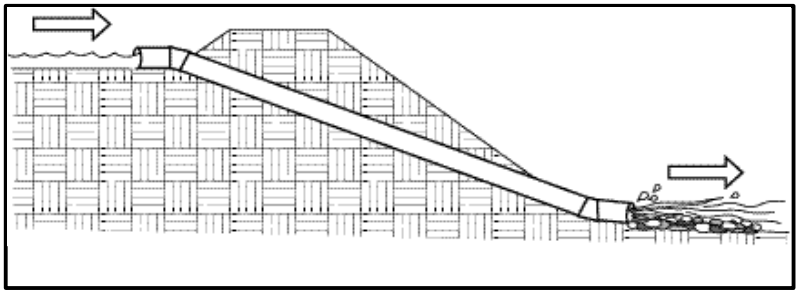


- Erosion Control
- Slope and Channel Protection
- Divert Runoff

Description

A lined channel or temporary pipe that is used to drain runoff from the top of a slope to a stable point at the bottom of a slope. The slope drain is used to prevent erosion of the slope. Slope drains may include rigid pipe drops; flexible pipe down drains; sectional pipe down drains; and concrete-lined terrace drains.

Rigid Pipes

Rigid pipe slope drains are typically made of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured to the slope. The pipe should be covered by at least twelve inches of soil. Installers may use concrete thrust blocks as determined necessary by calculated thrust forces. Pipes should be properly installed with collars secured with metal strappings.

Flexible Pipe

A flexible pipe is created of heavy duty material, securely attached to the slope. Metal strappings or water tight collars are used to attach the conduit to the inlet and outlet. Connections are watertight.

Sectional Down Drains

This type of pipe is a pre-fabricated, sectional conduit consisting of a third- or half-round material, that performs like a chute. As with the other pipes, it needs to be placed on undisturbed or compacted soils and properly secured to the slope.

Concrete-lined Terrace Drain

This permanent drain is a concrete channel that needs to be designed according to local drainage design criteria.

Applicability

Slope drains can be used:

- When concentrated surface runoff needs to be diverted down a slope to prevent erosion.
- With diversion dikes or swales located at the top of a slope (see BMPs WD-1 and WD-3).
- As an emergency spillway for a sediment or detention basin (see BMP SC-3).
- For drainage for the top of cut and fill slopes in areas where water will accumulate.

This measure is likely to significantly reduce erosion.

Approach and Standards

- Design conveyance pipe using a 10-year, 24-hour model storm, and local flood control requirements.
- Make sure inlet structures are entrenched properly and compacted to avoid major gully erosion.
- Surround the inlet with dikes to prevent gully erosion, and securely anchor the pipe to the slope.
- Stabilize the outlet using a velocity dissipater (see BMP VR-4), or direct to a stable sediment trap or basin (see BMPs SC-3, or SC-5). Consider using a riprap apron for stabilization in cases where the sediment trap/basin is not used.
- Especially for larger pipes, install a debris rack at the inlets to prevent clogging the pipe, and the resulting gully erosion. If children can enter the outlet pipe, include a debris rack there too for safety.
- If the drainage area is greater than 5 acres, a permanent improvement (e.g., paved chute, rock-lined channel) or other effective option should be installed. For smaller drainage areas, do not use a pipe smaller than the following:

Maximum Drainage Area (Acres)	Minimum Pipe Diameter (Inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

Source: California Storm Water Quality Task Force, ESC 32, 1993.

- For the pipe slope drain entrance, consider using a standard flare end section with a minimum 6-inch toe plate to prevent undercutting of the pipe inlet. If the entrance slope is typically more than 3 percent, consider securing the flared inlet section to the slope drain and using watertight connecting bands (see BMP VR-4).
- Consider rigorously compacting the soil around and under the pipe and pipe entrance.
- Make sure the slope drain sections are securely fastened to one another, that they have watertight gasket fittings, and are securely anchored to the soil.
- Consider using interceptor dikes—that are at least 12 inches higher at all points than the top of the inlet pipe—to divert runoff to the slope drain.
- Install slope drains so they are perpendicular to the contours of the slope.

Limitations

- Gully erosion can easily occur with slope drains that are not properly installed and maintained.
- Drainage areas per pipe slope drain should not exceed 5 acres unless effective options are incorporated that will maintain the integrity and effectiveness of the slope drain.
- Pipes can become clogged or overwhelmed during large storms, causing extensive slope erosion when water flows around the pipe.
- Failure of the structure can result in flooding and significant erosion.
- The sectional down drain must be sized correctly to ensure runoff does not spill over the drain sides and cause structural failure.

Requirements

Maintenance

- Installation and maintenance needs are relatively small, especially for flexible pipe.
- Perform inspection before and after rain storms, and every two weeks until the drainage areas have been stabilized. Then inspect routinely.

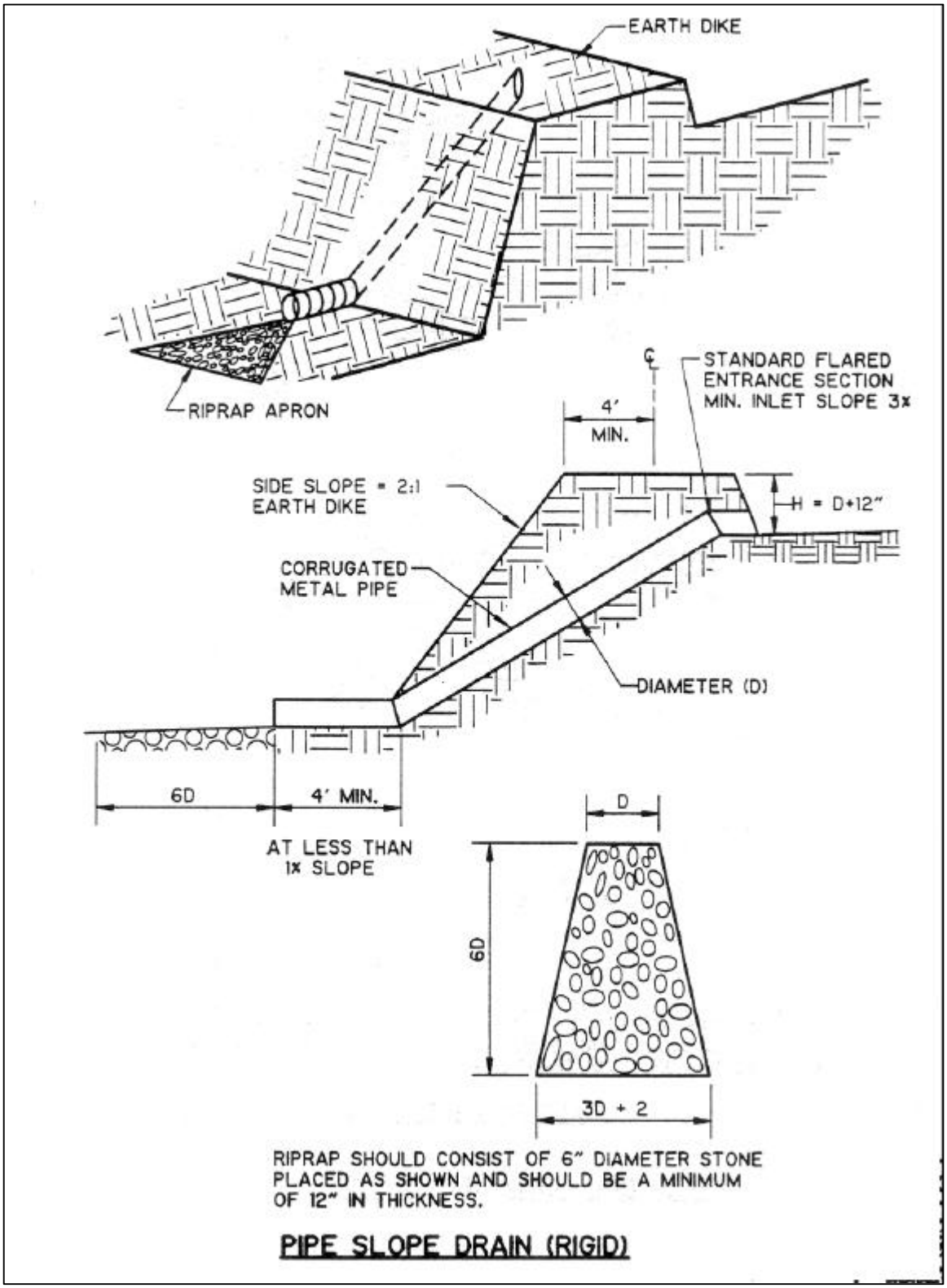
- When conducting inspections, examine for erosion and downstream scour near the outlet. Repair, install additional energy dissipation measures, and/or reduce discharge flows if needed.
- Also, inspect the slope drain for debris and sediment. Remove build-ups of either from entrances and outlets as required. If necessary, flush the drains, being sure to capture and settle the sediment in the drain water.
- Inspect to ensure that water is not ponding in inappropriate areas. Correct if needed.

Costs

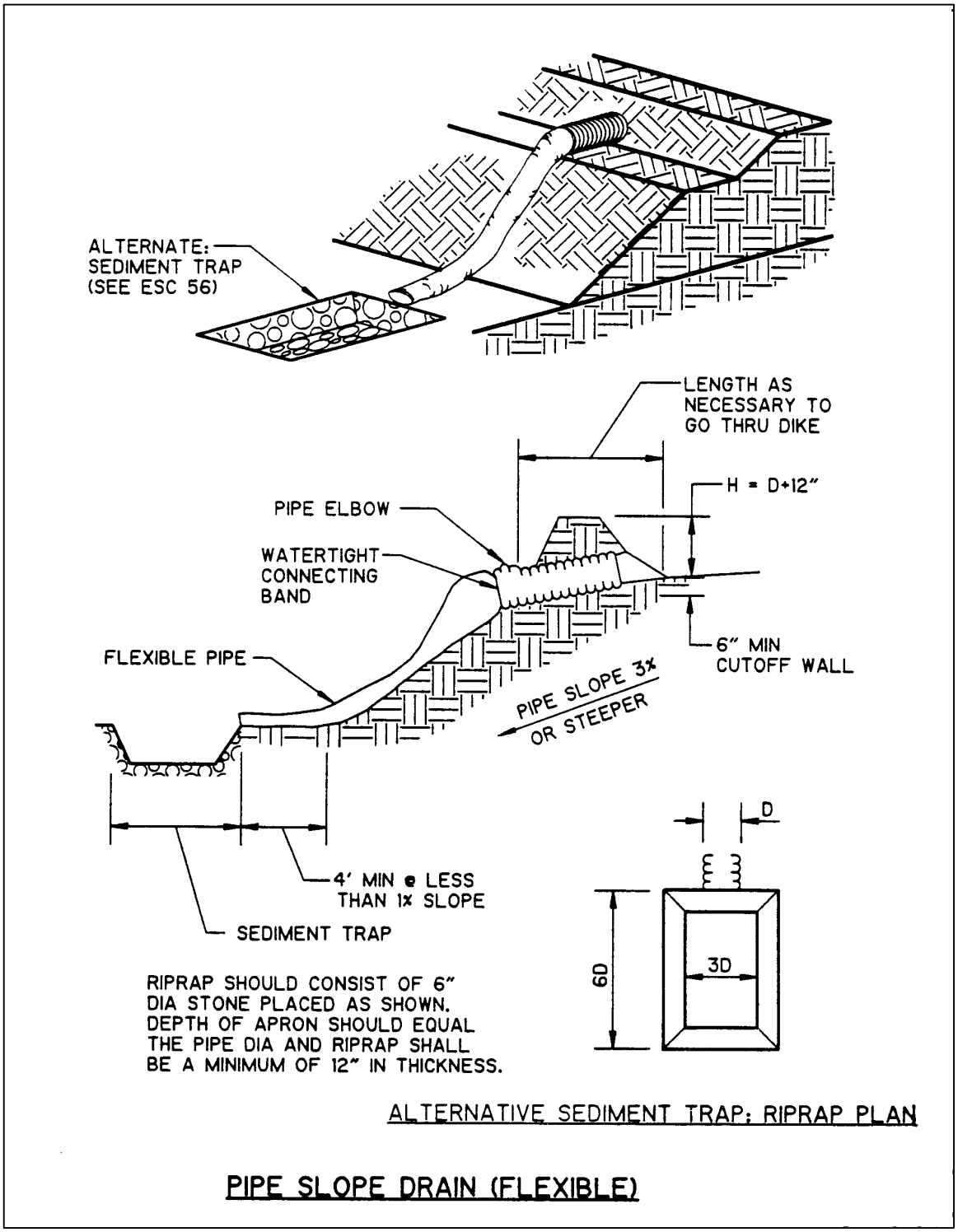
The costs of diversion devices are usually included in the earthwork cost, under the grading budget. This measure has moderate capital and maintenance costs and minimum operational costs.

Training

- Training is required for proper design and installation since improper design and installation can lead to severe erosion. Training on appropriate monitoring and maintenance is also important.

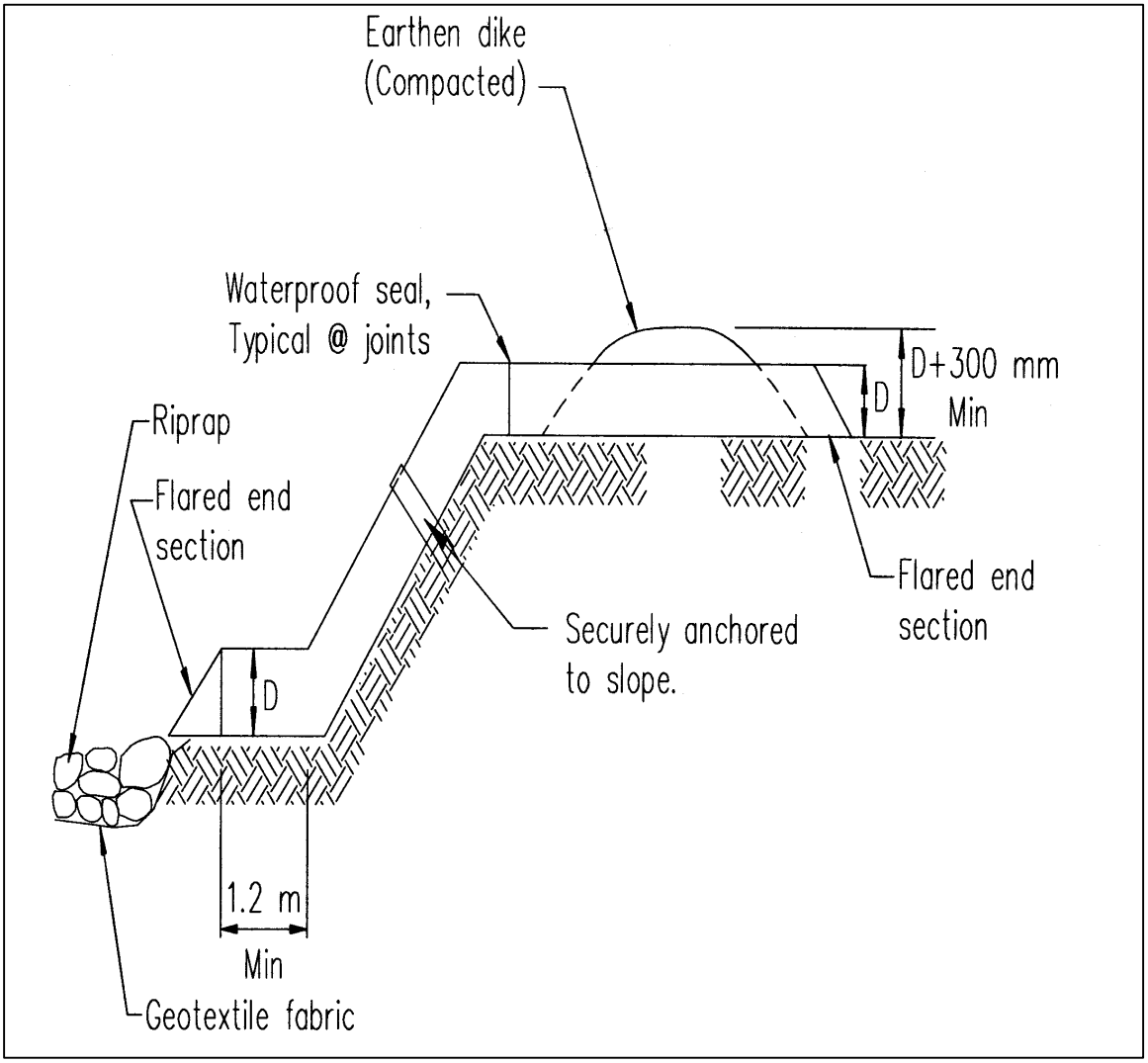


Source: California Storm Water Quality Task Force, 1993.



Source: California Storm Water Quality Task Force, 1993.

Slope Drain Illustration Alternative: Caltrans



Source: Caltrans, 1997.

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