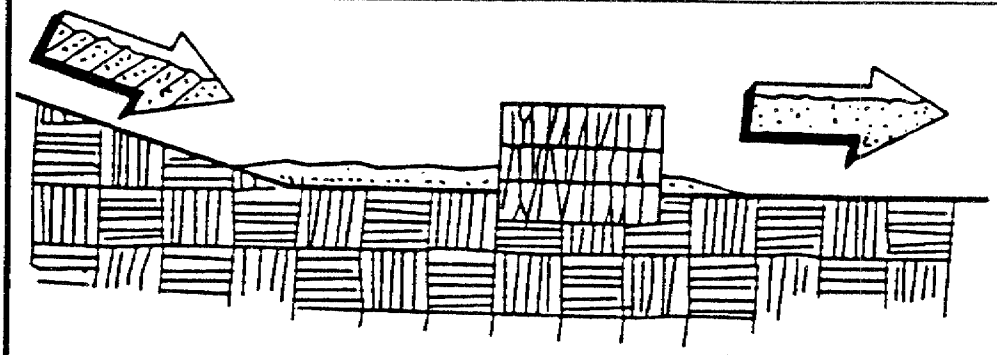
ATTACHMENT "A"

BMP'S, BAT'S AND BCT'S

BMP: STRAW BALE BARRIERS



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- **Control Site Perimeter**
- **Control Internal Erosion**

GENERAL DEFINITION

A straw bale barrier consists of straw bales placed end to end along a level contour in a shallow trench and staked to hold them in place. The barrier detains runoff, creating a pond behind the barrier where sedimentation occurs.

SUITABLE APPLICATIONS

- Along the perimeter of the site.
- Along streams and channels.
- Across swales with small catchments.
- Around temporary spoil areas.
- Below other small, cleared areas.

INSTALLATION/APPLICATION CRITERIA

- Use primarily in areas where sheet or rill flow occurs.
- No more than 1/4 acre per 100 feet of barrier should drain to the barrier.
- Install along a level contour.
- Place in a 4-inch deep trench.
- Backfill and compact the excavated soil on the upstream face of the barrier.
- Secure each bale with two stakes.
- Leave enough area (about 1200 sq. ft. per acre) behind the barrier for runoff to pond (no more than 1.5 ft. depth) and sediment to settle.

REQUIREMENTS

- Maintenance
  - Inspect weekly and after each rain.
  - Replace bales which have decomposed or whose bindings have broken.
  - Remove sediment behind the barrier when it reaches a depth of 6 inches.
- Costs (source: EPA, 1992)
  - Average annual cost for installation and maintenance (assumes 3 month useful life): $17 per lineal foot ($6,800 per drainage acre).

LIMITATIONS

- Straw bale barriers are not to be used for extended periods of time because they tend to rot and fall apart.
- Suitable only for sheet flow on slopes of 2% or flatter.
- Not appropriate for large drainage areas, limit to one acre or less.
- Straw bales lose their effectiveness rapidly due to rotting, thus constant maintenance is required.
- Not recommended for concentrated flow, inlet protection, channel flow, and live streams.
- Bale bindings of jute or cotton not recommended.

Targeted Pollutants

- ● Sediment
- ○ Nutrients
- ○ Toxic Materials
- ○ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

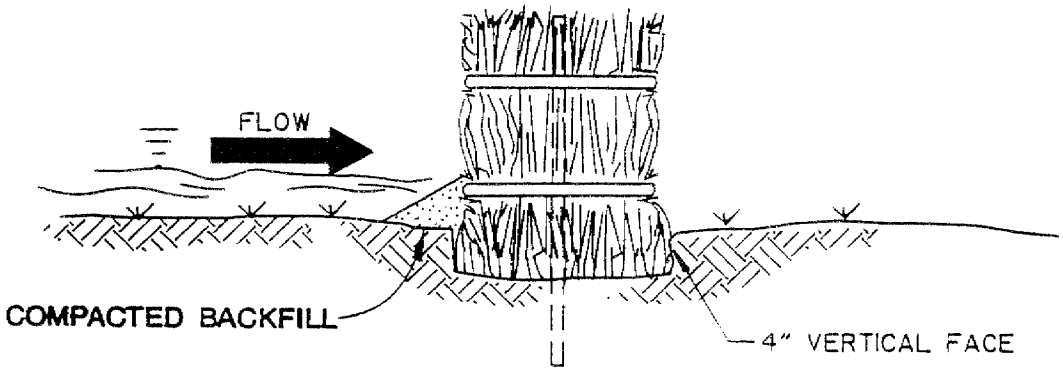
Implementation Requirements

- ● Capital Costs
- ● O&M Costs
- ● Maintenance
- ○ Training
- ○ Suitibility for Slopes >5%

● High ○ Low

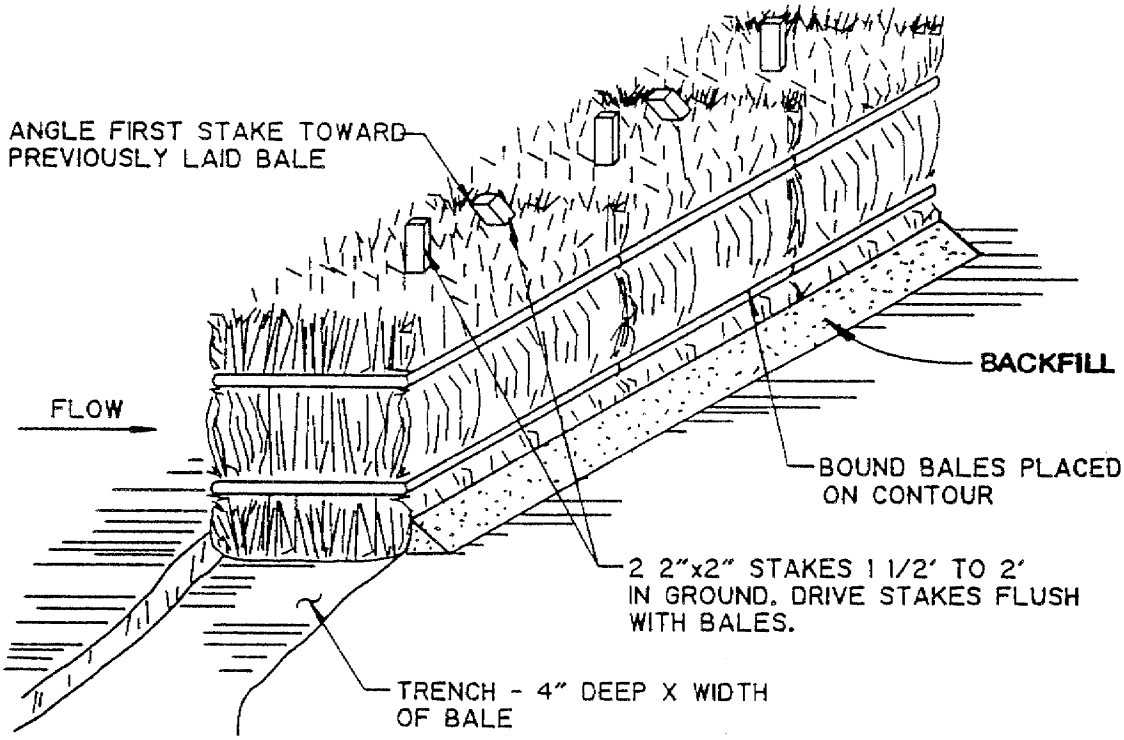
ESC51

Best Management Practices



- PROMOTES ON SITE SEDIMENTATION BY CREATING A TEMPORARY POND.

BEDDING DETAIL



SUBSTITUTION OF STEEL BARS FOR WOODEN STAKES IS NOT RECOMMENDED DUE TO POTENTIAL FOR DAMAGING CONSTRUCTION EQUIPMENT

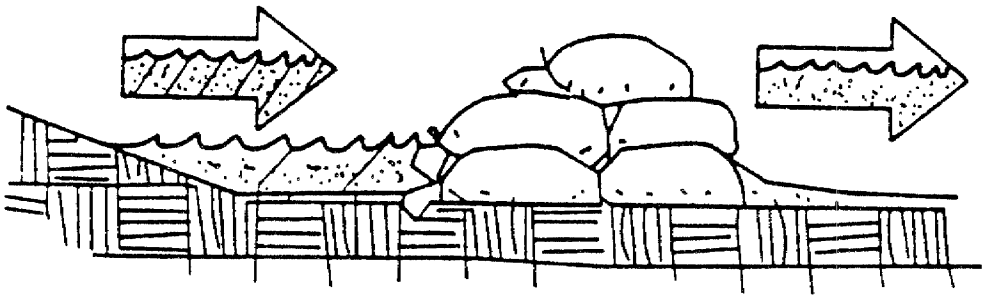
ANCHORING DETAIL

STRAW BALE BARRIERS

ESC51

Best Management Practices

BMP: SAND BAG BARRIER



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- (Protect Slopes/Channels)
- (Control Site Perimeter)
- (Control Internal Erosion)

GENERAL DEFINITION

Stacking sand bags along a level contour creates a barrier which detains sediment-laden water, ponding water upstream of the barrier and promoting sedimentation.

SUITABLE APPLICATIONS

- Along the perimeter of the site.
- Check dams across streams and channels.
- Along streams and channels.
- Barrier for utility trenches in a channel.
- Across swales with small catchments.
- Division dike or berm.
- Below the toe of a cleared slope.
- Create a temporary sediment trap.
- Around temporary spoil areas.
- Below other small cleared areas.

INSTALLATION/APPLICATION CRITERIA

- May be used in drainage areas up to 5 acres.
- Install along a level contour.
- Base of sand bag barrier should be at least 48 inches wide.
- Height of sand bag barrier should be at least 18 inches high.
- 4 inch PVC pipe may be installed between the top layer of sand bags to drain large flood flows.
- Provide area behind barrier for runoff to pond and sediment to settle, size according to sediment trap BMP criteria (ESC55).
- Place <u>below</u> the toe of a slope.
- Use sand bags large enough and sturdy enough to withstand major flooding.

REQUIREMENTS

- Maintenance
  - Inspect after each rain.
  - Reshape or replace damaged sand bags immediately.
  - Remove sediment when it reaches six inches in depth.
- Cost
  - Sand bag barriers are more costly, but typically have a longer useful life than other barriers.

LIMITATIONS

- Sand bags are more expensive than other barriers, but also more durable.
- Burlap should not be used for sand bags.

Targeted Pollutants

- ● Sediment
- ○ Nutrients
- ○ Toxic Materials
- ○ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

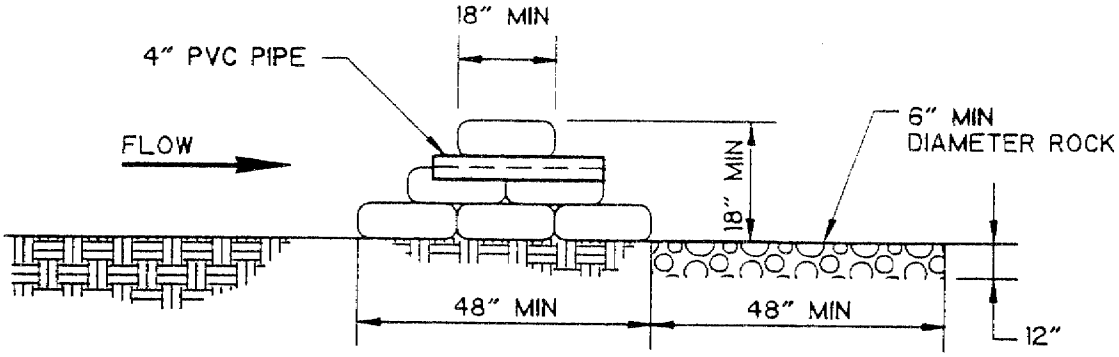
Implementation Requirements

- ● Capital Costs
- ○ O&M Costs
- ○ Maintenance
- ○ Training
- ◒ Suitability for Slopes >5%

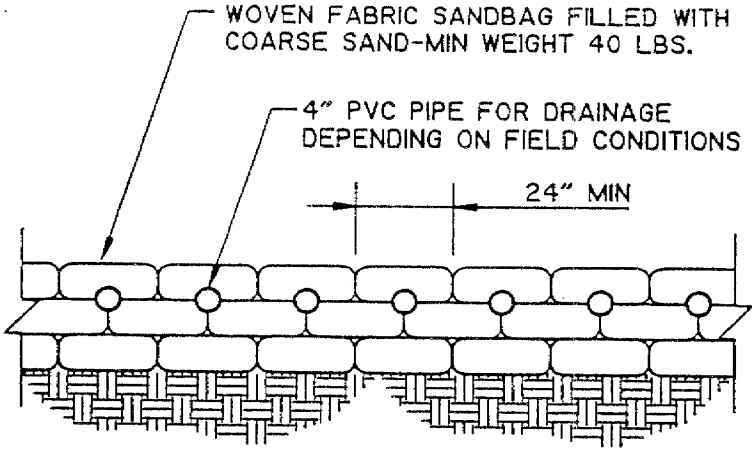
● High ○ Low

ESC52

Best Management Practices



CROSS-SECTION



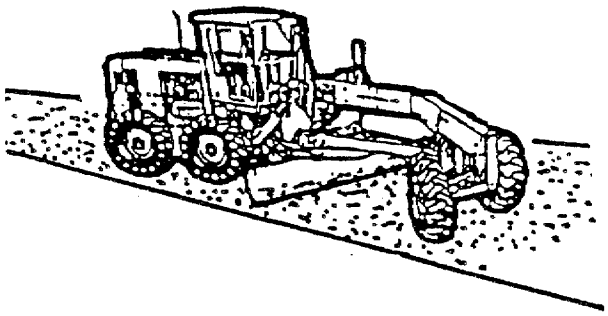
FRONT VIEW

SAND BAG BERM

ESC52

Best Management Practices

BMP: CONSTRUCTION ROAD STABILIZATION



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

GENERAL DESCRIPTION

Access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes should be stabilized immediately after grading and frequently maintained to prevent erosion and control dust.

SUITABLE APPLICATIONS

- Temporary construction traffic.
- Phased construction projects and off-site road access.
- Detour roads.
- Construction during wet weather.

INSTALLATION/APPLICATION CRITERIA

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15 percent.
- Gravel roads should be a minimum 4-inch thick, 2-3 inch coarse aggregate base applied immediately after grading, or as recommended by soils engineer.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (see Dust Control ESC 21).

REQUIREMENTS

- Maintenance
  - Periodically apply additional aggregate on gravel roads.
  - Active dirt construction roads are commonly watered three or more times per day during the dry season.
  - Inspect weekly, and after each rain.
  - Repair any eroded areas immediately.
- Cost
  - Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay.
  - No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

LIMITATIONS

- The roadway must be removed or paved when construction is complete.
- Certain chemical stabilization methods may cause storm water or soil pollution and should not be used (see Dust Control ESC 21).
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.

Targeted Pollutants

- ● Sediment
- ○ Nutrients
- ○ Toxic Materials
- ○ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

- ◒ Capital Costs
- ◒ O&M Costs
- ◒ Maintenance
- ○ Training
- ◒ Suitability for Slopes >5%

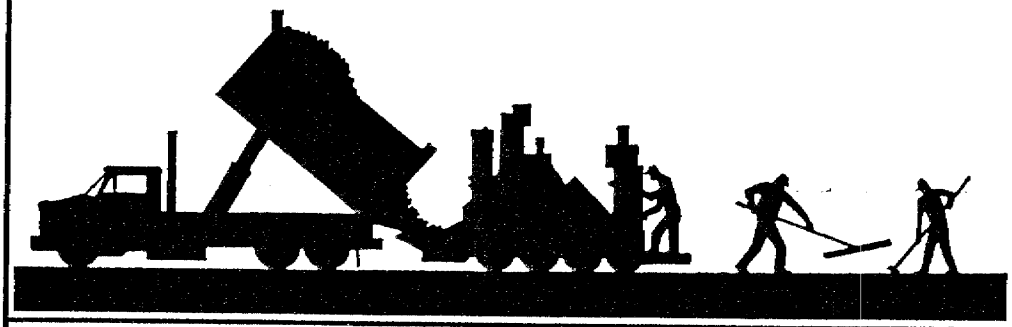
● High ○ Low

ESC23

Best Management Practices

ACTIVITY: PAVING OPERATIONS

Graphic: North Central Texas COG, 1993



DESCRIPTION

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

APPROACH

- Avoid paving during wet weather.
- Store materials away from drainage courses to prevent storm water runon (see CA10 Material Delivery and Storage).
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or trap/filter sediment (see Chapter 5).
- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials rather than burying. See CA32 (Vehicle and Equipment Maintenance) and CA12 (Spill Prevention and Control) in this chapter.
- Cover catch basins and manholes when applying seal coat, tack coat, slurry seal, fog seal, etc.
- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- If paving involves portland cement concrete, see CA23 (Concrete Waste Management) in this chapter.
- If paving involves asphaltic concrete, follow these steps:
  - Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks by sweeping. Properly dispose of this waste by referring to CA20 (Solid Waste Management) in this chapter.
  - Old asphalt must be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.
  - If paving involves on-site mixing plant, follow the storm water permitting requirements for industrial activities.
- Train employees and subcontractors.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above are low cost measures.
- Maintenance
  - Inspect employees and subcontractors to ensure that measures are being followed.
  - Keep ample supplies of drip pans or absorbent materials on-site.

LIMITATIONS

- There are no major limitations to this best management practice.

Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

Targeted Pollutants

- ◒ Sediment
- ○ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

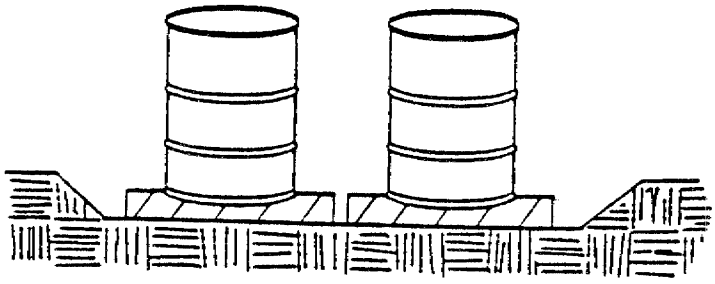
- ○ Capital Costs
- ○ O&M Costs
- ◒ Maintenance
- ◒ Training
- ○ Suitability for Slopes >5%

● High ○ Low

CA2

Best Management Practices

ACTIVITY: MATERIAL DELIVERY AND STORAGE



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from material delivery and storage by minimizing the storage of hazardous materials on-site, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see CA11 (Material Use), or CA12 (Spill Prevention and Control). For information on wastes, see the waste management BMPs in this chapter.

APPROACH

The following materials are commonly stored on construction sites:

- Soil,
- Pesticides and herbicides,
- Fertilizers,
- Detergents,
- Plaster or other products,
- Petroleum products such as fuel, oil, and grease, and
- Other hazardous chemicals such as acids, lime, glues, paints, solvents, and curing compounds.

Storage of these materials on-site can pose the following risks:

- Storm water pollution,
- Injury to workers or visitors,
- Groundwater pollution, and
- Soil contamination.

Therefore, the following steps should be taken to minimize your risk:

- Designate areas of the construction site for material delivery and storage.
  - Place near the construction entrances, away from waterways
  - Avoid transport near drainage paths or waterways
  - Surround with earth berms (see ESC30, Earth Dike.)
  - Place in an area which will be paved
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.
- Keep an accurate, up-to-date inventory of materials delivered and stored on-site.
- Keep your inventory down.

Targeted Pollutants

- ◒ Sediment
- ◒ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ◒ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

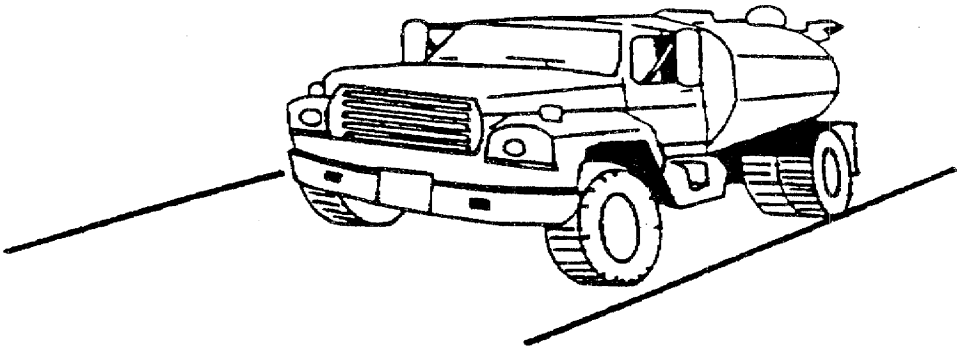
- ○ Capital Costs
- ○ O&M Costs
- ○ Maintenance
- ◒ Training
- ○ Suitability for Slopes >5%

● High ○ Low

CA10

Best Management Practices

BMP: DUST CONTROLS



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

GENERAL DESCRIPTION

Dust control measures are used to stabilize soil from wind erosion, and reduce dust generated by construction activities.

SUITABLE APPLICATIONS

- Clearing and grading activities.
- Construction vehicle traffic on unpaved roads.
- Drilling and blasting activities.
- Sediment tracking onto paved roads.
- Soil and debris storage piles.
- Batch drop from front end loaders.
- Areas with unstabilized soil.
- Final grading/site stabilization usually is sufficient to control post-construction dust sources.

INSTALLATION/APPLICATION CRITERIA

- Schedule construction activities to minimize exposed area (See ESC 1).
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling, and stone/gravel layering (See ESC 10 and 11).
- Identify and stabilize key access points prior to commencement of construction (See ESC 24).
- Minimizing the impact of dust by anticipating the direction of prevailing winds.
- Direct most construction traffic to stabilized roadways within the project site (See ESC 23).

REQUIREMENTS

- Maintenance
  - Most dust control measures require frequent, often daily, attention.
- Cost
  - Installation costs for water/chemical dust suppression are low, but annual costs may be quite high since these measures are effective for only a few hours to a few days.

LIMITATIONS

- Watering prevents dust only for a short period and should be applied daily (or more often) to be effective.
- Overwatering may cause erosion.
- Oil should not be used for dust control because the oil may migrate into drainageway and/or seep into the soil.
- Certain chemically-treated subgrades may make soil water repellant, increasing runoff.

Targeted Pollutants

- ● Sediment
- ○ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

- ○ Capital Costs
- ◒ O&M Costs
- ◒ Maintenance
- ○ Training
- ○ Suitability for Slopes >5%

● High ○ Low

ESC21

Best Management Practices

TABLE ESC 21.1 DUST CONTROL BMPs FOR GIVEN SITE CONDITIONS

SITE CONDITION	DUST CONTROL BMPs								
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt Surfacing	Sand Fences	Temporary Gravel Construction Entrances/Equipment Wash Down	Haul Truck Covers	Minimize Extent of Area Disturbed
Disturbed Areas not Subject to Traffic	X	X	X	X	X				X
Disturbed Areas Subject to Traffic			X	X	X				X
Material Stock Pile Stabilization			X	X		X			X
Demolition			X				X	X	
Clearing/Excavation			X	X					X
Truck Traffic on Unpaved Roads			X	X	X			X	
Mud/Dirt Carry-Out					X		X		

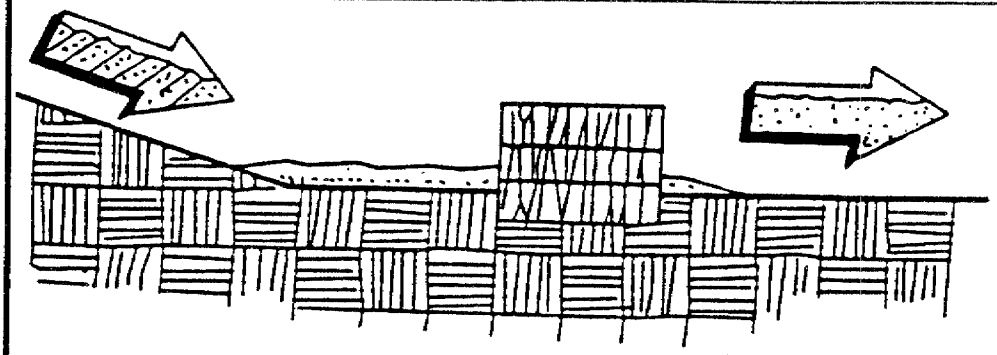
TABLE ESC 21.2 COMMONLY USED CHEMICALS FOR DUST CONTROL

	SALTS	ORGANIC, NON PETROLEUM-BASED	PETROLEUM BASED PRODUCTS[1]
CHEMICAL TYPES	• Calcium Chloride[2] • Magnesium Chloride • Natural Brines	• Calcium Lignosulfonate • Sodium Lignosulfonate • Ammonium Lignosulfonate	• Bunker Oil • Asphalt Primer • Emulsified Asphalt
LIMITATIONS	Can lose effectiveness in dry periods with low humidity. Leaches from road in heavy rain Not recommended for gravel road surfaces with low fines. Recommended 10-20% fines.	Not affected by dry weather and low humidity. Leached from road in heavy rain if not sufficiently cured. Best performance on gravel roads with high surface fines (10-30%) and dense compact surface with loose gravel.	Generally effective regardless of climatic conditions may pothole in wet weather. Best performance on gravel roads with 5-10% fines.
COMMENTS	Calcium Chloride is popular. May become slippery when wet on gravel surfaces with high fines.	Ineffective on gravel surfaces low in fines. May become slippery when wet on gravel surfaces with high fines content.	Creates a hardened crust.

[1] Motor oils and oil treatments are not recommended due to adverse effects on plant life and groundwater.

[2] Not recommended due to adverse effects on plant life.

BMP: STRAW BALE BARRIERS



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- **Control Site Perimeter**
- **Control Internal Erosion**

GENERAL DEFINITION

A straw bale barrier consists of straw bales placed end to end along a level contour in a shallow trench and staked to hold them in place. The barrier detains runoff, creating a pond behind the barrier where sedimentation occurs.

SUITABLE APPLICATIONS

- Along the perimeter of the site.
- Along streams and channels.
- Across swales with small catchments.
- Around temporary spoil areas.
- Below other small, cleared areas.

INSTALLATION/APPLICATION CRITERIA

- Use primarily in areas where sheet or rill flow occurs.
- No more than 1/4 acre per 100 feet of barrier should drain to the barrier.
- Install along a level contour.
- Place in a 4-inch deep trench.
- Backfill and compact the excavated soil on the upstream face of the barrier.
- Secure each bale with two stakes.
- Leave enough area (about 1200 sq. ft. per acre) behind the barrier for runoff to pond (no more than 1.5 ft. depth) and sediment to settle.

REQUIREMENTS

- Maintenance
  - Inspect weekly and after each rain.
  - Replace bales which have decomposed or whose bindings have broken.
  - Remove sediment behind the barrier when it reaches a depth of 6 inches.
- Costs (source: EPA, 1992)
  - Average annual cost for installation and maintenance (assumes 3 month useful life): $17 per lineal foot ($6,800 per drainage acre).

LIMITATIONS

- Straw bale barriers are not to be used for extended periods of time because they tend to rot and fall apart.
- Suitable only for sheet flow on slopes of 2% or flatter.
- Not appropriate for large drainage areas, limit to one acre or less.
- Straw bales lose their effectiveness rapidly due to rotting, thus constant maintenance is required.
- Not recommended for concentrated flow, inlet protection, channel flow, and live streams.
- Bale bindings of jute or cotton not recommended.

Targeted Pollutants

- ● Sediment
- ○ Nutrients
- ○ Toxic Materials
- ○ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

- ● Capital Costs
- ● O&M Costs
- ● Maintenance
- ○ Training
- ○ Suitibility for Slopes >5%

● High ○ Low

ESC51

Best Management Practices

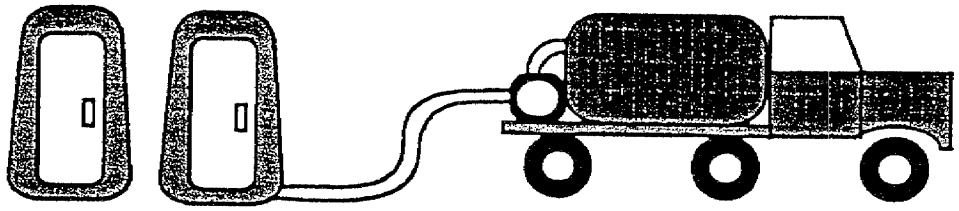
TABLE ESC 21.2 COMMONLY USED CHEMICALS FOR DUST CONTROL

	SALTS	ORGANIC, NON PETROLEUM-BASED	PETROLEUM BASED PRODUCTS[1]
CHEMICAL TYPES	• Calcium Chloride[2] • Magnesium Chloride • Natural Brines	• Calcium Lignosulfonate • Sodium Lignosulfonate • Ammonium Lignosulfonate	• Bunker Oil • Asphalt Primer • Emulsified Asphalt
LIMITATIONS	Can lose effectiveness in dry periods with low humidity. Leaches from road in heavy rain Not recommended for gravel road surfaces with low fines. Recommended 10-20% fines.	Not affected by dry weather and low humidity. Leached from road in heavy rain if not sufficiently cured. Best performance on gravel roads with high surface fines (10-30%) and dense compact surface with loose gravel.	Generally effective regardless of climatic conditions may pothole in wet weather. Best performance on gravel roads with 5-10% fines.
COMMENTS	Calcium Chloride is popular. May become slippery when wet on gravel surfaces with high fines.	Ineffective on gravel surfaces low in fines. May become slippery when wet on gravel surfaces with high fines content.	Creates a hardened crust.

[1] Motor oils and oil treatments are not recommended due to adverse effects on plant life and groundwater.

[2] Not recommended due to adverse effects on plant life.

ACTIVITY: SANITARY/SEPTIC WASTE MANAGEMENT



Objectives

Housekeeping Practices

Contain Waste

Minimize Disturbed Areas

Stabilize Disturbed Areas

Protect Slopes/Channels

Control Site Perimeter

Control Internal Erosion

DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from sanitary/septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

APPROACH

Sanitary or septic wastes should be treated or disposed of in accordance with State and local requirements. These requirements may include:

- Locate sanitary facilities in a convenient location.
- Untreated raw wastewater should never be discharged or buried.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an on-site disposal system (OSDS), such as a septic system, comply with local health agency requirements.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- If discharging to the sanitary sewer, contact the local wastewater treatment plant for their requirements.
- Sanitary/septic facilities should be maintained in good working order by a licensed service.
- Arrange for regular waste collection by a licensed hauler before facilities overflow.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above are low cost measures.
- Maintenance
  - Inspect facilities regularly.
  - Arrange for regular waste collection.

LIMITATIONS

- There are no major limitations to this best management practice.

REFERENCES

Best Management Practices and Erosion Control Manual for Construction Sites; Flood Control District of Maricopa County, AZ, September 1992.

Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Targeted Pollutants

- ○ *Sediment*
- ○ *Nutrients*
- ○ *Toxic Materials*
- ○ *Oil & Grease*
- ○ *Floatable Materials*
- ◒ *Other Construction Waste*

- ● *Likely to Have Significant Impact*
- ○ *Probable Low or Unknown Impact*

Implementation Requirements

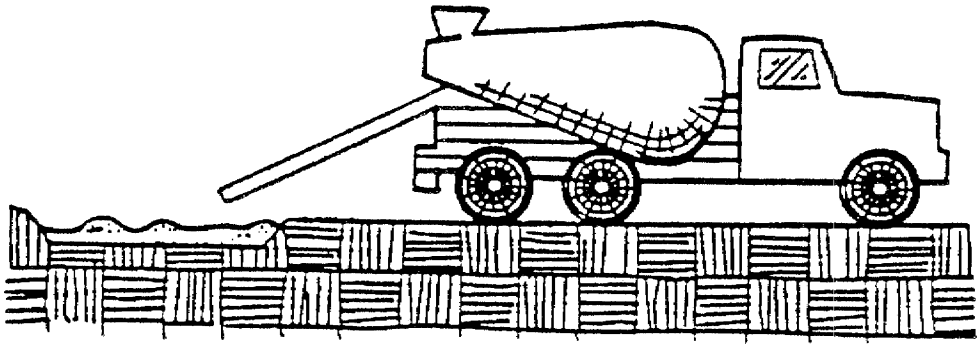
- ○ *Capital Costs*
- ○ *O&M Costs*
- ◒ *Maintenance*
- ○ *Training*
- ○ *Suitability for Slopes >5%*

● *High* ○ *Low*

CA24

Best Management Practices

ACTIVITY: CONCRETE WASTE MANAGEMENT



Objectives

Housekeeping Practices

Contain Waste

Minimize Disturbed Areas

Stabilize Disturbed Areas

Protect Slopes/Channels

Control Site Perimeter

Control Internal Erosion

DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from concrete waste by conducting washout off-site, performing on-site washout in a designated area, and training employees and subcontractors.

APPROACH

The following steps will help reduce storm water pollution from concrete wastes:

- Store dry and wet materials under cover, away from drainage areas.
- Avoid mixing excess amounts of fresh concrete or cement on-site.
- Perform washout of concrete trucks off site or in designated areas only.
- Do not wash out concrete trucks into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped on-site, except in designated areas.
- For on-site washout:
  - locate washout area at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste;
  - wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed of properly.
- When washing concrete to remove fine particles and expose the aggregate, avoid creating runoff by draining the water to a bermed or level area.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.
- Train employees and subcontractors in proper concrete waste management.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above are low cost measures.
- Maintenance
  - Inspect subcontractors to ensure that concrete wastes are being properly managed.
  - If using a temporary pit, dispose hardened concrete on a regular basis.

LIMITATIONS

- Off-site washout of concrete wastes may not always be possible.

Targeted Pollutants

- ○ *Sediment*
- ○ *Nutrients*
- ○ *Toxic Materials*
- ○ *Oil & Grease*
- ○ *Floatable Materials*
- ◒ *Other Construction Waste*

- ● *Likely to Have Significant Impact*
- ○ *Probable Low or Unknown Impact*

Implementation Requirements

- ○ *Capital Costs*
- ○ *O&M Costs*
- ◒ *Maintenance*
- ◒ *Training*
- ○ *Suitability for Slopes >5%*

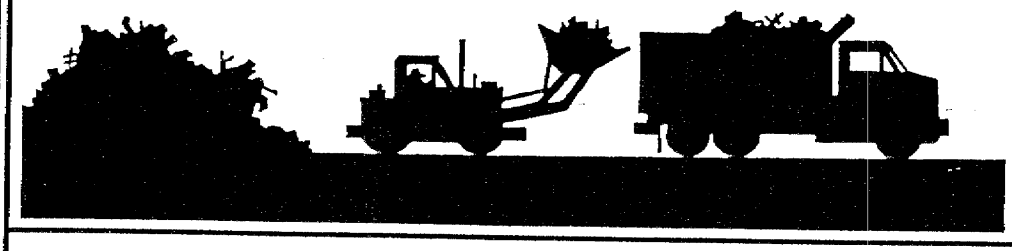
● *High* ○ *Low*

CA23

Best Management Practices

ACTIVITY: SOLID WASTE MANAGEMENT

Graphic: North Central Texas COG, 1993



DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

APPROACH

Solid waste is one of the major pollutants resulting from construction. Construction debris includes:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction;
- Packaging materials including wood, paper and plastic;
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products; and
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, and plastic wrappers, and cigarettes.

The following steps will help keep a clean site and reduce storm water pollution:

- Select designated waste collection areas on-site.
- Inform trash hauling contractors that you will accept only water-tight dumpsters for on-site use. Inspect dumpsters for leaks and repair any dumpster that is not water tight.
- Locate containers in a covered area and/or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it's windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Erosion and sediment control devices tend to collect litter. Remove this solid waste promptly.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Salvage or recycle any useful material. For example, trees and shrubs from land clearing can be used as a brush barrier (see ESC53), or converted into wood chips, then used as mulch on graded areas (see ESC11).
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to trash hauling contractor.
- Arrange for regular waste collection before containers overflow.

Objectives

- Housekeeping Practices
- **Contain Waste**
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

Targeted Pollutants

- ◒ Sediment
- ○ Nutrients
- ○ Toxic Materials
- ○ Oil & Grease
- ● Floatable Materials
- ● Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

- ○ Capital Costs
- ○ O&M Costs
- ◒ Maintenance
- ◒ Training
- ○ Suitability for Slopes >5%

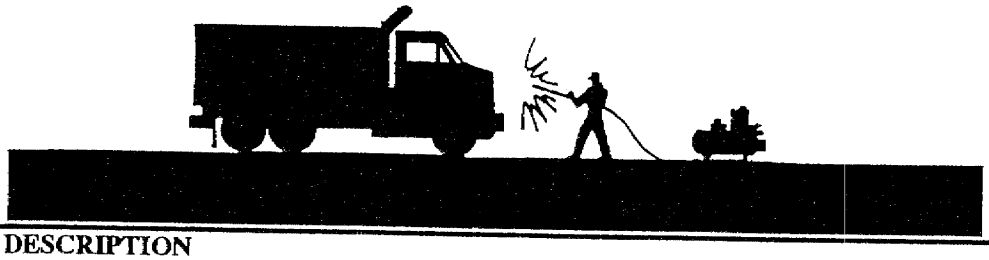
● High ○ Low

CA20

Best Management Practices

ACTIVITY: VEHICLE AND EQUIPMENT CLEANING

Graphic: North Central Texas COG, 1993



DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from vehicle and equipment cleaning by using off-site facilities, washing in designated, contained areas only, eliminating discharges to the storm drain by infiltrating or recycling the wash water, and/or training employees and subcontractors.

APPROACH

- Use off-site commercial washing businesses as much as possible. Washing vehicles and equipment outdoors or in areas where wash water flows onto paved surfaces or into drainage pathways can pollute storm water. If you wash a large number of vehicles or pieces of equipment, consider conducting this work at an off-site commercial business. These businesses are better equipped to handle and dispose of the wash waters properly. Performing this work off-site can also be economical by eliminating the need for a separate washing operation at your site.
- If washing must occur on-site, use designated, bermed wash areas to prevent wash water contact with storm water, creeks, rivers, and other water bodies. The wash area can be sloped for wash water collection and subsequent infiltration into the ground.
- Use as little water as possible to avoid having to install erosion and sediment controls for the wash area.
- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning on-site. Steam cleaning can generate significant pollutant concentrations.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above are low cost measures.
- Maintenance
  - Minimal, some berm repair may be necessary.

LIMITATIONS

- Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades.
- Sending vehicles/equipment off-site should be done in conjunction with ESC24 (Stabilized Construction Entrance).

REFERENCE

Swisher, R.D., 1987. Surfactant Biodegradation, Marcel Decker Corporation

Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

Targeted Pollutants

- ○ Sediment
- ○ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

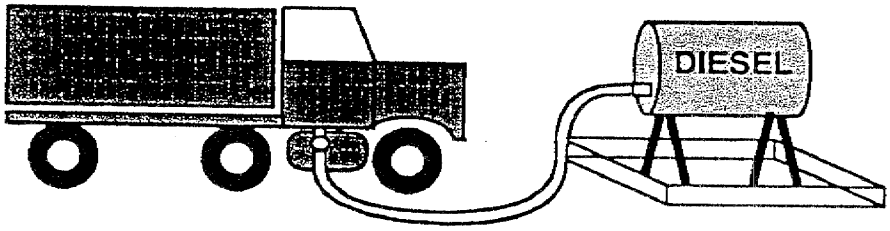
- ◒ Capital Costs
- ○ O&M Costs
- ◒ Maintenance
- ○ Training
- ○ Suitability for Slopes >5%

● High ○ Low

CA30

Best Management Practices

ACTIVITY: VEHICLE AND EQUIPMENT FUELING



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

DESCRIPTION

Prevent fuel spills and leaks, and reduce their impacts to storm water by using off-site facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors.

APPROACH

- Use off-site fueling stations as much as possible. Fueling vehicles and equipment outdoors or in areas where fuel may spill/leak onto paved surfaces or into drainage pathways can pollute storm water. If you fuel a large number of vehicles or pieces of equipment, consider using an off-site fueling station. These businesses are better equipped to handle fuel and spills properly. Performing this work off-site can also be economical by eliminating the need for a separate fueling area at your site.
- If fueling must occur on-site, use designated areas, located away from drainage courses, to prevent the runon of storm water and the runoff of spills.
- Discourage "topping-off" of fuel tanks.
- Always use secondary containment, such as a drain pan or drop cloth, when fueling to catch spills/leaks.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Use adsorbent materials on small spills rather than hosing down or burying the spill. Remove the adsorbent materials promptly and dispose of properly.
- Carry out all Federal and State requirements regarding stationary above ground storage tanks.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and perhaps forklifts, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above measures are low cost, except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.
- Maintenance
  - Keep ample supplies of spill cleanup materials on-site.
  - Inspect fueling areas and storage tanks on a regular schedule.

LIMITATIONS

- Sending vehicles/equipment off-site should be done in conjunction with ESC24 (Stabilized Construction Entrance).

Targeted Pollutants

- ○ Sediment
- ○ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

- ◒ Capital Costs
- ○ O&M Costs
- ◒ Maintenance
- ◒ Training
- ○ Suitability for Slopes >5%

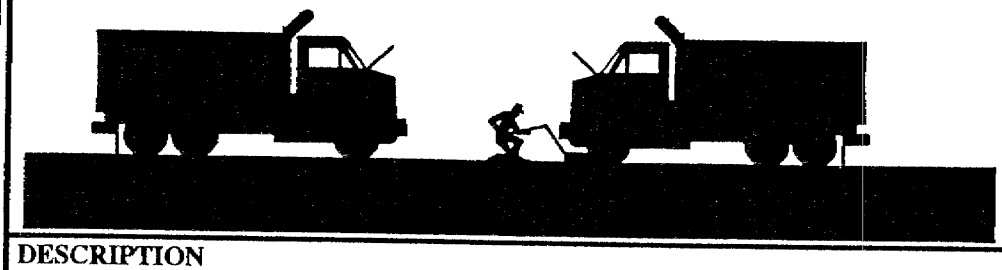
● High ○ Low

CA31

Best Management Practices

ACTIVITY: VEHICLE AND EQUIPMENT MAINTENANCE

Graphic: North Central Texas COG, 1993



Objectives

- Housekeeping Practices
- Contain Waste
- Minimize Disturbed Areas
- Stabilize Disturbed Areas
- Protect Slopes/Channels
- Control Site Perimeter
- Control Internal Erosion

DESCRIPTION

Prevent or reduce the discharge of pollutants to storm water from vehicle and equipment maintenance by running a "dry site". This involves using off-site facilities, performing work in designated areas only, providing cover for materials stored outside, checking for leaks and spills, containing and cleaning up spills immediately, and training employees and subcontractors.

APPROACH

- Keep vehicles and equipment clean, don't allow excessive build-up of oil and grease.
- Use off-site repair shops as much as possible. Maintaining vehicles and equipment outdoors or in areas where vehicle or equipment fluids may spill or leak onto the ground can pollute storm water. If you maintain a large number of vehicles or pieces of equipment, consider using an off-site repair shop. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work off-site can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur on-site, use designated areas, located away from drainage courses, to prevent the runon of storm water and the runoff of spills.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Use adsorbent materials on small spills rather than hosing down or burying the spill. Remove the adsorbent materials promptly and dispose of properly.
- Regularly inspect on-site vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment on-site.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic, and transmission fluids.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- For a quick reference on disposal alternatives for specific wastes, see Table 4.2, CA40, Employee/Subcontractor Training.

REQUIREMENTS

- Costs (Capital, O&M)
  - All of the above are low cost measures.
- Maintenance
  - Keep ample supplies of spill cleanup materials on-site.
  - Inspect maintenance areas on a regular schedule.

Targeted Pollutants

- ○ Sediment
- ○ Nutrients
- ◒ Toxic Materials
- ◒ Oil & Grease
- ○ Floatable Materials
- ○ Other Construction Waste

- ● Likely to Have Significant Impact
- ○ Probable Low or Unknown Impact

Implementation Requirements

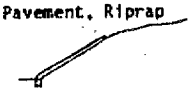
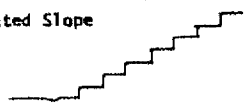
- ○ Capital Costs
- ○ O&M Costs
- ○ Maintenance
- ◒ Training
- ○ Suitability for Slopes >5%

● High ○ Low

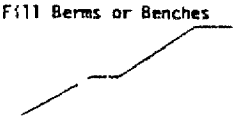
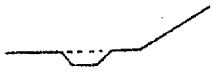
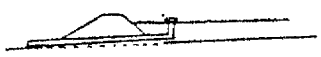
CA32

Best Management Practices

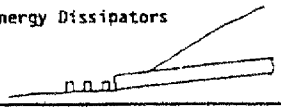
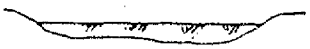
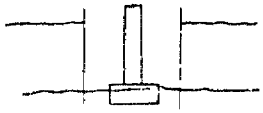
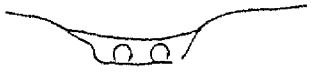
Erosion Control Measures (Continued)

Treatment Practice	Advantages	Problems
CUT SLOPES		
Berm @ top of cut 	Diverts water from cut Collects water for slope drains/paved ditches May be constructed before grading is started	Access to top of cut Difficult to build on steep natural slope or rock surface Concentrates water and may require channel protection or energy dissipation devices Can cause water to enter ground, resulting in sloughing of the cut slope
Diversion Dike 	Collects and diverts water at a location selected to reduce erosion potential May be incorporated in the permanent project drainage	Access for construction May be continuing maintenance problem if not paved or protected Disturbed material or berm is easily eroded
Slope Benches 	Slows velocity of surface runoff Collects sediment Provides access to slope for seeding, mulching, and maintenance Collects water for slope drains or may divert water to natural ground	May cause sloughing of slopes if water infiltrates Requires additional ROW Not always possible due to rotten material etc. Requires maintenance to be effective Increases excavation quantities
Slope Drains (pipe, paved, etc.) 	Prevents erosion on the slope Can be temporary or part of permanent construction Can be constructed or extended as grading progresses	Requires supporting effort to collect water Permanent construction is not always compatible with other project work Usually requires some type of energy dissipation
Seeding/Mulching 	The end objective is to have a completely grassed slope. Early placement is a step in this direction. The mulch provides temporary erosion protection until grass is rooted. Temporary or permanent seeding may be used. Mulch should be anchored. Larger slopes can be seeded and mulched with smaller equipment if stage techniques are used.	Difficult to schedule high production units for small increments Time of year may be less desirable May require supplemental water Contractor may perform this operation with untrained or unexperienced personnel and inadequate equipment if stage seeding is required
Sodding 	Provides immediate protection Can be used to protect adjacent property from sediment and turbidity	Difficult to place until cut is complete Sod not always available May be expensive
Slope Pavement, Riprap 	Provides immediate protection for high risk areas and under structures May be cast in place or off site	Expensive Difficult to place on high slopes May be difficult to maintain
Temporary Cover	Plastics are available in wide rolls and large sheets that may be used to provide temporary protection for cut or fill slopes Easy to place and remove Useful to protect high risk areas from temporary erosion	Provides only temporary protection Original surface usually requires additional treatment when plastic is removed Must be anchored to prevent wind damage
Serrated Slope 	Lowers velocity of surface runoff Collects sediment Holds moisture Minimizes amount of sediment reaching roadside ditch	May cause minor sloughing if water infiltrates Construction compliance

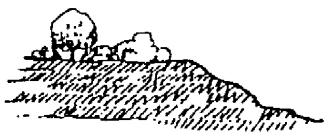
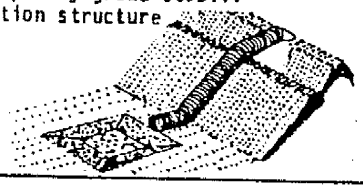
Erosion Control Measures (Continued)

Treatment Practice	Advantages	Problems
FILL SLOPES		
Berms at Top of Embankment 	Prevent runoff from embankment surface from flowing over face of fill Collect runoff for slope drains or protected ditch Can be placed as a part of the normal construction operation and incorporated into fill or shoulders	Cooperation of construction operators to place final lifts at edge for shaping into berm Failure to compact outside lift when work is resumed Sediment buildup and berm failure
Slope Drains 	Prevent fill slope erosion caused by embankment surface runoff Can be constructed of full or half section pipe, bituminous, metal, concrete, plastic, or other waterproof material Can be extended as construction progresses May be either temporary or permanent	Permanent construction as needed may not be considered desirable by contractor Removal of temporary drains may disturb growing vegetation Energy dissipation devices are required at the outlets
Fill Berms or Benches 	Slows velocity of slope runoff Collects sediment Provides access for maintenance Collects water for slope drains May utilize waste	Requires additional fill material if waste is not available May cause sloughing Additional ROW may be needed
Seeding/Mulching	Timely application of mulch and seeding decreases the period a slope is subject to severe erosion Mulch that is cut in or otherwise anchored will collect sediment. The furrows made will also hold water and sediment	Seeding season may not be favorable Not 100 percent effective in preventing erision Watering may be necessary Steep slopes or locations with low velocities may require supplemental treatment
PROTECTION OF ADJACENT PROPERTY		
Brush Barriers 	Use slashing and logs from clearing operation Can be covered and seeded rather than removed Eliminates need for burning or disposal off ROW	May be considered unsightly in urban areas
Straw Bale Barriers 	Straw is readily available in many areas When properly installed, they filter sediment and some turbidity from runoff	Require removal Subject to vandal damage Flow is slow through straw requiring considerable area
Sediment Traps 	Collect much of the sediment spill from fill slopes and storm drain ditches Inexpensive Can be cleaned and expanded to meet need	Do not eliminate all sediment and turbidity Space is not always available Must be removed (usually)
Sediment Pools 	Can be designed to handle large volumes of flow Both sediment and turbidity are removed May be incorporated into permanent erosion control plan	Require prior planning, additional ROW and/or flow easement If removal is necessary, can present a major effort during final construction stage Clean-out volumes can be large Access for clean-out not always convenient

Erosion Control Measures (Continued)

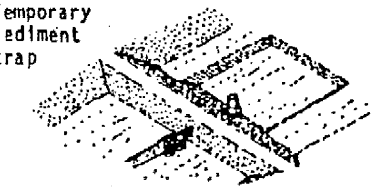
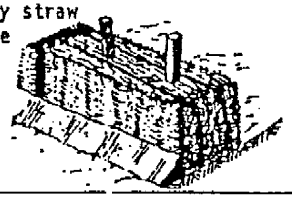
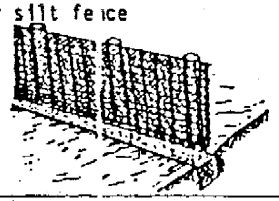
Treatment Practice	Advantages	Problems
PROTECTION OF ADJACENT PROPERTY (continued)		
Energy Dissipators 	Slow velocity to permit sediment collection and to minimize channel erosion off project	Collect debris and require cleaning Require special design and construction of large shot rock or other suitable material from project
Level Spreaders 	Convert collected channel or pipe flow back to sheet flow Avoid channel easements and construction off project Simple to construct	Adequate spreader length may not be available Sodding of overflow berm is usually required Must be a part of the permanent erosion control effort Maintenance forces must maintain spreader until no longer required
PROTECTION OF STREAM		
Construction Dike 	Permits work to continue during normal stream stages Controlled flooding can be accomplished during periods of inactivity	Usually requires pumping of work site water into sediment pond Subject to erosion from stream and from direct rainfall on dike
Cofferdam 	Work can be continued during most anticipated stream conditions Clear water can be pumped directly back into stream No material deposited in stream	Expensive
Temporary Stream Channel Change	Prepared channel keeps normal flows away from construction	New channel usually will require protection Stream must be returned to old channel and temporary channel refilled
Riprap	Sacked sand with cement or stone easy to stockpile and place Can be installed in increments as needed	Expensive
Temporary Culverts for Haul Roads 	Eliminate stream turbulence and turbidity Provide unobstructed passage for fish and other water life Capacity for normal flow can be provided with storm water flowing over the roadway	Space not always available without conflicting with permanent structure work May be expensive, especially for larger sizes of pipe Subject to washout
Rock-lined Low-Level Crossing 	Minimizes stream turbidity Inexpensive May also serve as ditch check or sediment trap	May not be fordable during rainstorms During periods of low flow passage of fish may be blocked

SUMMARY OF CONTROL MEASURE APPLICATIONS

CONTROL MEASURE	PURPOSE	CONDITION NEEDING CONTROL					
		CUT SLOPES	FILL SLOPES	DENUDED GENTLY SLOPING OR FLAT AREA	ERODING STREAMBANK	ERODING SWALE	PROTECTION OF ADJACENT PROPERTY
Temporary and permanent planting of exposed soils 	To stabilize soils by absorbing the impact of raindrops, reducing velocity of runoff, and allowing precipitation to enter the soil.	●	●	●			●
Temporary and permanent grass protection of waterways, swales and dikes 	To protect drainageways by lowering water velocity over the soil surface and by binding soil particles with roots.				●	●	●
Temporary dike 	To intercept storm runoff from small upland areas and divert it to an outlet, or to prevent runoff from entering a disturbed area and sediment-laden runoff from leaving the disturbed area.	○	●	●			●
Temporary swale 	To intercept storm runoff and divert it to a stable outlet or sediment-trapping device, or to prevent runoff from entering a disturbed area and to direct sediment-laden runoff leaving the disturbed area.	○	●	●			●
Temporary grade stabilization structure 	To convey concentrated, high-velocity runoff down slopes without causing erosion.	●	●				

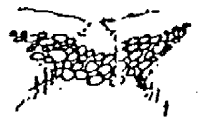
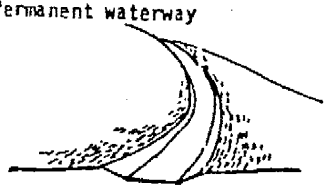
KEY: ● Preferred control measure ○ Alternative but less effective control measure.

(Cont'd) SUMMARY OF CONTROL MEASURE APPLICATIONS

CONTROL MEASURE	PURPOSE	CONDITION NEEDING CONTROL					
		CUT SLOPES	FILL SLOPES	DENUDED GENTLY SLOPING OR FLAT AREA	ERODING STREAMBANK	ERODING SWALE	PROTECTION OF ADJACENT PROPERTY
Temporary sediment basin 	To collect and hold runoff to allow suspended sediment to settle out.	●	●	●			●
Temporary sediment trap 	To intercept small quantities of sediment-laden runoff and trap the sediment.	○	○	●			●
Temporary stabilized construction entrance 	To reduce the tracking or flowing of sediment onto public rights-of-way.						●
Temporary straw bale dike 	To intercept and detain small amounts of sediment from small unprotected areas.			○			○
Temporary silt fence 	To intercept and detain the sediment in runoff from small erodible areas while decreasing the velocity of the runoff.			○			○

KEY: ● Preferred control measure ○ Alternative but less effective control measure

(Cont'd) SUMMARY OF CONTROL MEASURE APPLICATIONS

CONTROL MEASURE	PURPOSE	CONDITION NEEDING CONTROL					
		CUT SLOPES	FILL SLOPES	DENUDED GENTLY SLOPING OR FLAT AREA	ERODING STREAMBANK	ERODING SWALE	PROTECTION OF ADJACENT PROPERTY
Temporary check dam 	To reduce the velocity of concentrated stormwater flows in swales or ditches draining small areas.					●	●
Permanent waterway 	To intercept runoff and convey it to a stable outlet.	○	○		●	●	
Permanent riprap 	To protect a soil surface, drainageway or outlet from the erosive forces of water.	○			●	●	
Permanent storm drain outlet protection 	To convert pipe flow to channel flow and reduce water velocity where storm drain outlets discharge into streams or other drainage channels.				●	●	○
Permanent subsurface drain 	To remove runoff from and prevent water movement into a wet area, to regulate the water table and groundwater flow to improve plant growth and to dewater a sediment basin.	○	○	○			○

KEY: ● Preferred control measure ○ Alternative but less effective control measure.

(Cont'd) SUMMARY OF CONTROL MEASURE APPLICATIONS

CONTROL MEASURE	PURPOSE	CONDITION NEEDING CONTROL					
		CUT SLOPES	FILL SLOPES	DENUDED GENTLY SLOPING OR FLAT AREA	ERODING STREAMBANK	ERODING SWALE	PROTECTION OF ADJACENT PROPERTY
General land grading practices for minimizing erosion 	To provide for erosion control and plant establishment on areas where topography is to be re-shaped by grading	●	●	●			●

KEY: ● Preferred control measure ○ Alternative but less effective control measure