NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

CLOSURE OF WASTE IMPOUNDMENTS

(No.)

CODE 360

DEFINITION

The closure of waste impoundments (treatment lagoons and liquid storage facilities), that are no longer used for their intended purpose, in an environmentally safe manner.

PURPOSE

- Protect the quality of surface water and groundwater resources.
- Eliminate a safety hazard for humans and livestock
- Safeguard the public health.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to agricultural waste impoundments that are no longer needed as a part of a waste management system and are to be permanently closed or converted.

Where these impoundments are to be converted to fresh water storage and the original impoundment was not constructed to NRCS standards, this practice will only apply where the investigation, as required in National Engineering Manual (NEM) 501.23, shows structural integrity.

CRITERIA

General Criteria Applicable to All Purposes

In California, Closure Standards for Units other than Landfills (including surface impoundments, waste piles, and Land Treatment Units) are set forth in the Title 27 of the California Code of Regulations (Division 2, Subdivision 1, Chapter 3, Subchapter 5, Article 3: http://www.waterboards.ca.gov/cwphome/land/docs/t2797m.pdf.

All structures used to convey waste to waste impoundments and/or to provide drainage from the impoundment area shall be removed and replaced with compacted earth material or otherwise rendered unable to convey waste.

Liquid and slurry wastes shall be agitated and pumped to the extent conventional pumping will allow. Clean water shall be added as necessary to facilitate the agitation and pumping. The wastewater shall be utilized properly and in accordance with applicable regulations. The sludge remaining on the bottom and sides of the waste treatment lagoons or waste storage ponds may remain in place if it will not pose a threat to the environment. If leaving the sludge in place would pose a threat, it shall be removed to the fullest extent practical and utilized properly and in accordance with applicable regulations and NRCS criteria.

Embankment Impoundments. Waste impoundments that have water impounded against the embankment are considered embankment structures if the depth of water is three feet or more above natural ground.

Impoundments with embankments may be breached so that they will no longer impound water.

Waste shall be removed from the site before the embankment is breached. The slopes and bottom of the breach shall be stable for the soil material involved, however the side slopes shall be no steeper than three horizontal to one vertical (3:1).

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide.

Excavated Impoundments. Excavated impoundments may be backfilled so that these areas may be reclaimed for other uses.

The backfill height shall exceed the design finished grade by 5 percent to allow for settlement. The top one foot of the backfill shall be constructed of the most clayey material available and mounded to shed rainfall runoff. Incorporate available topsoil where feasible to aid establishment of vegetation.

Closed Waste Storage Structures. Closed waste storage structures shall be demolished or disassembled or otherwise altered to such an extent that no water can be impounded. Disassembled materials such as pieces of metal shall be temporarily stored until their final disposition in such a manner that they do not pose a hazard to animals or humans.

Demolished materials shall be buried on-site or moved off-site to locations designated by state or local officials. If buried on-site, the materials are to be covered with soil to a settled depth of one foot, and the backfill sufficiently mounded such that runoff will be diverted from the site after the backfill settles.

Conversion to Fresh Water Storage. The converted impoundment shall meet the requirements as set forth in the NRCS practice standard for the intended purpose.

Safety. When sludge is not removed from a waste impoundment that is converted to fresh water storage, it shall not be used for fish production, swimming, or livestock watering until water quality is adequate for these purposes. Precautions (fencing and warning signs) shall be used to ensure that the pond is not used for purposes incompatible with the current quality of water.

Personnel shall not enter an enclosed waste impoundment without breathing apparatus or taking other appropriate measures.

Protection - All disturbed areas shall be shaped and revegetated, or other suitable measures used to control erosion, properly manage runoff and drainage, and restore the aesthetic value of the site.

Measures shall be taken during construction to minimize site erosion and pollution of downstream water resources. This may include such items as silt fences, hay bale barriers, temporary vegetation, and mulching.

CONSIDERATIONS

Reduce pumping effort to empty waste impoundments where the surface is covered by a dense mat of floating vegetation by first applying herbicide to the vegetation and properly disposing of the residue.

Alternative methods of sludge removal may be required where the impoundments contain large amounts of oyster shells, soil, or other debris.

Minimize the impact of odors associated with emptying and land applying wastewater and sludge from a waste impoundment by using an incorporation application method at a time when the humidity is low, when winds are calm, and when wind direction is away from populated areas.

Soil to fill excavated ponds should not come from important farmlands (prime, statewide, local, and/or unique).

Breached embankments may detract from the overall aesthetics of the operation. To the degree practicable, embankments should be removed and the site returned to its original grade.

Keep sludge left in place covered with water to prevent its aerobic decomposition with the potential release of nutrients to surface and ground water.

Disassembled structural facilities may be suitable for assembly at another site. Care should be taken during closure to minimize damage to the pieces of the facility, particularly coatings that prevent corrosion of metal pieces

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may

require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Plans and specifications for closure of abandoned waste treatment lagoons and waste storage facilities shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall also be consistent with the requirements of that standard.

OPERATION AND MAINTENANCE

The proper closure of a waste treatment lagoon or waste storage pond should require little or no operation and maintenance; however, if it is converted to another use, such as a fresh water facility, operation and maintenance shall be in accordance with the needs as set forth in NRCS conservation practice standard for the intended purpose.

REFERENCES

USDA-NRCS, 1992, Agricultural Waste Management Field Handbook: 210-VI-NEH Part 651, 17 chapters (incl. rev dated 1992-1999). http://www.info.usda.gov/CED/

COMBINED SWRCB/CIWMB REGULATIONS DIVISION 2, TITLE 27

Article 3. SWRCB - Closure Standards for Units Other Than Landfills http://www.waterboards.ca.gov/cwphome/land/docs/t2797m.pdf

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND
(No.)
CODE 378

DEFINITION

A water impoundment made by constructing an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is 3 feet or more.

PURPOSE

To provide water for livestock, fish and wildlife, recreation, fire control, and other related uses, and to maintain or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This standard establishes the minimum acceptable quality for the design and construction of low-hazard ponds where:

1. Failure of the dam will not result in loss of life; damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.
2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.
3. The effective height of the dam is 35 feet or less, and the dam is hazard class (a).
4. For class "a" dams with a height-storage product greater than 3,000, and for class "b" and "c" dams, the design criteria shall be the more restrictive of the criteria set forth herein or as outlined in TR-60.
5. Hazard classification shall be documented by the procedures in NEM, Section 520.23(b), CA-Supplement.

GENERAL CRITERIA APPLICABLE TO ALL PONDS

All Federal, State and local requirements shall be addressed in the design.

A protective cover of vegetation shall be established on all exposed areas of embankments, spillways and borrow areas as climatic conditions allow, according to the guidelines in conservation practice standard 342, Critical Area Planting.

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed auxiliary spillway, (2) a combination of a principal spillway and an auxiliary spillway, or (3) a principal spillway.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater will provide an adequate supply of water for the intended purpose unless an alternate water source exists to serve this purpose. The quality shall be suitable for the water's intended use.

Reservoir area. The topography and geology of the site shall permit storage of water at a depth and volume that will ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

Water Rights. It is imperative that any owner planning to construct a facility to store runoff water be advised that the state water code requires filing for a water right, regardless of the amount of that storage.

Such a filing is made to the Water Rights Division of the California Water Resources Control Board. The Board may require a conduit or other satisfactory means to enable water to pass through the embankment or other barrier creating the storage. The requirement for a conduit cannot be prejudged. It is determined by the Board based on the circumstances of each individual situation.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

It is the responsibility of the owner to file for the water rights and advise NRCS of the Board's decision on the requirements for a conduit. The owner should also be advised of the possible need for other local, state or federal permits.

DESIGN CRITERIA FOR EMBANKMENT PONDS

Geological Investigations. Pits, trenches, borings, review of existing data or other suitable means of investigation shall be conducted to characterize materials within the embankment foundation, auxiliary spillway and borrow areas. Soil materials shall be classified using the Unified Soil Classification System.

The embankment foundation shall be investigated, thoroughly and to the depth required, to determine the following:

1. Depth to competent impervious layer.
2. Ability of the foundation to withstand load.
3. Seepage potential through the abutments and foundation.

The emergency spillway shall be investigated to determine the following:

1. The suitability of the material as a borrow source.
2. The potential for the spillway to erode.
3. The difficulty of excavation.

The borrow areas shall be defined by at least three pits, trenches, or borings. Quantities of borrow volumes shall be computed based upon the site investigation. The minimum borrow volume, excluding waste, shall exceed the embankment volume by 1.5.

The borrow operation shall not be permitted closer than 50 feet from the upstream toe of the embankment except where the cutoff trench extends into firm impervious material for its entire length.

Since all of California is classified as a high seismic area, appropriate design measures shall be incorporated into the design of each embankment as a defensive measure for earthquakes (NEM 520.24(a) (1). Examples of such design measures that would help the embankment withstand seismic loads include:

1. Constructing the embankment of compacted clayey materials.
2. The addition of a berm (or berms).
3. Increase the embankment top width.
4. Include an embankment drain.

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary to reduce seepage through the foundation. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall not be steeper than one horizontal to one vertical.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage could create swamping downstream, (3) such control is needed to insure a stable embankment, or (4) special problems require drainage for a stable dam. Seepage may be controlled by (1) foundation, abutment, or embankment filters and drains; (2) reservoir blanketing; or (3) a combination of these measures.

Embankment. The minimum top width for a dam is shown in table 1. If the embankment top is to be used as a public road, the minimum width shall be 16 feet for one-way traffic and 26 feet for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority. For dams less than 20 feet in height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in Table 1.

Table 1. Minimum top width for dams

Total height of embankment	Top width
feet	*feet*
Less than 10	8
10 – 14.9	10
15 – 19.9	10
20 – 24.9	12
25 – 34.9	14
35 or more	15

Side Slopes. The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections

Slope Protection. If needed to protect the slopes of the dam from erosion, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (Technical Releases 56, "A Guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments" and 69, "Riprap for Slope Protection Against Wave Action" contain design guidance).

Freeboard. The minimum elevation of the top of the settled embankment shall be 1 foot above the water surface in the reservoir with the auxiliary spillway flowing at design depth.

The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of the dam shall be 2 feet for all dams having less than a 20-acre drainage area or less than 20 feet in effective height.

The minimum difference in elevation between the crest of the earth auxiliary spillway and the settled top of dam shall be either depth of design flow plus 1 foot or 3 feet whichever is greater for dams having more than a 20 acre drainage area or more than 20 feet in height.

For concrete chute spillways the minimum difference in elevation between the crest of the emergency spillway and the settled top of dam shall be either the depth of flow plus 1.0 feet or 2.0 feet whichever is greater.

Settlement. The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent of the height of the dam, except where detailed soil testing and laboratory analyses or experience in the area show that a lesser amount is adequate.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of lined spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

For dams with a drainage area of 20 acres or less, the principal spillway crest elevation shall not be less than 0.5 feet below the auxiliary spillway crest elevation. For dams with a drainage area over 20 acres, this difference shall not be less than 1.0 feet.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that the design discharge will be generated in the conduit before there is discharge through the auxiliary spillway.

Pipe conduits designed for pressure flow must have adequate anti-vortex devices. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the auxiliary spillways. The diameter of the principal spillway pipe shall not be less than 4 inches. Pipe conduits used solely as a supply pipe through the dam for watering troughs and other appurtenances shall not be less than 1-1/4 inches in diameter.

If the pipe conduit diameter is 10 inches or greater, its design discharge may be considered when calculating the peak outflow rate through the auxiliary spillway.

Pipe conduits shall be ductile iron, welded steel, corrugated steel, corrugated aluminum, reinforced concrete (pre-cast or site-cast), or plastic. Pipe conduits through dams of less than 20 feet total height may also be cast iron or unreinforced concrete.

Pipe conduits shall be designed and installed to withstand all external and internal loads without yielding, buckling, or cracking. Rigid pipe shall be designed for a positive projecting condition. Flexible pipe shall be designed for a maximum deflection of 5 percent. The modulus of elasticity for PVC pipe shall be assumed as one-third of the amount designated by the compound cell classification to account for long-term reduction in modulus of elasticity. Different reductions in modulus may be appropriate for other plastic pipe materials.

The minimum thickness of flexible pipe shall be SDR 26, Schedule 40, Class 100, or 16 gage as appropriate for the particular pipe material. Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations.

All pipe conduits shall be designed and installed to be water tight by means of couplings, gaskets, caulking, waterstops, or welding. Joints shall be designed to remain watertight under all internal and external loading including pipe elongation due to foundation settlement.

In lieu of a specific design for strength requirements for the pipe, specifications in Tables 2 and 3 are to be followed for polyvinyl chloride(PVC), steel and aluminum pipe.

Table 2. - Acceptable PVC pipe for use in earth dams[1]

Nominal pipe size *inches*	Schedule for standard dimension ratio (SDR)	Max. depth fill over pipe *feet*
4 or smaller	Schedule 40	15
	Schedule 80	20
	SDR 26	10
6, 8, 10, 12	Schedule 40	10

Schedule 80	15
SDR 26	10

Table 3. - Minimum gage for corrugated metal pipe (2-2/3in X 1/2 in corrugations)[1]

Fill height (ft)	Minimum gauge for steel pipe with diameter (in) of 21 and less	24	30	36	42	48	Minimum thickness of aluminum pipe[2] with diameter (in) of 21 and less	24	30	36
1-15	16	16	16	14	12	10	.06	.075	.075	.075
15-20	16	16	16	14	12	10	.06	.075	.075	.105
20-25	16	16	14	12	10	10	.06	.105	.135	[3]

[1]Pipe with 6-,8-, and 10-in diameters has 1-1/2 in x 1/4 in corrugations.
[2]Riveted or helical fabrication.
[3]Not permitted.

Pipe Conduits. Pipe conduits shall be placed through or under embankments where required for safety, for proper operation of the reservoir and spillway, or for water rights requirements.

Where a pipe conduit is to be installed, the following shall apply:

1. No valve shall be installed when the conduit serves the single purpose of carrying flow from a trickle tube riser. For secondary discharge systems, control valves shall be installed on the upstream end unless otherwise approved by the State Conservation Engineer.
2. The conduit shall be placed in a trench excavated in firm foundation or in compacted fill not more than three feet above firm foundation.
3. All pipe conduits through earth embankments shall be concrete bedded or encased in concrete as defined below:

Embankment Minimum Treatment Height:

A. Concrete Pipe with Round Rubber Gasket joints

10 feet or less	2-inch concrete bedding up 1/3 the O.D. on both sides of the pipe centerline.
10 to 25 feet	1/2 O.D. Concrete cradle
25 to 35 feet	1/2 O.D. Concrete cradle

B. Corrugated Metal Pipe and Plastic

25 feet	Complete encasement
25 feet or greater	CMP shall not be used

[1]Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ASTM-D-1785 or ASTM-D-2241.

4. When a pipe conduit is to be encased with concrete, the trench shall be excavated to the neat lines and grades so that the bottom and two sides become suitable forms for the concrete.
5. Anti-seep collars are considered adequate for seepage control along conduits through embankments less than 20 feet in effective height. When used for seepage control they should be installed around the conduit within the normal saturation zone, the upstream two thirds of the conduit length or upstream of a positive embankment drainage system.

   These collars shall extend beyond the pipe or encasement not less than 18 inches in all directions except where a watertight seal can be obtained by tying the collar into firm rock.

   The maximum spacing shall not exceed 15 feet. Corrugated metal collars are not permitted.
6. The installation of trickle tubes are allowed provided the tube is buried in the embankment side slopes at a shallow depth of 1.0 feet to protect the pipe. Usually trickle tubes are installed to convey water to a trough for livestock use.
7. When cathodic protection is needed, the procedures of Design Note 12 shall be used.

Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Other suitable devices such as a Saint Anthony Falls stilling basin or an impact basin may be used to provide a safe outlet.

All steel pipe and couplings shall have protective coatings in areas that have traditionally experienced pipe corrosion, or in embankments with saturated soil resistivity less than 4000 ohms-cm or soil pH less than 5. Protective coatings shall be asphalt, polymer over galvanizing, aluminized coating or coal tar enamel as appropriate for the pipe type. Plastic pipe that will be exposed to direct sunlight shall be ultraviolet-resistant and protected with a coating or shielding, or provisions provided for replacement as necessary

Cathodic Protection. Cathodic protection is to be provided for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating, and where the need and importance of the structure warrant additional protection and longevity. If cathodic protection is not provided for in the original design and installation, electrical continuity in the form of joint-

bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need.

Seepage Control. Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 feet.
2. The conduit is of smooth pipe larger than 8 inches in diameter.
3. The conduit is of corrugated pipe larger than 12 inches in diameter.

Seepage along pipes extending through the embankment shall be controlled by use of a drainage diaphragm, unless it is determined that anti-seep collars will adequately serve the purpose.

Drainage Diaphragm. The drainage diaphragm, when required, shall function both as a filter for adjacent base soils and a drain for seepage that it intercepts. The drainage diaphragm shall consist of sand meeting the requirements of ASTM C-33, for fine aggregate. If unusual soil conditions exist such that this material may not meet the required filter or capacity requirements, a special design analysis shall be made.

The drainage diaphragm shall be a minimum of 2 feet thick and extend vertically upward and horizontally at least three times the outside pipe diameter, and vertically downward at least 18 inches beneath the conduit invert. The drainage diaphragm shall be located immediately downstream of the cutoff trench, but downstream of the centerline of the dam if the cutoff is upstream of the centerline.

Water shall be transported safely from the drainage diaphragm, to a point downstream of the dam, in a pipe or series of pipes, called drainage diaphragm discharge pipe(s). A filter and drain system shall be provided around the pipe(s) to prevent movement or piping of drain, filter or embankment material. Protect the outlet for these pipes from surface erosion.

Anti-seep Collars. When anti-seep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe but not more than 25 feet. The minimum spacing shall be 10 feet. Collar material shall be compatible with pipe materials. The anti-seep collar(s) shall increase by at least 15 percent the seepage path along the pipe.

Trash Guard. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser unless the watershed does not contain trash or debris that could clog the conduit.

Other Outlets. A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by State law. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Auxiliary spillways. Auxiliary spillways convey large flood flows safely past earth embankments and have historically been referred to as “Emergency Spillways”.

An auxiliary spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an auxiliary spillway: a conduit with a cross-sectional area of 3 ft^2 or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The auxiliary spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days’ drawdown, whichever is higher. The 10-day drawdown shall be computed from the crest of the auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed auxiliary spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth or in-situ rock. The side slopes shall be stable for the material in which the spillway is to be constructed. For dams having an effective height exceeding 20 feet, the auxiliary spillway shall have a bottom width of not less than 10 feet.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed auxiliary spillway shall fall within the range established by discharge requirements and permissible velocities.

Capacity. The minimum capacity of the natural or constructed emergency spillway shall be that required to pass

the peak outflow expected from a 50-year 24-hour frequency storm, less any reduction creditable to conduits or detention storage.

The minimum bottom width shall be 5 feet for dams up to 20 feet in effective height and 10 feet for dams exceeding 20 feet in effective height. The minimum capacity of a closed emergency spillway shall be sufficient to pass the peak flow expected from a 100-year 24-hour frequency storm, less any reduction creditable to principal spillways or detention storage.

Where there are dams in series (NEM, 520.24(a) (1), the design of the downstream structure shall address what will happen should the upstream structure fail. Some precautions that could be considered are:

1. Adding additional freeboard to the embankment.
2. Larger capacity emergency spillway.
3. Address how overtopping will affect the structure being designed.

Erosion Protection. Earth or vegetated spillways shall be non-erosive for the runoff from a 50 year 24 hour frequency storm. Pipe spillways may be used to carry part or all of this flow where erosion will occur. If some erosion will occur during higher frequency storms, the quantity of sediment and its effect downstream shall be addressed.

Side Slopes. Where spillway levees or training dikes are required to protect the downstream toe of the fill, they shall have side slopes not steeper than 3:1.

The minimum top width for the spillway training dikes or levees shall be 12 feet.

Structural auxiliary spillways. If chutes or drops are used for principal spillways or auxiliary spillways, they shall be designed according to the principles set forth in the Part 650, Engineering Field Handbook, and the National Engineering Handbook, Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways.

State Division of Dam Safety. Drawings and specifications for dams within the jurisdiction of the California Division of Safety of Dams shall also meet the requirements of that organization.

Dams within the State jurisdiction dams are:

1. Dams over 25 feet in height and with storage of 15 acre-feet or more.
2. Dams over 6 feet in height and with storage of 50 acre-feet or more.

In general the design for state-size dams will need to meet the minimum requirements for a "b" hazard structure as outlined in Technical Release 60.

Pipe conduits must be placed through or under all embankments that are of a size to be within the jurisdiction of the California Division of Safety of Dams.

CRITERIA FOR EXCAVATED PONDS

Geological Investigations. Pits, trenches, borings, review of existing data or other suitable means of investigation shall be conducted to characterize materials within the excavation. Soil materials shall be classified using the Unified Soil Classification System.

The area to be excavated for the pond shall be investigated, thoroughly and to the depth of at least 2 feet below the anticipated lowest expected grade, to determine the following:

1. Seepage potential through the pond.
2. The difficulty of excavation.

Clay or plastic pond liners should be used on excavated ponds where seepage losses are considered excessive.

Runoff. Runoff flow patterns shall be considered when locating the excavated pond and placing the spoil.

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical. If livestock will water directly from the pond, a watering ramp of ample width shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than three horizontal to one vertical.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 feet, with the top graded to a continuous slope away from the pond.
2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 feet from the edge of the pond.
3. Shaped to a designed form that blends visually with the landscape.
4. Used for low embankment construction and leveling of surrounding landscape.
5. Hauled away.

CONSIDERATIONS

On ponds lined with flexible membrane liners, the top width may need to be increased around the curves to facilitate construction of the anchor trench.

Visual Resource Design. The visual design of ponds should be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

Fish and Wildlife. Project location and construction should minimize the impacts to existing fish and wildlife habitat.

When feasible, structure should be retained, such as trees in the upper reaches of the pond and stumps in the pool area. Upper reaches of the pond can be shaped to provide shallow areas and wetland habitat.

If fish are to be stocked, consider criteria and guidance in conservation practice standard 399, Fishpond Management.

Vegetation. Stockpiling topsoil for placement on disturbed areas can facilitate revegetation.

Consider placement and selection of vegetation to improve fish and wildlife habitat and species diversity.

Water Quantity.

Consider effects upon components of the water budget, especially:

1. Effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Variability of effects caused by seasonal or climatic changes.
3. Effects on downstream flows and impacts to environment such as wetlands, aquifers, and; social and economic impacts to downstream uses or users.
4. Potential for multiple purposes.

Water Quality

1. Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that are carried by runoff.
2. Effects on the visual quality of onsite and downstream water resources.
3. Short-term and construction-related effects of this practice on the quality of downstream water courses.
4. Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
5. Effects on wetlands and water-related wildlife habitats.
6. Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.
7. Effects of soil water level control on the salinity of soils, soil water, or downstream water.
8. Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

PLANS AND SPECIFICATIONS

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or individual responsible for operation and maintenance.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

RIPARIAN FOREST BUFFER
(Acre)
CODE 391

DEFINITION

An area of predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

PURPOSE

- Create shade to lower water temperatures to improve habitat for fish and other aquatic organisms.
- Provide a source of detritus and large woody debris for fish and other aquatic organisms and riparian habitat and corridors for wildlife.
- Create wildlife habitat and establish wildlife corridors.
- Reduce excess amounts of sediment, organic material, nutrients, pesticides and other pollutants in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.
- Provide a harvestable crop of timber, fiber, forage, fruit, or other crops consistent with other intended purposes.
- Provide protection against scour erosion within the floodplain.
- Restore natural riparian plant communities.
- Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats.
- To increase carbon storage in plant biomass and soils.

CONDITIONS WHERE PRACTICE APPLIES

On areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands and areas with ground water recharge that are capable of supporting woody vegetation.

CRITERIA

General Criteria Applicable To All Purposes

The location, layout and density of the riparian forest buffer will accomplish the intended purpose and function.

The buffer will consist of a zone (identified as Zone 1) that begins at the normal water line, or at the top of the bank, and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the water body.

Conservation practices needed to stabilize eroding stream channels must be designed during the riparian forest buffer planning stages. Some bank shaping, bank protection or grade control may be required to have adequate and sustaining connectivity between the channel and the floodplain.

Dominant vegetation will consist of existing, naturally regenerated, or planted trees and shrubs suited to the site and the intended purpose.

An adequate upstream or adjacent seed source must be present when using natural regeneration to establish a buffer.

Necessary site preparation and planting shall be done at a time and manner to insure survival and growth of selected species.

Site preparation will be sufficient for establishment and growth of selected species and will be done in a manner that does not compromise the intended purpose (Refer to Tree/Shrub Site Preparation – Standard 490).

For recommended plant species see the Vegetative Guide of the Field Office Technical Guide.

NRCS, CA

August 2006

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

Only viable, high quality, adapted planting stock will be used. Herbaceous vegetation will be selected which does not aggressively compete with trees and shrubs but provides erosion protection and filtration.

Livestock will be controlled or excluded as necessary to achieve and maintain the intended purpose (Refer to Use Exclusion – Standard 472 and Prescribed Grazing - Standard 528).

Livestock stream crossings and watering facilities shall be located and sized to minimize impacts to the buffer. On established buffers within grazed areas, set utilization rates of key browse species to maintain its intended function. Impaired function by livestock overuse (trampling, compaction, or over-utilization of woody plants, grasses, and sedges) shall require immediate removal of livestock from the riparian area.

Harmful pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose.

Comply with applicable federal, state and local laws and regulations during the installation, operation (including harvesting activities) and maintenance of this practice.

Combined Widths For Zones 1 and 2:

Active Floodplain Width	Buffer Width	Determination
<= 105 feet	35 feet	minimum
>105 feet, but < = 333 feet	36-99 feet	30% of the active floodplain
> 333 feet maximum	100 feet	

Zone 1:

Dominant vegetation in Zone 1 will consist of well-distributed existing or planted trees and shrubs suited to the site and the intended purpose(s). The composition of trees and shrubs will be diverse and resemble native stands.

Occasional removal of some tree and shrub products such as high value trees is permitted provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance.

Plant species in Zone 1 must be able to have their roots reach the water table during the growing season of the year they are planted. If this is not possible, supplemental irrigation may be necessary for plant survival.

When selecting trees for Zone 1, select at least one species that will become at least 18 inches dbh at maturity.

Within the existing buffer, maintain at least 85% of the existing trees that have a diameter at dbh of greater than 18 inches.

Zone 2:

Removal of tree and shrub products such as timber, nuts and fruit is permitted on a periodic and regular basis. The loss of vegetation or harvesting disturbance must not comprise the intended purpose(s).

Introduced trees may be used in Zone 2. Zone 2 trees and shrubs may be non-native xerophytic species.

Additional Criteria To Reduce Excess Amounts of Sediment, Organic Material, Nutrients and Pesticides in Surface Runoff and Reduce Excess Nutrients and Other Chemicals in Shallow Ground Water Flow.

An additional strip or area of land, Zone 2, will begin at the edge and up-gradient of Zone 1 and extend a minimum distance of 20 feet, measured horizontally on a line perpendicular to the water course or water body.

The minimum combined width of Zone 1 and 2 will be 100 feet or 30 percent of the geomorphic flood plain whichever is less, but not less than 35 feet.

Criteria for Zone 1 shall apply to Zone 2 except that removal of products such as timber, fiber, nuts, fruit and forbs is permitted and encouraged on a periodic and regular basis provided the intended purpose is not compromised by loss of vegetation or harvesting disturbance.

Zone 2 will be expanded in high nutrient, sediment, and animal waste application areas,

where the contributing area is not adequately treated or where an additional level of protection is desired.

A Zone 3 shall be added to the riparian buffer when adjacent to cropland or other sparsely vegetated or highly erosive areas to filter sediment, address concentrated flow erosion, and maintain sheet flow. The Filter Strip (Standard - 393) shall be used to design Zone 3.

Zone 3:

Concentrated flow or mass soil movement will be controlled in the up-gradient area immediately adjacent to Zone 2 prior to/or at the same time as the establishment of the riparian forest buffer. This area is identified as Zone 3.

This area will be designed in accordance with criteria contained in the Filter Strip Standard.

If Zone 3 is applicable the combined width of all zones will not exceed 150 feet.

Additional Criteria to Provide Habitat for Aquatic Organisms and Terrestrial Wildlife

Width of Zone 1 and/or Zone 2 will be expanded to meet the minimum requirements of the wildlife or aquatic species and associated communities of concern.

Establish plant communities that address the target wildlife needs and existing resources in the watershed.

To create shade to lower or maintain water temperatures for improvement of habitat for fish and other aquatic organisms:

Buffers will be designed to achieve 60 to 80 % canopy cover over watercourses having an active channel width of less than or equal to 50 feet.

Buffers will be designed to achieve 60 to 80 % canopy cover in water bodies with the canopy cover extending out a minimum of 35 feet.

Pesticide application may be utilized to control noxious weeds or pest outbreaks. However, they will be applied consistent with federal, state, and local regulations.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

Maximize width and length of the riparian forest buffer.

Select plants that have higher rates of carbon sequestration in soils and plant biomass and are adapted to the site to assure strong health and vigor. Plant the appropriate stocking rate for the site.

Additional Criteria Providing Course Woody Debris (CWD or LWD):

Where they are adapted select at least one coniferous species for Zone 1. Conifers should be planted to imitate, as much as possible, natural conditions.

Existing trees and snags that have fallen into the water may be retained by cabling, if necessary, to keep them in place (Refer to Streambank and Shoreline Protection Standard – 580).

CONSIDERATIONS

Tree and shrub species, which may be alternate hosts to undesirable pests, should be avoided.

Trees should be selected that have a mature canopy height greater than the active channel width. For narrow buffers, select trees that have a broad crown. For vegetation along the waters edge, select tree and shrub species that at maturity will have limbs that will overhang the water.

Allelopathic impacts of plants should be considered.

The severity of bank erosion and its influence on existing or potential riparian trees and shrubs should be assessed. Watershed-level treatment or bank stability activities may be needed before establishing a riparian forest buffer.

Cliffs and steep hills which provide topographic shading maybe considered to be part of the riparian area even though they may not support woody vegetation.

Woody phreatophytes and hydrophytes that deplete ground water should be used with caution in water-deficit areas.

Species diversity should be considered to avoid loss of function due to species-specific pests.

The location, layout and density of the buffer should compliment natural features. Avoid layouts and locations that would concentrate flood flows or return flows.

Avoid layouts and locations that concentrate flood flows or return flows. Low, flexible-stemmed shrubs will minimize obstruction of local flood flows.

When concentrated flow erosion and sedimentation cannot be controlled vegetatively, consider structural or mechanical treatments.

Consider establishing buffers on both sides of watercourses. This will provide more streambank protection, wildlife cover, less nutrient runoff, and other values. Complex ownership patterns of riparian areas may require group planning for proper buffer design, function and management.

Consider species that resprout when establishing new rows nearest to watercourses or bodies. For detritus and large woody debris, use species that will meet the specific requirements of fish and other aquatic organisms for food, habitat, migration, and spawning.

Avoid using large/tall trees when establishing buffers in locations prone to windthrow.

Consider the positive and negative impacts beaver, muskrat, deer, rabbits, and other local species may have on the successful management of the riparian and stream systems. Temporary and local population control methods should be used cautiously and within state and local regulations.

Consider the type of human use (rural, suburban, urban) and the aesthetic, social, and safety aspects of the area to determine the vegetation selection, arrangement, and management. For example, avoid using shrubs/trees that block views, and prune low branches along recreation trails.

For Zone 1:

Large trees that are dead or dying will be left as snags in Zone 1 provided they do not present a threat to life or property and do not harbor detrimental pests.

Shade along south and west sides of water bodies will provide more temperature protection than shading the north and east sides.

Roads, dikes and levees within the riparian buffer can take up a large percentage of the buffer area and potentially create additional water quality problems. It may be feasible to relocate them outside of the buffer area.

The joining of existing and new riparian buffers increases the continuity of cover and will further moderate water temperatures.

A mix of woody species with growth forms that vary from short and drooping to tall erect and wide-crowned will assist in moderating temperature.

Encourage the growth of woody vegetation or trees along irrigation diversion ditches, drainage ditches, etc. to moderate temperatures, provide shade and food production for aquatic life.

Where possible, consider wildlife travel corridors composed of woody vegetation between the water course or water body and isolated wetlands, constructed farm ponds and sediment basins.

For Zone 2:

Favor tree and shrubs that are native and have multiple values, such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics, and tolerance to locally used herbicides.

Tall trees will also help shade the water body. These trees can be upland species, especially in the arid portions of the state and/or where water is scarce.

For Zone 3:

Stiff, multi-stemmed grasses will assist in improving water quality by accelerating the deposition of sediment.

Where ephemeral, concentrated flow erosion and sedimentation is a concern in Zone 3, consider the application of a vegetated strip consisting of grasses and forbs.

CULTURAL RESOURCES CONSIDERATIONS

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental

Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

ENDANGERED SPECIES CONSIDERATIONS

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications will be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

Inspect the riparian forest buffer periodically and protect it from adverse impacts such as excessive vehicular traffic, pest infestations, pesticide damage, and livestock or fire damage.

Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is, or will progress to, a fully functional condition.

As applicable, control of concentrated flow erosion or mass soil movement shall be continued in the up-gradient area immediately adjacent to Zone 2 to maintain buffer function.

Any removal of tree and shrub products will be conducted in a manner that maintains the intended purpose and meets state regulations.

Any use of fertilizers, pesticides and other chemicals to assure buffer function will not compromise the intended purpose(s).

REFERENCES:

National Biology Handbook. Part 614.4. Conservation Corridor Planning at the Landscape Level. USDA-NRCS. August 1999.

Technical Note Engineering - CA-14. Planning and Design Guide For Stream Corridor Restoration. USDA-NRCS-CA. Sept. 2003

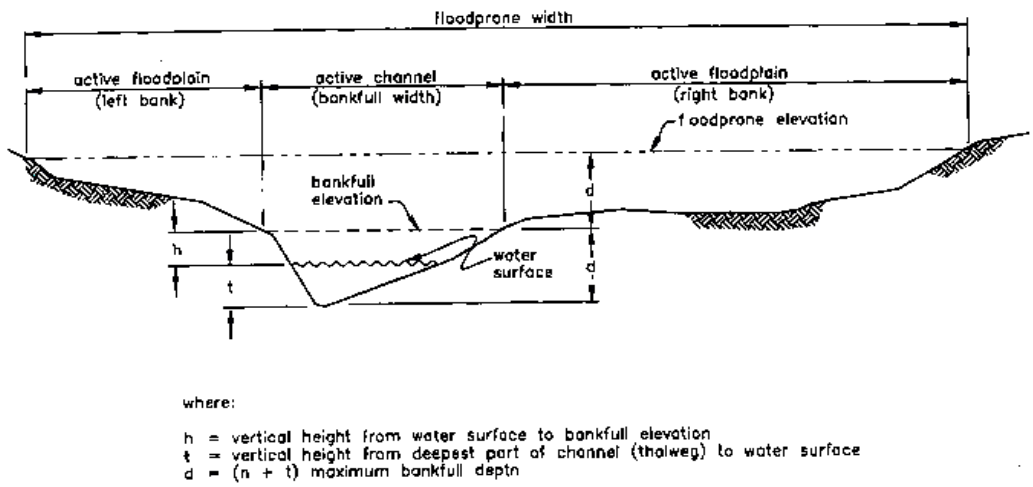

Figure 1. Determination of Active Floodplain Widths (looking downstream)

DEFINITIONS – (Figure I)

Active channel is the stream width at the bankfull discharge. Bankfull discharge is the flow rate that forms and controls the shape and size of the active channel. Bankfull discharge is approximately the flow rate at which the strewn begins to move onto its floodplain if the stream has an active floodplain. The bankfull discharge is expected to occur every 1.5 year on average. Active channel width is determined by asking the landowner how high the water gets every year, by observing the location of permanent vegetation, and other field indicators. The outside edge of the active channel is also as **the Ordinary High Water Mark (OHWM).**

Floodprone width (Rosgen 1994) is a floodplain value based on the size of the active channel. It includes the widths of the active (geomorphic) **floodplain** that would be inundated along each side of a watercourse during a flood event having a recurrence interval of 35 - 50 years.

Floodprone width has 3 components:

1. active channel (bankfull width),
2. active floodplain (left bank), and
3. active floodplain (right bank).

The active floodplain (left and right bank) are usually different widths.

At most sites along a water course, the active floodplain and resulting riparian areas are generally wider on one side of the channel than on the other. To determine the correct combined width for Zone I and Zone 2 for each side of a channel, using simple equipment such as a hand-level and stadia rod, refer to Figure I and do the following (preferably, at low flow):

1. Pick a cross-section where there is some woody vegetation and the channel is straight - usually at the crossover of a meander.

2. Find the elevation where the bankfull flow intersects the bank - usually found along the root-line of the woody vegetation, or where there is an obvious change in bank materials due to scour erosion, or changes in bank slope, etc.

3. Measure the vertical height (h) from the water surface to this line.

4. Measure the deepest part of the channel (t, for thalweg) at this site.

5. Then; the maximum bankfull depth (d) = h + t.

6. Floodprone elevation = elevation at the bankfull line + d.

7. At this height and perpendicular to the channel, find where a level line intersects the ground up-gradient of the streambank - the horizontal distance from the bankfull line to this intersection point is the active floodplain for that side of the channel.

8. For the opposite bank if the bankfull line is not evident, find it by projecting a level line from the near edge of the water to the bank, at elevation h.

NOTE: With the proper surveying equipment, the bankfull line, the intersection of the floodprone elevation, and the active floodplain can be found for the opposite side of the channel without crossing the channel. Although the bankfull (active channel) width is not required for determining the active floodplain width, it should still be recorded.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

391 – RIPARIAN FOREST BUFFER

I. SCOPE

The work shall consist of furnishing and planting trees and/or shrubs at the locations as shown on the drawings or as staked in the field.

Planting will be done to establish or increase the numbers of plants to intercept sediment, nutrients, pesticides, and other materials in surface runoff and to reduce nutrients and other pollutants in shallow subsurface water flow.

The woody vegetation in the buffer provides food and cover for wildlife, helps lower water temperatures by shading the waterbody, and slows out-of-bank flood flows. Additionally the vegetation nearest to the waterbody provides litter fall and large wood important to fish and other aquatic organisms as nutrient and structural components.

II. MATERIALS

Plants and numbers shall be as stated on the Practice Requirements Sheet.

Plants found to be root or pot bound will not be acceptable. Plants shall be vigorous and free of disease, insect pests, eggs, or larvae. Plant materials shall be grown in nurseries which have been inspected by the State Department of Agriculture.

Water shall be free of injurious amounts of oil, salt, acid, alkali, or any other toxic substance.

III. TIME OF PLANTING

The time period for planting shall be as stated on the Practice Requirement Sheet.

Surface soil should be moist, not saturated or dry. Care should be taken to ensure proper spacing.

Plantings will be made after the danger of heavy freezing has passed and soil moisture conditions are proper. Soil moisture conditions may be waived if plants are watered at the time of planting.

IV. TEMPORARY STORAGE OF PLANTING STOCK

Only viable planting stock grown from locally adapted seed shall be planted. Planting stock should be maintained in good condition from the time received until planted. This will include, but is not limited to, unpacking, storage, heeling in, transport to the planting site, and keeping plants protected and moist until and during planting.

- Care for stock before planting shall include:

Bareroot stock:

If seedlings are planted within a few days after they are received, they may be left in the shipping container and stored in a cool, moist environment (preferred temperature of 34-40 degrees F.). Open the container (stock may be tied in bundles and should remain so) and check root moisture and lightly water as needed. Do not stack bundles.

When planting is delayed more than 1 week:

- Store plants in enclosed areas from 34 to 40 degrees F. off the floor.
- If ice is utilized, do not allow contact with the roots.
- Bales of plants should not be stored higher than 3 feet.
- Roots will be facing one way for periodic watering and fungicide treatment. Seedling roots will be kept moist.

Or

- Heel-in beds. Make a trench with one 30 to 45-degree backslope. Remove seedlings from the shipping bundles, line out planting stock against sloped side and backfill. Pack soil firmly around the roots. Keep roots 1 to 2 inches below the ground line. Water as needed. A moderately course-textured soil is preferred.

2. Container Stock: Place in the shade or protected area (preferred temperature of 34-40 degrees F.) and water as needed.

3. Care for seedlings during planting shall include:

a. Bareroot: Keep seedlings covered and moist while planting. Ample water, or a water-saturated material (burlap, sawdust moss, etc.) must be kept in all planting containers to insure the seedlings remain moist.

b. Containerized Stock: Leave seedlings in the planting container until time to be planted. Then take them out of the container just prior to placing them in the planting hole.

V. PLANTING PROCEDURES

The plants shall be planted according to the arrangement as shown on the plans.

Plant seedlings in a vertical position with the root collar approximately one-half inch below the soil surface. Plant seedling roots straight down, not twisted, balled or J-shaped. Lateral roots will be spread to the sides.

Plant in adequately sized, sod-free holes or furrows for proper root development. The planting hole must be deep and wide enough to permit the roots to be spread out as naturally as possible.

After planting, pack the soil firmly around each seedling to eliminate air pockets.

On certain site, all species will be subject to unacceptable damage while on other sites no species may be subject to damage and plant protection may not be necessary.

Protect the plants by controlling rodents, and excluding livestock from original planting. Protect until planting has reached a height where it will not be browsed.

Potential mortality, weed competition, and pest populations may require additional seedlings initially or replanting later.

Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seedlings should preferably be of the same age as the planting seedlings.

VI. SEEDLING PROTECTION

1. COMPETING VEGETATION CONTROL

Physical Removal - Use planting hoe, shovel, brush cutting tool, chemicals, or chain saw to clear competing vegetation in the immediate area (a minimum of 3 feet in all directions) of the seedling.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Mulch - Spread mulch material (paper, plastic, geotextile, etc.) around base of seedlings at least 1.5 feet in all directions from the seedling. Mulch must have good contact with the soil to allow rainfall to percolate through rather than run off. (See Mulching Specification 484 for additional specifications.)

2. BROWSING OR FORAGING ANIMAL CONTROL

Physical Barriers - Erect physical barriers where animals are causing damage to seedlings. Physical barriers include: fences, nets, tubes, sleeves, and budcaps.

a. Material Specifications

- Fencing - (See Fencing #382 for specifications).
- Whole tree nets shall be of 6-15 mil photodegradable polypropylene fine mesh.

- Whole tree protectors shall be:

- Photodegradable polypropylene mesh tubes of 30 - 50 mil, or of spun polyester (Reemay) sleeves, 5 inches in diameter, 2-3 feet in length. The tubes will be fastened to a 24 inch 1x2 stake with 18 inches extending above the ground by one staple or a tie wire. The tubes will be flush with the ground.

- Chicken wire tree protection: Chicken wire with a mesh that does not exceed 1 inch will be shaped to form a cylinder a minimum of 5 inches in diameter and 18 inches high. A minimum of one 24 inch 1x2 stake with 18 inches extending above the ground will be used to support the stake by 2 evenly spaced staples or tie wires. The chicken wire will be flush with the ground. The barrier must be removed when the trunk diameter is within one-half inch of the chicken wire diameter.

Terminal leader protectors shall be of 15 - 50 mil photodegradable polypropylene mesh tubes, or of spun polyester (Reemay) sleeves, 1-3 inches in diameter, cut to length to enclose the leader and

leave 4-8 inches above the end of the leader to allow for growth.

- Budcaps shall be of spun polyester (Reemay) sheets or weatherproof paper cut into 4 by 5 inch rectangular pieces.

b. Method and Placement
- Apply tubes, nets, budcaps, and sleeves directly to seedlings to prevent browse damage.
- Fold budcaps lengthwise and staple around the terminal leader and bud, forming a protective cylinder.
- Staple leader tubes to small branchlets along the leader to prevent loss from wind.
- Secure net tubes with pins of 9 gauge wire, 14 inches long, hooked through the mesh and pressed into the ground.
- Support sleeves and tubes, on small seedlings (plugs and 2-0's), with a 3-4 foot stake (wood or bamboo) driven into soil next to the seedling to keep the seedling upright.

Repellents - Apply chemical repellents to control damage from browsing or foraging animals.

a. Materials
- Use commercially available repellents.

b. Application
- Follow label instructions. Repellents must be applied correctly, or damage to seedlings or injury to the applicator may occur.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Physical Removal -
Animal Pests - Physically remove animal pests causing damage to seedlings (foraging or browsing animals, or rodents) by trapping or hunting. Follow State and local hunting and trapping regulations.

Insect and Disease Pests - Physically remove insect or disease pests by:
- removing the affected branches, leaves or needles by pruning or (See Tree/Shrub Pruning #660 for specifications) by removing the affected individual trees or groups of trees.

Chemical Control - Apply chemical toxicants to control insect or disease pests.

a. Materials

- Use commercially available pesticides.

b. Application

- Properly identifying the pest.

- Apply chemical according to label instructions. - Follow proper container disposal procedures.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Biological Control - Use biological control to achieve protection from pests and to decrease the need for chemical use. Integrate biological control with other pest management practices.

a. Methods
- Introduce disease-causing organisms (i.e., Bacillus thuringiensis).
- Encourage increase of natural enemies through habitat enhancement.
- Introduce natural enemies from other areas.

b. Application
- Identify the causal agent and consult with a pest management specialist to identify disease causing organisms, natural enemies, or habitat requirements of natural enemies, and for treatment specifications.

Habitat Manipulation - Modify site conditions that are favorable to the destructive pests. Use habitat manipulation if the specific treatments do not contradict site limitations or landowner objectives.

a. Methods
- Plant forage species preferred by browsers to reduce browsing of seedlings.
- Plant species not browsed by the pest species
- Eliminate preferred habitat of pest species.

b. Application
- Identify the pest.
- Determine its habitat needs.
- Alter the affected site to discourage continued residence by the pest or to alter the feeding patterns of the pest.

EXCESS HEAT

Artificial Shade - Apply shade cards or collars where moisture is limiting and planting occurs on a south facing slope and if natural shade (debris or stumps) is not available.

a. Material Specifications
- Shade cards and collars shall be made of heavy weatherproof cardboard, wood, Styrofoam or other

suitable material.
- Minimum dimensions of cards shall be 8 inches by 12 inches, collars shall be 3 inches in diameter and 4 inches in height.
- Cards will be held in place by stake (wire or wood) attached to the card or inserted into the card.

b. Application
- Shade cards shall be placed 3 inches from seedling.
- Shade cards shall be placed to the south of seedlings with an east-west orientation.
- The bottom edge of the shade card shall be placed as close to the ground as possible.
- Shade collars shall be placed around the base of the seedling.

DROUGHT

If irrigation water is available irrigate at a rate of 1 gallon per tree soon after planting. (See Irrigation System #441/442/443 and Irrigation Water Management #449 for specifications). Apply supplemental water at the following rates when more than 2 months of the growing season are droughty.

Recommended irrigation rates:
- Establishment year:
  1 gallon per seedling per week.
- Second growing season:
  2 gallons per seedling per week.
- Third growing season:
  4 gallons per seedling per week.

Discontinue watering in the late summer to allow trees and shrubs to harden off. In the late fall, if soil moisture is depleted, a deep watering is beneficial in preventing winter desiccation damage.

VII. BASIS OF ACCEPTANCE

After the trees and/or shrubs have been planted, and after and establishment period of 12 months, an on-site inspection will be conducted to determine if 80% of the plants have survived, and are healthy with signs of good growth.

VIII. OPERATION AND MAINTENANCE

Plants shall be protected from fire, insects, disease, and animals until established.

Replanting will be required when survival is inadequate. Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seedlings should preferably be of the same age as the plantation seedlings.

Control of noxious weeds must be conducted.

Damaging pests will be monitored and controlled.

Competing vegetation will be controlled until the woody plants are established.

Supplemental watering may be desirable to ensure adequate survival.

Periodic applications of nutrients may be needed to maintain plant vigor.

Maintenance

Weed Control: Cultivation, cutting, scalping, placement of geotextile, herbicides or mowing may be used to control competing vegetation adjacent to and in between plants to a diameter of 3 feet for wildland plants. When cultivation is used, the tillage depth must not exceed four inches. The planted area may need to be marked with flagged stakes or lathe to avoid accidental tillage. Continue weed and grass control until unwanted vegetation no longer interferes with seedling growth. Follow specific herbicide instructions on the label and/or recommendations provided by your local Agricultural Commissioner.

Pest Control: Control harmful animals, diseases and insects by using rodent guards, trapping, fencing, removal of habitat or proper use of approved chemicals as appropriate to the identified pest. Pests include cattle, deer, rabbits, grasshoppers, squirrels, mice, gophers, and porcupines, etc.

Physical Barrier Maintenance:

Budcaps and sleeves:
- Inspect the treated area annually to assess need to repair, replace, remove, or adjust physical barriers.

- Budcaps and sleeves may need annual replacement or adjustment until trees grow beyond the reach of grazing or browsing animals.
- Nets and net tubing may require physical removal in areas of heavy shade (generally north slopes greater than 20% slope) to prevent girdling.

Repellants:
- Inspect the treated area annually to assess need to reapply.

Chemical control:
- Inspect the treated area annually to assess need to reapply or adjust treatment.

Biological control:
- Evaluate biological control measures annually for effectiveness and adjust practices as necessary to achieve desired results.

Habitat manipulation:
- Evaluate habitat manipulation measures annually for effectiveness and adjust as necessary to achieve desired results.

Excess Heat:
- Inspect the treated area annually, until seedling establishment is assured, to assess need to repair, replace, remove, or adjust shade cards.

Mortality: Assess mortality 1 year after planting. Consider 80 percent survival after two years to be adequate.

Fire Hazard: Maintain firebreaks, and/or fuelbreaks adjacent to and surrounding the planted area.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
391 – RIPARIAN FOREST BUFFER

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Purpose: __ Lower Water Temperature __ Intercept sediment, nutrients, pesticides, other items

__ Wildlife Habitat __ Other (Specify) _____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS.

1. Design Planting Sketch Attached

2. Practice Specifications 391, _____, _____, _____, _____

3. Soil or suitability group_____

4. Area to be planted: Length _____ Width _____ Acres _____

5. Species Avg Row Spacing Avg Plant Spacing Amount/acre

_____

:_____

_____

_____

Approx. total number per acre: _____

6. Planting Operation:

Planting shall be performed within the period: _____

Planting Method: (circle) Tree Planter Auger Hand Other _____

7. Irrigation: Type _____ (Circle) None Preplant PostPlant

8. Weed and Pest Control _____

_____

9. Establishment Protection:_____

_____

10. Other Management and Maintenance _____

_____

_____

_____

PRACTICE SPECIFICATION PREPRATION:

Prepared By:_____ Date:_____

_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date:_____

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FILTER STRIP

(Ac.)

CODE 393

DEFINITION

A strip or area of herbaceous vegetation situated between cropland, grazingland, or disturbed land (including forestland) and environmentally sensitive areas.

PURPOSE

- To reduce sediment, particulate organics, and sediment adsorbed contaminant loadings in runoff.
- To reduce dissolved contaminant loadings in runoff.
- To serve as Zone 3 of a Riparian Forest Buffer, Practice Standard 391.
- To reduce sediment, particulate organics, and sediment adsorbed contaminant loadings in surface irrigation tailwater.
- To restore, create or enhance herbaceous habitat for wildlife and beneficial insects.
- To maintain or enhance watershed functions and values.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies:

(1) in areas situated below cropland, grazing land, or disturbed land (including forest land)

(2) where sediment, particulate matter and/or dissolved contaminants may leave these areas and are entering environmentally sensitive areas;

(3) in areas where permanent vegetative establishment is needed to enhance wildlife and beneficial insects, or maintain or enhance watershed function.

This practice applies when planned as part of a conservation management system.

CRITERIA

General Criteria Applicable to All Purposes

Filter strips shall be designated as vegetated areas to treat runoff and are not part of the adjacent cropland rotation.

Overland flow entering the filter strip shall be primarily sheet flow. Concentrated flow shall be dispersed.

State listed noxious weeds will not be established in the filter strip and will be controlled if present.

Filter strip establishment shall comply with local, state and federal regulations.

Additional criteria to reduce sediment, particulate organics and sediment-adsorbed contaminant loadings in runoff

Filter strip flow length shall be determined based on field slope percent and length, and filter strip slope percent, erosion rate, amount and particle size distribution of sediment delivered to the filter strip, density and height of the filter strip vegetation, and runoff volume associated with erosion producing events. The minimum flow length for this purpose shall be 20 feet.

Filter strip location requirements:

- The filter strip shall be located along the downslope edge of a field or disturbed area. To the extent practical it shall be placed on the approximate contour. Variation in placement on the contour should not exceed a 0.5% longitudinal (perpendicular to the flow length) gradient.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide.

- The drainage area above the filter strip shall have greater than 1% but less than 10% slopes.
- The ratio of the drainage area to the filter strip area shall be less than 70:1 in regions with RUSLE-R factor values 0-35, 60:1 in regions with RUSLE-R factor values 35-175, and 50:1 in regions with RUSLE-R factor values of more than 175.
- The average annual sheet and rill erosion rate above the filter strip shall be less than 10 tons per acre per year

The filter strip shall be established to permanent herbaceous vegetation consisting of a single species or a mixture of grasses, legumes and/or other forbs adapted to the soil, climate, and nutrients, chemicals, and practices used in the current management system. Species selected shall have stiff stems and a high stem density near the ground surface. Stem density shall be such that the stem spacing does not exceed 1 inch.

Additional Criteria to Reduce Dissolved Contaminants in Runoff

The criteria given in "Additional criteria to reduce sediment, particulate organics and sediment adsorbed contaminant loadings in runoff" also apply to this purpose.

Filter strip flow length required to reduce dissolved contaminants in runoff shall be based on management objectives, contaminants of concern, and the volume of runoff from the filter strip's drainage area compared with the filter strip's area and infiltration capacity.

The flow length determined for this purpose shall be in addition to the flow length determined for reducing sediment, particulate organics and sediment-adsorbed contaminant loadings in runoff.

The minimum flow length for this purpose shall be 30 feet.

Additional Criteria to Serve as Zone 3 of a Riparian Forest Buffer, Practice Code 391

Except for the location requirements, the criteria given in **"Additional criteria to reduce sediment, particulate organics and sediment adsorbed contaminant loadings in runoff"** also apply to this purpose.

If concentrated flows entering Zone 3 are greater than the filter strip's ability to disperse them, other means of dispersal, such as spreading devices, must be incorporated.

Additional Criteria to Reduce Sediment, Particulate Organics and Sediment-adsorbed Contaminant Loadings in Surface Irrigation Tailwater

Filter strip vegetation may be a small grain or other suitable annual with a plant spacing that does not exceed 4 inches.

Filter strips shall be established early enough prior to the irrigation season so that the vegetation can withstand sediment deposition from the first irrigation.

The flow length shall be based on management objectives.

Additional Criteria to Restore, Create or Enhance Herbaceous Habitat for Wildlife and Beneficial Insects

If this purpose is intended in combination with one or more of the previous purposes, then the minimum criteria for the previous purpose(s) must be met.

Additional filter strip flow length devoted to this purpose must be added to the length required for the other purpose(s).

Any addition to the flow length for wildlife or beneficial insects shall be added to the downhill slope of the filter strip.

Vegetation to enhance wildlife may be added to that portion of the filter strip devoted to other purposes to the extent they do not detract from its primary functions.

Plant species selected for this purpose shall be for permanent vegetation adapted to the wildlife or beneficial insect population(s) targeted.

If this is the only purpose, filter strip width and length shall be based on requirements of the targeted wildlife or insects. Density of the vegetative stand established for this purpose shall consider targeted wildlife habitat requirements and encourage plant diversity. Dispersed woody vegetation may be used to

the extent it does not interfere with herbaceous vegetative growth, or operation and maintenance of the filter strip.

The filter strip shall not be mowed during the nesting season of the target wildlife.

Livestock and vehicular traffic in the filter strip shall be excluded during the nesting season of the target species.

Additional Criteria to Maintain or Enhance Watershed Functions and Values

Filter strips shall be strategically located to enhance connectivity of corridors and non-cultivated patches of vegetation within the watershed.

Filter strips shall be strategically located to enhance aesthetics of the watershed.

Plant species selected for this purpose shall be for establishment of permanent vegetation.

CONSIDERATIONS

Filter strips should be strategically located to reduce runoff, and increase infiltration and ground water recharge throughout the watershed.

Filter strips for the single purposes of wildlife/beneficial insect habitat or to enhance watershed function should be strategically located to intercept contaminants thereby enhancing air and water quality.

To avoid damage to the filter strip consider using vegetation that is somewhat tolerant to herbicides used in the up-slope crop rotation.

Increasing the width of the filter strip will increase the potential for capturing particulates.

Consider using this practice to enhance the conservation of declining species of wildlife, including those that are threatened or endangered.

Consider using this practice to protect National Register listed or eligible (significant) archaeological and traditional cultural properties from potential damaging contaminants.

Filter strip size should be adjusted to a greater flow length to accommodate harvest and maintenance equipment.

Select grass species that sequester more carbon.

Increasing the width of filter strip will increase the potential for carbon sequestration.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Based on this standard, plans and specifications shall be prepared for each specific field site where a filter strip will be installed. A plan includes information about the location, construction sequence, vegetation establishment, and management and maintenance requirements.

Specifications shall include:

a) Length, width, and slope of the filter strip to accomplish the planned purpose (length refers to flow length across the filter strip).

b) Species selection and seeding or sprigging rates to accomplish the planned purpose

c) Planting dates, care and handling of the seed to ensure that planted materials have an acceptable rate of survival

d) A statement that only viable, high quality and regionally adapted seed will be used

e) Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants, permanent filter strip vegetative plantings should be harvested as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially state-listed noxious weeds.

Prescribed burning may be used to manage and maintain the filter strip when an approved burn plan has been developed.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the filter strip.

To maintain or restore the filter strip's function, periodically regrade the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function, and then reestablish the filter strip vegetation, if needed. If wildlife habitat is a purpose, destruction of vegetation within the portion of the strip devoted to that purpose should be minimized by regrading only to the extent needed to remove sediment and fill concentrated flow areas.

Grazing shall not be permitted in the filter strip unless a controlled grazing system is being implemented. Grazing will be permitted under a controlled grazing system only when soil moisture conditions support livestock traffic without excessive compaction.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SPRINKLER

(No. and Ac.)

CODE 442

DEFINITION

An irrigation system in which all necessary equipment and facilities are installed for efficiently applying water by means of nozzles operated under pressure.

PURPOSE

This practice may be applied as part of a conservation management system to achieve one or more of the following:

- Efficiently and uniformly apply irrigation water to maintain adequate soil water for the desired level of plant growth and production without causing excessive water loss, erosion, or water quality impairment.
- Climate control and/or modification.
- Applying chemicals, nutrients, and/or waste water.
- Leaching for control or reclamation of saline or sodic soils.
- Reduction in particulate matter emissions to improve air quality.

CONDITIONS WHERE PRACTICE APPLIES

The sprinkler method of water application is suited to most crops, irrigable lands, and climatic conditions where irrigated agriculture is feasible. Areas must be suitable for irrigation or sprinkler water application and have an adequate supply of suitable quality water available for the intended purpose(s).

This standard applies to the planning and design of the overall water application through sprinkler discharge systems. This standard pertains to the planning and functional design of all sprinkler components except for special structures, such as permanently installed main and lateral pipelines or pumping plants. Other components shall meet appropriate NRCS Conservation Practice Standards.

This standard does not include criteria for mini- or micro-sprinkler systems, which are covered by NRCS Conservation Practice Standard 441 – Irrigation System, Microirrigation.

CRITERIA

General Criteria Applicable to All Purposes

The criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering principles.

Each sprinkler discharge system must be designed as an integral part of an overall plan of conservation land use and treatment for the intended purpose(s) based on the capabilities of the land and the needs of the operator. The selected system shall be based on a site evaluation, expected operating conditions and verification that soils and topography are suitable for the intended purpose(s).

Depth of Application. Net depth of application shall meet criteria for the intended purpose, not exceeding the available soil water holding capacity and meeting the land user's management plan for the intended purpose.

Capacity. The sprinkler irrigation system shall be designed with adequate capacity to accomplish the primary purpose(s) of the system.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

Design Application Rate. Rates shall be selected such that runoff, translocation, and unplanned deep percolation are minimized.

Additional conservation measures, such as furrow diking, dammer diking, in-furrow chiseling, conservation tillage or residue management shall be applied as needed and appropriate.

Distribution Patterns, Nozzle Spacing, and Height. A combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution shall be selected.

Coefficient of Uniformity (CU) data or distribution uniformity (DU) shall be used in selecting sprinkler spacing, nozzle size, and operating pressure. Definitions of each of these uniformity values can be found in the NRCS National Engineering Handbook, Part 652, Irrigation Guide, http://www.wcc.nrcs.usda.gov/nrcsirrig/irrig-handbooks-part652.html.

Pipelines. The design of main lines, submains, and supply lines shall insure that required water quantities can be conveyed to all operating lateral lines at required pressures. For detailed criteria, see NRCS Conservation Practice Standard 430 – Irrigation Pipeline.

Pump and Power Unit. Where required, pump and power units shall be adequate to efficiently operate the sprinkler system at design capacity and total dynamic head. For detailed criteria, see NRCS Conservation Practice Standard 533 – Pumping Plant.

Management Plan. An Irrigation Water Management plan, meeting NRCS Conservation Practice Standard 449 – Irrigation Water Management, shall be developed for this practice, unless the purpose of the practice is waste water application. Where implemented for waste application, as a component of a Comprehensive Nutrient Management Plan (CNMP), a waste utilization plan and/or nutrient management plan shall be developed that meets the requirements of NRCS Conservation Practice Standard 633 – Waste Utilization and 590 - Nutrient Management, as appropriate.

Additional Criteria Applicable to Center Pivot or Linear-Move Sprinkler Systems

Design Capacity. Sprinkler systems shall be designed to have the capacity to meet the primary purpose. For the purpose of crop irrigation, sprinkler irrigation systems shall have either (1) a design capacity adequate to meet peak water demands of all irrigated crops in the design area, or (2) adequate capacity to meet requirements of selected irrigations during critical crop growth periods when less than full irrigation is planned.

In computing capacity requirements, allowance must be made for reasonable application water losses.

Distribution Patterns, Nozzle Spacing, and Height. Pivot system (Heermann-Hein) or Linear (Christensen) CU shall not be less than 85% (76% DU), except as noted in criteria for a Low Energy Precision Application (LEPA) system. In lieu of the manufacturer's CU information, simulation modeling shall use Agricultural Research Service model Center Pivot Evaluation and Design (CPED) or similar modeling software. Manufacturer's information on nozzle packaging, allowing exclusion of the end gun and the first 12 percent of pivot length, not to exceed 250 feet, shall be considered acceptable documentation of system CU.

In the absence of CU data, sprinkler performance tables provided by the manufacturer shall be used in selecting nozzle size, operating pressure, and wetted diameter for the required sprinkler discharge. To the extent possible, low pressure spray nozzles shall be at uniform heights along the length of the lateral, with the exception of height adjustment to increase wetted diameter for runoff control. From a point midway between the first and second tower to the distal end of a center pivot, spray nozzle spacing along lateral lines shall not exceed 25% of the effective wetted diameter and impact sprinkler spacing shall not exceed 50 percent of the effective wetted diameter. The effective wetted

diameter shall be determined from manufacturer's information for the nozzle height.

Lower elevation nozzle application systems, typically less than 7 feet from ground surface, that discharge water in the crop canopy for a considerable length of time during the growing season shall also meet the criteria of a Low Pressure in Canopy (LPIC) system as defined in this standard.

Additional Criteria Applicable to LEPA and Low Elevation Spray Application (LESA) Center Pivot or Linear-Move Sprinkler Systems

Distribution Patterns. For center pivot systems, nozzle discharge CU using the Heermann-Hein weighted area method shall be used in selecting sprinkler spacing, nozzle size, and operating pressure. Nozzle discharge CU shall not be less than 94% of the calculated design flow rate needed at the discharge point. For linear systems, discharge shall be based on equivalent unit areas.

Nozzle Spacing. Nozzle spacing shall not be greater than two times the row spacing of the crop, not to exceed 80 inches.

Specific Additional Criteria for LEPA

Discharge Height. Water shall discharge through a drag sock or hose on the ground surface, or through a nozzle equipped with a bubble shield or pad at a uniform height not to exceed 18 inches.

Row Arrangement and Storage. LEPA systems are only applicable on crops planted with furrows or beds. LEPA systems shall have row patterns that match the lateral line movement (i.e., circular for center pivots). Water shall not be applied in the tower wheel track of a LEPA system. Runoff and translocation under LEPA systems shall be eliminated by providing surface basin storage such as furrow dikes, dammer dikes, or implanted reservoirs.

Slope. The slope for a LEPA system shall not exceed 1.0 percent on more than 50 percent of the field.

Systems that utilize bubble pads or shields, or drag hoses for a portion of the crop year and then spray nozzles at uniform height not exceeding 18 inches for a portion of the crop year shall meet LESA criteria.

Specific Additional Criteria for LESA

Discharge Height. LESA Systems shall discharge water through a spray nozzle at uniform heights not to exceed 18 inches.

Row Arrangement and Storage. LESA Systems are applicable on crops flat planted, drilled, or planted with furrows or beds. LESA Systems should employ some method of providing surface basin storage such as furrow dikes, dammer dikes, or implanted reservoirs, or farming practices such as conservation tillage, in-furrow chiseling, and/or residue management to prevent runoff.

Land Slope. The slope for LESA systems shall not exceed 3.0 percent on more than 50 percent of the field.

Additional Criteria Applicable to LPIC and Mid Elevation Spray Application (MESA) Center Pivot or Linear-Move Sprinkler Systems

Systems that utilize bubble pads or shields or drag hoses for a portion of the crop year and spray nozzles for a portion of the crop year not meeting all of the LEPA or LESA criteria shall meet LPIC criteria.

Distribution Patterns, Nozzle Spacing and Height. For row crops, when nozzles operate in canopy for 50 percent or more of the growing season, nozzle spacing shall not exceed every other crop row. In-canopy heights shall be such that areas of high leaf concentration are avoided (i.e., corn near the ear height (approximately 4 feet)). Local research and Extension Service information with applicable crops may serve as a guide for establishing appropriate nozzle spacing, height, and row arrangement.

CU (Heermann–Hein CU for center pivots) shall not be less than 90% for all LPIC and MESA Systems with nozzle heights less than 7 feet.

CU shall not be less than 85% (76% DU) for MESA Systems with nozzle heights 7 feet or greater.

Land Slope. The slope for LPIC and MESA systems shall not exceed 3.0 percent on more than 50 percent of the field for fine textured soils and not exceed 5 percent on more than 50 percent of the field on coarse textured soils.

Additional Criteria Applicable to Fixed-Solid-set, Big Gun and Periodic Move Sprinkler Systems

Design Capacity. Sprinkler irrigation systems shall have either (1) a design capacity adequate to meet peak water demands of all crops to be irrigated in the design area, or (2) adequate capacity to meet requirements of selected water applications during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, allowance must be made for reasonable application water losses.

Design Application Rate. The design application rate shall be within a range established by the minimum practical application rate under local climatic conditions, and the maximum application rate consistent with soil intake rate, slope, and conservation practices used on the land. If two or more sets of conditions exist in the design area, the lowest maximum application rate for areas of significant size shall apply.

Lateral Lines. Unless pressure reducers or regulators are installed at each outlet, or other pressure compensating or flow control devices are used, lateral lines shall be designed so that the pressure variation or flow variation at any sprinkler, resulting from friction head and elevation differential, does not exceed 20 percent of the design operating pressure or 10 percent of the design flow of the sprinklers, respectively.

Distribution Patterns and Spacing. A combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution shall be selected.

If available, CU (or DU) data shall be used in selecting sprinkler spacing, nozzle size, and operating pressure. CU shall not be less than the following:

75 % (60% DU) for deep-rooted (4 feet or more) field and forage crops where fertilizers and pesticides are not applied through the system.

85 % (76% DU) for high-value or shallow-rooted crops and for any crop where fertilizer or pesticides are applied through the system.

In the absence of CU data, maximum lateral and nozzle spacing shall comply with the following criteria:

1. For low (2-35 pounds/square inch (psi))-, moderate (36-50 psi)-, and medium (51-75 psi)-pressure sprinkler nozzles, the spacing along lateral lines shall not exceed 50 percent of the wetted diameter, as given in the manufacturer's performance tables, when the sprinkler is operating at design pressure. The spacing of laterals along the main line shall not exceed 65 percent of this wetted diameter.

   If winds that can affect the distribution pattern are likely during critical crop growth periods, spacing should be reduced to 60 percent for average velocities of 1 to 5 miles per hour (mph), to 50 percent for average velocities of 6 to 10 mph, and to 45 percent for average velocities greater than 10 mph.

2. For high-pressure and big gun type sprinklers (>75 psi), the maximum distance (diagonal) between two sprinklers on adjacent lateral lines shall not exceed two-thirds of the wetted diameter under favorable operating conditions

   If winds that can affect the distribution pattern are likely during critical crop growth periods, the diagonal spacing should be reduced to 50 percent of the wetted diameter for average velocities of 5 to 10 mph and to 30 percent for average velocities greater than 10 mph. Guidance for towpath spacing of travelers in Table

11-31 of NEH-15, Irrigation, Chapter 11, Sprinklers.

3. Sprinkler spacing requirements for orchards, including subtropical fruits:

a) Triangular pattern. The spacing along lateral lines shall not exceed 65 percent of the effective wetted diameter. The spacing of laterals along the main line shall not exceed 70 percent of the effective wetted diameter.

b) Square or rectangular pattern. The nozzle spacing along the lateral and the lateral spacing along the main line shall not exceed 65 percent of the effective wetted diameter at the design operating pressure.

c) Spacing between sprinklers and lateral lines shall be reduced by 2.5 percent for each mph over 3 mph average wind velocity normally occurring during planned hours of operation.

Risers. Except for under-tree operation, riser pipes used on lateral lines shall be high enough to prevent interference with the distribution pattern when the tallest crop is irrigated. Riser heights shall not be less than shown below:

Sprinkler discharge *(gallons/minute)*	Riser length *(inches)*
Less than 10	6
10-25	9
25-50	12
50-120	18
More than 120	36

Risers over 3 feet in height shall be anchored and stabilized.

Additional Criteria Applicable to Traveling Sprinkler Irrigation Systems

The towpath spacing shall follow the recommendations in Table 11-31, National Engineering Handbook (NEH) Section 15, Irrigation, Chapter 11, Sprinkler Irrigation.

Additional Criteria Applicable to Climate Control and/or Modification

Design Capacity. For temperature control, the sprinkler irrigation system shall have sufficient capacity to satisfy the evaporative demand on a minute-by-minute basis throughout the peak use period. NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for temperature control.

For frost protection, the system shall be capable of applying the necessary rate, based on the minimum temperature, maximum anticipated wind speed, and relative humidity, in a uniform manner. The capacity shall be sufficient to supply the demand for the entire crop being protected. NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for frost protection.

Additional Criteria Applicable to Chemical, Nutrient and/or Waste Water Application

The installation and operation of a sprinkler irrigation system for the purpose of chemical or nutrient application (chemigation) shall comply with all federal, state, and local laws, rules and regulations. This includes backflow and anti-siphon prevention measures. Additionally, surface waters shall also be protected from direct application.

Injectors (chemical, fertilizer, or pesticides) and other automatic operating equipment shall be located adjacent to the pump and power unit and installed in accordance with state regulations, or lacking the same, in accordance with manufacturer's recommendation. The chemical injection device shall be within 1 percent of maximum injection rates and easily calibrated and adjustable for all chemicals at the required injection rate.

Sprinkler irrigation systems used to apply waste shall be designed with sprinkler nozzles of sufficient size to prevent clogging. Treatment of the wastewater using solid separators, two stage lagoons, two-stage waste holding ponds, etc., may be needed to reduce percent solids.

Design Application Rate and Timing. Application rates shall meet the levels specified in General Criteria. Timing of chemical applications shall be the minimum length of time it takes to deliver the chemicals and flush the pipelines at rates specified by the label.

Coefficient of Uniformity. If available, CU (or DU) data shall be used in selecting sprinkler spacing, nozzle size, and operating pressure. The CU shall not be less than 70% for wastewater and not less than 85% (76% DU) for chemigation or fertigation. If CU data is not available, distribution patterns and spacing requirements shall be in keeping with the appropriate specific criteria of this standard.

Nutrient and Pest Management. Chemicals, fertilizers, and liquid manure shall be applied in accordance with appropriate NRCS Practice Standards: 590 – Nutrient Management, 595 – Pest Management, 633 – Waste Utilization and 634 – Manure Transfer. Chemical or nutrient application amounts shall not exceed these standards.

NEH, Part 623, Chapter 2 contains guidance on using sprinkler irrigation systems for chemigation.

Additional Criteria Applicable to Leaching

Design Application Rate and Depth. Application rates shall meet the levels specified in General Criteria. Design depth shall be determined as defined in NRCS, National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements.

Management or Reclamation Plan. A plan shall be developed conforming to the requirements contained in NRCS Practice Standard 610 – Salinity and Sodic Soil Management.

Additional Criteria Applicable to Reduction in Particulate Matter Emissions to Improve Air Quality

These criteria pertains to sprinkler systems used to improve air quality by controlling dust emissions from confined animal pen areas and other critical areas such as unpaved roads, staging areas, and equipment storage yards.

Installation of fixed solid set sprinklers or periodic move sprinkler systems for dust control shall conform to the criteria stated above, unless described by criteria in this section. The installation and operation of Sprinkler Systems for dust control on confined animal pen areas shall provide application coverage on the majority of pen areas occupied by livestock, except for feed bunk aprons. The quality of discharge water shall be pathogen free and fit for animal consumption.

Capacity and Application Rate. For dust control, the sprinkler irrigation system shall have sufficient capacity and operational flexibility to apply the design application depth every three days or less. When determining capacity requirements, allowance shall be made for reasonable water losses during application.

The minimum design application rate shall meet the maximum total daily wet soil evaporation rate, with allowances for moisture input to pen areas from animal manure and urine.

Open-lot management practices shall be applied that include scraping and removal of manure in pens between occupations, and shaping of the holding areas to prevent water ponding and chronic wet areas.

Over-application and excessive sprinkler overlap shall be avoided to minimize runoff and reduce odor and fly problems.

Water Amendments. Appropriately labeled chemicals for pest control or dust suppression may be applied through the sprinkler system when designed, installed, and operated with appropriate backflow prevention and anti-siphon devices. When chemicals are applied through the sprinkler system, surface waters and livestock watering facilities shall be protected from direct application unless chemical labels indicate that direct application will not negatively impact animal health or water quality.

Distribution Patterns and Spacing. A combination of sprinkler spacing, nozzle size, and operating pressure that provides the design application rate and distribution pattern shall be selected.

Maximum spacing of sprinklers along laterals shall not be greater than 75 percent, and no closer than 50 percent of wetted diameter listed in manufacturer's performance tables. Spacing between lateral shall comply with the following criteria:

1. For medium (51-75 psi)-pressure sprinkler nozzles, the spacing of laterals along the main line shall be no more than 90 percent, and no closer than 70 percent of wetted diameter.

2. For high-pressure sprinklers (>75 psi), the maximum distance between two sprinklers on adjacent lateral lines shall not exceed 100% of wetted diameter.

If winds impact distribution patterns during critical dust emission periods, the system shall be equipped with timer overrides and have the flexibility to be operated manually during periods of lesser wind, such as late evening and early morning.

Risers. Riser pipes used in lateral lines shall be high enough to minimize interference with the distribution pattern. The risers shall be constructed in a manner that provides protection from corrosive soils, equipment damage, and livestock damage. Riser heights shall place the discharge sprinkler not less than 6 feet above ground surface. Risers shall be anchored and stabilized.

System Valves and Controllers. Due to high application rates inherent with large sprinkler nozzle diameters, an automatic irrigation control system shall be utilized for all nozzles greater than 0.5-inch diameter. The automated control system shall utilize electro-hydraulic valves facilitating automatic operation. The valves shall be of a size and quality consistent with standard engineering practice. The operating system shall provide the flexibility to change sprinkling duration in one-minute increments and have a minimum of six start times per-day to provide for adjustment for climate conditions.

Systems shall be equipped with a rain sensor connected to the control valve network set to prohibit system operation during rainfall events.

Manual zone isolation valves shall be incorporated to isolate laterals allowing partial system operation during periods of maintenance and repair.

In areas of uneven or sloping terrain a control valve or low-head drainage device shall be incorporated at each sprinkler to ensure that line drainage to the lowest sprinkler is minimized.

CONSIDERATIONS

When planning this practice the following items should be considered, where applicable:

Application rates near the end of a center pivot may exceed soil intake rate. Light, frequent applications can reduce runoff problems, but may increase soil surface evaporation. Nozzle offsets or booms can be used to reduce peak application rates.

For low suspended nozzle application systems, row arrangement, nozzle spacing, discharge nozzle type and configuration, along with height all impact CU. System design and field management should complement each other to yield the highest CU. In general, circular rows for center pivot systems and straight rows for linear move systems provide higher CU's.

Some aspects of non-uniformity tend to average out throughout the irrigation season while others tend to accumulate. Factors that tend to average out during the irrigation season are climatic conditions and uneven travel speed for systems that start and stop. Factors that tend to accumulate during the irrigation season are nozzle discharge variances due to pressure or elevation differences, surface movement of water, and poor water distribution around field boundaries.

Consider the effects of a center pivot end gun operation on CU. A large end gun may reduce the average CU by 1 percent for each 1 percent of the area covered past the main system hardware.

Consider the on and off effects of center pivot corner arm units and end guns on overall sprinkler performance. Discharges reduce flow in the main tower, significantly lowering the CU.

Beneficial effects of conservation practices applied to limit surface redistribution of water and runoff may diminish over the irrigation season.

The velocity of prevailing winds and the timing of occurrence should be considered when planning a sprinkler system. Systems designed to operate in varied time increments aid in balancing the effects of day and night wind patterns.

Consider filtering or screening the irrigation water before it enters the system if it contains particulate matter, algae, or other material that could plug the sprinkler nozzles.

Drop tubes should be installed alternately on both sides of the mainline and when used in-crop they should have a flexible joint between the gooseneck pipes and the application device. Drops should be weighted or secured in windy areas.

Consider different sprinkler application depths and application rates with hand move and center pivot systems. With hand move systems, the application rates more nearly match the soil infiltration rate so that large irrigations can be applied and the number of hand moves reduced. With an automated system, such as a center pivot, hand labor is not a major consideration and small applications at high rates are normal.

Fertilizer and chemical application amounts may vary from prior application methods and rates, due to precise applications possible with some sprinkler irrigation systems.

Management of sprinkler irrigation systems normally include utilizing soil water stored in the root zone, especially during critical crop growth stages.

Deflection of spans on center pivots and linear-move systems is common when the lateral is loaded (filled with water). This should be considered when determining nozzle heights. Wheel track depth will also affect nozzle height.

Water distribution is greatly affected by nozzle spacing and height for LPIC and MESA systems. In general, smaller, more closely spaced nozzles will yield a higher uniformity than larger, more widely spaced nozzles.

On center pivot or linear move systems, nozzles should be diverted away from wheel tracks to avoid rutting.

Low pressure systems (35 psi or less) are sensitive to small changes in nozzle pressure. Consider using pressure regulators on all low pressure systems where elevation differences, pumping depth variations, and end gun or corner arm operation can significantly change nozzle discharge and sprinkler uniformity. Also consider installing a pressure gauge at both ends of the sprinkler system to monitor system pressure.

Consider system effects on the water budget, especially the volume and rate of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Consider system effects on erosion and movement of sediment, and soluble and sediment-attached substances carried by runoff.

Consider system effects on soil salinity, soil water or downstream water quality including subsurface drains. Crops may be more sensitive to salts applied to plant foliage during sprinkling than to similar water salinities applied by surface irrigation, subirrigation, and microirrigation. Information on foliar injury from saline water applied by sprinkler irrigation is contained in NEH, Part 623, Chapter 2. If the salt content of the irrigation water is high, other irrigation methods should be considered.

Where wastewater is used for irrigation, timing of irrigation based on prevailing winds should be considered to reduce odor. In areas of high visibility, irrigating at night should be considered. The use of wastewater may reduce the life of the system due to corrosion or abrasion.

When utilized for particulate matter reduction, check to assure adequate animal feeding operation water supplies are available to meet other operating needs, during sprinkler system operation.

Irregularly shaped pen areas that are impractical to treat with a sprinkler system and where potential dust sources may occur should be treated for dust control with tanker water trucks equipped with hoses, or nozzles designed to apply water at rates similar to an equivalent sprinkler system.

Open-feedlot management practices that minimize thickness of loose manure will reduce water demands for dust control, as well as, reduce wet areas and ponding that could increase ammonia emissions.

Cultural Resources

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http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

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PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation sprinkler systems shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan must provide specific instructions for operating and maintaining the system to insure that it functions properly. It should also provide information regarding periodic inspections and prompt repair or replacement of damaged components. The plan, at minimum, shall include provisions to address the following:

- Periodic checks and removal of debris and sediment as necessary from nozzles to assure proper operation.
- Inspection or testing of all pipeline and pumping plant components and appurtenances, as applicable.
- Regular testing of pressures and flow rates to assure proper operation.
- Periodic checks of all nozzles and spray heads for proper operation and wear.

- Routine maintenance of all mechanical components in accordance with the manufacturer's recommendations.
- Prior to retrofitting any electrically powered irrigation equipment, electrical service must be disconnected and the absence of stray electrical current verified.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

442 - IRRIGATON SYSTEM, SPRINKLER

I. SCOPE

The work will consist of furnishing and installing materials as required to provide a complete sprinkler irrigation system for the tract of land as shown on the drawings. A water measuring device will be required.

II. SOURCE OF WATER

The source of water shall be as shown on the drawings, and as previously determined by the landowner. Water rights for the use of the water are the responsibility of the landowner. The source shall provide the full capacity as may be needed for the system being installed.

III. INSTALLATION

The materials shall be fabricated in accordance with the manufacturer's instructions. The system shall be tested to determine if the system is in proper working order, and will deliver the required capacity to meet the crop consumptive use, and the specified uniformity distribution rate.

IV. BASIS OF ACCEPTANCE

The basis of acceptance shall be the ability of the system to deliver the required amount of water to meet the peak consumptive use of the crop, with a distribution uniformity rate of 80% or greater.

V. OPERATION AND MAINTENANCE ITEMS

A properly operated and maintained sprinkler irrigation system is an asset to your farm. This irrigation system was designed and installed to apply irrigation water to meet the needs of the crops without causing erosion or runoff. The estimated life span of this installation is at least 10 years. The life of this system can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic maintenance and may also require operational items to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

Operate the system according to the design parameters for the area.

Only operate the system when needed to furnish water for plant growth, the soil may also be used to store moisture within the rooting depth of the plant.

Operate the system at the pressure discharge rate, duration, and frequency as designed.

Periodically check the sprinkler heads for wear, and replace when defective or excessive wear is found with proper parts.

Monitor the crop noting areas of moisture stress and repair or adjust system operation.

Promptly repair all leaks, by replacing gaskets or worn parts.

During non-seasonal use place the system in an area where it will not be damaged but secure, if necessary.

Maintain all pumps, agitators, piping, valves and other electrical and mechanical equipment in good operating condition following the manufacturers' recommendations

Do not allow livestock near equipment or in area during operation.

Immediately repair any vandalism, vehicular or livestock damage.

Other items specific to your project are listed on the "Practice Requirement" sheet.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
442 - IRRIGATION SYSTEM, SPRINKLER

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications_____,_____,_____

3. Distribution Uniformity Rate (DU)_____

4. Special Requirements:_____

_____

_____

_____

_____

_____

_____

5. Special Maintenance Requirements:_____

_____

_____

PRACTICE APPROVAL:

Job Classification: (Ref: Section 501 NEM)

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Area Benefited _____	_____ac
_____	_____
_____	_____
_____	_____

Design Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the construction drawings and specification, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

LAND RECLAMATION
TOXIC DISCHARGE CONTROL

(No.)

CODE 455

DEFINITION

Control of acid or otherwise toxic aqueous discharge from abandoned coal mines or coal-mine waste.

PURPOSE

To improve water quality, eliminate unsightly residues, reduce erosion, and restore areas to beneficial use.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to locations where acid or toxic drainage is degrading water quality and the environment in and adjacent to streams, lakes, reservoirs, or wetlands.

CRITERIA

There are four primary methods for controlling toxic mine drainage: (1) mine sealing, (2) infiltration control, (3) “daylighting,” and (4) neutralization and precipitation.

Mine sealing. This method is usually used to reduce the amount of water entering or to promote inundation by water of underground mine workings to reduce or prevent oxidation of pyritic materials.

In the locations where air and surface water enter underground mines, the measures used for Shaft and Adit Closing (452) can be used. Other practices such as diversions or drains can be used to keep water from entrances. Reducing the amount of water entering the mine may solve the problem.

In the inundation process, physical barriers are constructed in the mine opening to control the escape of water. Sealing mines to reduce acid mine drainage by constructing wet seals at the mouths of mine portal drain ways provide air locks while allowing water to discharge. These seals must be designed to withstand maximum expected hydrostatic heads and be constructed of suitable materials such as masonry, concrete, grouted limestone, or clay.

Infiltration control. This method is designed to reduce the amount of water entering toxic surface materials. Strip mine overburden and deep mine refuse can be reshaped for better surface drainage and blanketed with compacted, slowly permeable soil materials to deter infiltration. Diversions, underground outlets, lined waterways, and grade stabilization structures can be used to control surface runoff or divert clean upslope runoff. All surfaces should be left with positive grades. Blanketing with pulverized limestone before revegetating may increase the pH of the infiltrate. Surface soils shall be amended as necessary to promote a healthy root environment for planned vegetation.

Another method of infiltration control is designed to prevent or reduce surface water from entering deep mines. This condition usually occurs where the bedrock has been fractured due to underground mining, allowing stream flow directly into deep mine workings. Two methods frequently used to control this type of infiltration are grouting of the streambed and piping the stream through the affected area.

Daylighting. This practice consists of surface

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

mining the existing underground coal, selectively placing toxic materials, regrading and vegetating the area, and diverting water to natural drainage ways. This method may work on surface mines if deeper coal seams are present that can be economically mined.

Neutralization and Precipitation. One method of treating acidic mine drainage is the chemical addition of alkaline material. By selecting the proper alkaline agent, many metal cations can be removed during neutralization as insoluble hydroxides. Several alkaline materials are available, such as hydrated lime (CaOH), caustic soda (NaOH), and limestone. A properly sized settling basin shall be provided to allow for the precipitation of metals. Chemical treatment is the least desirable measure for long term treatment of acidic water because of the long-term nature of the action and the excessive operation and maintenance costs involved.

Passive treatment is the most frequently used longterm method for treating acidic mine drainage. Vertical flow wetlands and anoxic limestone drains are two commonly used passive systems to neutralize acidity and provide collection of precipitated metals. Both of these systems use long term contact with high calcium carbonate limestone. The type of system used is based on the chemistry of the raw mine water. The size of each component within the treatment system is based on the design flow rate.

Alkaline discharges can usually be treated by providing adequate detention time to precipitate contaminating metals.

CONSIDERATIONS

1. Mine water quality and flow rates.
2. Geologic environment of the immediate area, including characteristics of overburden such as lithology, faults, joints and attitude.
3. Surface and subsurface hydrologic conditions.
4. Mining history.
5. Land use.
6. Post mining history and conditions.
7. Soils investigation.
8. Topography.
9. Spatial and stratigraphic location of pyrites and other sulfides
10. Availability of high quality limestone or other alkaline material.
11. Availability of blanketing materials.
12. Use of water.

Cultural Resources

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Endangered Species

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PLANS AND SPECIFICATIONS

Plans and specifications for toxic discharge control shall be in keeping with this standard

and shall describe the requirements for applying the practice to achieve its intended purpose. As a minimum, the following shall be included:

- Layout of the planned treatment system showing location of all practices.
- Specific alkaline agent to be used for neutralization.
- Details for handling, disposal/utilization of precipitated metals.

OPERATION AND MAINTENANCE

A specific operation and maintenance plan shall be developed for each long term treatment system. The plan will outline the flushing sequence to allow removal of accumulated metals and inert material.

A monitoring plan shall be developed to assess the efficiency and performance of the treatment system. It is recommended that water samples be taken monthly for one year after the system is in operation and quarterly thereafter. Flow rates at all measuring points shall be recorded when samples are collected.

Accumulated precipitate shall be removed from the treatment system components when capacity is reduced by one half.

REFERENCES

Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation. "The Science of Acid Mine Drainage and Passive Treatment." 1999.

Kepler, D. A., and E. C. McCleary. 1994. Successive alkalinity-producing systems (SAPS) for the treatment of acidic mine drainage. pp 195-204 *in* Volume 1 of Proceedings of the International Land Reclamation and Mine Drainage Conference and the Third International Conference on the Abatement of Acidic Drainage, Pittsburgh, PA, April 24 – 29, 1994.

Skovran, G. A. and C. R. Clouser. 1998. Design Considerations and Construction Techniques for Successive Alkalinity Producing Systems. pp 235 – 242 *in* Proceedings of the American Society for Surface Mining and Reclamation Annual Conference, St. Louis, MO, May 17 – 21, 1998.

Pennsylvania's Efforts to Address Operation, Maintenance and Replacement of AMD Passive Treatment Systems. Milavec, P.A. and D.R. Seibert. Proceedings from National Association of Abandoned Mine Land Programs Conference in Park City, UT, Sept. 15-18, 2002.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

POND SEALING OR LINING
COMPACTED CLAY TREATMENT

(No.)

CODE 521D

DEFINITION

A liner for a pond or waste storage impoundment constructed using compacted soil without soil amendments.

PURPOSE

To reduce seepage losses from ponds or waste storage impoundments constructed for water conservation and environmental protection.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Soils at the site would exhibit seepage rates in excess of acceptable limits or would allow an unacceptable migration of contaminants from the impoundment.
- An adequate quantity of soil suitable for constructing a clay liner without amendments is available at an economical haul distance.

Dispersive clay soils are not suitable soils to use for compacted clay treatment liners.

CRITERIA

Criteria for Limiting Seepage

Compacted soil liners for ponds not storing animal waste shall be designed to reduce seepage to rates that will allow the pond to function suitably as intended.

Compacted soil liners for waste storage impoundments shall be designed to reduce specific discharge (unit seepage) to rates suggested in the National Engineering Handbook Series, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D or rates mandated in state regulations if they are more restrictive. Other, lower specific discharge rates may be used for design at the discretion of the Designer.

The AWMFH, Chapter 10, Appendix 10D provides methods for computing unit seepage rates and includes recommended allowable rates of seepage. Other generally accepted methods for computing unit seepage rates may also be used.

Other Criteria

Compacted soil liners shall be filter-compatible with the sub-grade on which they are compacted to prevent loss of the liner soil into larger openings in the sub-grade material. The National Engineering Handbook, Part 633, Chapter 26-Gradation Design of Sand and Gravel Filters, provides guidance on filter compatibility.

Liner Thickness. The minimum thickness of the finished compacted liner shall be:

1. that required to achieve a specific discharge (unit seepage) design value selected by the designer, For ponds storing materials presenting high risk to groundwater such as animal waste water and salinity tailwater, the design unit seepage shall be 1×10^{-6} $cm^3/cm^2/s$, or
2. that required by state regulations, or
3. that given in the following table for ponds storing low risk materials, such as fresh water. The water depth to be used in the table is the normal full pool storage depth in the impoundment.

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Water Depth (feet)	Liner Thickness (inches)
≤ 16	12
16.1 – 24	18
> 24	24

Liner Protection. The soil liner shall be protected against damage caused by the effects of water surface fluctuations, wave action, rainfall during periods when the liner is exposed, water falling onto the liner from pipe outlets, agitation equipment, solids and sludge removal activity, animal activity, and penetrations through the liner.

Design should include measures to protect against damage to the compacted liner if a seasonal high water table occurs at a level above that of the lowest potential level of liquid in the impoundment. Perimeter drains to lower the water table, maintaining minimum liquid depth in the impoundment, and using liners thick enough to resist uplift water pressures are examples of protective design measures.

The finished liner should be protected against the effects of desiccation during periods when the pond or impoundment is empty. A protective soil cover may be used. For severe conditions, a protective soil cover may not adequately protect the liner from desiccation. Severe conditions include liners constructed with very high plasticity soils that are exposed to long periods of hot, low humidity conditions. Designs including a geomembrane in conjunction with a cover soil may be considered for severe conditions to protect the liner from desiccation adequately.

Side Slopes. The side slopes of ponds or waste storage impoundments should be 3H: 1V or flatter to facilitate compaction of soil on the slopes if the bathtub method of construction as described in Appendix 10D, AWMFH, is used. Slopes as steep as 2H: 1V may be used if the stair-step method of construction as described in Appendix 10D to the AWMFH is used for constructing the liner.

CONSIDERATIONS

Consider using a flexible membrane liner for sites that have water or waste storage depths greater than 24 feet.

Alternatives to compacted clay liners should be considered for poor foundation conditions such as karstic bedrock.

Flattening the slopes of ponds or waste impoundments to facilitate compactive efforts during construction should be considered.

Maintenance requirements should be considered when selecting side slopes.

Cultural Resources Considerations

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Endangered Species Considerations

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PLANS AND SPECIFICATIONS

Plans and specifications for compacted soil liners for ponds and waste storage impoundments shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall include such drawings, specifications, material requirements, quantities, construction requirements, equipment requirements, quality control requirements, and other documents as are necessary to describe the work to be done.

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage to the compacted soil liner. This includes, but is not limited to; excluding animals and equipment from the treated area; repairing damage to the liner occurring from erosion during initial filling; erosion resulting from wave action after the impoundment fills, and erosion caused by agitation, pumping operations, and activities involved in removal of solids and sludge. Damage that might be caused by roots from trees and large shrubs should be prevented by removing such vegetation. If the liner is damaged, any disturbed or eroded areas should be repaired to restore the liner to its original thickness and condition.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

521 D – POND SEALING OR LINING COMPACTED CLAY TREATMENT

1. SCOPE

The work shall consist of the construction of the clay liner as shown on the construction plans.

2. MATERIALS

Soils used in clay liner construction shall have a minimum plasticity index (PI) of 16 and a maximum PI of 40 as tested by Atterberg Limit tests (ASTM D-4318). The soils shall have a minimum of 20 percent passing the number 200 sieve and a maximum of 10 percent passing the number 4 sieve.

Clay materials shall be free of organic material, debris, sod, brush, roots, frozen soil, or other deleterious materials. Rock particles larger than 2 inches shall be removed prior to compaction of the clay.

If dry conditions are found at the borrow site, clay materials may have dried into large clods which can be difficult to reduce in size and add moisture. High-speed rotary pulverizers may be required if the conditions are especially unfavorable.

3. FOUNDATION PREPARATION

Foundation surfaces shall be graded to remove surface irregularities and shall be scarified or otherwise acceptably scored or loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the clay liner, and the surface materials of the foundation shall be compacted and bonded with the first layer of the clay liner as specified for subsequent layers of clay liner.

Work shall be suspended when the site is overly wet, muddy or otherwise unsuitable for construction.

4. PLACEMENT

The clay liner shall not be placed until the required foundation preparation has been completed and the foundation has been inspected and approved by the Engineer. The clay liner shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the clay liner.

The clay liner shall be placed in lifts. The thickness of each lift before compaction shall not exceed the smaller of 6 inches or the length of the teeth of the sheepsfoot compactor used.

The distribution of materials throughout the clay liner shall be essentially uniform, and the clay liner shall be free from voids, lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

The surface of each layer shall be scarified to a depth of not less than 2 inches before the next layer is placed.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of the clay liner, the moisture content of the clay being placed shall be maintained above optimum moisture as determined by the Standard Proctor Test (ASTM D-698).

The application of water to the clay shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the clay after placement and before compaction of the liner, if necessary. Uniform moisture distribution shall be obtained by disking.

After each layer has been placed, spread and moisture conditioned, the layer shall be compacted by passing compaction

equipment over the entire surface of the layer a sufficient number of times to obtain the required density.

Prior to placement of subsequent lifts, the previous lift shall be thoroughly scarified to a depth of 2 inches to provide good bonding between lifts.

Desiccation and crusting of the soil liner lift surface shall be avoided as much as possible. Cracked areas and swelling, heaving or other similar conditions shall be replaced or reworked to remove such defects.

6. COMPACTION

The clay liner shall be compacted to a minimum of 95 percent of Standard Proctor dry density (ASTM D-698), at a moisture content above optimum moisture as specified on the Practice Requirements Sheet.

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE LINER

Clay placed at densities lower than the specified minimum density or at moisture contents lower than optimum moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the specifications or removed and replaced by acceptable clay. The replacement clay and the foundation and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control, and compaction.

8. TESTING AND DOCUMENTATION REQUIREMENTS

Liner construction shall be tested and documented as specified below. Copies of the documentation report, including test locations and test results, shall be provided to the owner.

Field and laboratory soil tests shall be completed on the clay liner, by a third party engineering firm retained by the contractor, to document compliance with this specification. Testing shall be completed as the liner is being placed. The following tests shall be completed at the specified frequency.

Standard proctor test (ASTM D-698) 1 per 5,000 cubic yards of clay liner

Field density tests (ASTM D-2922, or 1 test per 100-foot grid per 1-foot thickness D2937, or of clay liner D2167, or D1556)

Atterberg Limit tests (ASTM D-4318) 1 per 1,500 cubic yards of clay liner

Grain size distribution (ASTM D-422) 1 per 1,500 cubic yards of clay liner

All test holes shall be backfilled using powdered bentonite mixed with clay soil used in liner construction and compacted by hand tamping. The clay shall be broken down into clods less than ½ inch in diameter. A minimum of 25 percent of the backfilled test hole volume shall be occupied by powdered bentonite after backfilling.

IX. CONSTRUCTION OPERATIONS

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The owner, operator, Contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

The completed job shall be workmanlike and present a good appearance.

X. OPERATION AND MAINTENANCE

A properly operated and maintained pond is an asset to your farm. This pond sealing was designed and installed to limit the seepage loss from the pond. The estimated life span of this system is at least 10 years. The life of this system can be assured and usually increased by

developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

Repairing damage to the liner occurring from erosion during initial filling.

Repair erosion resulting from wave action after the impoundment fills, and erosion caused by agitation, pumping operations, and activities involved in removal of solids and sludge.

Damage that might be caused by roots from trees and large shrubs should be prevented by removing such vegetation.

If the liner is damaged, any disturbed or eroded areas should be repaired to restore the liner to its original thickness and condition.

Maintain any soil coverings at the construction depth.

Limit the use or travel of any equipment in the area, which was sealed.

Prevent all livestock from using any area of the pond that was sealed by compacted clay treatment.

If fences are installed, they shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

Immediately remove any debris that may harm or reduce the effectiveness of the seal.

Other items specific to your project are listed on the "Practice Requirement" sheet.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
521D - POND SEALING OR LINING
COMPACTED CLAY TREATMENT

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications_____,_____,_____

3. Liner Thickness_____

4. Compaction: 95 Percent of Standard Proctor Percent of Optimum Moisture Content Optimum to +3

5. Special Requirements:_____

_____

_____

_____

_____

_____

_____

6. Special Maintenance Requirements:_____

_____

_____

NRCS, CA
August 2006

PRACTICE APPROVAL:

Job Classification: (Ref: Section 501 NEM)

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Area Treated _____	_____acres
Head on lining _____	_____feet
_____	_____
_____	_____

Design Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the construction drawings and specification, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

521D – POND SEALING OR LINING

COMPACTED CLAY TREATMENT

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained pond lining or sealing is an asset to the farm. This system was designed and installed to reduce seepage in a pond. The estimated life span of this installation is at least 15 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program:

GENERAL RECOMMENDATIONS

- Maintain the soil covering on liners at the construction depth.
- Limit the use or travel of any equipment in the area that was sealed. Avoid excessive speeds and sharp turns.
- Prevent all livestock from using any area of the pond which was sealed by artificial liners.
- Fences shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Immediately remove any debris that may harm or reduce the effectiveness of sealants.
- Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, or outlets or other apparatuses.

SPECIFIC RECOMMENDATIONS FOR YOUR POND LINING OR SEALING PROJECT

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE FOR YOUR POND LINING OR SEALING PROJECT.

NRCS, CA
August 2006

STATEMENT OF WORK
Pond Sealing or Lining (521D)
Compacted Clay Treatment

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM part 503-Safety, Section 503.00 through 503.22)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Hydrogeology
        ii. Type of Liner
        iii. Application Rate and/or Liner Thickness
        iv. Liner Protection
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Design Report and Inspection Plan as appropriate (NEM Part 511, Subpart B Documentation, 511.11 and Part 512, Subpart D Quality Assurance Activities, 512.30 through 512.32).
4. Operation and maintenance plan
5. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b)(2))
6. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client and contractor
2. Verification that client has obtained required permits
3. Staking and layout according to plans and specifications including applicable layout notes
4. Installation inspection
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
7. Certification that the installation process and materials meets design and permit requirements

CHECK OUT

Deliverables

1. As-built documentation
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03(c)(1))
3. Progress reporting

STATEMENT OF WORK
Pond Sealing or Lining (521D)
Compacted Clay Treatment

REFERENCES

- Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard, Pond Sealing or Lining – Compacted Clay Treatment 521D.
- National Engineering Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

AMENDMENTS FOR TREATMENT OF AGRICULTURAL WASTE

(AU)

CODE 591

DEFINITION

Treatment of manure, process wastewater, storm water runoff from lots or other high intensity areas, and other wastes, with chemical or biological additives

PURPOSE

To alter the physical and/or chemical characteristics of the waste stream to facilitate the implementation of a waste management system to:

- Improve or protect air quality
- Improve or protect water quality
- Improve or protect animal health
- Alter the consistency of the waste stream to facilitate implementation of a waste management system

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where the use of a chemical or biological amendment will alter the physical and chemical characteristics of the waste stream as a part of a planned waste management system. This practice does not include amendments added to the animal feed.

CRITERIA

General Criteria Applicable To All Purposes

Laws, Rules and Regulations. Use of amendments as a part of a waste management system shall be planned and implemented to meet all Federal, state, and local laws, rules, and regulations.

Labeling and Instructions for Use. Products to be used as manure amendments shall be labeled or accompanied by instructions containing the following information as a minimum:

- Active ingredients and their percentage of the whole. Proprietary terminology may be used as long as the actual chemical and/or biological names are included.
- The purpose(s) for which the amendment is intended.
- Recommended application rate(s) to achieve the intended purpose(s).
- Application timing and methodology to optimize the effectiveness of the amendment.
- Incorporation requirements (if any).
- Special handling and storage requirements for the amendment.
- Any safety concerns relating to the use of the amendment and recommended measures to overcome the safety concern, including any required personal protective equipment.

Validation of Product. The species-specific rate, timing and application methodology of an amendment to achieve a needed level of treatment addressing a specific purpose must be documented by a university or other independent research entity acceptable to the NRCS. Documentation from peer reviewed journals is preferable. The effectiveness of the amendment under different climatic factors shall be included in the documentation, or if there are no difference in effectiveness, the documentation shall so state. Potential adverse impacts of the amendment on the ecosystem shall also be identified in the documentation. It shall be the responsibility of

the amendment provider to furnish the documentation to the NRCS.

CONSIDERATIONS

The use of an amendment may alter the composition of the waste stream. The use of amendments should be limited to situations where impacts of the altered waste stream on other aspects of the planned system have been identified.

Some amendments have been shown to affect multiple purposes of this standard and other aspects of a livestock production operation. Preference should be given to amendments with the greatest environmental and economic benefit.

The use of amendments to reduce ammonia and other emissions from manure in confined spaces may allow altered ventilation strategies at an appreciable energy savings. The reduction of ammonia emissions will also increase the proportion of nitrogen in the manure.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s). Specifications for the use of an individual amendment will be developed in accordance with the label directions and other instructions provided by the vendor. As a minimum, the plans and specifications shall provide the following:

- The name of the amendment, the purpose(s) for its use, and the planned outcome(s).
- Application methodology, including rates, timing, mixing instructions, temperature requirements, etc.
- Required tests to determine the effectiveness of the amendment as appropriate.

OPERATION AND MAINTENANCE

A site-specific operation and maintenance (O&M) plan shall be developed and reviewed with the operator and owner prior to implementation of the practice. The O&M plan shall be consistent with the purposes of the practice, safety considerations, and label directions and other instructions provided by the vendor.

The O&M plan shall provide sufficient detail as to amendments to be used, application rates and timing, and equipment to be used.

The O&M plan shall detail all safety precautions necessary when handling the specific chemicals or biological amendments to be used.

The O&M plan shall provide for record keeping in sufficient detail to describe the amendment's use, actual application rates and timing, and any tests performed (including nutrient analysis).

Field Office Technical Guide

USDA NRCS
Field Office Technical Guide, Section IV

A Practice Specification has not been prepared. Specifications and design details will be prepared upon request of the Area Engineer or State Conservation Engineer.

General Resources References - Reference List

STATEMENT OF WORK
Amendments For Treatment Of Agricultural Waste (591)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Type and amount
        ii. Method of application and Frequency
        iii. Environmental Considerations
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits...
3. Operation and Maintenance Plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03 (a) (3)).
5. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
    a. Actual materials used (Part 512, Subchapter D Quality Assurance Activities, 512.33)
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the application process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. As-Built documentation.
    a. Extent of practice units applied
    b. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03 (c) (1)).
3. Progress reporting.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Amendments For Treatment Of Agricultural Waste, 591
- NRCS National Engineering Manual (NEM).
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SALINITY AND SODIC SOIL MANAGEMENT

(Ac.)

CODE 610

DEFINITION

Management of land, water, and plants to control and minimize accumulations of salts and/or sodium on the soil surface and in the crop rooting zone.

PURPOSE

- To reduce and control harmful salt concentrations in the root zone.
- To reduce problems of crusting, permeability, or soil structure on sodium affected soils.
- To promote desired plant growth and to utilize excess water in the root zone in non-irrigated saline seep areas and their recharge areas.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where the concentration or toxicity of salt limits the growth of desirable plants or where excess sodium causes crusting and permeability problems. This practice also applies to non-irrigated land where a combination of factors such as topography, soils, geology, precipitation, vegetation, land use, and cultural/structural practices can increase the extent and concentration of salts in saline seep areas.

CRITERIA

General Criteria Applicable to All Purposes

All work, including associated practices for management of drainage and runoff, shall comply with Federal, State, and local laws and regulations.

Type and rate of application of soil amendments shall be based on the chemistry of both the soil water and irrigation water (where applicable) regarding concentrations and types of salts and/or sodium, sodium adsorption ratio (SAR or RNa), exchangeable sodium percentage (ESP), concentration and types of salts, and pH.

Improve surface and subsurface drainage as needed to reduce localized ponding and or high water tables.

Additional Criteria to Reduce Salt Concentrations in the Root Zone

On irrigated lands, leaching requirements shall be determined as presented in National Engineering Handbook Part 623, Chapter 2.

On non-irrigated land, reclamation shall utilize vegetative methods, soil amendments, and/or enhanced drainage to effect a reduction in soil salinity.

Additional Criteria to Reduce Problems of Crusting, Permeability, or Soil Structure on Sodium-affected Soils.

Apply soil amendments containing soluble calcium, or that cause calcium in the soil to become available.

Additional Criteria Specific to Saline Seeps and Their Recharge Areas

Plant and/or maintain adapted high water use vegetation in recharge areas to utilize soil water.

CONSIDERATIONS

Soil salinity levels can be monitored to minimize the effects of salinity on crops and to evaluate management practices.

Tools such as electromagnetic induction (EMI) and salinity probes are appropriate for evaluating and for monitoring soil salinity levels.

The drainage water from this practice may have high levels of salts. Select an outlet or disposal area that will minimize the effects of this saline water.

Removal of salts from the root zone by leaching operations may increase contamination of water tables. Avoid excessive leaching and schedule leaching operations during seasons when potential contaminants in the soil profile, such as nitrogen, are low.

For irrigated conditions, an irrigation water management plan should minimize non-point pollution of surface and groundwater resources.

Chiseling and subsoiling can improve permeability, root penetration, and aeration where water movement is restricted by layered soils. Avoid inversion tillage that can bring salinity to the surface and interrupt the leaching process.

Green manure crops or applications of organic matter can improve soil structure and permeability.

Polyacrylamides may improve effectiveness of leaching and reclamation of some soils.

Applications of gypsum, sulfur, or calcium will help in displacing sodium from the root zone.

Water of slight to moderate salinity not dominated by sodium can enhance leaching of salts.

Residue management can improve the organic matter content of the soil, improve infiltration, and minimize surface evaporation and capillary rise of salts to the soil surface.

Consider selecting crops with tolerance to salinity/ sodium levels in the soil.

Consider using bedding and planting methods designed to reduce salinity near plant root zone, especially for germinating seeds.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the Criteria,

Considerations, and Operation and Maintenance described in this standard. Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

No operation and maintenance requirements, national in scope, have been identified for this practice.

REFERENCES

Ayers, R.S., and D.W. Westcot, 1994. FAO Irrigation and Drainage Paper 29 Rev. 1, Water Quality For Agriculture. http://www.fao.org/DOCREP/003/T0234E/T0234E00.HTM

ASCE, 1990. Agricultural Salinity Assessment and Management, ASCE Manuals and Reports on Engineering Practice No. 71, New York, NY.

California Fertilizer Association. 1998. Water and plant growth. p. 21-66. *In* Western Fertilizer Handbook. Interstate Publishers, Inc., Danville, Illinois.

Rhoades, J.D., and J. Loveday. 1990. Salinity in Irrigated Agriculture. p. 1089-1142. *In* B.A. Stewart and D.R. Nielsen (ed.) Irrigation of Agricultural Crops. Agron. Monogr. 30. ASA, CSSA and SSSA, Madison, WI.

USDA, Soil Conservation Service. 1993. National Engineering Handbook (NEH), Part 623, Chapter 2- Irrigation Water Requirements. Washington, D.C. http://www.info.usda.gov/CED/ftp/CED/neh15-02.pdf#search=%22NEH%20part%20623%2C%20chapter2%22

USDA. 1954. Diagnosis and Improvement of Saline and Alkali Soils. Agriculture Handbook No. 60. Washington, DC. http://www.ars.usda.gov/SP2UserFiles/Place/53102000/hb60_pdf/hb60intro.pdf#search=%22Diagnosis%20and%20Improvement%20of%20Saline%20and%20Alkali%20Soils.%20%20Agriculture%20Handbook%20No.%2060.%20%20%22

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

610A – SALINITY AND SODIC SOILS MANAGEMENT

IRRIGATED LANDS

I. SCOPE

The work shall consist of providing water and amendments to leach the salt concentration in the soil.

II. GENERAL

The estimated quantity of water required for the initial leaching job, and to assure sufficient supply may be determined as a general rule - for each foot of soil to be leached:

a. 6 inches of irrigation water is required to leach out 50 percent of the salt

b. 12 inches of irrigation water is required to leach out 80 percent of the salt, and

c. 24 inches of irrigation water is required to leach out 90 percent of the salt.

For sodic soils, add such soil amendments as gypsum, sulfur, lime sulfur solution, sulfuric acid, iron sulfate, aluminum sulfate, or limestone at a rate based on laboratory analysis. Refer to Table 6, page 49, of USDA, Agricultural Handbook 60, for amounts of gypsum land sulfur required to replace indicated amounts of exchangeable sodium.

High sodium soils may require 4 to 5 tons/acre of gypsum, or 4 tons/acre of lime if the soil pH is low. Incorporate low soluble amendment into the topsoil before leaching is started. Some amendments can be dissolved and applied in irrigation water during the leaching period.

If necessary, provide subsurface drainage so that water will move downward and out of the soil profile.

Take periodic soil and water tests to determine the level or salinity. The required level in reached when the electrical conductivity of a saturation extract or soil paste is at the level required for satisfactory plant growth of the desired crop.

III. PONDING METHOD

Level land as needed for uniform ponding and surface control and perform deep tillage.

Construct dikes or borders on a contour to obtain uniform ponding. Dikes may be constructed by any convenient method.

Temporary water control structures are generally required to control depth of water in ponds. These structures may be wooden, metal, or concrete. Plastic lined spillways may be used in lieu of the above structures.

Alternate wetting and drying may be more efficient than continuous wetting on some soils.

IV. SPRINKLER METHOD

Sprinkling ordinarily provides better water control than ponding, giving adequate salt reduction with less water and allows for more uniform leaching especially when deep tillage is performed.

Design sprinkler system in the same manner as sprinkler system for irrigation.

The coefficient of uniformity (CU) should be 80 or greater. The more uniform the water is applied the better the leaching will be.

The application rates should be less than field intake rates in order to avoid ponding. Where intake rate is a problem, intermittent sprinkling may be desirable, especially on finer textured soils.

More water shall be applied than evaporates. Evaporation rates are greater in the daytime. Therefore, it may be advantageous to use sprinklers at night, especially on fine textured soils where the application rate may be almost the same as evaporation rates.

V. MAINTENANCE

Sufficient water must be infiltrated during the irrigation season to avoid new concentration of salts in the root zone.

Avoid tillage when soil is wet and any other tillage that compacts the soil. Ripping, subsoiling and plowing when dry leaving the field rough will be helpful in getting water into the soil, but should not be used as a substitute for proper leveling, contour bordering, or other practices needed for irrigation water management.

Maintain soil tilth and productivity by using good management practices that include conservation cropping system, drainage improvement, proper water use, subsoiling, crop residue use, cover cropping, green manure and mulching. These are important practices that will help keep a soil free from salt.

Subsequent to the leaching operation, the soil may be quite sterile and devoid of organic matter and needed nutrients. A good practice is to plant a green manure crop as the first or even second crop and plow in to build up organic content and improve the tilth of the soil. Animal manure and/or commercial fertilizer are usually needed to replace nitrogen that is usually lost with the leachate.

In the event the leaching process was not complete, for some reason stopped short of completeness, consideration should be given to planting a salt tolerant crop, as a cash crop, for the first season following leaching. This will provide for further natural leaching, during the growing of the cash crop and will provide the operation with some income during this period.

VI. OTHER REQUIREMENTS

The owner, operator, contractor, and other persons shall conduct all work and operations in accordance with proper safety codes for the type of equipment and operations being performed with due regard to the safety of all persons and their property.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
610A – SALINITY AND SODIC SOIL MANAGEMENT

IRRIGATED LANDS

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications____610A_____,_____,_____

3. Soil Amendments and Rate of Application: _____

4. Desired Soil Salinity: _____

5. Special Requirements:_____

_____

_____

_____

_____

_____

_____

_____

NRCS, CA

August 2006

PRACTICE APPROVAL:

Job Classification:

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Area benefited_____	_____ac.
_____	_____
_____	_____
_____	_____

Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

STATEMENT OF WORK
SALINITY AND SODIC SOIL MANAGEMENT (610)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
2. Practice purpose(s) as identified in the conservation plan.
3. List of required permits to be obtained by the client.
4. Practice standard criteria-related inventories and analyses to develop a soil salinity management plan
5. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
6. Certifications that the design meets practice standard criteria and comply with applicable laws and regulations
7. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre-application conference with client
2. Verification that client has obtained required permits
3. Application assistance
4. Facilitate and implement required management plan modifications with client and original designer
5. Certification that the application process meets the management plan and permit requirements
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations, and NRCS policies during installation.
7. Certification that the application process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. Records of application
    a. Extent of practice units applied
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Salinity and Sodic Soil Management - 610
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

TREE/SHRUB ESTABLISHMENT

(Ac.)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE

To establish woody plants for forest products, wildlife habitat, long-term erosion control and improvement of water quality, treat waste, increase carbon storage in biomass and soils, renewable energy production, energy conservation, and enhance aesthetics.

CONDITIONS WHERE PRACTICE APPLIES

On any area where woody plants can be grown.

CRITERIA

General Criteria Applicable to All Purposes

Species will be adapted to site conditions and suitable for the planned purpose(s).

Planting or seeding rates will be adequate to accomplish the planned purpose.

Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.

Only viable, high-quality and adapted planting stock or seed will be used.

Site preparation shall be sufficient for establishment and growth of selected species.

Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Timing and use of planting equipment will be appropriate for the conditions.

The acceptability and timing of coppice regeneration shall be based on species, age, and diameter.

The planting will be protected from unacceptable adverse impacts from pests, wildlife, livestock damage, or fire.

Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth.

Use locally adapted seed, seedlings or cuttings. Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials will meet a minimum standard, such as the American Nursery and Landscape Association, Forest Service, or state-approved nursery.

Tree and shrub plantings will be designed so that they do not impact the safe operation of electric and gas line transmission corridors.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Additional Criteria for Improving or Restoring Natural Diversity

Species selected will be indigenous to the site and will reflect species composition of the desired stands.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

For optimal carbon sequestration, select plants that have higher rates of sequestration in

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

biomass and soils and are adapted to the site to assure strong health and vigor. Plant the appropriate stocking rate for the site.

When using trees and shrubs for greenhouse gas reductions, prediction of carbon sequestration rates shall be made using current, approved carbon sequestration modeling technology.

CONSIDERATIONS

Transmission Requirements.

Clients must be asked to review their land rights documents to determine if there are transmission land rights for a specific parcel where the planting is to be accomplished.

a. Electric Transmission Guidelines

If there are no restrictive easements, plantings will not be accomplished within the following distances from the edge of the transmission line:

Voltage	Distance
70 kv or less:	
Trees which will grow to more than 25 feet in height will not be planted under lines.	
70 kv or less	25 feet
For trees which will grow to more than 25 feet in height.	
115 kv	35 feet
230 kv	50 feet
500 kv	60 feet

b. Underground gas line clearance:

If there are no restrictive easements, plantings will not be accomplished within 20 feet of the center line of the transmission line.

When inter or reinforcement planting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Where multiple species are available to accomplish the planned objective, consideration should be given to selecting species which best meet wildlife needs.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Residual chemical carryover should be evaluated prior to planting.

Species considered locally invasive or noxious should not be used.

Species used to treat waste should have fast growth characteristics, extensive root systems, capable of high nutrient uptake, and may produce wood/fiber products in short rotations.

Prescribed burning may be required for natural regeneration of serotinous cone species and for site preparation for other species.

Planting can be done either by machine or by hand. Machine planting will be limited by small areas, steep topography, windfalls, rock outcrop and heavy brush or slash accumulation. Hand planting is adaptable to all areas. Any equipment that can create a suitable planting cavity can be used, e.g., shovel, auger, planting bar.

The location for each planted seedling should take advantage of every moisture conserving and heat-protecting factor available, such as: shade provided from stumps, logs, surface rocks, clods, hummocks, etc.

When selecting species, consideration should be given to esthetic values for recreation areas and borders along through fares or any other public access sites or viewscapes.

Spacing for beatification, recreation and restoration plantings will vary depending on objectives, and site conditions.

Temporary or permanent irrigation may be necessary on some areas and for some species.

When irrigation is planned, have the systems in place prior to planting. To increase survival, irrigate after planting to aid in packing the soil

around the seed or roots and assure enough water to begin growth.

Rooting hormones and fertilizers have not significantly improved success compared to the cost of the materials.

Potential mortality, weed competition, and pest populations may require additional seedlings initially or replanting later.

All sites and all plant species may be subject to unacceptable damages due to browsing, grazing, vandalism or other human impacts. Protection may be required to hold damages to an acceptable level. Planning will include preparing estimates of the occurrence of animal populations, which have the potential of causing damage. Sightings of gopher mounds, animal trails, beaver activity, frequency of scat, and evidence of browsing on native plants will yield data that can help determine the need for plant protection. In urban areas use of signs and/or barriers may be required to reduce damage to an acceptable level.

Harsher sites (warmer, drier) may require additional actions to ensure adequate survival. These actions include the installation of shade cards and/or mulch.

Seedling Selection:

Use published seed zone maps. Use materials from the same seed zone in which the planting is to be done.

Tree stock can generally be 1-0, if it is over 8" and vigorous. However, the harsher the site the more important for 2-0, 2-1, 1-2 stock.

On sites infected with root rots or blue stain reforest the infected area (and 100 feet beyond visibly affected trees or stumps) with species that are immune or resistant and adapted to the site. Areas will be clearly marked to aid planting crews.

White pine blister rust: When white pines are planted no more than 80% will be white pine blister rust resistant.

Additional Criteria For:

Pole Plantings/Cuttings:

When used in highly erodible areas some method of protection should be placed in front of the pole plantings/cuttings. The toe can be very susceptible to erosive flows and scour. If rock is used to stabilize the area careful application is required. Improperly placed rock can result in erosion problems on the opposite bank and downstream.

Give careful attention to both the upstream and downstream ends of the treatment area to ensure flows do not get behind the treatment. Try to divert flows away from the endpoints by tying into existing features such as trees, rocks, etc. or consider utilizing brush or other suitable revetments.

Forest land:

Planting Dates:

Planting should be made as early possible when soil moisture conditions are sufficient. Fall (November) planting is acceptable provided adequate soil moisture is present at planting time. Avoid fall planting in areas subject to frost heaving. Areas with limited access due to substantial amounts of snow will be later than lower elevation plantings.

Sierra Nevada: Suitable planting dates generally range from December to late April.

Coast Range: December through March

South of the Tehachapi Range: December through March.

Siskiyous: February to April

Trees per Acre:

Coast Redwood Region: 300 to 360 trees per acre

Remainder of Northern California:

Option A. Standard Approach. Planting is dense. This, generally, requires a pre-commercial thinning of residual trees 15 to 30 years after planting.

Option A: 436 to 681 trees per acre.

Option B. High Management Approach (for Class 1 and 2, 3 soils only). Number of trees planted is significantly less and requires:

a. Review the fall fallowing the year of planting. Must be 80% or more survival. If not must be reinforcement planted to bring up to 80% survival the following spring.

b. Planned treatment to control competing vegetation 12 to 36 months after planting and a follow-up 5 years after the first treatment

c. Anticipate pruning the lower limbs to reduce loss by fire and to improve quality when stems are 3 to 7 inches in diameter.

Option B: Trees to be planted: 260 or more trees per acre.

Or

All Areas: Stocking meeting the California Forest Practice Rules – Resource Conservation Standards for Minimum Stocking.

Southern California (Southern Region):

Site Class I, II, III (Meyer): 222 - 302 trees per acre

This may require a pre-commercial thinning of residual trees 15 to 30 years after planting.

Site Class IV, V, VI, VII (Meyer): 170 – 222 trees per acre

Requires:

a. Review the fall following the year of planting. Must be 80% or more survival. If not must be reinforcement planted to bring up to 80% survival the following spring.

b. Planned treatment to control competing vegetation 12 to 36 months after planting and a follow-up 5 years after the first treatment

c. Anticipate pruning the lower limbs to reduce loss by fire and to improve quality when stems are 3 to 7 inches in diameter.

All plantings to utilize mats or approved mulch material. Shade cards may be needed on South and Southwest facing slopes.

Fuel break Planting. Between 200 and 225 trees per acre.

Reinforcement or Inter Planting: Between 120 and 225 trees per acre.

Other Plantings:

Pinyon: Between 130 and 200 trees per acre.

Other Species: Species selection and spacing information is contained in the respective MLRA Vegetative Guide in the Field Office Technical Guide.

Christmas trees at spacings no closer than 4x4 feet and no further apart than 8x8 feet. Spacing should fit the cultivation, mowing, spraying, or cultural practices required.

Spacing for Windbreak /Shelterbelt plantings are found in Practice #380 Windbreak/Shelterbelt Establishment.

Spacing for wildlife plantings are found in Practice #645 Wildlife Upland Habitat Management.

Direct Seeding:

All direct seeding of conifers and hardwoods will be by spot seeding. Direct seeding of forestland coniferous and deciduous species will require the review and approval of a NRCS forester.

Softwood Seeding:

Seeding Rates:

Rates of Pure Live Seed shall be as shown.

Species	seeds/spot
ponderosa pine	4 to 8
Jeffrey pine	4 to 8
True Firs	10 to 15
red fir	
Shasta red fir	
white fir	
Coastal Douglas-fir	4 to 8
Inland Douglas-fir	8 to 10

Timing of Seeding:

Just before or right after the first precipitation of the season.

Protective Measures:

Prior to the initiation of seeding the area to be seeded will be evaluated for the potential of seed predation. If the evaluation indicates predation will significantly impact the success of the seeding, the seeding should be postponed until techniques are utilized to decrease predation.

Hardwood Seeding:

Blue Oak

Blue oak will not be recommended for seeding if the soils are less than 20 inches deep, has more than 35 percent clay or a hardpan within 20 inches of the surface, has an average annual rainfall of less than 16 inches, is not present, or has not been historically present in the vicinity of the proposed seeding.

Soils may contain any amount of coarse fragments and should have a high base saturation.

California Black Oak

California black oak will not be recommended for seeding where the soils have a restrictive layer within 40 inches of the surface, are not well drained, the clay content exceeds 35 percent, are compacted, on soils originating from serpentine, or where the average annual precipitation is less than 20 inches. They will do well on medium to coarse textured, deep and well-drained soils.

Do not seed where California black oak is not present or has not been historically present in the vicinity of the proposed seeding.

Canyon Live Oak

Canyon live oak may be recommended for seeding on soils derived from sedimentary, metasedimentary, granitic, serpentine, and perodite parent materials. It may be seeded in soils with a depth of 12 inches or greater and the average annual precipitation must exceed 12 inches. Canyon live oak must be present or have been historically present in the vicinity of the proposed seeding.

Oregon White Oak

Oregon white oak may be recommended for seeding on moderately deep soils of varied parent material, including serpentine. It may also be seeded on flood plains in heavy clay soils and where there is standing water or a shallow water table during a lengthy wet season. Do not seed where it is not present or has not been historically present in the vicinity of the proposed seeding.

Valley Oak

Valley oak will not be recommended for seeding if the soil is less than 60 inches deep, has an average annual rainfall less than 12 inches, valley oak is not present or have not been historically present in the vicinity of the proposed seeding. Additionally, they will not be seeded when the elevation exceeds 5000 feet in the Coast Range and Southern California, and where the elevation exceeds 2000 feet in northern and central California.

Irrigation is not required for the establishment of valley oak. However, if irrigation is utilized the water applied must be sufficient to wet the soil profile to the depth of the water table or twelve feet, whichever is least restrictive.

Seeding Dates

Acorns will be planted in the fall after the first major rains. The soil profile will have moisture to a depth of at least 2 feet. If there are no major rains they will be planted by the end of December.

Seeding Rates

Acorns may be planted individually or in multiples at each planting site. For acorns to be planted individually the minimum percent acorn germination rate must exceed 95 percent.

Plant acorns on their side a minimum of one inch deep and not more than 2 inches deep. If multiple acorns are planted at a single site they must be a minimum of 4 inches apart.

Protective Measures

Control of Competing Vegetation.

Control of competing vegetation will be accomplished within a 3-foot diameter at a minimum. A 5 to 6 foot diameter area of controlling competing vegetation is preferred. Plant competition may be removed by hand, mechanical or chemical means.[1/] Mulches (See Practice 484 - Mulching) may be applied to the planting site to control competing vegetation and conserve moisture.

[1/] Chemical application recommendations and application rates will be made by a licensed applicator, farm advisor, or others licensed to do so in California.

Predation Control

In areas where ground squirrel and/or gopher activity may impact germination and survival, acorns may enclosed in wire mesh cylinders or baskets (0.5 to 1.0 inch mesh) buried at least 12 inches in the soil and extending at least 12 inches above the ground.

Where rabbits, deer, elk, cattle etc., are expected to pose a hazard above ground protective devices of chicken wire, rigid polypropylene, either mesh or twin walled, will be utilized to protect the emerging oak and first year seedling. Individual protective devices at least 4 feet high will be required to provide protection until the seedlings reach a point where the growing point is not readily browsed. Control may be by a number protective devices including Chicken wire tree protection, rigid polypropylene - mesh tube tree protection, and rigid polypropylene - twin walled extrusion. Colors may range from white (low light conditions) to brown. Where cavity nesting birds or other wildlife entering the tubes may be a problem the tops of the tubes will be covered with a mesh sleeve to prevent entry.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Plans and specifications will include the following: adapted tree species for the purposes outlined, spacing, planting methods, cultural practices, maintenance requirements, and variations in methods and species between interplanting, underplanting, and planting in open areas. Separate specifications can be prepared for each of these planting methods.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled.

Replanting will be required when survival is inadequate.

Supplemental water will be provided as needed.

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

Periodic applications of nutrients may be needed to maintain plant vigor. Replanting will be required when survival is inadequate.

Supplemental water will be provided as needed.

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

Periodic applications of nutrients may be needed to maintain plant vigor

REFERENCES:

PG&E Electric Transmission Guidelines G0070 Rev. Vegetation Management Policy. Effective date 3-1-1999

Reforestation Practices for Conifers in California. 1971.

Regenerating Rangeland Oaks in California. 2001

Reforestation Practices in Southwestern Oregon and Northern California. 1992.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

612A - TREE / SHRUB ESTABLISHMENT BAREROOT/CONTAINERIZED STOCK

I. SCOPE

The work shall consist of furnishing and planting trees and/or shrubs at the locations as shown on the drawings or as staked in the field.

Planting will be done to establish or increase the numbers of plants for proper stocking levels; to conserve soil and moisture, beautify an area, protect a watershed, or produce wood crops.

Tree planting is applicable in open or understocked areas, beneath less desirable trees in areas suitable for producing wood crops, where erosion control or watershed protection is needed, where greater natural beauty is wanted, or where a combination of these is desired.

II. MATERIALS

Plants and numbers shall be as stated on the Practice Requirements Sheet.

Plants found to be root or pot bound will not be acceptable. Plants shall be vigorous and free of disease, insect pests, eggs, or larvae. Plant materials shall be grown in nurseries which have been inspected by the State Department of Agriculture.

Water shall be free of injurious amounts of oil, salt, acid, alkali, or any other toxic substance.

III. TIME OF PLANTING

The time period for planting shall be as stated on the Practice Requirement Sheet.

Surface soil should be moist, not saturated or dry. Care should be taken to ensure proper spacing.

Plantings will be made after the danger of heavy freezing has passed and soil moisture conditions are proper. Soil moisture conditions may be waived if plants are watered at the time of planting.

IV. TEMPORARY STORAGE OF PLANTING STOCK

Only viable planting stock grown from locally adapted seed shall be planted. Planting stock should be maintained in good condition from the time received until planted. This will include, but is not limited to, unpacking, storage, heeling in, transport to the planting site, and keeping plants protected and moist until and during planting.

- Care for stock before planting shall include:

Bareroot stock:

If seedlings are planted within a few days after they are received, they may be left in the shipping container and stored in a cool, moist environment (preferred temperature of 34-40 degrees F.). Open the container (stock may be tied in bundles and should remain so) and check root moisture and lightly water as needed. Do not stack bundles.

When planting is delayed more than 1 week:

- Store plants in enclosed areas from 34 to 40 degrees F. off the floor.
- If ice is utilized, do not allow contact with the roots.
- Bales of plants should not be stored higher than 3 feet.
- Roots will be facing one way for periodic watering and fungicide treatment. Seedling roots will be kept moist.

Or

- Heel-in beds. Make a trench with one 30 to 45-degree backslope. Remove seedlings from the shipping bundles, line out planting stock against sloped side and backfill. Pack soil firmly around the roots. Keep roots 1 to 2 inches below the ground line. Water as needed. A moderately course-textured soil is preferred.

2. Container Stock: Place in the shade or protected area (preferred temperature of 34-40 degrees F.) and water as needed.

3. Care for seedlings during planting shall include:

a. Bareroot: Keep seedlings covered and moist while planting. Ample water, or a water-saturated material (burlap, sawdust moss, etc.) must be kept in all planting containers to insure the seedlings remain moist.

b. Containerized Stock: Leave seedlings in the planting container until time to be planted. Then take them out of the container just prior to placing them in the planting hole.

V. PLANTING PROCEDURES

The plants shall be planted according to the arrangement as shown on the plans.

Spacings for beatification, recreation and restoration plantings will vary depending on objectives, and site conditions.

Spacings for Windbreak /Shelterbelt plantings are found in Practice #380 Windbreak/Shelterbelt Establishment. Windbreaks will be staked or otherwise marked to assure proper alignment of rows and spacing.

Spacings for wildlife plantings are found in Practice #645 Wildlife Upland Habitat Management.

Plant seedlings in a vertical position with the root collar approximately one-half inch below the soil surface. Plant seedling roots straight down, not twisted, balled or J-shaped. Lateral roots will be spread to the sides.

Plant in adequately sized, sod-free holes or furrows for proper root development. The planting hole must be deep and wide enough to permit the roots to be spread out as naturally as possible.

After planting, pack the soil firmly around each seedling to eliminate air pockets.

On certain site, all species will be subject to unacceptable damage while on other sites no species may be subject to damage and plant protection may not be necessary.

Protect the plants by controlling rodents, and excluding livestock from original planting. Protect until planting has reached a height where it will not be browsed.

Potential mortality, weed competition, and pest populations may require additional seedlings initially or replanting later.

Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seedlings should preferably be of the same age as the planting seedlings.

VI. SEEDLING PROTECTION

1. COMPETING VEGETATION CONTROL

Physical Removal - Use planting hoe, shovel, brush cutting tool, chemicals, or chain saw to clear competing vegetation in the immediate area (a minimum of 3 feet in all directions) of the seedling.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Mulch - Spread mulch material (paper, plastic, geotextile, etc.) around base of seedlings at least 1.5 feet in all directions from the seedling. Mulch must have good contact with the soil to allow rainfall to percolate through rather than run off. (See Mulching Specification 484 for additional specifications.)

2. BROWSING OR FORAGING ANIMAL CONTROL

Physical Barriers - Erect physical barriers where animals are causing damage to seedlings. Physical barriers include: fences, nets, tubes, sleeves, and budcaps.

a. Material Specifications

- Fencing - (See Fencing #382 for specifications).
- Whole tree nets shall be of 6-15 mil photodegradable polypropylene fine mesh.

- Whole tree protectors shall be:

- Photodegradable polypropylene mesh tubes of 30 - 50 mil, or of spun polyester (Reemay) sleeves, 5 inches in diameter, 2-3 feet in length. The tubes will be fastened to a 24 inch 1x2 stake with 18 inches extending above the ground by one staple or a tie wire. The tubes will be flush with the ground.

- Chicken wire tree protection: Chicken wire with a mesh that does not exceed 1 inch will be shaped to form a cylinder a minimum of 5 inches in diameter and 18 inches high. A minimum of one 24 inch 1x2 stake with 18 inches extending above the ground will be used to support the stake by 2 evenly spaced staples or tie wires. The chicken wire will be flush with the ground. The barrier must be removed when the trunk diameter is within one-half inch of the chicken wire diameter.

Terminal leader protectors shall be of 15 - 50 mil photodegradable polypropylene mesh tubes, or of spun polyester (Reemay) sleeves, 1-3 inches in diameter, cut to length to enclose the leader and leave 4-8 inches above the end of the leader to allow for growth.

- Budcaps shall be of spun polyester (Reemay) sheets or weatherproof paper cut into 4 by 5 inch rectangular pieces.

b. Method and Placement

- Apply tubes, nets, budcaps, and sleeves directly to seedlings to prevent browse damage.

- Fold budcaps lengthwise and staple around the terminal leader and bud, forming a protective cylinder.

- Staple leader tubes to small branchlets along the leader to prevent loss from wind.

- Secure net tubes with pins of 9 gauge wire, 14 inches long, hooked through the mesh and pressed into the ground.

- Support sleeves and tubes, on small seedlings (plugs and 2-0's), with a 3-4 foot stake (wood or bamboo) driven into soil next to the seedling to keep the seedling upright.

Repellents - Apply chemical repellents to control damage from browsing or foraging animals.

a. Materials

- Use commercially available repellents.

b. Application

- Follow label instructions. Repellents must be applied correctly, or damage to seedlings or injury to the applicator may occur.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Physical Removal -

Animal Pests - Physically remove animal pests causing damage to seedlings (foraging or browsing animals, or rodents) by trapping or hunting. Follow State and local hunting and trapping regulations.

Insect and Disease Pests - Physically remove insect or disease pests by:

- removing the affected branches, leaves or needles by pruning or by burning of forest floor litter (See Tree/Shrub Pruning #660 and Prescribed Burning #338 for specifications). Removing the affected individual trees or groups of trees (See Forest Stand Improvement - 666 for specifications).

Chemical Control - Apply chemical toxicants to control insect or disease pests.

a. Materials

- Use commercially available pesticides.

b. Application

- Properly identifying the pest.

- Apply chemical according to label instructions. - Follow proper container disposal procedures.

NOTE: Restricted use chemicals can only be recommended or applied by licensed applicators, and are subject to Federal and State regulations.

Biological Control - Use biological control to achieve protection from pests and to decrease the need for chemical use. Integrate biological control with other pest management practices.

a. Methods

- Introduce disease-causing organisms (i.e., Bacillus thuringiensis).
- Encourage increase of natural enemies through habitat enhancement.
- Introduce natural enemies from other areas.

b. Application

- Identify the causal agent and consult with a pest management specialist to identify disease causing organisms, natural enemies, or habitat requirements of natural enemies, and for treatment specifications.

Habitat Manipulation - Modify site conditions that are favorable to the destructive pests. Use habitat manipulation if the specific treatments do not contradict site limitations or landowner objectives.

a. Methods

- Plant forage species preferred by large game to reduce browsing of seedlings (See Wildlife Upland Habitat Management - 645 for specifications).
- Improve the quantity and quality of forage away from the damage-susceptible sites (See Prescribed Grazing #528, and Forest Stand Improvement #666 for specifications).
- Plant species not browsed by the pest species
- Leave logged areas unburned to restrict movement of browsing animals.
- Eliminate preferred habitat of pest species.

b. Application

- Identify the pest.
- Determine its habitat needs.
- Alter the affected site to discourage continued residence by the pest or to alter the feeding patterns of the pest.

EXCESS HEAT

Artificial Shade - Apply shade cards or collars where moisture is limiting and planting occurs on a south facing slope and if natural shade (debris or stumps) is not available.

a. Material Specifications

- Shade cards and collars shall be made of heavy weatherproof cardboard, wood, Styrofoam or other suitable material.

- Minimum dimensions of cards shall be 8 inches by 12 inches; collars shall be 3 inches in diameter and 4 inches in height.
- Cards will be held in place by stake (wire or wood) attached to the card or inserted into the card.

b. Application

- Shade cards shall be placed 3 inches from seedling.
- Shade cards shall be placed to the south of seedlings with an east-west orientation.
- The bottom edge of the shade card shall be placed as close to the ground as possible.
- Shade collars shall be placed around the base of the seedling.

DROUGHT

If irrigation water is available irrigate at a rate of 1 gallon per tree soon after planting. (See Irrigation System #441/442/443 and Irrigation Water Management #449 for specifications). Apply supplemental water at the following rates when more than 2 months of the growing season are droughty.

Recommended irrigation rates:

- Establishment year:

  1 gallon per seedling per week.

- Second growing season:

  2 gallons per seedling per week.

- Third growing season:

  4 gallons per seedling per week.

Discontinue watering in the late summer to allow trees and shrubs to harden off. In the late fall, if soil moisture is depleted, a deep watering is beneficial in preventing winter desiccation damage.

VII. BASIS OF ACCEPTANCE

After the trees and/or shrubs have been planted, and after and establishment period of 12 months, an on-site inspection will be conducted to determine if 80% of the plants have survived, and are healthy with signs of good growth.

VIII. OPERATION AND MAINTENANCE

Plants shall be protected from fire, insects, disease, and animals until established.

Replanting will be required when survival is inadequate. Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seedlings should preferably be of the same age as the plantation seedlings.

Control of noxious weeds must be conducted.

Damaging pests will be monitored and controlled.

Competing vegetation will be controlled until the woody plants are established.

Supplemental watering may be desirable to ensure adequate survival.

Periodic applications of nutrients may be needed to maintain plant vigor.

Maintenance

Weed Control: Cultivation, cutting, scalping, placement of geotextile, herbicides or mowing may be used to control competing vegetation adjacent to and in between plants to a diameter of 3 feet for wildland plants. When cultivation is used, the tillage depth must not exceed four inches. The planted area may need to be marked with flagged stakes or lathe to avoid accidental tillage. Continue weed and grass control until unwanted vegetation no longer interferes with seedling growth. Follow specific herbicide instructions on the label and/or recommendations provided by your local Agricultural Commissioner.

Pest Control: Control harmful animals, diseases and insects by using rodent guards, trapping, fencing, removal of habitat or proper use of approved chemicals as appropriate to the identified pest. Pests include cattle, deer, rabbits, grasshoppers, squirrels, mice, gophers, and porcupines, etc.

Physical Barrier Maintenance:

Budcaps and sleeves:

- Inspect the treated area annually to assess need to repair, replace, remove, or adjust physical barriers.

- Budcaps and sleeves may need annual replacement or adjustment until trees grow beyond the reach of grazing or browsing animals.
- Nets and net tubing may require physical removal in areas of heavy shade (generally north slopes greater than 20% slope) to prevent girdling.

Repellants:

- Inspect the treated area annually to assess need to reapply.

Chemical control:

- Inspect the treated area annually to assess need to reapply or adjust treatment.

Biological control:

- Evaluate biological control measures annually for effectiveness and adjust practices as necessary to achieve desired results.

Habitat manipulation:

- Evaluate habitat manipulation measures annually for effectiveness and adjust as necessary to achieve desired results.

Excess Heat:

- Inspect the treated area annually, until seedling establishment is assured, to assess need to repair, replace, remove, or adjust shade cards.

Mortality: Assess mortality 1 year after planting. Consider 80 percent survival after two years to be adequate.

Fire Hazard: Maintain firebreaks, and/or fuelbreaks adjacent to and surrounding the planted area.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
612A - TREE / SHRUB ESTABLISHMENT
BAREROOT/CONTAINERIZED STOCK

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS.

1. Drawings, No._____ _____ _____

2. Practice Specifications 612A___, _____, _____, _____

3. Soil or suitability group_____

4. Acres to be planted: _____

5. Species:_____Amount/ac _____
   Species:_____Amount/ac _____
   Species:_____Amount/ac _____
   Species:_____Amount/ac _____

   Total number of Trees per acre: _____

6. Spacing:_____

7. Planting shall be performed within the period: _____

8. Seedling Protection Requirements:_____

_____

_____

_____

NRCS, CA
August 2006

9. Operations and Maintenance:_____

_____

_____

_____

_____

PRACTICE SPECIFICATION PREPRATION:

Prepared By:_____ Date:_____

_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date:_____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

612B - TREE / SHRUB ESTABLISHMENT DIRECT SEEDING

I. SCOPE

The work shall consist of furnishing seeds, planting, and maintaining the seeds to achieve growth at the location as shown on the plans or drawings.

II. MATERIALS

The species to be planted shall be as listed on the Practice Requirement Sheet.

III. TIME OF PLANTING

The time period for planting shall be as listed on the Practice Requirement Sheet.

IV. PLANTING STOCK

Methods of Seeding:

Direct seeding will be accomplished by spot seeding.

A. Softwood (Coniferous) Species

These species will not be recommended for woodland/forest land direct seeding without the case-by-case approval of a forester.

Seeding Rates:

Rates Of Pure Live Seed shall be as shown.

Species	seeds/spot
Ponderosa Pine	4 to 8
Jeffrey Pine	4 to 8
True Firs	10 to 15
Red Fir	
Shasta Red Fir	
White Fir	
Coastal Douglas-Fir	4 to 8
Inland Douglas-Fir	8 to 10

Timing of Seeding:

Just before or right after the first precipitation of the season.

B. Hardwood (Deciduous) -Seeding

Seeding Rates:

130 to 180 tree spots per acre

Blue Oak

Blue Oak will not be recommended for seeding if the soils are less than 20 inches deep, have more than 35 percent clay or a hardpan within 20 inches of the surface, have an average annual rainfall of less than 16 inches, are not present, or have not been historically present in the vicinity of the proposed seeding.

Soils may contain any amount of coarse fragments and should have a high base saturation.

California Black Oak

California Black Oak will not be recommended for seeding where the soils have a restrictive layer within 40 inches of the surface, are not well drained, the clay content exceeds 35 percent, are compacted, on soils originating from serpentine, or where the average annual precipitation is less than 20 inches. They will do well on medium to coarse textured, deep and well-drained soils.

Do not seed where California Black Oak is not present or has not been historically present in the vicinity of the proposed seeding.

Canyon Live Oak

Canyon Live Oak may be recommended for seeding on soils derived from sedimentary, metasedimentary, granitic, serpentine, and perodite parent materials. It may be seeded in soils with a depth of 12 inches or greater and the average annual precipitation must exceed 12 inches. Canyon Live Oak must be present or have been historically present in the vicinity of the proposed seeding.

Oregon White Oak

Oregon White Oak may be recommended for seeding on moderately deep soils of varied parent material, including serpentine. It may also be seeded on flood plains in heavy clay soils and where there is standing water or a shallow water table during a lengthy wet season. Do not seed where it is not present or has not been historically present in the vicinity of the proposed seeding.

Valley Oak

Valley Oak will not be recommended for seeding if the soil is less than 60 inches deep, has an average annual rainfall less than 12 inches, Valley Oak is not present or have not been historically present in the vicinity of the proposed seeding. Additionally, they will not be

seeded when the elevation exceeds 5,000 feet in the Coast Range and Southern California, and where the elevation exceeds 2,000 feet in northern and central California.

Irrigation is not required for the establishment of Valley Oak. However; if irrigation is utilized, the water applied must be sufficient to wet the soil profile to the depth of the water table or twelve feet, whichever is least restrictive.

Acorn Collection and Storage

Collection - Gather acorns in the late summer or early fall (August to November) directly from the trees or gather from the ground. Begin collecting when they are beginning to turn from green to brown and some are beginning to fall. Do not collect when they are all dark green and it is difficult to remove the caps. Those on the ground may be desiccated or damaged.

Storage - Sort acorns, discarding those with pinholes, small, cracked, feel light, or are hollow. Remove acorn caps, place them in a container and cover with water. Soak for 12 hours. Remove and discard acorns that float. Remove water, place into storage containers, and store in a refrigerator or other place which maintain the moisture and cold temperatures. Check occasionally for mold. If mold does develop, remove the acorns and rinse them to remove the mold and put back in the refrigerator. Seeds may be kept in storage for several months (October to January).

Seeding Dates

Acorns will be planted in the fall after the first major rains. The soil profile will have moisture to a depth of at least 2 feet. If there are no major rains, they will be planted by the end of December.

Methods of Seeding and Seeding Rates

Remove acorns from storage. Resort and discard ones with new exit holes or those whose roots have started to decay or are distorted. Acorns that are beginning to germinate, or have short, healthy roots may be planted. Care must be taken not to break the root or allow the acorn and root to dry out.

Acorns may be planted individually or in multiples at each planting site. For acorns to be planted individually, the minimum percent acorn germination rate must exceed 95 percent.

Plant acorns on their side a minimum of one inch deep and not more than 2 inches deep. If multiple acorns are planted at a single site, they must be a minimum of 4 inches apart.

V. PROTECTIVE MEASURES

A. Control of Competing Vegetation.

Control of competing vegetation will be accomplished within a 3-foot diameter at a minimum. A 5 to 6-foot diameter area of controlling competing vegetation is preferred. Plant competition may be removed by hand, mechanical or chemical means.[1/] Mulches (See Practice 484 - Mulching) may be applied to the planting site to control competing vegetation and conserve moisture.

Physical Removal - Use planting hoe, shovel, brush cutting tool, chemicals[1], or chain saw to clear competing vegetation in the immediate area (a minimum of 3 feet in all directions) of the seedling.

Mulch - Spread mulch material (paper, plastic, geotextile, etc.) around base of seedlings at least 1.5 feet in all directions from the seedling. Mulch must have good contact with the soil to allow rainfall to percolate through rather than run off. (See Mulching Specification 484 for additional specifications.)

B. Predation Control

In areas where ground squirrel and/or gopher activity may impact germination and survival, acorns may enclosed in wire mesh cylinders or baskets (0.5 to 1.0 inch mesh) buried at least 12 inches in the soil and extending at least 12 inches above the ground.

Where rabbits, deer, elk, cattle, etc., are expected to pose a hazard, above ground protective devices of chicken wire, rigid polypropylene, either mesh or twin walled, will be utilized to protect the emerging oak and first year seedling. Individual protective devices at least 4 feet high will be required to provide protection until the seedlings reach a point where the growing point is not readily browsed.

Chicken wire tree protection - Chicken wire with a mesh that does not exceed 1 inch will be shaped to form a cylinder minimum of five inches in diameter and 18 inches high. A minimum of 24 inch 1x2 stake with 18 inches extending above the ground will be used to support the stake by 2 evenly spaced staples or tie wires. The chicken wire will be flush with the ground. The barrier must be removed when the trunk diameter is within one-half inch of the chicken wire diameter.

Rigid polypropylene - mesh tube tree protection - Tubes will be of a diamond pattern with a minimum 30 mil strand diameter. The tubes will be a minimum of a 5 inch diameter and 18 inches high. The tubes will be

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[1/] Chemical application recommendations and application rates will be made by a licensed applicator, farm advisor, or others licensed to do so in California.

fastened to a 24 inch 1x2 stake with 18 inches extending above the ground by one staple or a tie wire. The tubes will be flush with the ground. Tubes must be capable of UV breakdown in 2 to 5 years.

Rigid polypropylene - twin walled extrusion - Tubes will be a minimum of 3 inches and a maximum of 6 inches in diameter. Height will be a minimum of 24 inches. Tubes will be fastened to a 24 inch 1x2 stake with at least 8 inches extending into the ground. Tubes will be fastened to the stake by at least one tie device. Tubes will be seated approximately 1 inch into the ground surface. Tubes will be capable of remaining intact for at least 5 years. Color may range from white (low light conditions) to brown. Where cavity nesting birds or other wildlife entering the tubes may be a problem the tops of the tubes will be covered with a mesh sleeve to prevent entry.

Repellents - Apply chemical repellents[1] to control damage from browsing or foraging animals.

a. Materials

- Use commercially available repellents.

b. Application

- Follow label instructions. Repellents must be applied correctly, or damage to seedlings or injury to the applicator may occur.

Physical Removal -

Animal Pests - Physically remove animal pests causing damage to seedlings (foraging or browsing animals, or rodents) by trapping or hunting. Follow State and local hunting and trapping regulations.

Insect and Disease Pests - Physically remove insect or disease pests by:

- removing the affected branches, leaves or needles by pruning or by burning of forest floor litter (See Tree/Shrub Pruning #660 and Prescribed Burning #338 for specifications). removing the affected individual trees or groups of trees (See Forest Stand Improvement - 666 for specifications).

Chemical Control[1] - Apply chemical toxicants to control insect or disease pests.

a. Materials

- Use commercially available pesticides.

b. Application

- Properly identifying the pest.

- Apply chemical according to label instructions. - Follow proper container disposal procedures.

Biological Control - Use biological control to achieve protection from pests and to decrease the need for chemical use. Integrate biological control with other pest management practices.

a. Methods

- Introduce disease-causing organisms (i.e., Bacillus thuringiensis).
- Encourage increase of natural enemies through habitat enhancement.
- Introduce natural enemies from other areas.

b. Application

- Identify the causal agent and consult with a pest management specialist to identify disease causing organisms, natural enemies, or habitat requirements of natural enemies, and for treatment specifications.

Habitat Manipulation - Modify site conditions that are favorable to the destructive pests. Use habitat manipulation if the specific treatments do not contradict site limitations or landowner objectives.

a. Methods

- Plant forage species preferred by large game to reduce browsing of seedlings (See Wildlife Upland Habitat Management - 645 for specifications).
- Improve the quantity and quality of forage away from the damage-susceptible sites (See Prescribed Grazing #528, and Forest Stand Improvement #666 for specifications).
- Plant species not browsed by the pest species
- Leave logged areas unburned to restrict movement of browsing animals.
- Eliminate preferred habitat of pest species.

b. Application

- Identify the pest.
- Determine its habitat needs.
- Alter the affected site to discourage continued residence by the pest or to alter the feeding patterns of the pest.

EXCESS HEAT

Artificial Shade - Apply shade cards or collars where moisture is limiting and planting occurs on a south facing slope and if natural shade (debris or stumps) is not available.

a. Material Specifications

- Shade cards and collars shall be made of heavy weatherproof cardboard, wood, Styrofoam or other suitable material.
- Minimum dimensions of cards shall be 8 inches by 12 inches; collars shall be 3 inches in diameter and 4 inches in height.

- Cards will be held in place by stake (wire or wood) attached to the card or inserted into the card.

b. Application

- Shade cards shall be placed 3 inches from seedling.
- Shade cards shall be placed to the south of seedlings with an east-west orientation.
- The bottom edge of the shade card shall be placed as close to the ground as possible.
- Shade collars shall be placed around the base of the seedling.

DROUGHT

If irrigation water is available irrigate at a rate of 1 gallon per tree soon after planting. (See Irrigation System #441/442/443 and Irrigation Water Management #449 for specifications). Apply supplemental water at the following rates when more than 2 months of the growing season are droughty.

Recommended irrigation rates:

- Establishment year:

  1 gallon per seedling per week.

- Second growing season:

  2 gallons per seedling per week.

Discontinue watering in the late summer to allow trees and shrubs to harden off. In the late fall, if soil moisture is depleted, a deep watering is beneficial in preventing winter desiccation damage.

VI. BASIS OF ACCEPTANCE

At the end of the first growing season, a field inspection will be conducted to determine if 80% of the spots planted have a plant that has have survived, and are healthy with signs of good growth.

VII. OPERATION AND MAINTENANCE

Plant competition can be removed by hand, mechanical, or chemical means. Do not disturb or otherwise damage seedlings by the improper use of chemicals, tools or machinery. When mechanical cultivation is used, do not cultivate deeper than 3 inches.

Animal, rodent, disease, and insects should be controlled by rodent guards, fencing, trapping, general cleanup or the use of approved chemicals.

Exclude livestock and poultry from plantings.

Plants shall be protected from fire, insects, disease, and animals until established.

Replanting will be required when survival is inadequate. Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seed should preferably be of the same species as was originally planted.

Control of noxious weeds must be conducted.

Damaging pests will be monitored and controlled.

Competing vegetation will be controlled until the plants are established.

Supplemental watering may be desirable to ensure adequate survival.

Periodic applications of nutrients may be needed to maintain plant vigor.

Maintenance

Weed Control: Cultivation, cutting, scalping, placement of geotextile, herbicides or mowing may be used to control competing vegetation adjacent to and in between plants to a diameter of 3 feet for wildland plants. When cultivation is used, the tillage depth must not exceed four inches. The planted area may need to be marked with flagged stakes or lathe to avoid accidental tillage. Continue weed and grass control until unwanted vegetation no longer interferes with seedling growth. Follow specific herbicide instructions on the label and/or recommendations provided by your local Agricultural Commissioner.

Pest Control: Control harmful animals, diseases and insects by using rodent guards, trapping, fencing, removal of habitat or proper use of approved chemicals as appropriate to the identified pest. Pests include cattle, deer, rabbits, grasshoppers, squirrels, mice, gophers, and porcupines, etc.

Physical Barrier Maintenance:

- Inspect the treated area annually to assess need to repair, replace, remove, or adjust physical barriers.

Repellants:

- Inspect the treated area annually to assess need to reapply.

Chemical control:

- Inspect the treated area annually to assess need to reapply or adjust treatment.

Biological control:

- Evaluate biological control measures annually for effectiveness and adjust practices as necessary to achieve desired results.

Habitat manipulation:

- Evaluate habitat manipulation measures annually for effectiveness and adjust as necessary to achieve desired results.

Excess Heat:

- Inspect the treated area annually, until seedling establishment is assured, to assess need to repair, replace, remove, or adjust shade cards.

Mortality: Assess mortality 1 year after planting. Consider 80 percent survival after two years to be adequate.

Fire Hazard: Maintain firebreaks, and/or fuelbreaks adjacent to and surrounding the planted area.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
612B - TREE / SHRUB ESTABLISHMENT
DIRECT SEEDING

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS.

1. Drawings, No._____ _____ _____

2. Practice Specifications 612B___, _____, _____, _____

3. Soil or suitability group_____

4. Acres to be planted: _____

5. Species:_____Seeds/spot _____
   Species:_____Seeds/spot_____
   Species:_____Seeds/spot_____
   Species:_____Seeds/spot_____

6. Spacing:_____

7. Seeding period: _____

8. Special Maintenance Requirements:_____

_____

_____

_____

PRACTICE SPECIFICATION PREPRATION:

Prepared By:_____ Date:_____

_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date: _____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

612C - TREE / SHRUB ESTABLISHMENT POLE PLANTINGS/CUTTINGS

I. SCOPE

The work shall consist of furnishing and planting trees and/or shrubs at the locations as shown on the drawings or as staked in the field.

Planting will be done to establish or increase the numbers of plants, to conserve soil and moisture, beautify an area, protect a watershed, or produce wood crops.

Planting is applicable in open or understocked areas, beneath less desirable trees, where erosion control or watershed protection is needed, where greater natural beauty is wanted, or where a combination of these is desired.

II. MATERIALS

Plants and numbers shall be as stated on the Practice Requirements Sheet.

Collect cuttings during the dormant season from a healthy stand. Do not remove more than 2/3ds of the total plant. Select cuttings with leaf buds near the top of each cut.

Larger diameter cuttings have a greater supply of stored energy for rooting than smaller diameter cuttings. The bigger diameter and longer lengths are better suited for severely eroded areas and fluctuating water tables.

Pole planting materials should have a butt diameter of 1 to 4 inches in diameter. Their minimum length should be the depth to the water table plus 3 feet where they will be planted.

Slips should be from ¼ to 3/4 inches in diameter at the butt end and 10 to 24 inches long.

Trim off all side and terminal branches.

Remove all of the flower buds and the terminal bud.

Cuttings can be tied in bundles for ease of movement to the planting site and if necessary, storage facilities.

Plants shall be vigorous and free of disease, insect pests, eggs or larvae. When plant materials are purchased, they shall be grown in nurseries which have been inspected by the State Department of Agriculture.

Mulch: see Practice Specification 484 - Mulching

Water shall be free of injurious amounts of oil, salt, acid, alkali, or any other toxic substance.

III. TIME OF PLANTING

The time period for planting shall be as stated on the Practice Requirement Sheet.

Control noxious weeds prior to planting.

Surface soil should be moist, not saturated or dry.

Plantings will be made after the danger of heavy freezing has passed and soil moisture conditions are proper. Soil moisture conditions may be waived if plants are watered at the time of planting.

IV. TEMPORARY STORAGE OF PLANTING STOCK

A. Care for stock before planting shall include:

1. If planted within 7 days of collection:

   Place the materials in water or refrigerate.

2. If planted after 7 days of collection:

   Store the materials in a cool, moist environment (preferred temperature of 34-40 degrees F. and 50 to 70 percent humidity).

   Monitor conditions regularly to detect problems such as drying, sprouting, or mold.

B. Care during planting shall include:

1. Only the materials required to be planted each day should be removed from storage.

2. On the site the cuttings should be stored out of direct sunlight and protected from the wind. Keep covered and moist while planting. Ample water or a water-saturated material (burlap, sawdust moss, etc.) may be used to insure the cuttings remain moist.

V. PLANTING PROCEDURES

The plants shall be planted according to the arrangement as shown on the plans and/or drawings.

Planting locations will be staked or otherwise marked to assure proper alignment of rows and spacing.

Pole plantings:

Plant in adequately sized, sod-free holes. Auger a hole to the water table. Place materials in the augured hole one-half foot above the growing season water table.

After planting, pack the soil firmly around each pole to eliminate air pockets. "Mudding" by filling the hole with water and then adding more soil to make a slurry can remove air pockets.

Cuttings:

Plant cuttings upright as vertically as possible. Place at least 2/3ds of the cutting in the ground.

Leave no more than 2 leaf buds above the ground. If more than two leaf buds, more than ¼ of the cutting, or 6 inches of the cutting is above ground, remove the excess buds and/or trim the cutting.

VI. PROTECTION

On certain sites, all species will be subject to unacceptable damage, while on other sites no species may be subject to damage and plant protection may not be necessary.

Protect the plants by controlling rodents, such as beaver, and excluding livestock from the planting. Protect until planting has reached a height where it will not be browsed.

Replant, as necessary and practicable, to maintain a fully productive stand. Replacements should preferably be of the same age as the originally planted materials.

Chicken wire tree protection: Chicken wire with a mesh that does not exceed 1 inch will be shaped to form a cylinder a minimum of 5 inches in diameter and 18 inches high. A minimum of one 24 inch 1x2 stake with 18 inches extending above the ground will be used to support the stake by 2 evenly spaced staples or tie wires. The chicken wire will be flush with the ground. The barrier must be removed when the trunk diameter is within one-half inch of the chicken wire diameter.

Rigid polypropylene - mesh tubes tree protection: Tubes will be of a diamond pattern with a minimum 30 mil. strand diameter. The tubes will be a minimum of a 5 inch diameter and 18 inches high. The tubes will be fastened to a 24 inch 1x2 stake with 18 inches extending above the ground by one staple or a tie wire. The tubes will be flush with the ground.

VII. BASIS OF ACCEPTANCE

After the trees and/or shrubs have been planted, and after and establishment period of 12 months, an on-site inspection will be conducted to determine if 80% of the plants have survived, and are healthy with signs of good growth.

VIII. OPERATION AND MAINTENANCE

Plants shall be protected from fire, insects, disease, and animals until established.

Replanting will be required when survival is inadequate. Replant, as necessary and practicable, to maintain a fully productive stand. Replacement seedlings should preferably be of the same age as the plantation seedlings.

Control of noxious weeds must be conducted.

Damaging pests will be monitored and controlled.

Competing vegetation will be controlled until the woody plants are established.

Supplemental watering may be desirable to ensure adequate survival.

Periodic applications of nutrients may be needed to maintain plant vigor.

Flood debris lodged around cuttings and pole plantings should be removed to allow for growth and prevent excessive shading.

Maintenance

Weed Control: Cultivation, cutting, scalping, placement of geotextile, herbicides or mowing may be used to control competing vegetation adjacent to and in between plants to a diameter of 3 feet for wildland plants. When cultivation is used, the tillage depth must not exceed four inches. The planted area may need to be marked with flagged stakes or lathe to avoid accidental tillage. Continue weed and grass control until unwanted vegetation no longer interferes with seedling growth. Follow specific herbicide instructions on the label and/or recommendations provided by your local Agricultural Commissioner.

Pest Control: Control harmful animals, diseases and insects by using rodent guards, trapping, fencing, removal of habitat or proper use of approved chemicals as appropriate to the identified pest. Pests include cattle, deer, rabbits, grasshoppers, squirrels, mice, gophers, and porcupines, etc.

Mortality: Assess mortality 1 year after planting. Consider 80 percent survival after two years to be adequate.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
612C - TREE / SHRUB ESTABLISHMENT
POLE PLANTINGS/CUTTINGS

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS.

1. Drawings, No._____ _____ _____
2. Practice Specifications: 612C___, _____, _____, _____, _____
3. Soil or suitability group_____
4. Acres to be planted: _____
5. Materials Minimum Diameter:_____ Length:_____
6. Species:_____Amount/ac _____
   Species:_____Amount/ac _____
   Species:_____Amount/ac _____
7. Total numbers per acre: _____
8. Spacing:_____
9. Planting shall be performed within the period: _____
10. Special Maintenance Requirements:_____

_____

_____

PRACTICE SPECIFICATION PREPRATION:

Prepared By:_____ Date:_____

_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date: _____

STATEMENT OF WORK
Tree/Shrub Establishment (612)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Practice standard criteria-related computations and analyses to develop plans and specifications including but not limited to:
        i. Determination of adapted species of woody plants to be planted and/or naturally reestablished
        ii. Protective measures for planted stock: including supplemental water, cultural treatments to enhance survival and health, and use exclusion
        iii. Additional provisions, as required, for improving or restoring natural diversity and increasing carbon storage in biomass and soils
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Documentation of needed operation and maintenance.
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations.
5. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre-application conference with client.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Application guidance as needed.
5. Facilitate and implement required design modifications with client and original designer.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the application process and materials meet design and permit requirements.

CHECK OUT

Deliverables

1. Records of application.
    a. Extent of practice units applied
    b. Actual plant materials used and protective measures
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits.
3. Progress reporting.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Tree/Shrub Establishment, 612
- NRCS National Forestry Handbook (NFH), Part 636.4
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

STATEMENT OF WORK
Tree/Shrub Establishment (612)

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTE TREATMENT

(No.)

CODE 629

DEFINITION

The mechanical, chemical, or biological treatment of agricultural waste.

PURPOSE

To use mechanical, chemical, or biological treatment facilities and/processes as part of an agricultural waste management system:

- To improve ground and surface water quality by reducing the nutrient content, organic strength, and/or pathogen levels of agricultural waste.
- To improve air quality by reducing odors and gaseous emissions
- To produce value added byproducts
- To facilitate desirable waste handling, storage, or land application alternatives.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where the form and characteristics of agricultural waste make it difficult to manage so as to prevent it from becoming a nuisance or hazard or where changing the form or composition provides additional utilization alternatives, and where conventional waste management alternatives are deemed ineffective. More specifically:

- Liquids and solids need to be separated for further processing or for effective transport and subsequent utilization.
- Raw agricultural waste contains excess nutrients for land application based on crop utilization requirements or nutrient ratios need to be modified to be more consistent with crop utilization requirements.
- There is a need to reduce the potential for leaching or runoff of nutrients.
- Odors and/or gaseous emissions from livestock production facilities and waste storage/treatment system components must be reduced.
- Value-added byproducts can be produced to offset treatment costs.
- Reduction of pathogens is required.

CRITERIA

General Criteria Applicable to All Waste Treatment Purposes.

Laws and Regulations. Waste treatment facilities and processes must be planned, designed, and constructed to meet all federal, state, and local laws and regulations.

Design. The system provider shall complete and supply to the land owner/operator a detailed design of the facility/process clearly outlining the objectives and anticipated outcomes of implementation.

The design documentation shall include a process diagram containing, at a minimum, the following information:

1. Volumetric flow rates including influent, effluent, and recycle streams.

2. Waste load projections including volume, mass, and characteristics of the waste important to the waste treatment facility or process.

3. Unit process volumes and hydraulic retention times where appropriate.

4. Air emissions projections from the system.

5. Nutrient fate projections within the system.

6. Process monitoring and control system

requirements as described below in the Monitoring section of the criteria.

Independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations shall be provided.

Where use of a waste treatment facility or process to improve one resource concern negatively impacts another, impacts and mitigation measures, if required by state or local agencies, are to be documented. The mitigation measures shall become a required component of this practice.

Plans and Specifications to document this practice shall be as described below.

Components. Waste treatment facilities and processes may consist of multiple components. Where criteria for individual components are described in existing NRCS practice standards, those practice standards and their specific criteria shall be used for planning, designing, and installation of that component.

Where components of a facility or process are not described in a current NRCS practice standard, the system provider shall furnish a one year warranty on all construction or applied processes. In addition, the manufacturer shall provide a warranty that describes the service life of each component and what the warranty covers.

The waste treatment facility or process shall have a minimum practice life of ten years. Where components have less than a ten year service life, their planned replacement during the life of the practice shall be clearly identified in the Operation and Maintenance Plan.

Expected System Performance. The expected system performance shall be clearly documented prior to system installation. At a minimum, the expected system volumetric flow rate, expected macro-nutrient reductions or change in form, expected pathogen reductions, gaseous ammonia and hydrogen sulfide emissions reductions (or increases) shall be documented.

Operating Costs. Where components of a facility or process are not described in a current NRCS Conservation Practice Standard, the system provider shall furnish an annual estimate of operating costs for the system. Operating costs not based on actual systems data shall be clearly identified as estimates.

Monitoring. Equipment needed to properly monitor and control the waste treatment facility or process shall be installed as part of the system. Process control parameters to be monitored shall include those parameters identified in the design documentation. Parameters considered critical to proper system operation shall be identified in the Operation and Maintenance Plan. Run status of critical equipment and unit processes shall be monitored.

Byproducts. Implementation of a waste treatment process or operation of a waste treatment facility shall not result in discharge of byproducts harmful to the environment.

All byproducts shall be handled and stored in such a manner as to prevent nuisances to neighbors or to the public at large.

Byproducts land applied to supply plant nutrients shall meet the criteria in NRCS Conservation Practice Standard 633, Waste Utilization and NRCS Conservation Practice Standard 590, Nutrient Management.

Any unmarketable or unused byproducts shall be handled and disposed of in accordance with all applicable federal, state, and local laws and regulations. A plan for dealing with such byproducts shall be prepared and approved by NRCS prior to utilization of the process or installation of the waste treatment facility, and shall include a listing of any permits or permissions required for the execution of the plan.

Byproducts shall be recycled to the extent possible without causing a hazard to the environment.

Safety. Design of the process or facility shall include safety features to minimize hazards. Guards and shields shall be provided for moving parts of the equipment used in the treatment process. Waste treatment facilities shall be fenced and warning signs shall be posted where needed to prevent children and others from entering a hazardous area.

All treatment processes shall be carried out in accordance with all safety regulations.

Protective clothing shall be utilized when handling potentially harmful chemicals that may be used in the process. Proper ventilation shall be provided.

CONSIDERATIONS

Location. The waste treatment facility should be located as near the source of manure or other waste as practicable and as far from neighboring dwellings or public areas as possible. Proper location should also consider slope, distance of manure and other waste transmission, vehicle access, wind direction, proximity of streams and flood plains, and visibility.

In determining the location of the facility, consider elevation and distance from various components to take advantage of gravity flow where possible.

Manure Characteristics. Waste treatment may require specific total solids and nutrient contents of the waste stream. Pretreatment options such as dilution or settling could be used to adjust the solids content before entering the waste treatment facility or process.

Visual Screening. The visual impact of the waste treatment facility or process should be evaluated within the overall landscape context. Screening with vegetative plantings, landforms, or other measures may be implemented to alleviate a negative impact or enhance the view.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Plans shall include engineering drawings and supporting documentation as well as other plans required to manage the system; e.g. a nutrient management plan for proper land application of byproducts.

Plans and specifications for waste treatment facilities shall be prepared in accordance with the criteria of this standard and good engineering practice.

As a minimum, the plans and specifications shall provide the following:

1. Layout and installation details of livestock facilities, waste collection points, waste transfer components, waste treatment, and storage facilities.
2. Location of all inflow and discharge pipelines, pipeline materials, diameter, and slope.
3. Details of support systems for all components of the treatment facility.
4. Fencing and signage as appropriate for safety purposes.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be developed and reviewed with the owner/operator prior to construction of a waste treatment facility or implementation of a waste treatment process. The O&M plan shall be consistent with the proper operation of all system components and shall contain requirements including but not limited to:

- Recommended loading rates of the waste treatment facility or process for hydraulic and critical pollutant parameters.
- Proper operating procedures for the waste treatment facility or process, including the amount and timing of any chemicals added.
- Operation and maintenance manuals for pumps, blowers, instrumentation and control devices, and other equipment used as components of the waste treatment facility or process.
- Description of the planned startup procedures, normal operation, safety issues, and normal maintenance items. This includes procedures for the planned replacement of components with less than a ten year service life.
- Alternative operation procedures in the event of equipment failure.
- Troubleshooting guide.
- Monitoring and reporting plan designed to demonstrate system performance on an ongoing basis.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

629 – WASTE TREATMENT

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained waste treatment system is an asset to your farm. This facility was designed and installed to use mechanical, chemical, or biological treatment facilities and/processes as part of an agricultural waste management system:

- To improve ground and surface water quality by reducing the nutrient content, organic strength, and/or pathogen levels of agricultural waste.
- To improve air quality by reducing odors and gaseous emissions
- To produce value added byproducts
- To facilitate desirable waste handling, storage, or land application alternatives.

The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

GENERAL RECOMMENDATIONS

- Do not allow human entry to any enclosed structure without appropriate safety equipment. Maintain appropriate warning signs.
- Inspect safety items twice a year and repair or replace as necessary.
- Ensure that all warning signs and safety instructions are posted in a visible location and in readable condition. Repair or replace as necessary.
- Maintain all electrical and mechanical equipment in good operating condition by following the manufacturer's recommendations. Repair as necessary.

- Repair spells, cracks and weathered areas in concrete surfaces.
- Repair or replace rusted or damaged metal and apply paint as a protective coating.
- Maintain grounding rods and wiring for all electrical equipment in good condition.
- Immediately repair any vandalism, vehicular, or livestock damage.

SPECIFIC RECOMMENDATIONS FOR YOUR WASTE TREATMENT

- Recommended loading rates of the waste treatment facility or process for hydraulic and critical pollutant parameters.
- Proper operating procedures for the waste treatment facility or process, including the amount and timing of any chemicals added.
- Operation and maintenance manuals for pumps, blowers, instrumentation and control devices, and other equipment used as components of the waste treatment facility or process.
- Description of the planned startup procedures, normal operation, safety issues, and normal maintenance items. This includes procedures for the planned replacement of components with less than a ten year service life.
- Alternative operation procedures in the event of equipment failure.
- Troubleshooting guide.
- Monitoring and reporting plan designed to demonstrate system performance on an ongoing basis.

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN.

STATEMENT OF WORK
Waste Treatment (629)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Type and amount
        ii. Method of application and Frequency
        iii. Environmental Considerations
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits...
3. Operation and Maintenance Plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03 (a) (3)).
5. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
    a. Actual materials used (Part 512, Subchapter D Quality Assurance Activities, 512.33)
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the application process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. As-Built documentation.
    a. Extent of practice units applied
    b. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03 (c) (1)).
3. Progress reporting.

STATEMENT OF WORK
Waste Treatment (629)

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Waste Treatment , 629
- NRCS National Engineering Manual (NEM).
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SOLID/LIQUID WASTE SEPARATION FACILITY

(No.)

CODE 632

DEFINITION

A filtration or screening device, settling tank, settling basin, or settling channel used to separate a portion of solids from a liquid waste stream.

PURPOSE

To partition solids, liquids and their associated nutrients as part of a conservation management system to:

- improve or protect air quality.
- improve or protect water quality.
- improve or protect animal health.
- meet management objectives.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where solid/liquid separation will:

- remove solids from the liquid waste stream as a primary treatment process and allow further treatment processes to be applied such as composting and anaerobic digestion.
- allow partly digested feed to be separated from the liquid waste stream so that it can be used as a feed supplement or for bedding.
- reduce problems associated with solids accumulation in liquid storage facilities.
- reduce solids in stored liquids so liquids can be recycled for other uses (i.e. flush water).
- reduce solids in stored liquids to better facilitate land application of liquids using irrigation techniques.
- assist with partitioning nutrients in the waste stream to improve nutrient management.

CRITERIA

General Criteria Applicable to All Purposes

Laws and regulations. Waste treatment facilities must be planned, designed, and constructed to meet all federal, state, and local regulations.

Location. Solid/Liquid separation facilities shall be located so that the waste stream can be safely routed to and from the facility.

Solid/Liquid Separator Selection. Table 1 provides guidance on the different types of solid/liquid separators available. Capture efficiency varies widely for each type of separator depending on the type and consistency of the waste to be treated. The type of solid/liquid separator selected shall be based on site-specific data for the liquid waste stream and management conditions where specific management objectives are to be met.

Solid/Liquid Separation Efficiency. The volume of solids separated shall be based on estimates of daily wastewater volume and the total solids capture efficiency for the type of solid/liquid separation device selected. Where manufacturer information or local data concerning total solids capture efficiencies are not available for the type of solid/liquid separation device selected, the efficiencies in Table 1 can be used to estimate the volume of separated solids generated.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

Chemical Amendments. Guidance for the addition of chemicals to the liquid waste stream for improving total solids capture efficiencies is given in Conservation Practice Standard 591, Amendments for Treatment of Agricultural Waste.

Table 1

Solid/Liquid Separators	Total Solids Capture Efficiency
Static Inclined Screen	10-20%
Inclined Screen with Drag Chain	10-30%
Vibratory Screen	15-30%
Rotating Screen	20-40%
Centrifuge	20-45%
Screw or Roller Press	30-50%
Settling Basin	40-65%
Weeping Wall	50-85%
Dry Scrape	50-90%
Geotextile Container	50-98%

Storage of Separated Solids. Adequate storage areas shall be provided for separated solids so they can be properly managed. Temporary storage areas shall be provided for separated solids unless they are transported directly from the separator to the final utilization location (i.e. offsite composter).

Storage facilities for separated solids shall be designed in accordance with requirements of Conservation Practice Standard 313, Waste Storage Facility.

All seepage from solid storage facilities shall be directed to short or long term liquid storage facilities.

Outlets. The outlet capacity for a solid/liquid separation facility shall be capable of safely conveying the design capacity to a storage or utilization location.

Outlets may include pipelines, perforated or slotted pipe risers, porous plank walls or dams, or screened walls. Screening used to separate solids at the outlet of settling basins should provide at least 10% open area.

Emergency overflow appurtenances such as notched weirs, or pipe bypasses can be used to control flows exceeding design capacity. Emergency overflow appurtenances shall be designed to pass the peak runoff from the drainage area of the facility for a 25 year-24 hour storm frequency plus the normal waste stream discharge. Any discharge from the solid/liquid separation facility must be captured in a waste storage or treatment structure unless it meets local, state, and federal regulations regarding discharge to surface and ground waters.

Additional Criteria for Filtration or Screening Devices

Flow rate. The design flow rate (combined flow of solid and liquid waste) for filtration and screening devices shall be in accordance with the manufacturer's recommendations.

Velocity. The liquid waste stream velocity through filtration and screening devices shall be in accordance with the manufacturer's recommendations.

Structural Design. Structural supports for filtration and screening devices shall be designed in accordance with the requirements of Conservation Practice Standard 313, Waste Storage Facility.

General Criteria Applicable to Settling Basins

Velocity. The liquid waste stream velocity through settling basins shall not exceed 1.5 feet per second.

Depth. The total depth for settling basins that are to be cleaned out using conventional front-end loading equipment shall be 5 feet or less. Safety concerns during cleanout shall be addressed where the total depth for settling basins will exceed 5 feet.

The total depth of earthen settling basins shall be based on the sum of the depth needed for liquids and solids storage plus 1 foot of freeboard.

The total depth of concrete settling basins shall be based on the sum of the depth needed for liquids and solids storage.

The minimum liquid depth of settling basins shall be based on a minimum hydraulic

retention time and the solids settling rate. A minimum hydraulic retention time of 30 minutes shall be used except where sand is a major component of the liquid waste stream. Where sand is a major component in the liquid waste stream the hydraulic retention time shall be a minimum of 3 minutes and a maximum of 5 minutes.

The maximum solids settling rate used for design shall be 4 feet per hour for settling basins with a total storage depth greater than 2 feet and 2 feet per hour for settling basins with a total storage depth equal to or less than 2 feet.

Bottom Width. The minimum bottom width for settling basins shall be 10 feet.

Where settling basins are not used for dewatering, an earthen bottom can be used (i.e. level diversion).

Settling basins used for dewatering shall be constructed of concrete and/or lined with a geosynthetic, compacted soil, or geomembrane liner meeting applicable local laws and regulations. A settling basin not utilizing a concrete slab for the basin floor shall be designed to provide adequate support for clean out equipment. A settling basin constructed according to these criteria shall also meet appropriate criteria in Conservation Practice Standard 313, Waste Storage Facility.

Access. The minimum top width of earthen embankments for settling basins shall be 15 feet where equipment access is needed for clean out. Where no access is needed for clean out, the minimum top width shall be governed by the equipment used to construct the embankment or berm, but shall not be less than 4 feet.

The side slopes of earthen embankments shall be 2 horizontal to 1 vertical (2:1) or greater. For earthen embankments greater than 3 feet in height, the side slopes shall be no steeper than 3:1 on the outside and 2:1 on the inside of the embankment.

Access ramps to allow entry into the basin for clean out by normal front end loading equipment shall be no steeper than 10:1. Steeper slopes shall be allowed where special surfacing of the ramp is done for traction purposes and the equipment used can accommodate the steeper slope but in no case shall the access ramp be steeper than 4:1.

Additional Criteria for Settling Basins Receiving Lot Runoff

Settling basins used in conjunction with or without screening to remove waste solids from process generated liquid waste streams (i.e. flush water from covered freestall barns, or milking parlor waste water) that include significant external drainage fall into this category.

Flow rate. The design flow rate for a settling basin that receives lot runoff shall be based on the normal liquid waste stream discharge from the operation plus the peak runoff from the drainage area of the basin computed using a 10 year-1 hour storm frequency.

Volume. The design volume for settling basins receiving lot runoff shall be based on the total depth needed for liquid and solids storage and the minimum surface area required for the basin. Where no specific information is available on sludge accumulation rates from lot surfaces, use 0.05 cubic feet per square foot-Month for unpaved lots and 0.01 cubic feet per square foot-Month for paved lots. These values should be increased by 50% if lots are steep or poorly maintained.

Additional Criteria for Settling Basins that Exclude Lot Runoff

Settling basins used in conjunction with or without screening to remove waste solids from process generated liquid waste streams (i.e. flush water from covered freestall barns, or milking parlor waste water) and do not receive significant external drainage fall into this category.

Flow rate. The design capacity for a settling basin that excludes lot runoff shall be based on the normal liquid waste stream discharge from the operation.

Volume. The design volume for settling basins that exclude lot runoff shall be the volume needed to provide solids storage for a specified treatment period plus temporary liquid storage necessary during dewatering. Minimum temporary liquid storage shall be

based on the volume of the liquid waste stream for one-day.

CONSIDERATIONS

Location. Locating solid/liquid separation facilities should consider elevation and distance from the source of material to be separated and the location of long-term liquid and solid waste storage facilities. Location of solid/liquid separation facilities should take advantage of gravity flow wherever possible.

Other considerations for locating solid/liquid separation facilities include vehicle access, wind direction, neighboring dwellings, proximity of streams and floodplains, and visibility.

Weeping Walls. To maximize drainage and solid/liquid separation, weeping walls should be used on the entire perimeter of the waste to be treated and drainage paths maintained to and through the walls. Ensure drainage is transferred to a liquid storage facility.

Waste Water Transfer Piping. It is standard practice to route flow to and from a solid/liquid separation facility using underground and above ground pipe. Refer to Conservation Practice Standard 634, Manure Transfer for guidance in designing pipelines for wastewater transfer.

Visual Screening. Consider vegetative screens or other methods to shield solids separation facilities from public view and for more aesthetic conditions.

Rainfall. Rainfall falling on the solids storage areas associated with solid/liquid separation facilities can result in increased wastewater discharge into the long-term storage facility. Consider covering solids storage facilities in locations where high rainfall amounts occur.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

OPERATION AND MAINTENANCE

Where sand is a major component of the liquid waste stream, special emphasis should be given to abrasion resistant waste transfer piping and pumps to reduce frequency of repairs.

The owner and operator should understand the level of operation and maintenance (O&M) required ensuring the type of separator selected will be operated as intended.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and good engineering practice. The plans and specifications shall include all details necessary for construction and completion of the solid/liquid separation facilities.

As a minimum, the plans and specifications shall provide the following:

1. Layout of waste production facilities, waste collection points, waste transfer pipelines, waste treatment and storage facilities.
2. Location of all inflow and discharge pipelines and a description of pipeline materials, diameter, and slope.
3. Details of support systems for solid/liquid separation devices.
4. Fencing and signage as appropriate for safety purposes.
5. Operating characteristics.

Warranties. The contractor shall provide a one-year warranty on all construction. If a manufactured solid/liquid separation device is installed, the manufacturer shall provide a warranty that describes the design life of the device and what the warranty covers.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be developed and reviewed with the owner and operator prior to constructing the solid/liquid separation facility. The O&M plan shall be consistent with the purposes of the solid/liquid separation device chosen, its intended life, safety requirements, and the criteria for its design. The plan shall contain operation and maintenance requirements including but not limited to:

1. Documentation of design assumptions.
2. Design capacity for the facility.
3. A description of normal operation of the facility, safety issues, and normal maintenance items.
4. Alternative operation procedures in the event of equipment failure.
5. Daily inspection of the following:
    - Separation device and support structure.
    - Screens and outlets.
    - Remaining capacity in storage facilities.

REFERENCES

1. USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.1992, Last revised, June 1999.
2. Mid West Plan Services Handbook 18, Livestock Waste Facilities Handbook, Third Edition, 1993.
3. Burns, R.T. and Moody, L.B.. 2003. Development of a Standard Method for Testing Mechanical Manure Solids Separators. ASAE-CIGR Meeting Paper No. 034131. St. Joseph, MI.: ASAE

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

632 – SOLID/LIQUID WASTE SEPARATION FACILITY

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained solid/liquid waste separation facility is an asset to your farm. This facility was designed and installed to separate solid and liquid waste as part of a conservation management system. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

GENERAL RECOMMENDATIONS

- Do not allow human entry to any enclosed structure without appropriate safety equipment. Maintain appropriate warning signs.
- Inspect safety items twice a year and repair or replace as necessary.
- Ensure that all warning signs and safety instructions are posted in a visible location and in readable condition. Repair or replace as necessary.
- Maintain all electrical and mechanical equipment in good operating condition by following the manufacturer's recommendations. Repair as necessary.
- Repair spells, cracks and weathered areas in concrete surfaces.
- Repair or replace rusted or damaged metal and apply paint as a protective coating.
- Maintain grounding rods and wiring for all electrical equipment in good condition.
- Inspect haul roads and approaches to and from the facility frequently to determine the need for stabilizing materials.

- All fences, railings, and/or warning signs shall be maintained to prevent unauthorized human or livestock entry.
- Immediately repair any vandalism, vehicular, or livestock damage.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.

SPECIFIC RECOMMENDATIONS FOR YOUR SOLID/LIQUID WASTE SEPARATION FACILITY

The O&M plan shall be consistent with the purposes of the solid/liquid separation device chosen, its intended life, safety requirements, and the criteria for its design. The plan shall contain operation and maintenance requirements including but not limited to:

1. **Documentation of design assumptions.**
2. **Design capacity for the facility.**
3. **A description of normal operation of the facility, safety issues, and normal maintenance items.**
4. **Alternative operation procedures in the event of equipment failure.**
5. **Daily inspection of the following:**

- **Separation device and support structure.**
- **Screens and outlets.**
- **Remaining capacity in storage facilities.**

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR SOLID/LIQUID WASTE SEPARATION FACILITY.

NRCS, CA
August 2006

STATEMENT OF WORK
Solid/Liquid Waste Separation Facility (632)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client.
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06).
    d. List of facilitating practices
    e. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Geology and Soil Mechanics (NEM Subpart 531a).
        ii. Storage Volume and Maximum Operating Level.
        iii. Structural, Mechanical and Appurtenances.
        iv. Maximize Clean Water Diversion.
        v. Environmental Considerations (e.g. liner failure, location, breaching, air quality).
        vi. Safety Considerations (NEM Part 503- Safety, Subpart A, 503.06 through 503.12).
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Design Report and Inspection Plan as appropriate (NEM Part 511, Subpart B Documentation, 511.11 and Part 512, Subpart D Quality Assurance Activities, 512.30 through 512.32).
4. Operation and Maintenance Plan
5. Certifications that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b)(2)).
6. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
    a. Actual materials used.
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meet design and permit requirements.

STATEMENT OF WORK
Solid/Liquid Waste Separation Facility (632)

CHECK OUT

Deliverables

1. As-Built documentation.
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03(c)(1)).
3. Progress reporting.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Solid/Liquid Waste Separation Facility, 632
- NRCS National Engineering Manual (NEM).
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
634 – MANURE TRANSFER

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications_____,_____,_____

3. Special Requirements:_____

_____

_____

_____

_____

_____

_____

4. Special Maintenance Requirements:_____

_____

_____

NRCS, CA

August 2006

PRACTICE APPROVAL:

Job Classification: (Ref: Section 501 NEM)

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Capacity_____	_____cfs
_____	_____
_____	_____
_____	_____

Design Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specification, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION
(Ac.)
CODE 657

DEFINITION

The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE

To restore wetland functions, values, habitat, diversity, and capacity to a close approximation of the pre-disturbance by:

- Restoring hydric soils
- Restoring hydrology (depth duration and season of inundation, and/or duration and season of soil saturation).
- Restoring native hydrophytic vegetation (including the removal of undesired species, and/or seeding or planting of desired species).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to natural wetland sites with hydric soils, or problem soils that are hydric, which have been subject to hydrologic or vegetative degradation, or to sites where hydric soils are covered by fill, sediment, or other deposits.

This practice is applicable only where the natural hydrologic conditions, including the hydroperiods, can be approximated by modifying drainage and/or by artificial inundation or saturation of a duration and frequency similar to the original, natural conditions.

This practice does not apply:

- to treat point and non-point sources of water pollution (Constructed Wetland - 656);
- to modify an existing wetland where specific attributes are heightened by management objectives, and/or returning a degraded wetland back to a wetland but to a different type than what previously existed on the site (Wetland Enhancement - 659);
- To create a wetland on a site location which historically was not a wetland (Wetland Creation - 658).

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals and objectives of the restoration shall be clearly outlined, including soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

The nutrient and pesticide tolerance of the species planned shall be considered where known nutrient and pesticide contamination exists.

Upon completion of the restoration, the site shall meet soil, hydrology, vegetation, and habitat conditions of the wetland that previously existed on the site to the extent practicable.

Where offsite drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes (e.g., increased water depth, berms, or microtopography).

Sites suspected of containing hazardous waste shall be tested to identify appropriate remedial measures. Sites containing hazardous material shall be cleaned prior to the installation of this practice.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. This includes the manipulation of water levels to control unwanted vegetation. The establishment and/or use of non-

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

native plant species shall be discouraged where possible.

Criteria for Hydric Soil Restoration

Restoration sites will be located on hydric soils, or on problem soil areas where alterations to the land have created wetter conditions than previously existed.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall, to the extent technically feasible, be removed.

Criteria for Hydrology Restoration

The hydrology (including the timing of inflow and outflow, duration, and frequency) and hydroperiod of the restored site shall approximate the conditions that existed before alteration. Impacts to the watershed caused by roads, ditches, drains, terraces, etc. shall be evaluated to determine the effects on hydrology.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement, or permit.

A natural water supply should be used to reestablish the site's hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used; however, these sources shall not be diverted from other wetland resources (e.g. prairie pothole wetland complexes or springs).

To the extent technically feasible, reestablish topographic relief and/or microtopography. Use reference sites within the area to determine desired topographic relief.

Excavations from within the wetland shall remove sediment to approximate the original topography and/or microtopography or establish a water level that will compensate for the sediment that remains. Soils investigations are necessary to ensure that earthwork excavations do not exceed impermeable soil textures which may be necessary to maintain surface hydrology.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Measures designed and installed to restore wetlands shall meet NRCS standards and specifications for the particular structure and type of construction.

Criteria for Vegetative Restoration

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of pre-identified, selected species will realistically dominate within 5 years, sites may be left to revegetate naturally. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the type of vegetative communities present and the vegetation type planned:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years; or, a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six species. Seeding rates shall be based upon percentage of pure live seed that shall be tested within 6 months of planting.

CONSIDERATIONS

Sites containing hazardous materials should be evaluated for the feasibility and cost effectiveness of clean-up and remedial actions.

It is expected that for wildlife purposes, planting density and stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than those used for production purposes.

On sites where woody vegetation will dominate, consider adding 1 to 2 dead snags, tree stumps, or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

Water control structures are often necessary to control and manage inflow, outflow and drainage from a wetland. Controlling the outflow from a wetland may involve capacity to store and release stormwater, regulate pool elevation and possibly allow for total drawdown of the wetland for management purposes.

Consider impact that water surface draw-downs will have on concentrating aquatic species such as turtles into diminished pool area resulting in increased mortality.

Consider existing wetland functions and/or values that may be adversely impacted.

Consider the effect restoration will have on disease vectors such as mosquitoes. It is important to include water management capabilities into the restoration plan, especially when restoring flooding hydrology. Refer to the Central Valley Joint Venture publication "Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands", June 2004 for design and management guidelines recommended for controlling mosquitoes.

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider the effect of water control structures on the ability of fish or other aquatic species to move in and out of the wetland.

Consider establishing herbaceous vegetation by a variety of methods over the entire site, or a portion of the site, and at densities and depths appropriate.

Consider the broader effects on wetlands and water-related resources, including fish and wildlife habitats, which would be associated with the practice. Restoration objectives should address the habitat needs of both game and non-game species, including reptiles, amphibians, grassland birds, shorebirds and any special status species that may benefit. Reference the California Natural Diversity Database (CNDDB) for information on species occurrences within 3-5 miles of the planned restoration.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland's use and colonization by the native flora and fauna.

Consider establishing vegetative buffers on surrounding uplands to reduce sediment and soluble and sediment-attached substances carried by runoff and/or wind.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Consider the effects of soil disturbance and probability of invasion by unwanted species.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

Consider microtopography and hydroperiod when determining which species to plant.

Consider controlling water levels to prevent oxidation of organic soils and inundated organic matter and materials.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the

adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland restoration.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides, and other chemicals shall assure that the intended purpose of the wetland restoration shall not be compromised;

Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) shall be implemented where available and feasible;

Establish an inspection schedule for embankments and structures for damage assessment;

The depth of accumulated sediment should be measured and the accumulations removed when the planned project objectives are jeopardized.

Management actions shall maintain vegetation, and control undesirable vegetation.

For wildlife habitat purposes, haying and grazing, if justified as a necessary wildlife/wetland management tool, can be used for management of vegetation. Disturbance to ground nesting species shall be minimized.

The control of water depth and duration may be utilized to control unwanted vegetation.

REFERENCES:

1. Executive order 13112, Invasive Species, February 3, 1999. Federal Register: Vol.64, No.25. Feb. 8, 1999.
2. Galatowitsch, Susan, et al, 1994. Restoring Prairie Wetlands: an ecological approach. Iowa State University Press, Ames IA. 246 pp.
3. Hall, C.D. and F.J. Cuthbert. 2000. Impact of a controlled wetland drawdown on Blanding's Turtles in Minnesota. Chelonian Conservation Biology. Vol. 3, No. 4, pp. 643-649Hurt, G.W. and V.W. Carlisle, 2001. Delineating Hydric Soils, in Wetland Soils – Genesis, Hydrology, Landscapes and Classification. Edited by J.L. Richardson and M.J Vepraskas. CRC Press, Boca Raton, FL pp. 183 – 206.
4. Kingsbury, Bruce & Joanne Gibson, 2002. Habitat Management Guidelines for Amphibians and Reptiles of the Midwest. Partners in Amphibian & Reptile Conservation, Ft Wayne IN, 57 pp.
5. M.J. Vepraskas ands S. W. Sprecher editors, 1997. Aquic Conditions and Hydric Soils: The Problem Soils. Soil Science Society of America Special Publication Number 50. SSSA, Inc. Madison, WI.
6. Maschhoff, Justin T & James H. Dooley, 2001. Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, ASAE Meeting Presentation, Paper No: 012059.
7. USDA, NRCS, 2003. ECS 190-15 Wetland Restoration, Enhancement, Management & Monitoring. 425 pp.
8. USDA, NRCS. Wetland Restoration, Enhancement, or Creation, Engineering Field Handbook Chapter 13, Part 650, pp. 3, 24, 77, 78.
9. USDA, NRCS. 2002. Field Indicators of Hydric Soils in the U.S., Version 5.0. G.W. Hurt, P.M. Whited and R.F. Pringle (eds.). USDA, NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX.

10. Kwasny, D.C.et al., 2004. Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands, Central Valley Joint Venture. 35 p.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND CREATION
(Ac.)
CODE 658

DEFINITION

The creation of a wetland on a site that was historically non-wetland.

PURPOSE

To create wetlands function and values.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to sites where no natural wetlands occurred historically and contain soils that are not hydric.[1,2,3]

This practice does not apply to:

- a constructed wetland (656) intended to treat point and non-point sources of water pollution;
- wetland enhancement (659) intended to rehabilitate a degraded wetland where specific functions and/or values are enhanced beyond original conditions; or
- wetland restoration (657) intended to rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to approximate original wetland conditions.

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals, and objectives of the creation shall be clearly defined, including the soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before the wetland is created.

Where known nutrient and pesticide contamination exists, the species selected will be tolerant of these conditions.

Upon completion, the site shall meet the appropriate wetland hydrology, hydrophitic vegetation, and hydric soils criteria and provide wetland functions and values as defined in the project's objectives.

Sites containing hazardous material shall be cleaned prior to the installation of this practice. Soil testing shall be used to determine appropriate actions to clean sites suspected of containing hazardous wastes.

Water rights shall be assured prior to creation.

Disturbance to ground nesting species shall be minimized.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the effectiveness of the practice) shall be controlled on the site. The establishment and/or use of non-native plant species shall be discouraged and, where possible, controlled.

Criteria for Soils

Created wetlands shall be located in landscape positions and contain soil types capable of supporting the wetland functions and values. Soils investigations are necessary to ensure that earthwork excavations do not exceed impermeable soil textures which may be necessary to maintain surface hydrology.

Loosening of compacted soils, addition of organic matter, or other soil preparation activities, shall be accomplished where necessary to establish desired vegetation.

Criteria for Hydrology

The site shall be designed to create hydrologic conditions (including the timing of inflow and outflow, duration, and frequency) that provide the desired wetland functions and values.

Wetland micro- and macro-topography shall be created to achieve hydrologic diversity and enhance the desired effect.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement, or permit.

Engineering structures constructed for wetland creation shall approximate or mimic existing natural topography and micro- and macro-topography.

Measures designed and installed create wetlands shall meet NRCS standards and specifications for the particular structure and type of construction.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Criteria for Vegetation

Establish hydrophytic vegetation typical for the wetland type(s) being established.

Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of selected species will realistically dominate within 5 years, sites may be left to revegetate naturally. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the types of vegetative communities present and the vegetation type planned. To achieve habitat diversity and minimize the adverse effects of climate, disease, and other limiting factors, several species adapted to the site will be established.

Seeding rates shall be based upon percentage of pure live seed to be tested within 6 months of planting.

CONSIDERATIONS

Sites containing hazardous materials should be evaluated for the feasibility and cost effectiveness of clean-up and remedial actions.

On sites where woody vegetation will dominate, consider adding 1 or 2 dead snags, tree stumps, or logs per acre, where appropriate, to provide structure and cover for wildlife and a carbon source for food chain support.

Creation of various water depths and associated uplands can maximize habitat diversity.

The potential for occurrence of threatened or endangered species shall be evaluated for each site proposed for wetland creation.

Consider existing wetland and floodplain functions and/or values that may be adversely impacted.

Consider the effect that wetland creation will have on disease vectors such as mosquitoes. It is important to include water management capabilities into the restoration plan, especially when restoring flooding hydrology. Refer to the Central Valley Joint Venture publication “Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands”, June 2004 for design and management guidelines recommended for controlling mosquitoes.

Water control structures are often necessary to control and manage inflow, outflow and drainage from a wetland. Controlling the outflow from a wetland may involve capacity to store and release stormwater, regulate pool elevation and possibly allow for total drawdown of the wetland for management purposes.

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider the effect of water control structures on the ability of fish and other aquatic species to move in and out of the wetland.

Consider timing of water control to mimic the natural hydrological regime of a natural wetland in the area, further enhancing the habitat for aquatic species.

Consider linking wetlands by corridors of vegetation or habitat wherever appropriate to enhance the wetland’s use and colonization by the native flora and fauna. Restoration objectives should address the habitat needs of both game and non-game species, including reptiles, amphibians, grassland birds, shorebirds and any special status species that may benefit. Reference the California Natural Diversity Database (CNDDB) for information on species occurrences within 3-5 miles of the planned restoration.

Consider establishing vegetative buffers on surrounding uplands to reduce sediment and

soluble and sediment-attached substance carried by runoff and/or wind.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Soil disturbance associated with the installation of this practice may increase the potential for invasion by unwanted species.

Consider micro-topography, hydrology, and hydroperiod when determining which species of vegetation to plant.

Where visual quality would be impacted by structures (e.g., outlet structures, dikes, etc.), consider using low profile structures, natural screening, and/or colors that minimize the impact.

Consider controlling water levels to prevent oxidation of organic soils and inundated organic matter and materials.

Consider the effects that location, installation and management may have on subsurface cultural resources.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland restoration.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides and other chemicals to assure the wetland enhancement function shall not compromise the intended purpose.

Control of undesirable plant species and pests using biological means (e.g., use of predator or parasitic species), or by manipulation of water levels shall be implemented where available and feasible.

Timing and level setting of water control structures is required for the establishment of desired hydrologic conditions, for management of vegetation and for optimum wildlife and fish use.

An inspection schedule shall be established for embankments and structures for damage assessment.

Management actions shall maintain vegetation and control unwanted vegetation.

Haying and grazing will be used as appropriate to manage vegetation.

The control of water depth and duration may be utilized to control unwanted vegetation.

REFERENCES

1. Hurt, G.W. and V.W. Carlisle, 2001. Delineating Hydric Soils, in Wetland Soils – Genesis, Hydrology, Landscapes and Classification. Edited by J.L. Richardson and M.J Vepraskas. CRC Press, Boca Raton, FL pp. 183 – 206.
2. USDA, NRCS. 2002. Field Indicators of Hydric Soils in the U.S., Version 5.0. G.W. Hurt, P.M. Whited and R.F. Pringle (eds.). USDA, NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX.
3. Vepraskas, M.J., ands S. W. Sprecher (eds), 1997. Aquic Conditions and Hydric Soils: The Problem Soils. Soil Science Society of America Special Publication Number 50. SSSA, Inc. Madison, WI
4. Endangered Species Act of 1973, as amended, Section 7, p 19 – 28.
5. Executive Order 13112, Invasive Species, February 3, 1999. Federal Register: vol.64, no.25. Feb. 8, 1999.
6. Galatowitsch, Susan, et al, 1994. Restoring Prairie Wetlands: an ecological approach. Iowa State University Press, Ames IA. 246 pp.
7. Kingsbury, Bruce & Joanne Gibson, 2002. Habitat Management Guidelines for Amphibians and Reptiles of the Midwest. Partners in Amphibian & Reptile Conservation, Ft Wayne IN, 57 pp.
8. Maschhoff, Justin T & James H. Dooley, 2001. Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, ASAE Meeting Presentation, Paper No: 012059.
9. USDA, NRCS. Wetland Restoration, Enhancement or Creation. Engineering Field Handbook Chapter 13, Part 650, pp. 3, 24, 77, 78.
10. USDA, NRCS, 2003. ECS 190-15 Wetland Restoration, Enhancement, Management & Monitoring. 425 pp. http://msa.ars.usda.gov/ms/oxford/nsl/projects/restoration/RestorationManual.html.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND ENHANCEMENT
(Ac.)
CODE 659

DEFINITION

The rehabilitation or re-establishment of a degraded wetland, and/or the modification of an existing wetland.

PURPOSE

To provide specific wetland conditions to favor specific wetland functions and targeted species by:

- hydrologic enhancement (depth duration and season of inundation, and/or duration and season of soil saturation).
- vegetative enhancement (including the removal of undesired species, and/or seeding or planting of desired species).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on any degraded or non-degraded existing wetland where the objective is specifically to enhance selected wetland functions.

This practice does not apply to the following where the intention is to:

- treat point and non-point sources of water pollution (Constructed Wetland 656);
- rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to original conditions (Wetland Restoration 657);
- create a wetland on a site that historically was not a wetland (Wetland Creation 658).

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals, and objectives of the enhancement shall be clearly outlined, including the soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The impact of this practice on existing non-degraded wetland functions and/or values will be evaluated.

The soils, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before enhancement of the site begins.

Soils investigations are necessary to ensure that earthwork excavations do not exceed impermeable soil textures which may be necessary to maintain surface hydrology.

Where known nutrient and pesticide contamination exists, species selected will be tolerant of these conditions.

Sites containing hazardous material shall be cleaned prior to the establishment of this practice. Appropriate actions to clean sites suspected of containing hazardous wastes shall be based on soil tests.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. The establishment and/or use of non-native plant species shall be discouraged.

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides, and other chemicals shall assure that the intended purpose of the wetland enhancement shall not be compromised.

Criteria for Hydrologic Enhancement

The hydrology of the site (defined as the rate and timing of inflow and outflow, source, duration, frequency, and depth of flooding, ponding, or saturation) shall meet the project objectives. An adequate source of water must be available to meet hydrology designs.

Timing and level setting of water control structures is required for the establishment of desired

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

hydrologic conditions for management of vegetation and for optimum wildlife and fish use.

Measures designed and installed to enhance wetlands shall meet NRCS standards and specifications for the particular structure and type of construction.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Criteria for Vegetative Enhancement

Establish native hydrophytic vegetation typical for the wetland type(s) being established. Each state will develop specific guidelines that consider soil, seed sources, and species.

Where natural colonization of selected species will dominate within 5 years, natural regeneration can be left to occur.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

If the targeted hydrophytic vegetation is predominantly herbaceous, several species adapted to the site shall be established. Herbaceous vegetation may be established by a variety of methods including: mechanical or aerial seeding, topsoiling, organic mats, etc., over the entire site or a portion of the site and at densities and depths appropriate.

For forested wetland establishment, where six or more native species are adapted to the site, reforestation shall include at least six species.

Seeding rates shall be based upon percentage of pure live seed within 6 months of planting.

CONSIDERATIONS

Sites containing hazardous materials should be evaluated for the feasibility and cost effectiveness of clean-up and remedial actions.

Water control structures are often necessary to control and manage inflow, outflow and drainage from a wetland. Controlling the outflow from a wetland may involve capacity to store and release stormwater, regulate pool elevation and possibly allow for total drawdown of the wetland for management purposes.

Consider manipulation of water levels to control unwanted vegetation.

Consider existing wetland functions and/or values that may be adversely impacted.

Consider effect enhancement will have on disease vectors such as mosquitoes. It is important to include water management capabilities into the restoration plan, especially when restoring flooding hydrology. Refer to the Central Valley Joint Venture publication “Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands”, June 2004 for design and management guidelines recommended for controlling mosquitoes.

The inclusion of microtopography can achieve changes in depth and duration of flooding without changing extent of surface area.

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider effects on fish and wildlife habitats that would be associated with the practice.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland’s use and colonization by the flora and fauna. Restoration objectives should address the habitat needs of both game and non-game species, including reptiles, amphibians, grassland birds, shorebirds and any special status species that may benefit. Reference the California Natural Diversity Database (CNDDB) for information on species occurrences within 3-5 miles of the planned restoration.

Establishing vegetative buffers on surrounding uplands can reduce sediment and soluble and sediment-attached contaminant delivery by runoff and/or wind.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Soil disturbance associated with the installation of this practice may increase the potential for invasion by unwanted species.

On sites where woody vegetation will dominate, consider adding 1 to 2 dead snags, tree trunks, or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

When determining which species to plant, consider microtopography and the different hydrology levels.

Consider the effects that location, installation, and management may have on subsurface cultural resources.

Consider the effect of water control structures on the ability of fish to move in and out of the wetland.

Consider the effects that water level draw drowns will have on the mortality of aquatic species such as turtles.

Consider timing of water control to mimic the natural hydrological regime of the area, further enhancing the habitat for aquatic species.

Consider design modifications that will limit potential negative impacts of wetland plants and animals on the project.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland enhancement.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) should be implemented where available and feasible.

Inspection schedule for embankments and structures for damage assessment.

Depth of sediment accumulation to be allowed before removal is required.

Management needed to maintain vegetation, including control of unwanted vegetation.

Haying or grazing shall be used as appropriate to manage vegetation. Minimize disturbance to ground nesting species, especially during the primary nesting season.

REFERENCES

1. Executive Order 13112, Invasive Species, February 3, 1999. Federal Register: vol.64, no.25. Feb. 8, 1999.
2. Hall, C.D. and F.J. Cuthbert. 2000. Impact of a controlled wetland drawdown on Blanding's Turtles in Minnesota. Chelonian Conservation Biology. Vol. 3, No. 4, pp. 643-649.
3. Kingsbury, Bruce and Joanne Gibson. 2002. Habitat Management Guidelines for Reptiles and Amphibians of the Midwest. Partners for Amphibian and Reptile Conservation. Ft. Wayne, IN. 57 pp.
4. Maschhoff, Justin T. and James H. Dooley. 2001. Functional requirements and design parameters for restocking coarse woody features in restored wetlands. ASAE Meeting Presentation. Paper No. 012059.
5. USDA, NRCS, 2003. ECS 190-15: Wetland Restoration, Enhancement, Management & Monitoring. 425 pp.
6. USDA, NRCS. Wetland Restoration, Enhancement, or Creation, Engineering Field Handbook Chapter 13, Part 650, pp. 3, 24, 77, 78
7. Kwasny, D.C.et al., 2004. Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands, Central Valley Joint Venture. 35p.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TREE/SHRUB PRUNING

(Ac.)

CODE 660

DEFINITION

Removing all or parts of selected branches or leaders from trees and shrubs.

PURPOSE

- Improve the appearance of trees or shrubs
- Improve the quality of wood products.
- Reduce fire and/or ladder fuels, or safety hazards.
- Improve the growth and vigor of understory plants.
- Adjust the foliage and branching density for other specific intents, such as wind and snow control, noise abatement, access control, and visual screens.

CONDITIONS WHERE PRACTICE APPLIES

On any area with trees or shrubs, or to provide an area for fire control and to remove hazardous or diseased portions of trees.

CRITERIA

General Criteria Applicable to All Purposes

The pruning and shearing method and timing will match the limitations of the site and soils, achieve purposes for the specific tree or shrub species, and be conducted in a safe and efficient manner.

Pruning or shearing will not adversely reduce the growth and vigor of the tree or shrub for the intended purpose.

Debris and vegetative material left on the site after treatment will not present an unacceptable fire or pest hazard or interfere with the intended purpose and other management activities.

Burning of removed vegetation shall follow the criteria in Forest Slash Treatment (384).

Comply with applicable federal, state and local laws and regulations during the installation, operation and maintenance of this practice.

Criteria Applicable to Quality of Wood Products

Pruning will only be done in Douglas-fir, Jeffrey and Ponderosa Pine stands when the site index exceeds 70 (McArdle) (Meyer).

No pruning of true firs (White, Red, and Shasta), hemlock and spruce will be planned. These species are more prone to invasion by decay causing fungi.

Pruning will be in lifts (stages).

Pruning in Urban Areas for Recreation, Visual Aesthetics and Other Uses

Pruning techniques will follow established guidelines contained in the Standards of Pruning for Certified Arborists published by the Western Chapter of the International Society of Arborists

CONSIDERATIONS

Pruning and shearing should be timed to minimize disturbance to seasonal wildlife activities. It should also consider the nesting and breeding requirements of arboreal species.

Pruning and shearing tools should be disinfected to prevent the spread of pathogens.

Review the estimated cost and projected economic benefits of the project before starting a pruning or shearing project.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

To maintain plant growth and sustain vigor, pruning and shearing may be done in two or more timed intervals.

Time pruning and shearing to minimize potential damage to the tree bole and stems.

Debris and other vegetation (biomass) removed may be used to produce energy. Management alternatives should consider the amount of energy required to produce and convert the biomass into energy with the amount produced by the biomass.

Sufficient herbaceous vegetation must be left in the stand following pruning to prevent wind erosion and other natural resource concerns.

In urban areas special considerations need to be given for safety hazards.

Removing the lower limbs provides protection from fire. For some shrubs it may increase browse by resprouting in the lower bole.

Pruning any pine limb releases host volatiles (odors) which may attract bark beetles, Ips, on small diameter trees (less than 9 inch d.b.h.) and Dendroctinous, spp., such as mountain pine beetle, on large diameter trees (greater than 9 inch d.b.h.). When the threat of beetles is a consideration:

1) Timing of the pruning operation will coincide with the periods of lowest beetle activity, normally when temperatures are not conducive to beetle flights (November to March).
2) Slash treatment will follow guidance in Forest Stand Improvement Specification (666) to reduce the threat of population increases of beetles.

Pruning may create basal sprouts. These may need to be periodically controlled by any number of methods including cutting, mowing or chemical application.[1]

[1/] Chemical application recommendations and application rates will be made by a licensed applicator, farm advisor, or others licensed to do so in California.

Pruning should be planned in conjunction with the application of other Conservation Practices and activities including Forest Stand Improvement (Standard 666), Fuel Break (383) etc.

Pruning for Christmas Trees

Pruning can increase the value of plantation trees and reduce the number of unmerchantable culls.

Once pruning occurs it may be required one or more times each year until harvest.

Basal pruning: Delay until no more than one-third of the total foliage on the tree will be cut off to prevent excessive shock.

Pruning for Quality Saw Logs

Under ideal conditions natural pruning removes the limbs providing clean boles. However, because spacing and other considerations are seldom perfect, artificial pruning is required to produce high quality clean bole trees. The greatest need for pruning is in open-grown or poorly stocked stands where lower limbs will persist indefinitely.

Stands should be healthy and vigorous.

Avoid pruning stands on exposed areas prone to windthrow, sites with a high water table or a high incidence of root rot.

Pruning in the spring or periods of active shoot elongation will be avoided. Pruning in pines should be accomplished after the new growth has elongated and hardened.

Fuel Hazard Reduction

Prune to break up the fuel ladder.

Along roads consider the removal of limbs to allow the passage of emergency vehicles.

Consider properly cutting portions of the limbs to provide at least 10 feet of ground clearance.

Shrub Pruning

Prune to direct or control growth.

Prune to encourage flower and fruit production.

Prune to promote plant health. Cutting at the 2 to 3-foot level will promote new growth and better quality forage for some wildlife browse species.

Prune to repair damage.

Prune to achieve a special effect or an artificial form.

Prune to alter, restore, or rejuvenate an established or neglected plant to make it more attractive. On taller shrubs lower limbs can be removed, transforming it in to a multi-stemmed shrub, resembling a small tree, and breaking up the fuel ladder.

Prune to compensate for transplanting. The balance between roots and top is upset when the plant is transplanted. Pruning can restore this balance.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes and narrative statements in the conservation plan, or other acceptable documentation.

Species, site limitations, methods, equipment, season of year, and guides to pruning for the applicable purpose shall be considered.

OPERATION AND MAINTENANCE

Periodically inspect plant condition and take additional actions as necessary, e.g., additional pruning, pest management, nutrient management and forest stand improvement.

REFERENCES

9624-2815-MTDC. *Pruning in Timbered Stands*. USDA-Forest Service, Technology & Development Program. Missoula, MO. 1996.

Ortho Books. *All About Pruning*. The Solaris Group. San Ramon, CA. 1989.

Shigo, A. and Marx, H. G. *Compartmentalization of Decay (Part A, B, C)*. INF-NE-405. USDA-Forest Service, Northeast Experiment Station. PA. 1977.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

660 - TREE / SHRUB PRUNING

I. SCOPE

The work shall consist of pruning trees and/or shrubs at the locations as shown on the plans or drawings.

II. TIMING OF PRUNING

Specific dates or time periods shall be as stated on the Practice Requirement Sheet.

Trees. Except for some Christmas tree species, pruning will be done during dormancy. Pruning during this time reduces disturbance to nesting birds. Pruning in the spring or periods of active shoot growth will be avoided to reduce harm to the trees.

See attached exhibits for proper methods to prune conifers and hardwoods.

Shrubs. Normally deciduous shrubs are pruned at two different times of the year. Early flowering shrubs are pruned immediately after pruning. The remainder are pruned in the late winter or early spring. Exceptions are plants that bleed when pruned. Because the sap loss is unsightly and to prevent sap loss these plants can be pruned when fully leafed out. Remove dead, diseased and broken parts when they are first noticed.

III. TOOLS TO USE

Pruning tools include a curved pruning saw 14 to 18 inches long and with 5 to 8 points per inch. The first 6 to 8 feet above the ground can be pruned with a hand saw. In open stands the remainder of the pruning up to 19 feet in height can be done with a pole saw. For large acreage it is more efficient to use a power pole saw. Be careful not to harm the tree or yourself.

IV. PRUNING FOR QUALITY SAWLOGS

Sawlog pruning will only be done in Douglas-fir, Jeffrey, incense-cedar and ponderosa pine stands when the site index exceeds 70 (McArdle) (Meyer).

Pruning is designed to provide a clear butt log in 8 foot multiples up to a height of 18 to 19 feet. Under ideal conditions natural pruning removes the limbs providing clean boles. Because spacing and other considerations are seldom perfect, pruning may be required to produce high quality clean bole trees. Dead limbs exceeding two inches in diameter tend to persist indefinitely. They form loose knots, which degrades wood quality. Pruning may begin when the tree has reached a dbh of 3 inches. No pruning will be accomplished when the dbh exceeds 9 inches.

The smaller crop trees can not be pruned to 18 or 19 feet in one pruning operation. Ideally, pruning is completely accomplished in 2 to 3 operations spanning 5 to 20 years. The first pruning removes the lower limbs and subsequent pruning extend the pruning height. Prune high sites first and only the dominant and co-dominant trees.

No more than 100 to 150 well spaced crop trees will be pruned per acre.

Branches will be pruned or be removed in lifts until a height of 19 feet is reached.

Remove no more than one-third of the live crown in one pruning.

Branches will be sawed off just outside the branch flare of the limb collar without damaging it (See attached). Lower dead branches may be carefully removed with a lightweight axe.

V. PRUNING CHRISTMAS TREES

Pruning (selective removal or cutting back of individual branches) or shearing (clipping of both terminal and lateral shoots) does the shaping. The intent is to produce an ideally shaped tree, or one which has a 66 2/3 percent taper, and meets the Agricultural Marketing Service grades for Christmas trees.

A. Pines

1. Shaping will be done when the new growth (candles) snap off easily and cleanly with the fingers. The new growth must not have hardened to woody material.
2. The leader will be pruned to control height growth. The maximum distance from the branch whorl will be 12 inches and the cut will be at a 45-degree angle. If the leader is pruned, the top whorl must be pruned to 6 to 8 inches in length to prevent them from taking over terminal growth.
3. Shear current year's growth on a lateral branch to maintain a cone-like symmetry.

4. If a lateral branch must be removed it will be cut off near a side branch so a stub of dead wood will not be left.
5. Basal pruning will be done to form a handle of 8" to 12" in length.

B. Spruces and Firs

1. Shaping will be done after periods of active growth during dormancy (late summer, fall, winter, early spring).
2. The leader will be pruned to control height. The distance from the branch whorl will be 8 to 12 inches. The cut will be made at an angle 3/8 to 1/2 inch above a live single bud. If two or more buds are present, all but one bud will be removed. The top whorl must be pruned to 3 to 5 inches shorter than the leader to prevent it from taking over terminal growth.
3. Shear the lateral branches to maintain a cone-like symmetry without regard to individual branches.
4. Remove the bottom whorl of branches to form a handle.

VI. PRUNING TO REDUCE TO REDUCE WILDLAND FIRE THREATS

A. Trees

Removing the lower limbs provides protection from fire, and allows for an increase in understory production

Pruning will be done during dormancy (fall, winter, early spring) or late summer.

Pruning in the spring or periods of active shoot elongation will be avoided. Pruning in pines should be accomplished after the new growth has elongated and the new growth hardens to woody material.

All trees exceeding 20 feet in height will have all limbs within 10 feet of the ground removed.

Remove no more than one-half of the live crown in one pruning.

B. Shrubs

All:

Cut out dead, diseased, or damaged branches. Cut back to healthy wood at the point of origin or back to a strong lateral branch or shoot below the injury or disease.

Remove all branches that cross or rub against each

other (These activities may open up the canopy sufficiently so that no further pruning is necessary).

Manzanita and other broad leafed evergreens:

Use the thinning out method to remove branches to open up the plant and make it more open and airy (this method allows for a more open plant while not stimulating excessive top growth and without changing the plants natural appearance or habit of growth.).

Deciduous shrubs:

Use gradual renewal pruning techniques:

Remove a few (no more than 1/4) of the oldest, tallest branches at or slightly above the ground.

Thin to shorten the longest branches or to maintain shape.

VII. DISPOSAL OF DEBRIS

See Forest Slash Disposal Specification 384.

VIII. SPECIAL CONSIDERATIONS

Do this unless otherwise noted. Pruning any pine limb releases primary attractants (odors) which may attract bark beetles, *Ips spp.*, on small diameter trees (less than 9 inch d.b.h.) and *Dendroctinous spp.*, mountain pine beetle, on large diameter trees (greater than 9 inch d.b.h.). When the threat of beetles is a consideration:

1. Timing of the pruning operation will coincide with the periods of lowest beetle activity, normally when temperatures are not conducive to beetle flights (November to March).
2. Slash treatment will follow guidance in Forest Stand Improvement Specification (666) to reduce the threat of population increases of beetles.

IX. BASIS OF ACCEPTANCE

After pruning has been completed, an on-site inspection with the Contractor to determine the condition of the trees and adherence with practice specifications.

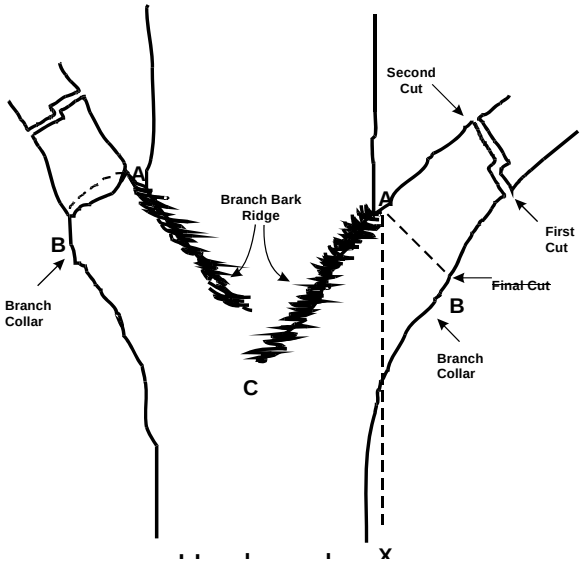
X. OPERATION AND MAINTENANCE

Inspect annually and reprune as needed for the prescribed purposes.

Prune plants damaged by storms or vandalism or ones with dead limbs as soon as possible to avoid additional insect and disease problems that may develop.

EXHIBIT A — HARDWOOD PRUNING

Trees and other woody plants respond in specific and predictable ways to pruning and other maintenance practices. Careful study of these responses by Dr. Alex Shigo has led to pruning practices which preserve and enhance the beauty, structural integrity, and functional value of trees. His research discovered that the collar is an area of tissue, which contains a chemically protective zone for the rest of the tree. Naturally, as a dead branch decays, the decay moves downward. It then meets an internal protected zone, with an area of very strong wood meeting an area of very weak wood. The branch then falls away at this point leaving a small area of decayed wood within the branch collar. This decay is walled off from the remainder of the tree by the collar. If the collar is removed, the protective zone is also removed. Wood-decay fungi can easily infect the trunk. If the branch is living, removing the collar also still causes injury and can allow entry by fungi.



Pruning Techniques:

When cutting branches over 1-½ inches in diameter use the three-part cut technique:

Step 1: Locate the branch bark ridge and collar. Find the outside edge of the bark ridge (A). Then locate the swelling where the branch meets the branch collar (B). Move up the branch 6 to 12 inches from this point. If no collar is visible, the angle of the cut should approximate the angle formed by the branch bark ridge and the trunk. *(Figure angle X-A-B)*

Step 2. Saw an undercut from the bottom of the branch about one third of the way through the limb. Make a second cut on the top about 1 to 3 inches further from the undercut until the branch falls away.

Step 3. Remove the stub by carefully cutting along angle XAB. Pruning cuts should be clean and smooth with the bark at the edge of the cut firmly attached to the wood.

When removing a dead branch, the final cut should be made outside the collar of live callus tissue. If the collar has grown out along the branch stub, only the dead stub should be removed, the live collar should remain intact, and uninjured.

Large or heavy branches that cannot be thrown clear should be lowered on ropes to prevent injury to the tree or other property.

Wound dressings and tree paints have not been shown to be effective in preventing or reducing decay. Therefor, they are not recommended for use when pruning.

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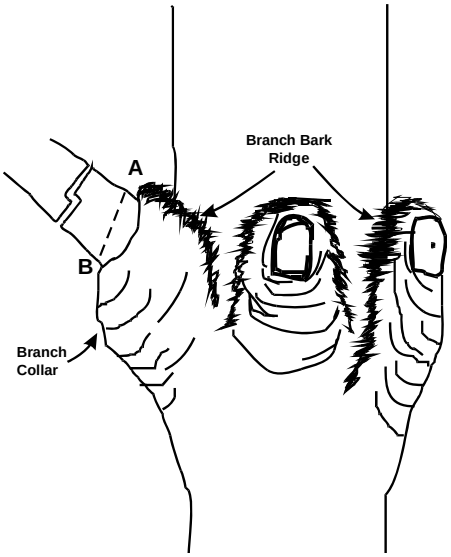
EXHIBIT B — CONIFER PRUNING

Trees and other woody plants respond in specific and predictable ways to pruning and other maintenance practices. Careful study of these responses by Dr. Alex Shigo has led to pruning practices which preserve and enhance the beauty, structural integrity, and functional value of trees. His research discovered that the collar is an area of tissue, which contains a chemically protective zone for the rest of the tree. Naturally, as a dead branch decays, the decay moves downward. It then meets an internal protected zone, with an area of very strong wood meeting an area of very weak wood. The branch then falls away at this point leaving a small area of decayed wood within the branch collar. This decay is walled off from the remainder of the tree by the collar. If the collar is removed the protective zone is also removed. Wood-decay fungi can easily infect the trunk. If the branch is living removing the collar also still causes injury and can allow entry by fungi.



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Step 2. Saw an undercut from the bottom of the branch about one third of the way through the limb. Make a second cut on the top about 1 to 3 inches further from the undercut until the branch falls away.

Step 3. Remove the stub by carefully cutting along angle XAB. Pruning cuts should be clean and smooth with the bark at the edge of the cut firmly attached to the wood.

When removing a dead branch, the final cut should be made outside the collar of live callus tissue. If the collar has grown out along the branch stub, only the dead stub should be removed, the live collar should remain intact, and uninjured.

Large or heavy branches that cannot be thrown clear should be lowered on ropes to prevent injury to the tree or other property.

Wound dressings and tree paints have not been shown to be effective in preventing or reducing decay. Therefore they are not recommended for use when pruning.

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U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
660 - TREE / SHRUB PRUNING

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS.

1. Drawings, No._____ _____ _____

2. Practice Specifications: 660 , 384 _____,_____,_____

3. Species to be Pruned:_____

4. Dates of Pruning:_____

5. Numbers of Trees per Acre to be Pruned:_____

6. Special Instructions:_____

_____

_____

7. Maintenance: _____

_____

_____

PRACTICE SPECIFICATION PREPRATION:

Prepared By:_____ Date:_____

_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date: _____

STATEMENT OF WORK
Tree/Shrub Pruning (660)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Practice standard criteria-related computations and analyses to develop plans and specifications including but not limited to:
        i. Determination of woody plants to be treated to achieve intended purpose(s)
        ii. Minimum and maximum crown/branch removals by individual plant types and species
        iii. Mitigation measures (e.g., slash and debris disposal) to minimize wildfire hazard and attraction of pests
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Documentation of needed operation and maintenance.
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations.
5. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre-application conference with client.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Application guidance as needed.
5. Facilitate and implement required design modifications with client and original designer.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the application process and materials meet design and permit requirements.

CHECK OUT

Deliverables

1. Records of application.
    a. Extent of practice units applied
    b. Mitigation measures used and applied
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits.
3. Progress reporting.

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Tree/Shrub Pruning, 660
- NRCS National Forestry Handbook (NFH), Part 636.4
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook