c. Verify the correct location of placed conduit and pull boxes etc.
- d. Look for damages to existing facilities



- What should the pull box between the service cabinet and the irrigation controller cabinet be labeled as? See Standard Plan ES-8 (Irrigation).
- Pull boxes must be spaced no more than 200 feet apart.
- Install Type 3-1/2 Pull box - For two conduits
- The pull boxes are installed on a crushed rock base for non-structure installations.
- The conduits should protrude 2 inches above the crushed rocks.
- The pull box must be installed flush to grade in paved areas like gores, pavement or sidewalks.
- The pull box must be 1 inch above grade in dirt areas as shown.
- Pull boxes installed on steep slopes should be installed to conform with the slope, so that the pull box stays in the dirt after a couple of rainy days.
- Bonding jumpers must be a bare or green insulated copper wire or copper braid of the same cross sectional area as a No. 8 or larger for all other systems. Note the smaller the gage number (AWG #) the thicker the wire.
- All 120V conduits in every pull box must be sealed with compound.

Bushings: Bushings protect conductor insulation from sharp conduit edges during cable pulls. Often contractors don't install bushings even though the specs call for it. If your using GRS (Type 1) conduit how is the contractor going to bond the conduit runs going in and out of a pull box? Bushings are needed to bond the conduits together with bare copper wire.

Grounding: All metallic components such as service cabinets, controller cabinets, conduit, PVC conduit with pulled bare ground wire, and electronic equipment must be grounded together by means of bonding jumpers or straps to maintain these units at the same ground potential. In other words, ground them all together.



- Splicing is only permitted in pull boxes. Running splices within conduit is not permitted. Splicing conductors and pulling the spliced conductor within a conduit run is prohibited.
 - You must actually watch the electrician do the splicing. Contractors usually try to avoid soldering though its required. Plus, most don't adhere to Method B splicing as required per ES-13A of the Standard Plans. Wire nuts and *ketchup pack* types of insulation bags are not permitted.
 - No open flame torches allowed for splicing conductors. It will damage the insulation. Plus, it's a fire hazard. Use the soldering gun as specified. Contractors hate using the soldering gun, because it takes time to heat up and they have to bring their truck with a generator.
1. Strip Conductors: Cut off insulation with electrician's knife. Wire cutters may nick the wire if the cutting slot used is smaller than the wire.
 2. For wires larger than #8 AWG (#6 AWG, #4 AWG etc.), crimp together with butt compression connector. Solder #8 AWG or smaller wires. Use soldering iron. No open flame!
 3. Cover splice area with electrical insulation coating.
 4. Wrap the conductor with 2 layers of half lapped self fusing rubber tape. (This tape is thick)
 5. Wrap and diaper over the rubber tape with vinyl electrical tape. (It's shiny)
 6. Brush on insulation coating.
- Contractor insulation tests the conductor. An insulation resistance test is usually made with a megohmmeter (Megger), which is a small hand-operated or battery-operated generator, which usually generates about 500 volts. Megger between earth ground and the conductor should be greater than 100M ohms. Nicked or faulty splicing would be less than 100M ohms.

During Construction: Irrigation

Heat-Shrink Tubing Splice

Electrical Service

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SS Section 86-2.09D states that the Contractor can use either Method B or Heat-shrink tubing. Most seem to use Method B splice.

Heat-shrink method:

1. Strip Conductors: Cut off insulation with electrician's knife. Wire cutters may nick the wire if the cutting slot used is smaller than the wire.
2. For wires #8 AWG or larger (#6 AWG, #4 AWG etc.) crimp together with butt compression connector OR Solder #8 AWG or smaller wires. Use soldering iron. No open flame!
3. When 3 or more conductors are spliced together, coat each conductor with mastic before placing in tubing.
4. Wrap the conductor with medium to heavy weight, 3 to 1 shrink, polyolefin heat shrink tubing containing an adhesive mastic inner wall. Tubing shall overlap conductor installation by at least 1 ½" after shrinking.
5. Shrink tubing with a heat gun. No open flame torches allowed.
6. Cover entire splice with electrical insulation coating and allow to dry.

During Construction: Irrigation

Irrigation Controller (IC) 

Enclosure Cabinet

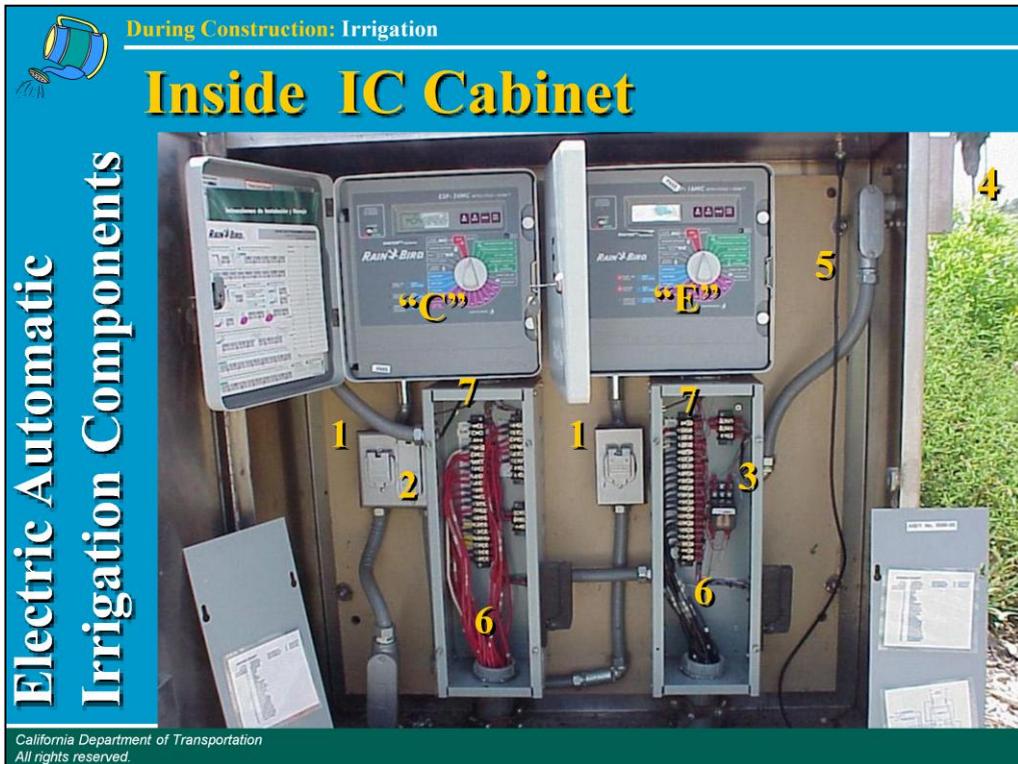
Electric Automatic Irrigation Components



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This is a Single Irrigation Controller Enclosure Cabinet with 2 controllers inside- **C** & **E**. Cabinets must be stainless steel.

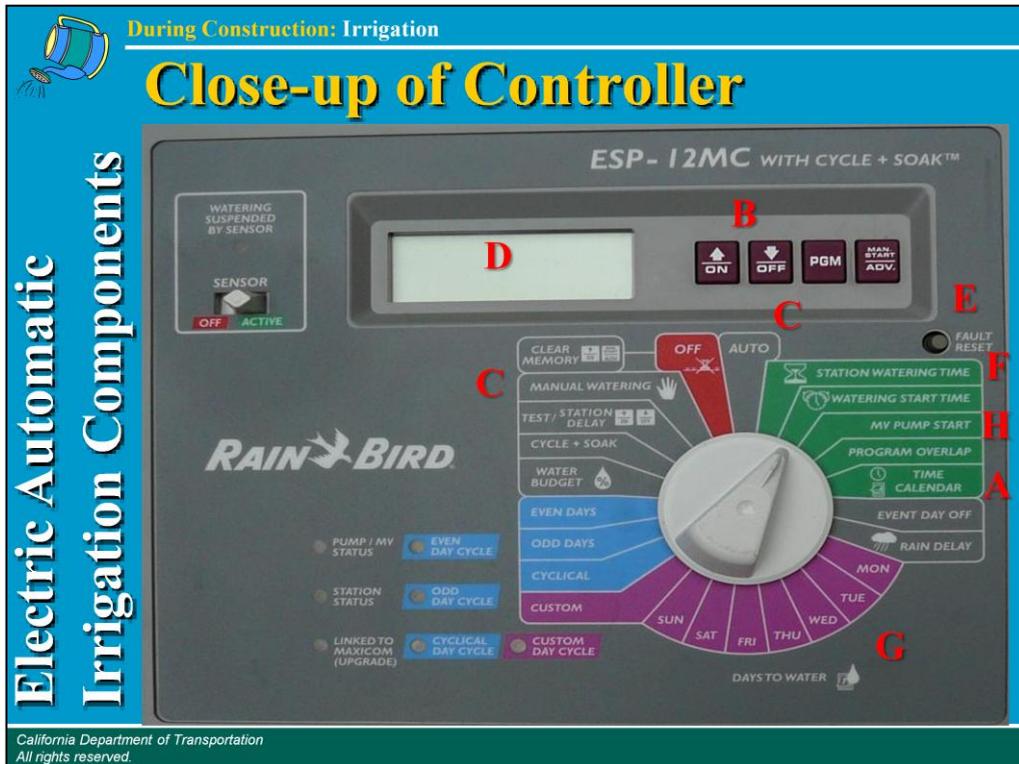
Irrigation Controller (IC) – electronic device to automatically turn on/off valves at specific times and designated periods. Controllers must be capable of manual or automatic operation.



Identify auxiliary equipment inside controller cabinet unit:

Controllers **C** (has 24 stations) & **E** (has 16 stations)

- 1: On/off switches (one per each controller).
- 2: Duplex (standard 120v, 20a) outlet w/cover.
- 3: Control Relay--- needed when 2 or more Controllers operate the same Master Remote Control Valve.
- 4: Rain gauge, will stop the controller from operating the valves during a rain event (precipitation collects in cup). Merely an override. It does not change any programmed information on the controller.
- 5: Antenna Lead for Valve Actuator System (when required).
- 6: Low Voltage Conductors. Note bushings protecting wires coming up through conduit.
- 7: Terminal strips with open ended crimp terminals on the low voltage conductors.



Close up of typical irrigation controller.

A- TIME CALENDAR -- 14-day or longer irrigation program. (follow steps as they appear in the screen – this will include the blue and lilac areas also)

B- ON/OFF switch

C- AUTOMATIC or MANUAL control

D- Watering time display

E- FAULT RESET -- Fuse or Circuit breaker.

F- STATION WATERING TIME -- Each station variable timing adjustment -- use the up/down arrows to set time for each station in sequence.

G. PROGRAM SCHEDULES

H. MV PUMP START -- Output for pump start .. Remote control valve (master)...

Irrigation controllers for a specific project must be manufactured by the same company, (in this instance RAINBIRD)

During Construction: Irrigation

IC - Remote Valve Actuator

Electric Automatic Irrigation Components




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Right PICTURE--- Remote Control Hand Unit of a Valve Actuator System. These will be specified in SSPs. To be turned over to Maintenance at end of project. They allow 1 person to test/check systems !!

Left PICTURE--- The #1 indicates the Valve Actuator Slave unit attached to a controller and antenna lead. Note this is a 24-station controller, plus 4 black leads for either a pump start or to a second control relay for operation of a second MRCV shared with another controller served by the same water meter.



THINK !

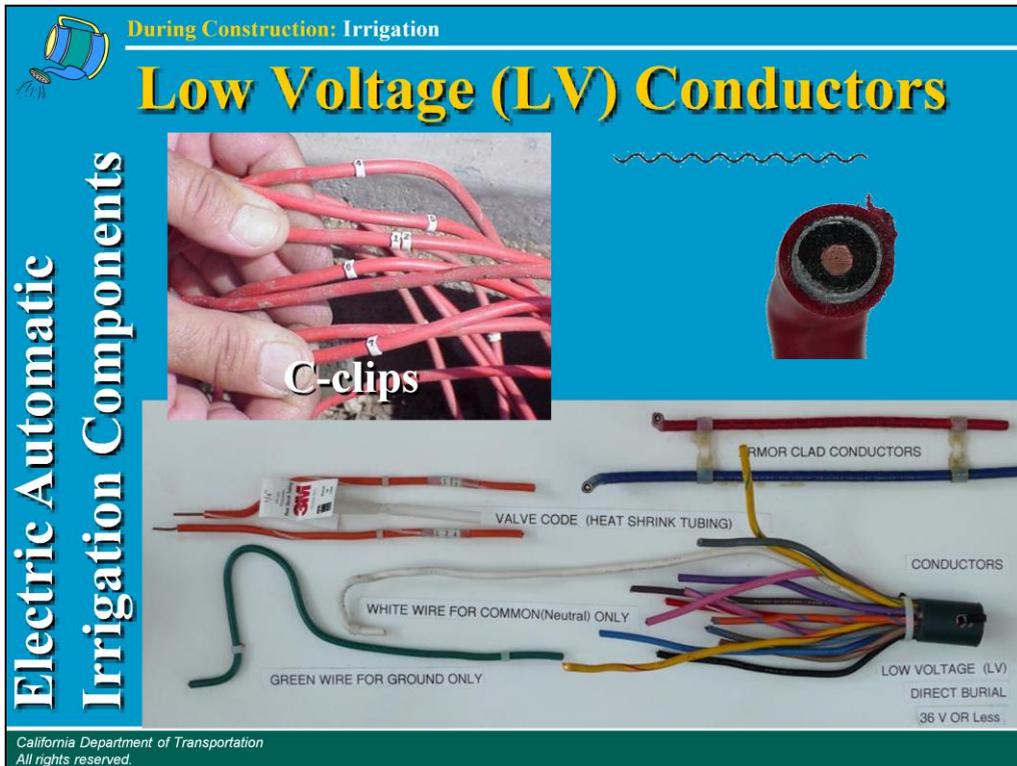
**Location,
Location,
LOCATION**



This Irrigation Controller is behind a sound wall with **NO ACCESS** through wall, and a ditch on right. It should not have been placed there.

If the sound wall came in afterwards, then a gate should have been installed or a *bridge* built to cross the ditch or some other safe access provided to allow for maintenance.

Remember the size of the symbol shown on the irrigation plans is almost 10' in scale so it allows for some movement. And there is no reason to stop THINKING just because there is a plan. Use your best judgment to place the controller at a safely accessible location.



Low voltage is under 50 volts, < 1 amp DC current. See the Standard Specifications for direction for:

- Wire plans: Review and Approve.
- Wire sizing
- Identification
- Armor Clad wire on right needed in areas of high rodent activity and usually between pump controls and FS to provide mechanical protection and false signal initiation.
- Installation - *wrapped .. 5-foot intervals.*
- Splicing - Heat-Shrink Tubing splice is the better splice for Landscape electrical work.

One conductor for each valve **PLUS** common conductor in white for all valves. The white wire goes from the controller to all RCVs.

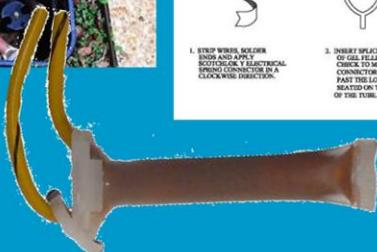
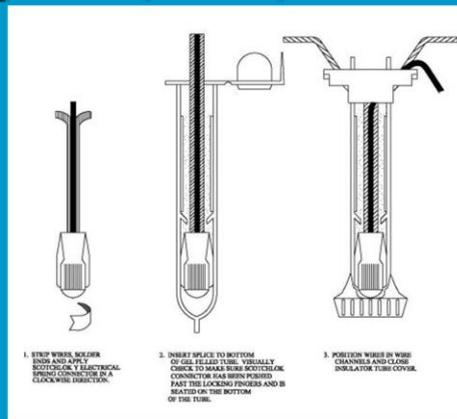
Coding is very important in operating the system, especially correcting or changing the order of operation and finding and correcting malfunctions. Conductors must be color coded according to controller when two or more controllers are in the same enclosure and when conductors from different controllers share a common trench.



During Construction: Irrigation

Direct Burial Splice (DBY)

Electric Automatic
Irrigation Components



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DBY's are about as fool-proof as possible so should be 1st choice and the only 2nd choice be the epoxy bags (not as desirable as DBY). The RE Pending File should state the preferred splice.

During Construction: Irrigation

Epoxy Bag Splice Sealer

Electric Automatic Irrigation Components



Engineering/ Architectural

The material is a two-part epoxy resin packaged in the 3M Unipak™ two-part polyethylene bag. The resin must be mixed within the Unipak™ container simply by separating the barrier between the two parts of the bag and working the contents back and forth within the bag.

Installation

CAUTION:
Turn power off before installing connector, then make connection per manufacturer's instructions. All electrical work should be done according to appropriate electrical codes.

NOTE:
When temperature is below 50° F (10°C), keep resin in a warm place prior to mixing (for example, in an inside pocket next to the body).

1. Thoroughly clean and dry the surface of the substrate to which the material is desired to bond.
2. Remove guard bag, using caution not to damage inner bag.
3. Grip both edges of bag at the center barrier (FIG. 1) and wrinkle and flex the bag across the barrier. This will weaken the barrier.
4. Squeeze the clear side of the resin, forcing the resin through the center barrier.
5. Mix thoroughly to a uniform color by squeezing contents back and forth 25-30 times.
6. Squeeze resin to one end of bag, and cut off other end. (FIG. 2)
7. Slowly insert connection into sealing pack until it fits snugly against the opposite end. (FIG. 3)
8. Wrap open end of bag with Scotch® Super 33+ Vinyl Electrical Tape and position the taped end up until resin gels. (FIG. 4)



FIG. 1



FIG. 2



FIG. 3



FIG. 4

Refer to Material Safety Data Sheet for health, safety and precautionary information, or call 800-364-3577.

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The catsup packets.

Why are these not used much?—if not properly mixed (by squeezing a minimum 5 minutes each) the material will not harden and provide the proper seal. Try squeezing just one of these then imagine trying to do a dozen or more a day. If they do not harden within a day they need to be replaced.

Must be allowed by the SSPs.

During Construction: Irrigation

Valve Box

Electric Automatic Irrigation Components



w/Armor Clad wire



w/Direct Burial wire



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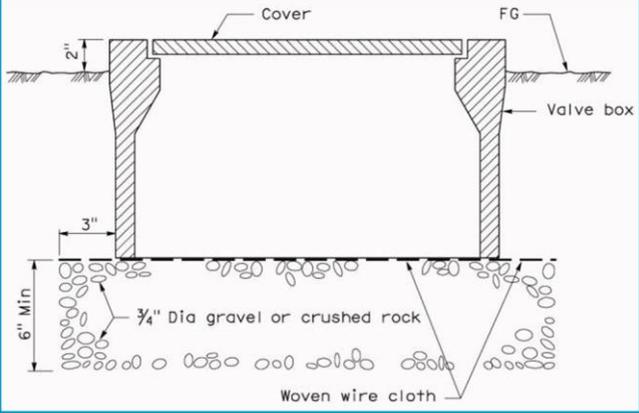
Specifications require 2 feet of slack... but the armor clad is harder to coil as tightly as the normal direct burial wire, so just a big coil in the box.

Direct burial wire is more flexible, by using approx 11+ coils around a 1/2" pipe to equal the 2' of slack. This is the preferred method as it keeps the box less cluttered.

During Construction: Irrigation

Low Voltage Pull Box

Electric Automatic Irrigation Components

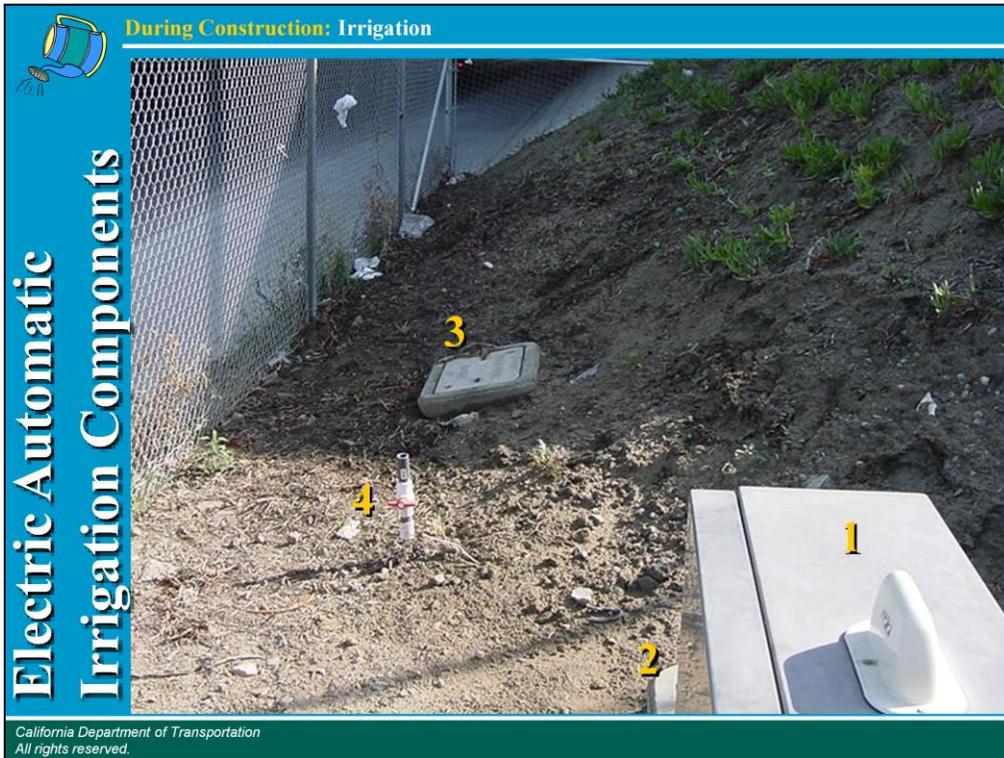



...and PVC Conduit

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- LV Conductors only
- Spaced 500' apart
- Installed the same manner as the valve box
- Valve Boxes ***do NOT COUNT as PULL BOXES***

PVC Electrical conduit may be required for LV conductors in areas of high rodent activity or as required by the SSPs. It is installed the same as previously discussed for solvent welded pipe.



1- Irrigation Controller Cabinet

2- Corner of pull box for LV conductors - 1st one is to be within 5 feet of cabinet.

3- Pull box for LV sprinkler control conductors, not to exceed 500 feet between pull boxes.

4- A ball valve installed to test a low flow sprinkler system.



During Construction: Irrigation

LV Wiring Check List

Electric Automatic Irrigation Components

- Wiring Size
- Wiring Identification
- Proper Splicing
- Taped w/Electrical Tape @ 5' intervals in trenches
- 2' Slack @ Pull Boxes & RCVs
- LV Pull Boxes every 500'
- LV Pull Boxes at Irrigation Conduits



During Construction: Irrigation

System Tests

- Pressure (SS 20-2.01A(4)(b))**
 - Main, Laterals & risers (capped) installed
 - Trenches are open
- Conductors (SS 86-2.14B)**
 - LV Conductors Installed
 - Trenches are backfilled & compacted
- Other- Job Specific**
 - Remote Valve Actuator
 - RICS

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The testing of the irrigation system is important to ensure that new planted material will be watered properly and that irrigation systems will not have to be repaired or adjusted through the PEP and beyond. Before planting operations can begin, all irrigation work must be done and the following tests should be completed.

Pressure Tests:

- METHOD A: 125 psi for 1 hour supply side, max 5 psi drop (Irrigation Conduits must use this type)
- METHOD B: water pressure for 8 hours supply side or for 1 hour lateral side-...”full pressure from the source...”

Conductor testing

- Continuity for each circuit
- Ground for each circuit
- Insulation resistance for each circuit: test at 500 V (DC) ... insulation resistance shall not be less than 10 Mega-Ohm (**not** to be done with a magnetometer)

 **During Construction: Irrigation**

System Tests (Cont.)

- ❑ **Functional Test**
 - ❑ **Controllers (One Cycle)**
 - ❑ **Check RCV (Opening/Closing)**
 - ❑ **Adjust RCV (Flow)**
 - ❑ **Check Sprinklers (Coverage)**



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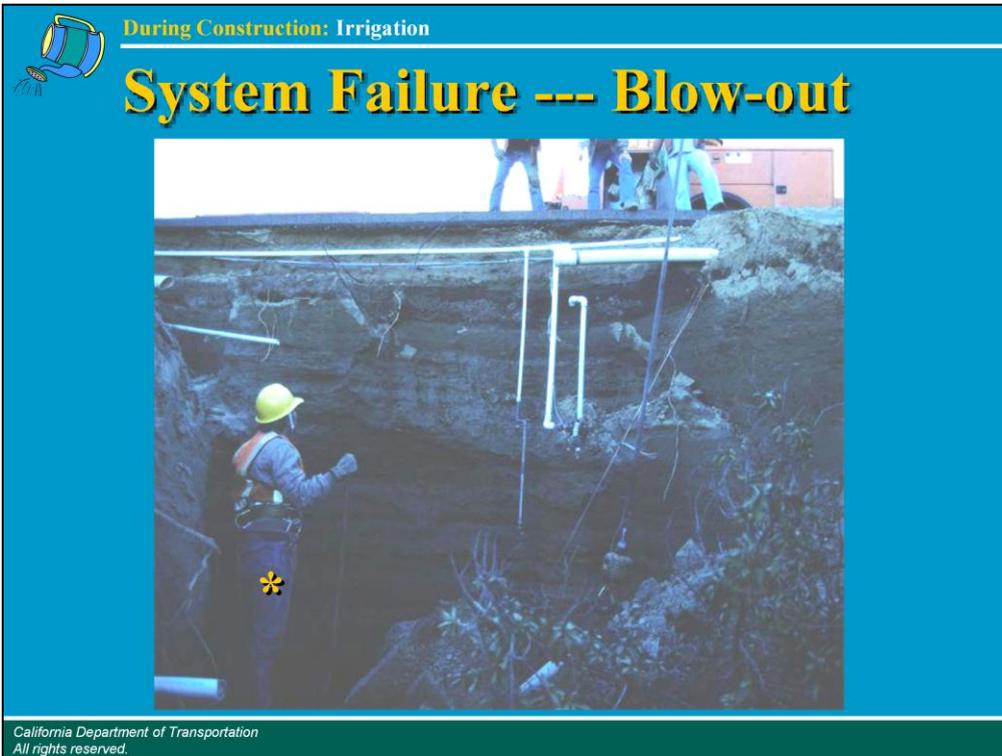
Functional Test occurs after every component of the irrigation system has been installed.

One Cycle: The controller automatically starts on the day and time selected. Starting with station 1, run station for its pre-selected duration, shuts off and proceeds to station 2, repeats, station 3, etc. until all stations have operated.

The station sequence cycle time: stations do not operate for their full duration, but sufficient time to tell that the laterals and all sprinklers on the station (valve) are operating at the intended pressure. Suggested durations are:

- Overhead Spray 20-50' Radius: 3-5 Minutes
- Overhead Spray 5'-15' Radius: 10-15 minutes
- Individual < 4' Radius: 20-25 minutes

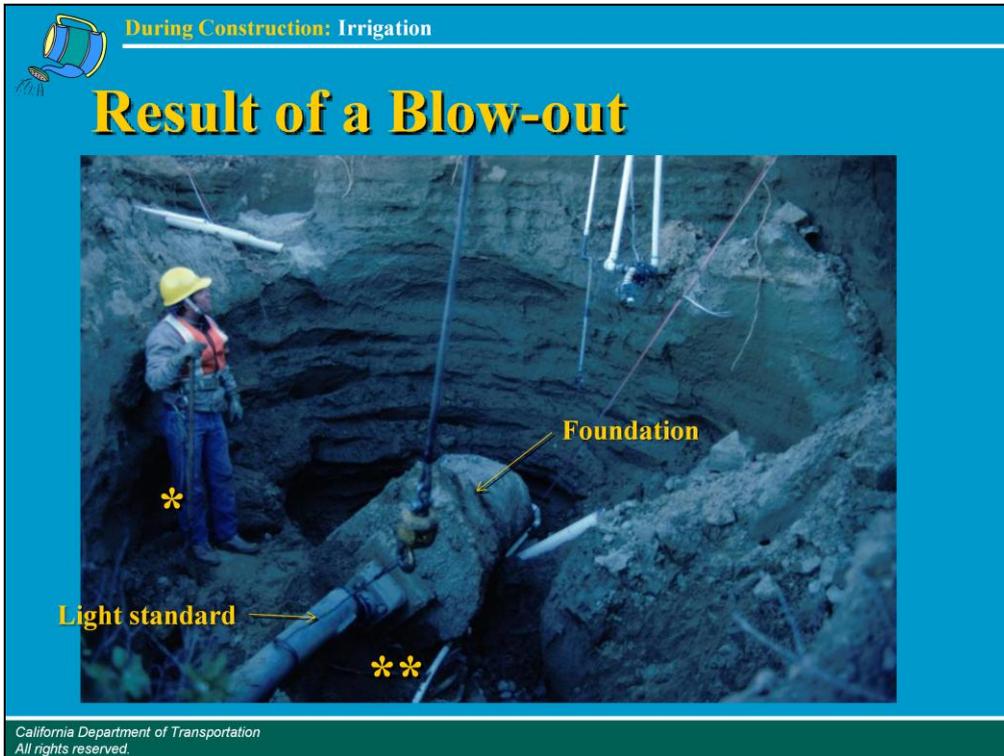
The rain sensor is check by running one of the stations again and pouring water over the sensor to see if the station will shut off.



Note that this is a fill section. The 3 men at top are on the shoulder.

A bad glue joint resulted in this washout after less than 20 minutes before the water was shut off. Remember, moving water carries over 10 times it's weight-- approx 160 lbs/SQFT-- add to that 60+psi pressure pushing it !

Take notice of worker w/yellow hard hat and * , then look to next photo...



The man in yellow hard hat is the same as the previous picture.*--- This camera angle and light shows real extent of damage.

The foundation with the light standard is shown being lifted out of the hole approximately 5-7 feet above the bottom of the washout.**

The #4 lane had to be closed and an emergency contract let to backfill/compact the washout to prevent the shoulder and #4 lane from collapsing.

Thus, proper installation of irrigation systems is critical to protecting the highway investment.



Review Questions

1. What type of backflow preventers do we normally use on State landscape projects?
2. What type of pipe is installed between the water service and the backflow preventer?
3. Supply line should be how far behind the shoulder?
4. Supply line should be how deep?
5. Sprinklers should be how far behind shoulders?
6. What are the LV wiring items to check ?
7. Must controllers be capable of manual and automatic operation?
8. When must conductors be color coded according to controller?

1. Reduced pressure with double check valve
2. Galvanized steel pipe
3. Minimum of 4'
4. 12" of cover for solvent weld, 18" of cover for ring-type
5. 6.5' to 8'
6. A) Wire sizing; B) Wire identification ; C) Proper Splicing; D) Taped w/ Electrical tape at 5' intervals in trenches; E) 2' slack at pull boxes & at splices; F) LV Pull boxes every 500' –Valve Boxes are not included as part of the 500'; G) Pull boxes at sprinkler control crossovers
7. Yes
8. When two or more controllers are in the same enclosure and when conductors from different controllers share a common trench.

Be sure to watch training video: *Irrigation for Highway Planting* (TRT 24:45)



MEMORANDUM

To: Landscape Inspection Trainee

FROM: T. Rex, Resident Engineer

SUBJECT: Fourth Commandment

“Thou shall wear thy seat belt at all times when in the state vehicle and wear thy hard hat and vest when on the job site, and thou shall not be under the influence of any illegal substance or be in excess of any legal limits”





Sequence

- Cultivation
- Germinate Weeds
- Plant Layout
- Prepare Holes
- Plant Inspection
- Place Plants
- Construct Basins



- Cultivation: till the ground for a loose condition to depth of 6” and soil clod size of 2” or less. Planting areas to be cultivated will be designated in the special provisions or show on the project plans.
- Germinate Weeds: Water the ground to get the weeds to grow so they can be killed by use of systemic (Roundup) pesticide spray. Desirable to have a weed germination period; check special provisions to see if required (usually minimum of 14 day days).
- Contractor provides manpower to plant plants—YOU inspect plants and approve plant layout, so check plant legend
- Prepare Holes: To fit root ball or as designated on the project plans.
- Plant Plants
- Construct Basins: Hold water to get the plants well established and get the roots to spread beyond the original root ball/container/dug hole.



Cultivation

- Limits
- Depth
- Rocks and Debris
- No Compaction



- Verify limits and depth of cultivation with plans and special provisions.
- After cultivated areas are completed, no rubber tired equipment is allowed. If compaction results from contractor's equipment, then it should be re-cultivated.

Picture: Track equipment is preferred over rubber tire due to less compaction on the soil.



During Construction: Planting

Rocks and Debris

Cultivation



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Ice plant has just been spread out in an area that was cultivated.

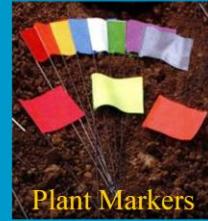
- Rock and debris encountered during cultivation or hole excavation are brought to surface at contractor's expense; disposal of rock and debris is paid for as extra work
- Use removed rock in the job limits as energy absorbers to prevent erosion rather than haul away and pay dump fees at CCO. Use the removed rock at locations like this within the job limits. Saves contract dollars and protects from possible erosion damage and future maintenance costs.



Set Backs / Growth Size

Plant Layout

PLANTING LIMITS							REMARKS
TRVD WAY	MINIMUM DISTANCE (ft) FROM					ON CENTER (ft)	
	PVMT	FENCE	WALL	PAVED DITCH	EARTH DITCH		
40		20	20	15		④	TREE
—	6	6	6	6	6	6	SHRUB ⑧
—	13	13	13	13	16	10	SHRUB ⑧
—	13	13	13	13	16	6	SHRUB
—	10	6	6	10	12	6	SHRUB ⑧
—	10	10	10	10	12	8	SHRUB
—	—	—	—	8	10	10	VINE
—	10	8	—	8	—	10	SHRUB
—	6	6	6	10	10	1.5	GROUNDCOVER ⑧
9	—	15	15	15	—	④	TREE
9	—	15	15	15	—	④	TREE
9	—	15	15	15	—	④	TREE



Plant Markers

The Engineer designates placement or layout of plants and the contractor furnishes all labor for layout. Setbacks are noted on the project plans. Review Plant Legend sheet first. Trees and shrubs must be at least 8' from impact, rotary, gear driven, or pop-up sprinklers.

- Ultimate (mature) plant size - Is the plant appropriate to the location it is being planted? Don't put a large shrub that is sized at 10' on center in an area only 5' wide. The plant will out grow the area. But always consult with the landscape architect prior to making changes to the design. The VARIETY of the species is a very important consideration, i.e. Nerium oleander *Sister Agnes* will grow 20' x 20' - but the *Mrs. Roeding* variety will only grow to 5' x 5'.
- Irrigation should be brought to the plant – not plant to irrigation.
- Spray heads, bubblers, emitters are placed on the uphill side of plants.

The contractor provides colored flags for plant layout. Use a different color for each type of plant.



During Construction: Planting

Narrow Area

Plant Layout



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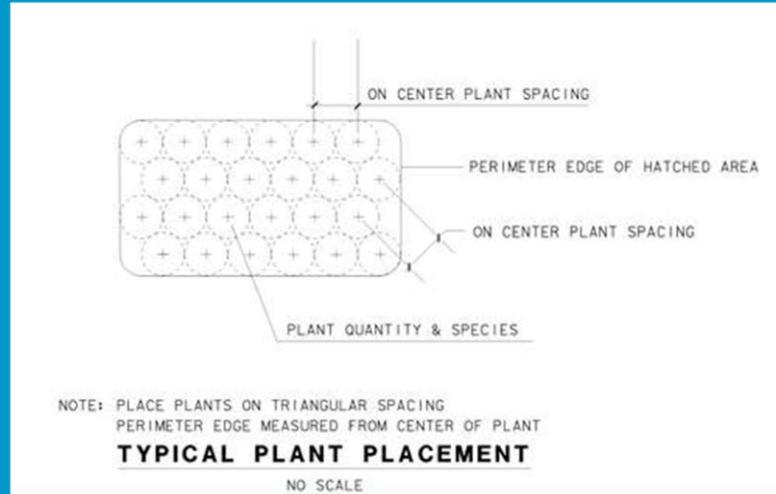
This photo shows a narrow area that is less than 30' wide – The plans show to plant large trees?

- Why?—The R/W fence was moved closer to the roadway due to a sale of surplus parcels between the time the plans were drawn and the contract was actually advertised and awarded.
- This should have been noticed during irrigation installation by the type and number of sprinklers being shown for this area. Consult with the Landscape Architect to determine how to proceed. A CCO to change the design may be needed.



Plant Rows

Plant Layout



Plant rows are staggered, triangular spacing, so that the landscape areas will be covered faster to reduce weeds and eliminate erosion by not providing a straight path for runoff.



Prepare Holes

- Dig
- Additives
 - Iron Sulfate
 - Soil Amendment
 - Root Protector
- Jetting



HOLE SIZE (inches)		BASIN TYPE	IRON SULFATE ①	SOIL AMEND ①
DIA	DEPTH			
18	②		—	—
18	②		—	—
18	②		—	—
18	②		—	—
18	②		—	—
18	②		—	—
18	②		—	—
18	②		—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
36	②		—	—
36	②		—	—
36	②		—	—

- Dig: Hole size varies by plant type and is stated in the project plans. Any holes dug in cultivated areas must maintain the cultivation, aka no heavy equipment, try a shovel. Purpose is to loosen the dirt in the size (depth and diameter) stated in the plans. Dirt stays in hole.
- Additives, if required by the contract (SSPs & Plans), are for soil improvement.
 - Iron Sulfate: Lack of this nutrient results in yellow plants, applied to keep the plants green.
 - Soil Amendments: to improve the structure of the soil, i.e. organic materials, like compost, to improve sandy soils or break up clay soils.
 - Certificate of compliance is required from the contractor for additives.
- A root protector may be required by the SSP's to protect the roots from rodents.
- Jetting: Moisture is added to the hole from the bottom up! Proper method of *jetting* holes is to use a piece of galvanized pipe at the end of the hose, inserted to the bottom of the hole so that water will flow up and fully saturate the hole. This method is also used in “jetting” the irrigation trenches.



Container Sizes

Prepare Holes



SIZE
No 1
EACH
No 15
No 15
No 15

When the depth of the plant hole is designated in the Planting Legend to be *sufficient to receive root ball*, the size relates to the container size of the plant.

During Construction: Planting

Container Sizes

Prepare Holes

Balled & Burlapped

No 1 (1 gal) **No 5 (5 gal)** **No 5 (5 gal)** **No 15 (15 gal)**

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Shown here are some examples of the various container sizes you will see for trees and shrubs on landscape projects.

Palm trees are generally grown in the ground at the nursery and are balled & burlapped rather than grown in a container. They are usually sized by the length of their trunk (brown trunk height).



Container Sizes

Prepare Holes



T4 (4" sq. x 14" deep)



DP (2 1/2" dia. x 10" deep)

Deeper pot sizes allow the plant's roots to become more developed without becoming root bound. This helps the plant to become established sooner and increasing survival rates. These deep pots are often used with native plants such as oak trees.



During Construction: Planting

Container Sizes

Prepare Holes



72" Box

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Transplanting : This existing Pine tree has been boxed for relocation away from traveled way prior to a ramp being widened. Special care is required to successful transplant trees. See the Standard Specifications, 20-3.02C(3) and SSPs for direction.

During Construction: Planting

Digging

Prepare Holes

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Three types of equipment can be used to drill holes.

Which ones could be done on cultivation areas?

Hint: rubber tired vehicles not allowed after cultivation work is completed.



Plant Inspection

- Review Invoices
- Identification tag
- Root System
 - Overgrown
 - Proper Size and Height
- Disease and Pest Free



- Inspection of plants may be done at nursery site or at the project site before plant material is to be planted.
- Plants furnished by the Contractor must be healthy, shapely and well-rooted, and roots must show no evidence of having been restricted or deformed at any time. Plants must be well-grown, free from insect pests and disease, and must be grown in nurseries which have been inspected by the State Department of Food and Agriculture and have complied with the regulations thereof.



During Construction: Planting

Review Invoices

Plant Inspection

- Plant List
- Commercial Nursery
- Certificate of Compliance
- County Agriculture Stamp



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- Verify plants delivered are the contract specified type, including number and size according to the Planting Legend.
- Check to make sure that the plants come from a commercial nursery. All commercial nurseries must have regular inspections by the County Agriculture Department and they have a license number on the invoice.
- Plants must have a certificate of compliance from the nursery.
- If plants come from outside the county, they must have an inspection stamp from the County Agriculture Department (i.e. infestation-free).

An exception:

- a *permit* is required for edule (ice plant) cuttings rather than an invoice..



During Construction: Planting

Identification Tag

Plant Inspection



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Each plant should be provided with an identification tag. Review the tags and make sure the plant is the species, variety, and size called for on the Planting Legend in the plans. If they don't match – reject them!



The condition of the roots of container plants furnished by the Contractor will be determined by removing the soil from the roots of not less than two plants nor more than 2 percent of the total number of plants of each species and variety.

- Root bound plants may survive, BUT they will not develop a healthy root/support system — resulting in being more easily blow over in wind, and not growing to the normal size or expected life span for the species. It may live long enough to get through a 3 year PE period, but not much more, and will die long before reaching normal size. A root bound plant will choke itself as roots will squeeze off flow of nutrients.
- Plants with insufficient root development will not be able to pick up the nutrients/water available in the plant hole, which is sized for the pot, and may die. The plant should have remained in the nursery to develop further where its nutrients/water are fed directly into the pot. When plants are delivered with insufficient root development, we are paying for bigger plants than what we are actually receiving. Reject them!



Plant Inspection

Overgrown



Here are examples of container plants whose roots have been restricted (root bound) and the foliage and stem system is deformed. Roots growing out of the bottom of the container is a sure sign of being overgrown. The plant is extremely large for the size of container and should be rejected!



During Construction: Planting

Plant Inspection

Proper Size and Height



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These plants are healthy, shapely, and well rooted:

- Evenly developed root system.
- Plant foliage is of proper size for the pot.
- No evidence of plant being cut back or pruned (big stem).

These plants can be accepted.



Disease and Pest Free

Plant Inspection



Lerp Psyllid



Oleander Scorch

- The first photo shows an infestation of Lerp Psyllid that may eventually lead the death of the plant. The psyllids, small insects that suck sap from leaves are, like the eucalyptus, native to Australia. They cause leaf damage and leaf drop which may stress the trees and make them susceptible to fatal attack by other insects. Psyllids also produce a sticky substance called honeydew, which drops to the ground on cars and sidewalks.
- Oleander gall is caused by the bacterium *Pseudomonas syringae* pv. *savastanoi*. The bacterium is systemic in the plant and causes galls to form on flowers, leaves, and stems. The bacterium must have a wound to enter the plant. Freeze damage to flowers in early spring after a rain is a common circumstance under which infection takes place. The bacterium enters through the damaged flowers and galls form on the inflorescences. Severe infections are most common after a cool wet spring.
- *Pulvinaria* species (Ice Plant Scale): There are more than a dozen different species of *Pulvinaria*. They are either fungi virus or insects.

Any plant that shows signs of disease must be rejected.

 **During Construction: Planting**

Trees, Shrubs, and Vines

Place Plants



- Water (in Containers)
- Remove Nursery Stakes
- Deliver to Planting Area
- Remove from Container
- Place in Hole
- Distance from Sprinkler
- Construct Basin
- Stake Plants
- Fertilize
- Water
- Apply Mulch
- Foliage Protector
- Remove Containers
- Count Plants

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- Remove all nursery stakes before delivery to planting area.
 - Deliver only as many plants to the planting area as can be planted that day.
- Trees and shrubs are usually planted before ground cover.
- Carefully remove plant from container to prevent breaking the root ball.
 - Install a foliage protector if required by the SSP's to prevent grazing by deer.

During Construction: Planting

Trees, Shrubs, and Vines

Place in Hole



Too High

Too Low

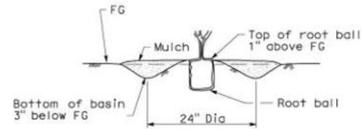
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These photos show examples of improper planting:

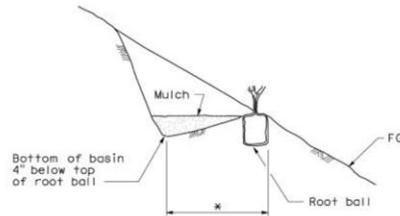
Planted too high: Root ball exposed, 2" exposed in picture. Plants are to be planted 1" above grade. Mulch is spread to prevent the plant from drying out. Drying of root ball and loss of plant support = death.

Planted too low: Root ball set 4"+ too deep below grade. Plant will die from suffocation. Accumulation of water and soil in this depression can lead to crown rot = death.

Basins – Type I



SECTION
(Flat Area)



SECTION
(Slope Area)

BASIN TYPE I

Basins are 3” deep around the plant on flat terrain or 4” deep when planted on a slope. The top of the root ball is at 1” above the ground. Usually 4” of mulch is added.

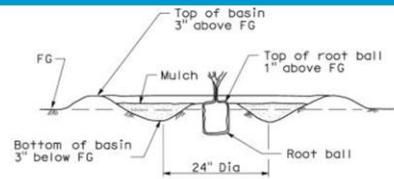
Basin Type I is usually for smaller (No 1 & No 5 container) plant material that don’t need a larger volume of water for the plant to start growing and become established.



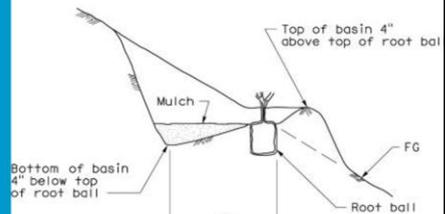
During Construction: Planting

Trees, Shrubs, and Vines

Basins – Type II



SECTION
(Flat Area)



SECTION
(Slope Area)

BASIN TYPE II

* Basin area equivalent to 24" Dia

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Basins are 3" deep and with additional 3" berm to increase the holding capacity (mulch & water) of the basin.

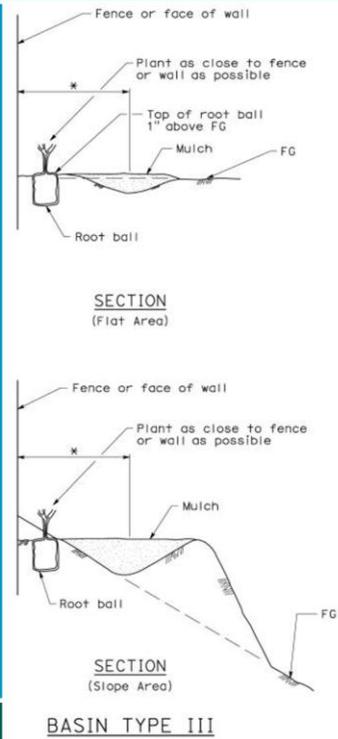
Basin Type II is usually for larger (No 15 & up container) plant material that need a larger volume of water for the plant to start growing and get established.

Palm Tree: It doesn't matter how deep you plant palm trees. They are an exception on the standard planting depth because they are continuously sending out roots.

Basins – Type III



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Basin Type III is the same as Basin Type I, only against a fence or wall and normally for vines.

Staking - Tree



Wrong



Correct



TREE STAKING

Wrong:

- Nursery stake and ties should have been removed before planting. Only for delivery.
- Tie is too narrow - not 1" wide
- Tie does not form a figure 8 between tree and stakes.
- Tie is too tight, allowing no flexibility, plus they are so tight they will actually damage the tree over time and constrain future growth.

Correct:

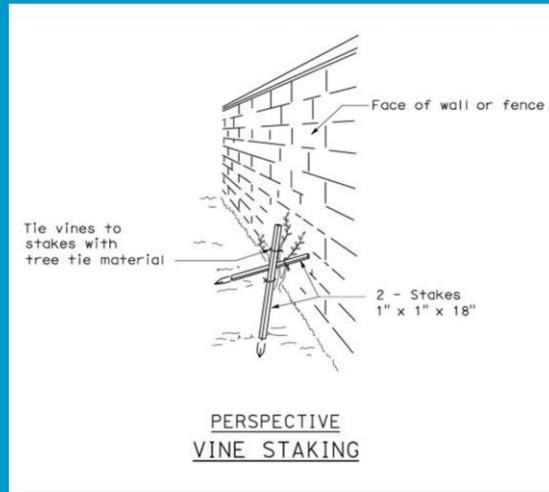
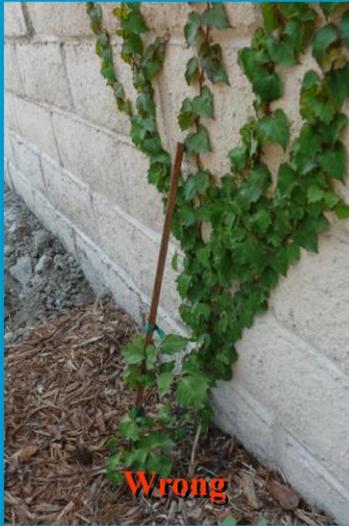
- Nursery stake has been removed
- Tie is 1" wide, 10 mils thick
- Tie forms figure 8 as shown in standard detail.
- Tie is 2" down from top of stake

Tree Staking

- Staking should be perpendicular to prevailing wind
- 2" x 2" nominal (1½" x 1½") dimension
- Redwood or equivalent (1 1/4" lodge pole pine)

To check pole strength: swing the stake like a baseball bat against the ground. It should not break.

Staking - Vine



This vine staking does not follow the detail.

- The nursery stakes were not removed before planting.
- The nursery stake is smaller than the 1" x 1" required by the detail.
- Only one stake is provided rather than the two crossing stakes.

A vine staking like this should not be accepted.

During Construction: Planting

Trees, Shrubs, and Vines

Fertilizer

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All fertilizers are labeled with three numbers representing N-P-K, giving the percentage (by weight) of nitrogen (N), phosphorus (P₂O₅), and potassium (K₂O). A 100 pound bag of fertilizer labeled 0-20-10 has 0 pounds of nitrogen, 20 pounds of phosphorus, 10 pounds of potassium, and 70 pounds of filler. Filler makes the fertilizer easier to spread and reduces the likelihood of burning plants with too much fertilizer.

Nitrogen (N) is a primary component of proteins and is a part of every living cell.

This nutrient is usually more responsible for increasing plant growth than any other nutrient. Shortages can cause slow growth, reduced leaf size, yellowing, short branches, premature fall color and leaf drop, and increases the likelihood of some diseases. An over abundance can cause excessive shoot and foliage growth, reduced root growth, low plant food reserves, increased susceptibility to environmental stresses, and some diseases.

Phosphorus (P) plays a role in photosynthesis, respiration, energy storage and transfer, cell division, and cell enlargement. It promotes early root formation and growth, and the production of flowers, fruits, and seeds. Many of our urban soils are low in phosphorus. Cultivated farm land often has a high phosphorus level from years of fertilization. In these cases, the addition of more phosphorus is not going to increase yields and can potentially harm the environment.

Potassium is involved in many plant growth processes; it is vital to photosynthesis and helps regulate water in plants. Potassium fertilization helps plants overcome drought stress, increases disease resistance, and improves winter hardiness. Potassium can be leached through the soil by water, but not as quickly as nitrogen.



Fertilizer Application

- Contractor must notify Engineer 5 days prior to application.
- Save bags – check ratios & quantities.
- Method of application – cyclone spreader: for ground cover
measured doses: for trees and shrubs
- Payment



Check the SSPs and the quantities for Fertilizer in the Engineers Estimate against what is shown on the Plant Legend and other quantity tables shown on the plans. You'll need to calculate the quantities at planting versus Plant Establishment especially if there is a separate item for Fertilizer.

Is the payment for fertilizer application a separate item or is it included in the lump sum price for plant establishment? The answer is -- both. Fertilizer applied at planting is a separate item; fertilizer applied during the PEP is included in the lump sum price for PE.

Watering

Correct



Incorrect



Plants must be watered immediately after planting. When watering with a hose, a water disbursement device must be used, as shown on the left. Under no circumstances should the full force of the water from the open end of the hose be allowed, as shown on the right.

Trees, Shrubs, and Vines

During Construction: Planting

Mulch






HOLE SIZE (inches)		BASIN MULCH cuft ①	REMARKS
DIA	DEPTH		
18	②	2	TREE
36	②	3	TREE

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The depth of mulch during planting will be shown on the plans. Check the SSPs to see if a second application of mulch is required near the end of the plant establishment period. If its not part of the contract, and if funding is available, consider adding this second application mulch to maintain the desired depth.

- If required by the SSPs, apply a preemergent before applying mulch.
- Mulch retains moisture in the root zone, acts as a weed barrier, and aids in controlling erosion.
- Mulch – normally spread at 2” – 4” depth throughout areas or 2” in basins.
- Deeper mulch is not always better. If too deep in areas where maintenance might drive, the vehicle could get stuck. Too deep at base of plant could cause crown rot and death. Beware of potential for smoldering or minor burning.
- Mulch is paid at item.
- A big rig truck can carry 40 cy/load.

Trees, Shrubs, and Vines

During Construction: Planting

Remove Containers



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Planted areas must be neat and clean before the contractor is allowed to begin the plant establishment period.

All of these scattered containers must be removed from the site.

Count Plants

PLANT GROUP	PLANT No	SYMBOL	BOTANICAL NAME	COMMON NAME	SIZE	REMARKS
A	1		EUCALYPTUS MACULATA	'SPOTTED' GUM	No 1	TREE
	2		LANTANA 'SPREADING SUNSHINE'	SPREADING YELLOW LANTANA	No 1	SHRUB (S)
	3		PLUMBAGO AUBICULATA	CAPE PLUMBAGO	No 1	SHRUB (S)
	4		BHAPHOLEPIS INDICA 'SPRINGTIME'	INDIAN HAWTHORNE	No 1	SHRUB
	5		THEVETIA PERUVIANA	YELLOW OLEANDER	No 1	SHRUB (S)
	6		PHORMIUM TENAX 'RUBRUM'	NEW ZEALAND FLAX	No 1	SHRUB
	7		CLYTOSTOMA CALLISTEGIOIDES	VIOLET TRUMPET VINE	No 1	VINE
	8		RHUS OVATA	SUGAR BUSH	No 1	SHRUB
F	9		HEDERA CANARIENSIS	ALGERIAN IVY	EACH	GROUNDCOVER (S)
U	10		CHORSIA SPECIOSA	FLOSS SILK	No 15	TREE
			GEIJERA PARVIFLORA	AUSTRALIAN WILLOW	No 15	TREE
			CASSIA LEPTOPHYLLA	GOLD MEDALLION TREE	No 15	TREE

8	204006	PLANT (GROUP F)	EA	106 300
9	204035	PLANT (GROUP A)	EA	3070
10	204038	PLANT (GROUP U)	EA	188

Why are there plant Groups A, F and U?

Plants are grouped by size, regardless of variety:

- Group A is No.1 (1 gallon)
- Group F is flats or cuttings (ground cover)
- Group U is No. 15 (15 gallon)

Payment of plants are by size and not by species. Plant Groups A & U are an individual count.

Plant Group F is a density count.

Density count: use a fiberglass tape to make a 10' square. Count the number of plants within the square. Plant spacing is:

- 12" on center - 90 plants (minimum)
- 18" on center - 40 plants (minimum)



Ground Cover

Place Plants

- Water ground area
- Plant plants
 - Staggered Rows
 - Proper Depth
 - Proper Spacing
- Fertilize
- Water
- Container pick-up/removal
- Calculate plant quantities



- Water ground area with the sprinklers for one station (RCV) at a time until the soil is moist.
- Plant at ground level at spacing shown on Plant Legend sheet with staggered rows. Plants are from liner plants, flats, or cuttings.
 - Liner & flats are planted at grade level.
 - Cuttings (ice plant), details following in next slide.
- Fertilize if required and water immediately after planting.
- Calculate quantity of plants. For Plant Group F, do a density count on 3% to 5% of the area. Take a 10' square area that is representative of the total area and count the number of plants.
 - 12" oc = 96 to 100 plants
 - 18" oc = 40 to 16 plants
 - 24" oc = 20 to 25 plants



The two common ice plant species used on the roadside are *Delosperma* and *Carpobrotus*.

Delosperma is smaller, lighter green in color, slower growing, but a more attractive abundant red flower.

Carpobrotus is larger, dark green, more abundant, faster growing, but has a very sporadic purple or white flowering.

Cutting length shall be:

Delosperma - 6 inches or more w/ no roots.

Carpobrotus - 10 inches or more w/ no roots.

Ice plant cuttings are collected by Permit from existing areas along the roadside.

This is a dual benefit to the state: cheaper prices for plant material and an existing area will be thinned as needed (under permit so we (CT) choose the areas).

Cuttings must be covered and kept wet until planted. They should not be allowed to dry out and wither. Cuttings must be planted not more than 2 days after being cut.

Do not plant *Carpobrotus* or *Delosperma* cuttings in soil that does not contain sufficient moisture at an average depth of 2 inches below the surface.

Cuttings (ice plant) are planted so that 2 nodes are not less than 2 inches below grade for *Delosperma* cuttings and not less than 4 inches deep for *Carpobrotus* cuttings (pictured).



During Construction: Planting

Review Questions

1. Who directs where the plant locations are to be placed?
2. Plant locations for trees and shrubs must be at what distance from an impact, rotary, gear driven or pop-up sprinkler?
3. Rocks brought to the surface during soil preparation and not shown on contract plans must be removed at whose cost?
4. Prior to planting, what must be completed?
5. What are 4 things to look for in plant inspection?
6. Must soil be moist prior to planting?
7. When holes are augured/drilled, the holes must be moistened in what manner?
8. Do nursery stakes have to be removed from the plant material before planting?
9. When planting ground cover, what do you look for (8 items)?

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1. Resident Engineer: RE directs the placement/lay-out; contractor furnishes all labor and materials for lay-out.
2. 8 ft
3. If ordered by the Engineer, the contractor removes as Extra Work.
4. Irrigation system and preparing planted areas.
5. Review invoices, plant identification tag, plant's root system, disease and pest-free.
6. Yes
7. With jetting
8. Yes
9. Water before planting, stagger rows, proper depth, proper spacing, fertilize, water after planting, container pick-up, count plants.

Be sure to watch the training video, *Inspecting Highway Planting* (TRT 14:22).



MEMORANDUM

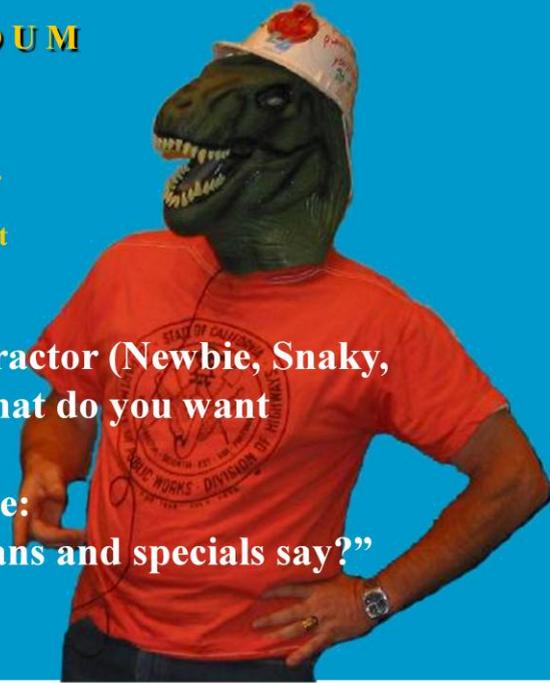
To: Landscape Inspection Trainee

FROM: T. Rex, Resident Engineer

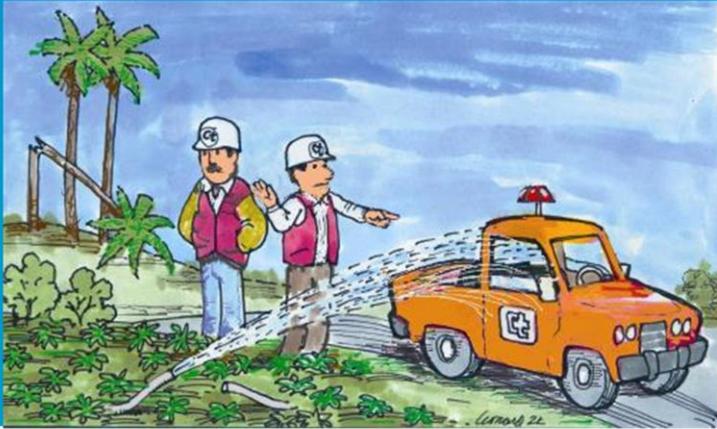
SUBJECT: Fourth Commandment

When asked by the contractor (Newbie, Snaky, or Argumentative) : “What do you want done?” -----

**Your first answer shall be:
“What do the project plans and specials say?”**



Chapter 3 Plant Establishment Period (PEP)



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A plant establishment period is a duration of time that allows newly installed plant material to reach a state of maturity, requiring minimal ongoing maintenance for survival. A plant establishment period typically includes the removal of litter and trash, weeding, water application, irrigation repair, replacement of plant material that dies, and other activities required to ensure the long-term survival of plant material.

Plant Establishment Period



Prior to PEP

- ✓  All construction work is complete
- ✓  Pre-emergents (Optional)
- ✓  Project site walk-through has been done
- ✓  Begin PEP letter has been issued

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- All elements of construction should be completed before the Contractor is allowed to begin the PEP.
 - Hardscape work is complete
 - Job site is neat and clean
 - All plants alive and growing
 - Mulch spread
 - Irrigation functional test has been completed
- After planting, the contractor should spray the project with pre-emergent (prevents the germination of any seed, but not harmful to plants) in order to minimize any weed growth during PEP.
- A field meeting has taken place to demonstrate that the new irrigation system operates correctly, review the planting work and all other construction elements with the area Maintenance personnel, Project Landscape Architect and Construction personnel.
- The contractor has been issued a letter indicating the start date of the PEP.



Types of PEP (review)



- **Type 1**
 - Usually associated with Highway Planting contracts
- **Type 2**
 - Usually associated with Roadway contracts with landscaping



- Type 1 PEP are for projects that are 100% Highway Planting.
- Type 2 PEP is for roadway projects that impact the existing highway planting and existing irrigations systems and have a minor amount of landscape work. When a major amount of replacement planting is required, it must be done by a separate Highway Planting contract.



PEP Requirements

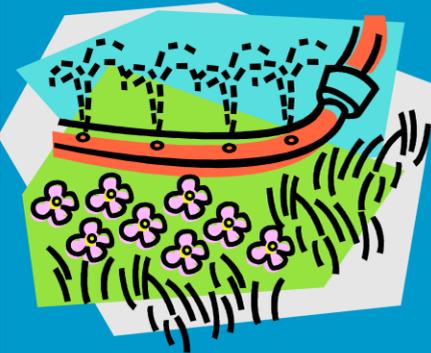


- **Maintaining the newly planted area**
 - replace unsuitable plants
 - maintain plant basins
 - trim groundcover
 - fertilizing

- The contractor should maintain the contract area in compliance with the contract Special Provisions and Standard Specifications.
- The contractor should monitor the new plants to ensure that they are thriving. If plants die they should be replaced in a timely manor and upsizing if required. Don't allow the contractor to wait until the end of the PEP to replace dead plants. They need time to become established.
- Maintain plant basins. If there is no plant basin the water will not be available where it is needed most.
- Maintain ground cover outer edges (fences, shoulders, plants, and ditches).
- See the contract Special Provisions and the contract Planting Legend for fertilizing frequencies and rates.

Plant Establishment Period

PEP Requirements



- Utilizing the new irrigation system
 - annual testing of backflow
 - irrigation system in the automatic mode
 - adequately water the new plants

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See the contract Standard Specifications 20-2.03 for the backflow testing requirements.

- To ensure the operation of the automatic irrigation system during the rainy period it should be operated periodically.
- It is also necessary to physically inspect plant basins to insure that adequate water is being applied.
- Watering by contractor must be reasonable to attain healthy growth; plants will be stunted and not grow in normal manner if sufficient water is denied plants (sometime contractor will limit watering to reduce weed growth).

Plant Establishment Period



PEP Requirements



- **Keeping the contract area neat and clean**
 - weed control
 - rodent control
 - trash and debris removal

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- Weeding ... Standard Specifications identify degree of weed maintenance (height, locations, etc.) and pre-emergent application requirements. Make sure the contractor submits their Form LA0017 (Report of Chemical Spray Operations). If there are no pre-emergent requirements -- consider writing a CCO to pay for that work -- Maintenance will love you for it!

- Why do we need to perform weed control?

- Safety/fire hazard
- Competition with the desired plantings for water, nutrients, sunlight, and growth.
- Noxious weeds - mandated removal.
- Nuisance, unsightly, complaints from Public – bad reflection on community.

- Rodent control ... this is a continuous effort to control gophers, etc.

- It is necessary to remove all litter and debris from planting areas. Trash pickup and removal can be a full time job depending where the project area is located and the type of plant material installed (i.e. roses can snare litter). Make sure the contractor keeps on top of it!



Correspondences

- WSWD
- Out of Compliance
- Off PEP
- Resume PEP
- Completion of PEP

- Weekly Statement of Working Days (WSWD) are issued throughout the entire contract period on a weekly basis. It is very important to record any changes to the controlling item of work if at any time during the PEP days stop being credited.
- When the contract area becomes out of compliance with the contract, a letter must be written giving the contractor a specified number of days to correct the deficiencies.
 - Normally a 10 working day notice is given (plants need to be attained and scheduled for planting)
 - Irrigation, weeding, etc. ... corrective notice could be issued at any time, but usually for good working relationships, verbal is given first and allow a 10 working day period--- If verbal is ineffective provide written notice to correct deficiencies.
 - If contractor fixes all items within the 10 day notice – no further action needed- no interruption in PEP days credited.
- If the deficiencies have not been corrected then the PEP days will stop being given until the contract area is back in compliance. This lapse in time can lead to Liquidated Damages if there are no Construction Working Days remaining.
- Another letter should be issued informing the contractor when PEP days have resumed.
- The contractor should be issued a letter stating that they have satisfactorily completed the contract and the PEP.



Inspection

- **Frequency**
- **Areas:**
 - Entire Project
 - Portions
 - Selected plants
- **Periodic Maintenance Meetings**

Inspect to insure the contractor is complying with the requirements of PEP.

Frequency:

- Inspection should be on an as-needed basis or may be listed in the special provisions at bench mark inspections:
 - Daily
 - Weekly
 - As needed/specified bench marks

Areas:

- Get out of the vehicle & walk the entire job ... be hands-on! Document all observations during PEP. Perform inspection/review at bench mark inspections w/contractor. Let the contractor know you are paying attention.
- Portions (trouble spots during construction). Were there areas prior to roadside clearing with no weeds? (potential for no plant growth)
- Selected plants—those on the low flow systems. Check condition of plants as indicator for proper watering i.e.: are the leaves turning yellow/brown, curling- will indicate clogged heads or insufficient time of watering.

- Periodic meetings with Maintenance during PEP on the job site.



There's been a traffic accident that affects the roadside. Check the irrigation system for damage and damage to the new planting areas. If possible, contact the Traffic Management Center to obtain the accident report from CHP and provide it to the contractor. The Contractor is responsible to repair all accident damage to facilities that they have installed (unless relief of maintenance is given) throughout the PEP.

Plant Establishment Period



Inspection

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If any of the plants become injured during PEP, do not hesitate to have the contractor replace them.

- Cambium layer damage, replacement of tree is needed.
- The Standard Specifications state: *Plants that show signs of failure to grow at any time or are so injured or damaged as to render them unsuitable for the purpose intended, must be removed, replaced, and replanted. Plants do not need to die before being replaced.* The sooner, the better so that they have a chance to become established prior to the end of PEP.

Plant Establishment Period



Inspection

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Is this tree healthy? What happened to the plant basin?

It appears this tree was root bound and planted too high. Replacement is needed.

Is tree too close to sprinkler? What kind of Sprinkler is this ?

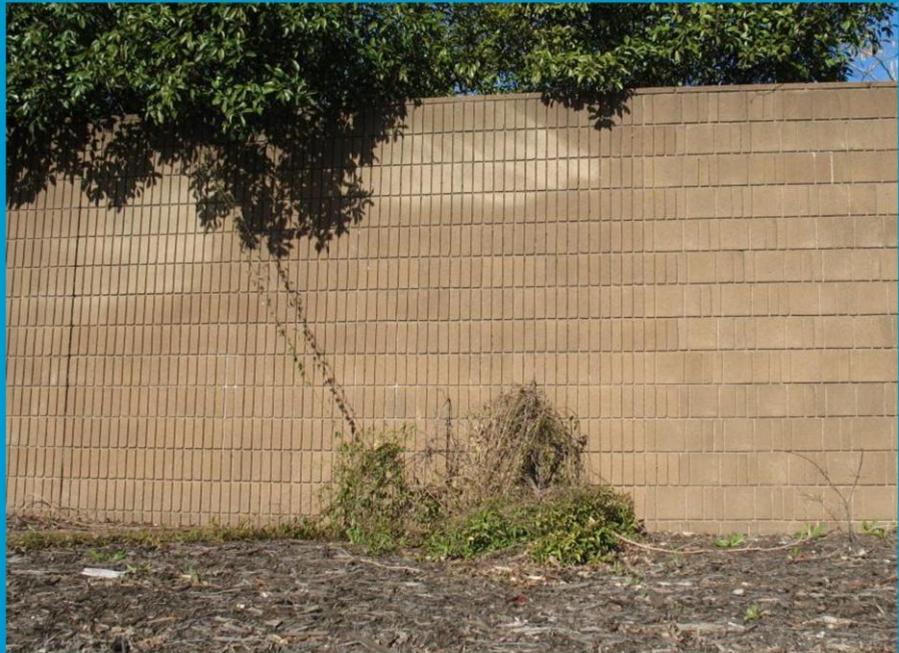
As discussed in the Irrigation section, the tree should be at least 8 feet from a sprinkler.

A replacement tree needs to be planted at the proper distance and the basin repaired.

Plant Establishment Period

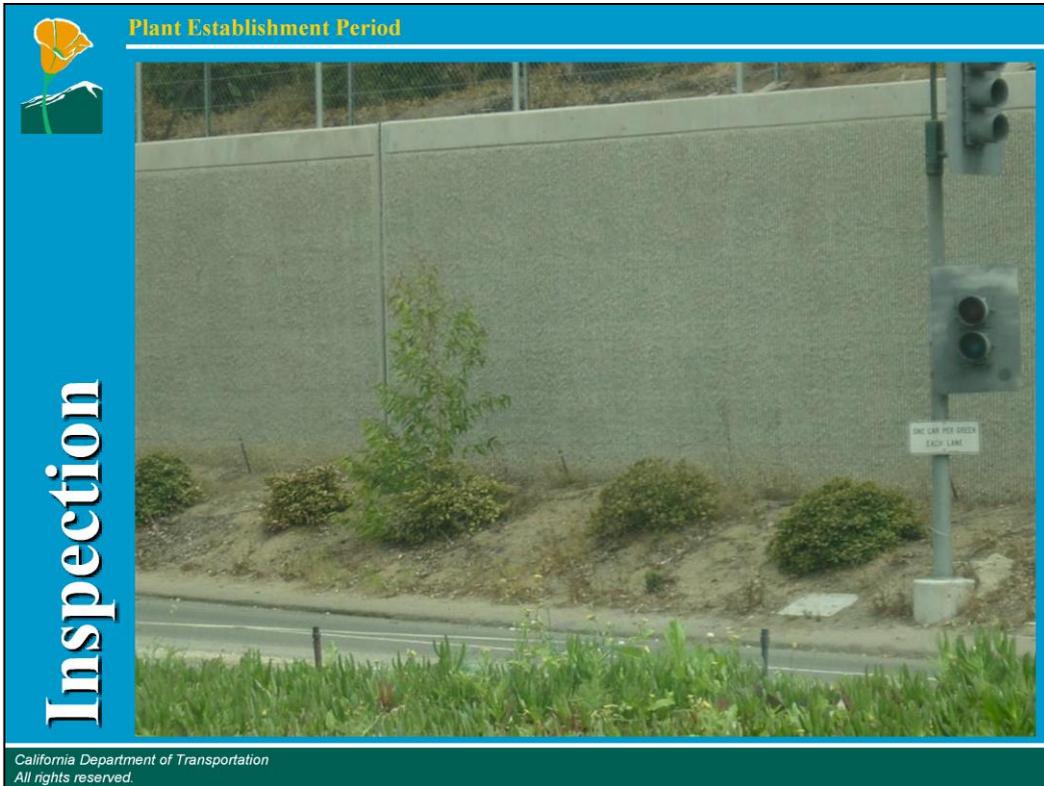


Inspection



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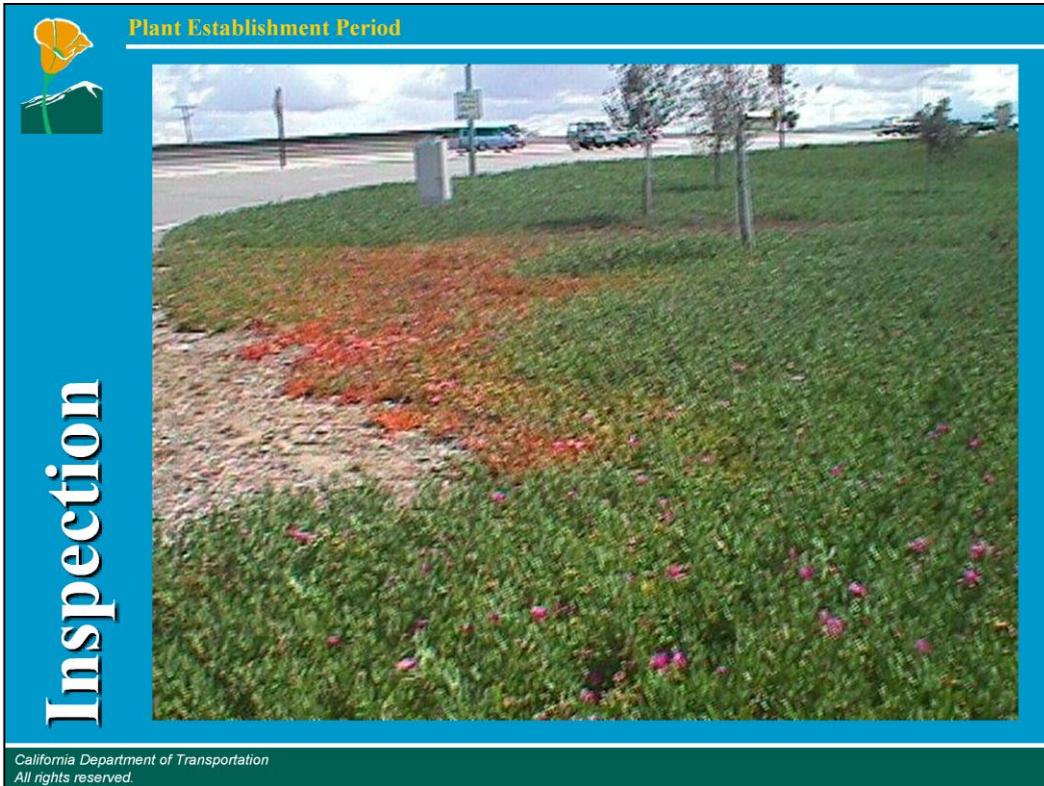
This vine has not been staked properly and is now growing as a groundcover instead of a wall cover. In this case, pruning is needed to direct the vines and correctly staked.



Anything wrong here?

Narrow shrub area with a Eucalyptus volunteer within 30' of the travel way.

This will become a fixed object if allowed to grow. It's easier to have the Contractor remove it now rather than Maintenance removing years later. Remove now!



Edule (Ice Plant) area with chemical damage (red singed area).

Why?: Contractor used the wrong chemicals to kill the weeds, resulting in the chemical damage.

Cure: Water and fertilize to restore healthy growth. If the ice plant dies, the contractor must replant the area using the spacing chart shown in the Standard Specifications.

Plant Establishment Period



Inspection

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Gopher damage to turf areas.

The contractor is responsible for repairing rodent damage during the PEP.



Final Walk Through

Inspection

- With Maintenance
- Planting
 - Healthy, disease free, pruning & staking
 - Fertilizer / pre-emergents applied
- Irrigation System
 - Everything works, optimal coverage, water schedule, laminated plans, valve box IDs, crossover markers
 - Training

- Punch list (listing of corrections the contractor must complete prior to contract acceptance). In writing to contractor. This list does not preclude additional items that may be included at a later date.
- Do this 20 working days prior to the calculated end of PEP to allow 10 days for correction and 10 days to make sure the repairs last.
- Engineer should make arrangements for the Contractor to provide training for our Maintenance personnel (as required in the Standard Specifications) of the controller and RICS system.

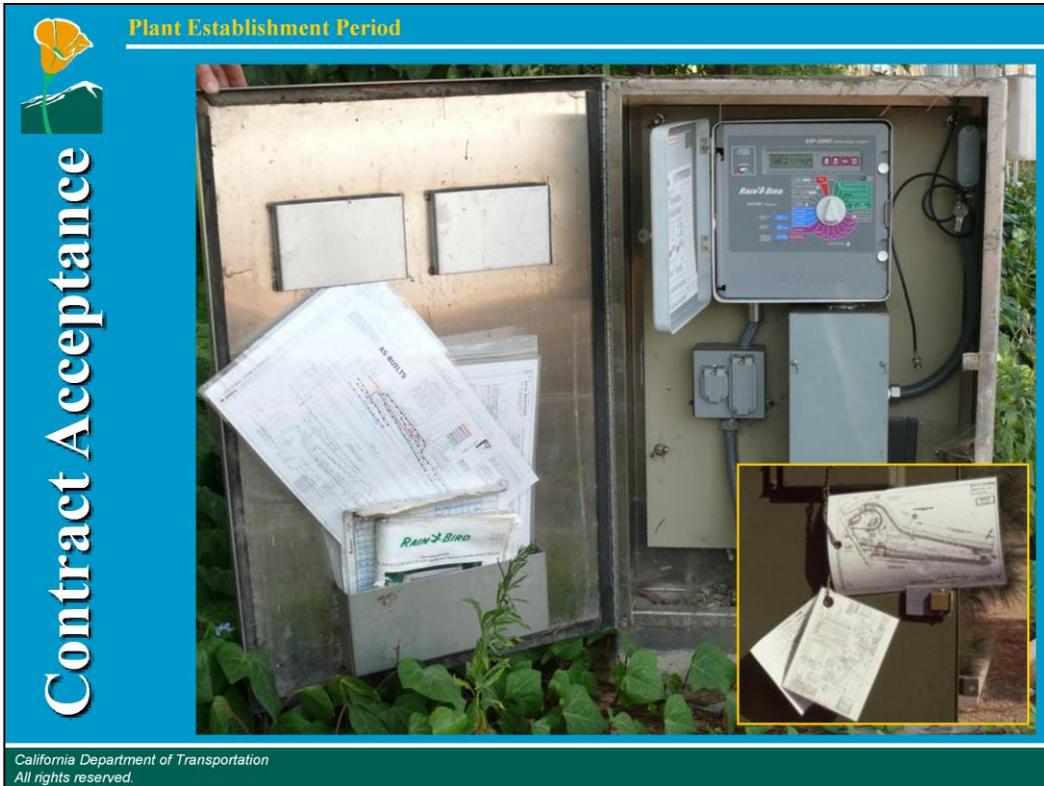


Final Walk Through

Inspection

- Warranties
- Hardscape
 - Access roads, MVPs, Shoulders, Rock Blankets, Slope Paving
- Miscellaneous under control:
 - Bermuda grass, gophers, weeds, trash
- Punch List completed

- Warranties for controllers should be identified in controller cabinet and information also given to Resident Engineer to be included in the Landscape Maintenance Pending File.



Laminated plans in controller (no shelf but permanent attachment provided)

- Laminated irrigation plans for that **particular controller**
- Irrigation wiring plans
- Sticker showing warranty time frame

Monitor the water program to be sure that plants receive sufficient water regardless of the submitted program. Figure a minimum of one change per year to the programs.



Landscape Maintenance Pending File

- As-built Plans (by RE)
- Spray Reports (LA-17)
- Pertinent CCOs
- Unusual problem notes
- Service Requests
- Equipment
- Manuals



As built

- Keep 2 sets of plans for as-builts
 - Correct plans as changes occur
 - Submit 1st set of red-lined as-built to D.O.
 - Submit 2nd set as-built in Landscape Maintenance Pending file
-
- Service Requests
 - Transfer of charges to Maintenance
 - Check SS and SSP in case there are additional irrigation units (sprinklers, valves, etc.) or special equipment (Remote Control Units) to be turned over to the Maintenance Branch.



Review Questions

1. When spraying a pre-emergent chemical, is a dye required? If so, what kind ?
2. What are the 2 types of plant establishment?
3. What are the 3 main components of the PEP?
4. How often must backflows be tested?
5. When project is completed, what 3 items are placed in controllers?

1. Yes, ... contrasting color and dissipates in 2-3 days.
2. Type 1 – Highway Planting projects, Type 2 – landscape work w/ major roadway construction contract.
3. Maintaining the newly planted area, utilize the new irrigation system and keep the areas neat and clean.
4. Once per year.
5. Laminated irrigation plans for that particular controller, irrigation wiring plans, sticker showing warranty time frame.



Memorandum:

To: Landscape Inspection Trainee

From : T. Rex, Resident Engineer

Subject: Seventh Commandment



When the contractor argues that
..I've been doing this for xx years...,
or ...on the other job I did w,y,z...

Your first response shall be:

“I do not know what those projects
were about, **SO on THIS** project
we'll follow the project plans and
specials (and any CCO's WE have
written)...”



Planting

Chapter 4: Plant Identification



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Part of the Landscape Inspector's responsibility is to inspect the contract plant material before it is planted to ensure that the plants identified in the Planting Legend in the contract plans are the correct plants. All plants should have identification tags which must be reviewed, but it is also desirable to be familiar with the names of the plants by simply looking at them.



Planting

Plant Identification

Plant Name

- Botanical name
- Common name

Common usage



Northern California



Southern California

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This section on plant identification will not make the RE/inspectors Plant Identification “experts”, but gives them a ready reference of the most common plants used on highway projects in the State.

- A **botanical name** is a formal scientific name, in Latin. It is based on the plants *GENUS* and *species*. The purpose of a scientific name is to have a single Latinized name that is accepted and used worldwide for a particular plant or plant group. Example: *SEQUOIA sempervirons*.
- A common name is an informal name often based on a plant’s indigenous location, appearance, or any number of characteristics. Example: Coast Redwood.

Common usage:

- Trees: Vertical design element.
- Shrubs: Mass Plantings (cover large areas) and screening of views.
- Vines: Soften fences and walls, graffiti deterrent.
- Groundcover : Erosion and provides a visual foreground while maintaining sight distances.

Botanical Name (Common Name) : *Platanus racemosa* (California Sycamore)



Deciduous; Large growing, 40 feet to 100 feet in height;
Often multiple stem; Used as mass planting of trees and
“naturalizing”



Botanical Name (Common Name) : *Platanus acerifolia* 'Bloodgood' (*London Plane Tree*)



Deciduous; Similar to *Racemosa* but faster growing, more upright tree to 80 feet. Note variety that may be specified.



Botanical Name (Common Name): *Eucalyptus citriodora* (*Lemon scented Eucalyptus Tree*)



Evergreen; Up to 200 feet; Used as vertical accents in landscape design; High maintenance, requires regular pruning.



Botanical Name (Common Name) : Lagerstroemia indica (Crape Myrtle)



Deciduous Tree or Shrub; Up to 15 to 20 feet; Showy flowers in many colors (white, pink, purple – check plant list for variety); Used mostly as accent on on/off ramps.



Botanical Name (Common Name) : *Chorisia speciosa* (Silk Floss Tree)



Evergreen; Up to 30 to 60 feet; Trunk may or may not have thorns; Showy large orchid like pink flowers; Large seed pods of Kapoc (old life vest filler); Used as accent for color, match city trees, etc. mostly at on/off ramps.



Botanical Name (Common Name) : *Quercus agrifolia* (California Live Oak)



Evergreen; Slow growing; Used in the foothills and for habitat restoration.



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Botanical Name (Common Name): *Tipuana tipu* (*Tipu Tree*)



Deciduous; Fast growing to 25 feet; Single trunk for a broad shape flat head; Multi trunks for an arching vase shape; Showy yellow pea shaped flowers in the spring to July; Used as accent for color and shape at on/off ramps.



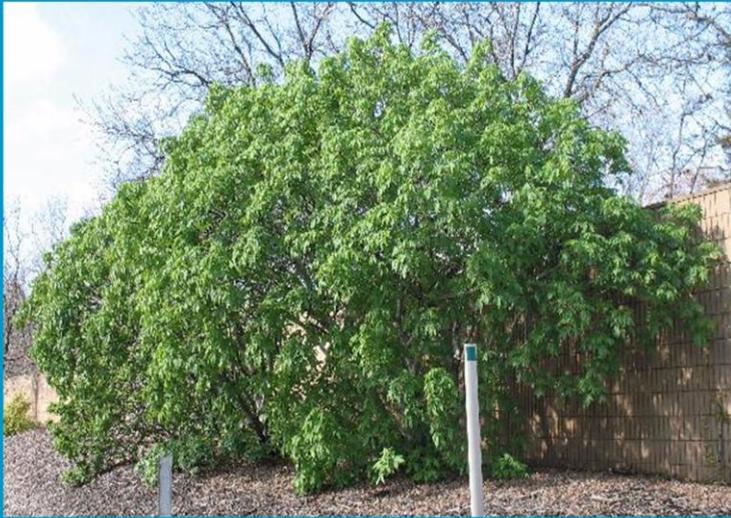
1 gal (overgrown)



Botanical Name (Common Name): *Aesculus californica* (*California Buckeye*)



Deciduous; Shrub or tree to 20 feet; Container size is important, they are susceptible to crown rot and should be in deep pot type containers; Should be planted Fall to Spring, as they require almost no water during Summer.



**T4 container
4" sq. x 14" long**



Botanical Name (Common Name): *Pinus canariensis* (Canary Island Pine)



Evergreen; Medium growth 60 to 80 feet; Slender and consistent in shape; Used in mass or as accents.



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Botanical Name (Common Name): Cedrus deodara (Deodar Cedar)



Evergreen; Himalayan native; Growth 80 to 90 feet; Ensure deep rooting by deep/infrequent watering first 3 years to insure drought tolerance when mature.



No. 15 (15 gal)

Botanical Name (Common Name): *Calocedrus decurrens* (*Incense Cedar*)



Evergreen; California native (most acceptable of natives); Growth 50 to 80 feet; Slowing growing at first; Ensure deep rooting by deep/infrequent watering first 3 years to insure drought tolerance when mature.



**T4 container
4" sq. x 14" long**



**No.1 (1 gal)
overgrown**



Botanical Name (Common Name) : *Quercus douglasii* (Blue Oak)



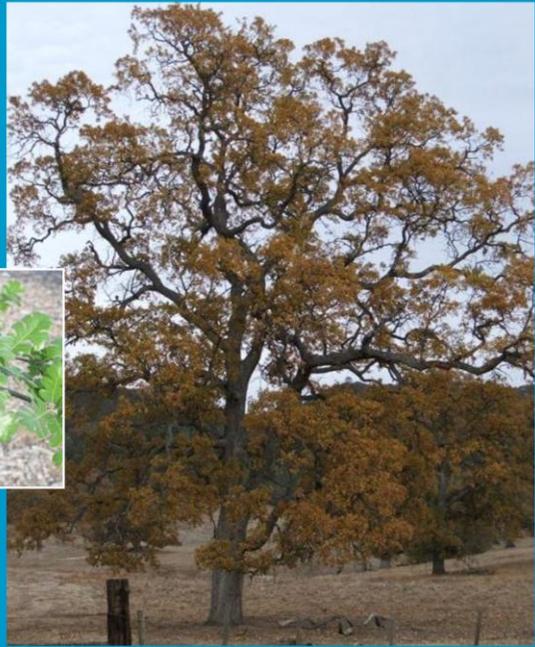
Evergreen; California (Central Valley) native; Growth up to 50 feet; Used for naturalizing and habitat restoration; Fall flowers.



Botanical Name (Common Name): Quercus Lobata (Valley Oak)



Deciduous; California native (mightiest oak); Growth up to 80 feet; Great for Fall color, leaves turn yellow, red.



Botanical Name (Common Name) : *Callistemon citrinus* (*Lemon scented bottle brush*)



Evergreen; Tree or shrub 10 to 12 feet height and width; Used for the color of the red bottlebrush like flowers most of the year or as a screen shrub.



No.1 (1 gal)



Tree



Shrub

Botanical Name (Common Name) : Photinia fraseri (Photinia)



Evergreen; Shrub 10 to 15 feet height and width;
New growth is red in spring and when well watered through the year.



Botanical Name (Common Name) : Nerium oleander “Sister Agnes” (White Oleander)



Evergreen; Shrub 20 feet height and width; Used as mass planting, screen in rows.

Note: there are smaller varieties (i.e. “Mrs. Roeding”) that only grow 5 feet high and used as a medium height mass planting at on/off ramps.



No. 5 (5 gal)



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11 Nerium oleander (“Sister Agnes”-white flower) too a small tree 20’ h & w, used as mass planting, screen in rows and may even be trained into a small tree.

Botanical Name (Common Name) : *Heteromesles arbutifolia* (*California Toyon*,
Christmas Berry, *California Holly*)



Evergreen; California Native; Shrub 6 to 10 feet height and width; can be a tree if trained (pruned); Container for deep rooted plants needed in areas of habitat restoration or naturalizing areas with no irrigation.



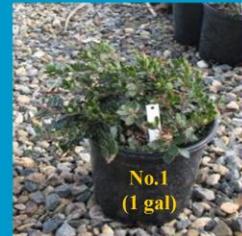
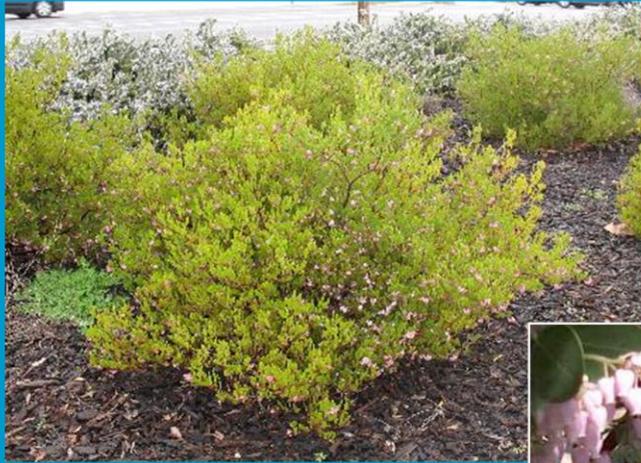
DP container
2 1/2" dia. x 10" long

Botanical Name (Common Name) : Arctostaphylos densiflora "Howard McMinn"

(Hill Manzanita)



Evergreen; California Native; Small shrub 5 to 6 feet tall and 7 feet wide; Slow growing; Pink flowers.



Botanical Name (Common Name) : Raphiolepis indica (India Hawthorn)



Evergreen; Small shrub 8 feet maximum; Used in narrow areas; Bright pink flowers in Spring.



No.5
(5 gal)



Botanical Name (Common Name) : Rhamus californica (Coffeeberry)



Evergreen/Deciduous (water availability);
California native; Small shrub 3 to 15 feet;
Can be planted year around (can be watered
in the Summer); Has a long tap root that
requires a deep container.



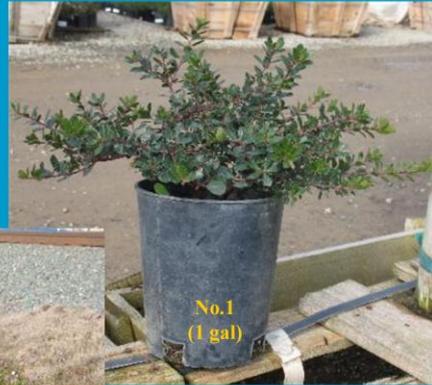
DP container 2 1/2" dia x 10" long



Botanical Name (Common Name) : *Acrostaphylos* “Emerald Carpet”
(*Prostrate Manzanita*)



Evergreen; California native; Low spreading shrub 15 inches tall and 5 to 8 feet wide; Water in Winter and Spring, cut back water in Summer; Naturalizing areas.



Botanical Name (Common Name): *Baccharis pilularis* "Twin Peaks"
(*Coyote Bush* or *Dwarf Chaparral Bush*)



Evergreen; California native; Low spreading shrub 12 to 24 inches tall and 6 feet wide;
Used as ground cover, accent and naturalizing.



Botanical Name (Common Name): Muhlenbergia rigens (Deer Grass)



Evergreen; California native; Shrub 1 to 3 feet tall;
Used as accent and naturalizing.



Botanical Name (Common Name) : Rosa meidiland (Mediland Rose)



Evergreen; Shrub; 12 inches high; Slow growing; Used as ground cover accent; Check plant list for size, can be very scrawny.



Botanical Name (Common Name) : *Parthenocissus tricuspidata* (*Boston Ivy*)



Deciduous; Vine; Fresh growth is light green, turns darker through season, will turn red in cold Fall weather and lose leaves in Winter; Used to cover sound walls.



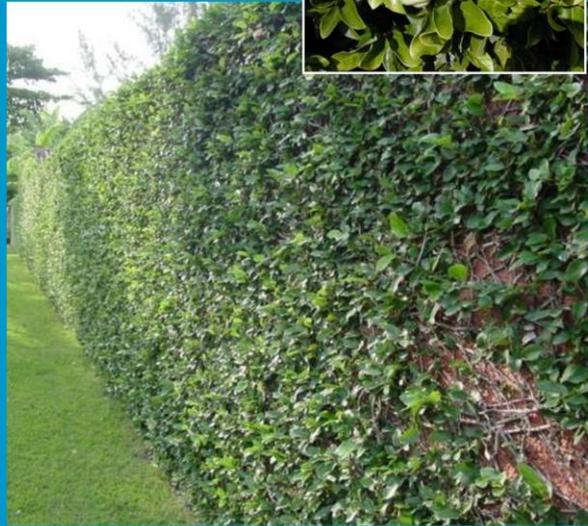
No.1 (1 gal)



Botanical Name (Common Name) : *Ficus pumila* (Creeping Fig)



Evergreen; Vine; Leaves small, 1/4" when young, 2 to 3 inches as matures; Aggressive; Used to cover sound walls.



Botanical Name (Common Name): *Lantana camara* - "confetti" (Orange/Yellow Lantana)



Evergreen; Ground Cover; 15 inches tall and planted 15 on center; Specific variety "confetti" (orange/yellow flowers); Available in white/purple and other variegated colors.



Botanical Name (Common Name) : *Lantana montevidensis* (Purple Lantana)



Evergreen; Ground cover; 15 inches tall and planted 15 feet on center.



Note: Same as *Lantana conferta*, only flowers color is different.



Botanical Name (Common Name) : Myoporum parvifolium “pacificum”



(Prostrate Myoporum)

Evergreen; Ground cover; Grows 18 to 24 inches high and planted 15 feet on center:
Mounds 18 to 24 inches.



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Myoporum prostrata "Pacificum"

Botanical Name (Common Name): *Acacia redolens* (Prostrate Acacia)



Evergreen; Spreading shrub used as ground cover; Planted 15 feet on center; Mounds up to 6 feet (much higher than Myoporum); Grey green in color.



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Botanical Name (Common Name) : Hedera helix (English Ivy)



Evergreen; Ground cover; Usually from flats; Planted at 12 to 18 inches on center; Needs extra water in hot weather (before sun comes up); Slow growing to start.



The light green portion!



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Botanical Name (Common Name) : *Delosperma rosea* (Red Trailing Ice Plant)



Evergreen; Ground cover; Usually from flats; Planted at 10 to 12 inches on center; Slower and lower growing than *Carpobrotus edulis* (ice plant); Has flowers year in/out.



Picture is the Route 57 at Katella Ave. The Honda Center (Big A Stadium) on/off ramp in Anaheim .



Botanical Name (Common Name) : *Carpobrotus edulis* (*Ice Plant or Hottentot Fig*)



Evergreen; Ground cover (most common); Usually by 10 inch cuttings; Planted at 18 inches on center; Flowers (white or purple) when under stress from lack of water; Fast growing, green and cheap; Drought tolerant and will *almost* comeback from the dead.



No.1 (1 gal)



Cuttings