

5.4 Lining of On-Farm Irrigation Ditches

Applicability

This BMP is applicable to agricultural producers that use open channels to convey irrigation water to fields.

Description

This practice is accomplished by installing a fixed lining of impervious material in an existing or newly constructed irrigation field ditch. The three most commonly used impervious liners for irrigation canals in Texas are Ethylene-Propylene-Diene Monomer (EPDM), urethane, and concrete. Each type of liner has benefits and detriments specific to the liner. EPDM is the least expensive and concrete the most expensive. Reinforced concrete liners have the longest durability but may have the largest seepage rate. Urethane has low seepage rates but uses hazardous chemicals during installation. The U.S. Bureau of Reclamation report titled “Canal Lining Demonstration Project Year 7 Durability Report” provides a detailed description of these and other liners.

Implementation

The specific steps required to implement this BMP depend on the type of ditch liner used and the existing conditions of the ditch to be lined. Installation specifications, material specifications and detailed installation instructions for most types of ditch liners are available from liner manufacturers and governmental agencies. In general, most ditch lining projects require the following steps:

- 1) A site survey of the proposed ditch being lined which includes the length of ditch and one or more typical cross-sections of the ditch;
- 2) Development of a plan that details the installation and materials specifications;
- 3) Preparation of the ditch bed, including removal of any vegetation, bed compaction, and bed shaping;
- 4) Installation of liner; and
- 5) Finish work including inlets and outlets to lined ditch.

Schedule

The time required to line a farm irrigation ditch depends on the size of cross-sectional perimeter of the ditch, the amount of work needed to prepare the ditch for lining, and the type of liner used to line the ditch. EPDM liners are usually the easiest and quickest to install. For a typical farm ditch with a top width of five feet, between 500 and 1,000 feet of EPDM liner can be installed per day with a crew of five persons. Slip form concrete lining of the same ditch with the same number of workers can line between 200 and 500 feet per day.

Scope

Replacement of on-farm ditches with low-pressure pipelines is an alternative to lining the ditch. Typically, small ditches with flow capacities less than 5 cubic feet per second are candidates for replacement with a buried pipeline. Each type of liner has advantages and disadvantages. EPDM should not be used in a location where the ditch is subject to large animal or other traffic that might tear the liner. Concrete liners handle most traffic well, but are subject to crack formation due to soil heave, tree root pressure, or thermal expansion.

Documentation

To document this BMP, the agricultural water user shall gather and maintain the following documentation:

- 1) Copies of equipment invoices or other evidence of equipment purchase and installation;
- 2) Any USDA Farm Service Agency or other governmental agency evaluation and assistance reports that may relate to the project.
- 3) Water measurement records from the period both before and after conversion to the water efficient irrigation system.

Determination of Water Savings

The seepage rate of a farm ditch can be estimated by conducting a ponding test with a typical section of the ditch prior to the ditch being lined. A ponding test measures the rate at which the level of water ponded behind an earthen dam placed in the ditch drops over two to twenty-four hours. The amount of the ditch that is wetted by the pond behind the dam must be measured. The seepage rate can be calculated as acre-feet per mile of ditch per day. The total quantity of water lost to seepage from the ditch is estimated by multiplying the seepage rate times the number of days per year the ditch is used to convey water. For example, a small farm ditch with a wetted perimeter of 5 feet and a length of 1/2 mile is found to have a seepage rate of 1.0 acre-feet per mile per day, assuming the ditch is used to carry irrigation water 40 days per year. The total seepage from the ditch is 20 acre-feet per year ($1/2 \times 1.0 \times 40$). Lining the ditch with an EPDM liner would result in minimal or no seepage. Seepage loss from a concrete lining depends on how the liner was constructed and the amount of water that seeps through cracks and expansion joints in the concrete. A conservative estimate would be that concrete lining salvages 80 percent of the original seepage, or for the example, 16 acre-feet.

Cost-Effectiveness Considerations

U.S. Bureau of Reclamation in June of 2001 published "Construction Cost Tables – Canal Lining Demonstration Project." The cost table included material and installation costs for approximately thirty-five different types of liners or coatings. The cost for an installed EPDM liner was approximately \$0.85 per square foot and \$1.43 per square foot for urethane. The cost for concrete lining ranges from \$2.50 to \$3.50 per square foot. For the example above the cost per acre-foot of water salvaged in the first year for the EPDM liner would be \$11,220 (\$561 per acre-foot), for urethane liner \$18,876 (\$944 per acre-foot) and for concrete \$33,000

(\$1,650 per acre-foot). Because each of these types of liner has a different life expectancy a present value analysis of cost should be performed. For example, while the concrete liner may have the most expensive installation cost, it also has the longest life expectancy.

References for Additional Information

1. *Conservation Practice Standard, Irrigation Water Conveyance, Flexible Membrane Ditch and Canal Lining*, 9 p. Natural Resources Conservation Service, October 1980.
2. *Canal Lining Demonstration Project Year 7 Durability Report*, 156 p. U.S. Bureau of Reclamation, Pacific Northwest Region, September 1999.
3. *Canal Lining Demonstration Project,- 2000 Supplemental*, 46 p. U.S. Bureau of Reclamation- Pacific Northwest Region, January 2000.
4. *Construction Cost Tables – Canal Lining Demonstration Project*, 5 p U.S. Bureau of Reclamation, Pacific Northwest Region, June 2001.