TECHNICAL NOTES

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

March 2015

ENG -210 - TECHNICAL NOTE UT210-15-03
190-VI

SUBJECT: ENG – Guidelines for Sizing Sediment Sluicing Structures.

Purpose: To transmit a method for sizing an increasing trapezoidal cross-section sluicing structure to remove sediment and bed load from diverted surface water.

Effective Date: Upon receipt.

Contents of Technical Note:

This structure consists of using an increasing trapezoidal cross-section reach and related appurtenances to remove sediment from irrigation water. This structure is also known as the Laney Sluice in Utah.

This structure has been successfully used in Utah as a means to remove sediment and bed load from open channel irrigation flow.

Theory of operation is that the water flowing near the surface has less sediment than water flowing near the bottom of the structure. Suspended sediment settles to the bottom when velocity decreases. Coarser sediment drops first. Particles drop through water at a velocity dependent on size and density.

The structure is shaped so the average water velocity is continually decreasing toward the irrigation inlet. Experience indicates that most sands and silts will drop to the bottom when the structure has capacity for a 3 minute retention time.

Operation consists of operating the sluice gate. High velocity flow when the sluice gate opens removes accumulated sediment. Sustained flow then removes sediment along the bottom. The sediment on the sides slide to the bottom and is removed if the sediment has been removed on a timely basis. When the water supply exceeds the irrigation needs, the sluice gate is slightly open; sediment is continuously removed from the bottom. When the irrigation needs equal or exceed the available inflow, the sluice gate is closed except for periodic opening for flushing. Successful operation depends on removing the sediment often enough to prevent large accumulations.

Criteria
Retention time of total inflow should be 3 minutes or longer.

1. This retention time will remove all gravel and most sand and silt. This is dependent upon water inflow and structure storage volume for water.

   T = retention time (minutes)
   V = total structure storage volume to design water level (cubic feet)
   I = total water flow into sediment structure (cubic feet per second) (cfs)

$$T = \frac{V}{60I}$$

2. Bottom slope 4% or greater.

3. Bottom width 2 feet (can be wider for larger flows).

4. Side slopes 1:1 or steeper.

5. Sluice gate diameter is equal to bottom width. Place gate frame so that it does not obstruct spillway or irrigation outlet.

6. The sluice outlet pipe shall be the same diameter as the sluice gate and have no flow restrictions.

7. The sediment structure must be located so that the lowest floor level is sufficiently above the sluice pipe outlet to provide high velocity flow. The pipe can outlet to a river or stream or to a designated sediment disposal area. Keep bends to a minimum and allow no reverse or flat grades for sediment to collect in the pipe.

8. Sluice gate invert at lowest bottom elevation of sediment structure.

9. Irrigation flow is taken from surface water and the irrigation outlet is located at downstream end of the sediment structure. Design the structure so the required irrigation flow can discharge with the water surface at crest elevation of the spillway overflow.

10. The length of the sediment structure should be less than 150 feet. Typical length is 125 feet.

11. An overflow must be provided. This keeps water moving through the sediment structure and prevents plugging of the inlet pipe or channel with sediment. Capacity of the overflow must equal or exceed the total maximum inflow.

12. Overflow must be directed back to the river or stream in such a manner as to prevent erosion. Mechanical protection in the river or stream may be required.

13. Place filter drains under lining to prevent uplift.

14. Several configurations of overflow and irrigation inlets have been successful.

15. The irrigation inlet should be screened to prevent floating debris from entering the irrigation system.

16. Place a chain link fence around the sediment structure to prevent animals and people from falling into the pool. It is very difficult or impossible to get out of this structure.

17. Sediment structure constructed of reinforced concrete and the surface of the sloping walls and floor shall be smooth.

Operation

1. If available flow exceeds irrigation flower the overflow will be flowing. Adjust sluice gate so the sediment structure water level is just above the crest of the overflow. This will cause a constant small flow out of the sluice gate. A large portion of the sediment removed from the irrigation flow will be discharged continuously from the sluice gate.

2. If inflow is less than or equal to irrigation flow, close the sluice gate. All sediment trapped will settle to the bottom of the sediment structure. It is necessary to fully open the sluice gate on a periodic basis to remove the accumulated sediment. This will stop the irrigation flow; therefore it would be necessary to restart any pumps etc. Leave gate open until sediment is removed. Hint: Closing sluice gate and allowing sediment structure to refill then opening again may take less time. The frequency of opening the sluice gate depends upon the amount of sediment flowing into the structure. Experience shows that waiting too long between sluicing allows the sediment to "setup" and become difficult to remove.

3. Clean screens and grills as necessary. Check each time the site is visited.

4. Make sure security fence is intact and gate is closed.

5. It is recommended that the sediment structure remain full of water during winter. This will keep lining in place. Ice will not damage lining.

Environmental

The installation of this type of sluicing structure where sediments are returned to the river or stream can be considered a point source of pollution because it increases the concentration of sediment in the river or stream. If continuous sluicing is used, slugs of sediment do not occur; however, the sediment concentration for downstream water users is increased; with periodic sluicing, very high short term concentrations of

sediment occur. Provisions may be required in the design for the disposal of collected sediment outside of the stream.
Design Aid. An excel spreadsheet has been developed to help size these structures and is available on the Utah eFOTG site at:

http://efotg.sc.egov.usda.gov/references/public/UT/Sluice_Design.xls

Filing Instructions. File in the Technical Notes notebook under ENG-210

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