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SUSTAINABLE AGRICULTURE TECHNIQUES

Tailwater Recovery Using Sedimentation Ponds and Pumpback Systems

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Figure 1. A constructed sedimentation pond will collect irrigation tailwater for reuse on the farm.

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A tailwater recovery system is a system that reuses irrigation water runoff on the farm. One type of tailwater recovery system involves the use of a sedimentation pond. Irrigation runoff water is directed to a pond, sediment is allowed to settle out, and the water is then returned to the irrigation system. Sediment is periodically removed from the pond and returned to fields.

Water can be moved from the pond to lower-elevation fields via gravity, using a ditch or pipeline. If water is returned to the upper end of a field, a pumping plant and pipeline—a "pumpback" system—is required.

Why use a sedimentation pond?

This type of tailwater recovery system can have two primary benefits: reduced costs for farmers and irrigation districts and improved water quality. These benefits are realized due to the following:

- **Reduced water withdrawals:** By allowing reuse of irrigation water, a tailwater recovery system can improve irrigation efficiency. Overall, less water needs to be delivered, whether from groundwater or surface water. Several growers report that they are receiving about one-third less water from the irrigation district than that needed to adequately furrow-irrigate their crops. The water recovery gives them greater assurance of water supply to meet their crops' needs.
- **Reduced loss of sediment and nutrients from the farm:** Soil loss is reduced when sediment is returned to the field. Also, the nutrients in runoff water can be reapplied, resulting in lower fertilizer costs. However, it is hard to quantify exactly the amount of fertilizer recycled.
- **Less sediment, nutrients, and chemicals carried to streams:** Irrigation runoff water often carries high loads of sediment and nutrients, including phosphorus. When these contaminants reach surface waters, they can degrade fish habitat. By returning runoff water, sediment, and nutrients to the farm, contamination of nearby surface waters is reduced.

What factors determine system design?

The type, capacity, and location of the recovery system will depend on your farm's topography and irrigation system, and on your goals and irrigation practices. Proper design is of utmost importance. Local USDA NRCS and county soil and water conservation districts (SWCD) can provide standards and specifications (see "Where can I get help?" on page 4). The following are some factors to consider.

Closed versus open systems

Some tailwater recovery systems are "closed"; only certain fields under the grower's own management drain into the sedimentation pond, and all runoff water is captured and recycled. A closed system should be designed with a drain if needed to remove salty water.

Some growers have "open" systems that allow water from sources outside their control to enter the system. Water may enter from neighbors' irrigation, water spilled from irrigation ditches, springs, or highway runoff. A system can also be "open" in the sense that tailwater recovered beyond the limit of storage exits the reservoir pond. Open systems are more difficult to manage because the water supply is less predictable.

Figure 2. Intake pipe, motor, and pump for pumping water from the pond back into the irrigation system.

Number of ponds

Malheur County growers experienced in using tailwater recovery systems prefer designs with two ponds. The first pond serves principally as a sedimentation pond and is often fashioned by enlarging a drain ditch. The water then exits the

Figure 3. Pumpback system layout at the Malheur Experiment Station, Ontario, Oregon.

drain ditch and enters a second pond that serves as a reservoir to hold water to be pumped back for irrigation (Figure 4). The advantage of a two-pond system is that it is easier to allow the pond catching the bulk of the sediment to dry for the removal of accumulated sediment.

System capacity

It is tempting to undersize the pond or the pipe that carries water back up to the top of the field. Smaller ponds are less costly, but the pond needs to be large enough for the volume of runoff. Likewise, smaller diameter pipe is less costly, but may make irrigation more challenging. One Malheur County grower said that he wishes he had installed a 12-inch-diameter pipe for return flow rather than an 8-inch pipe. The 8-inch pipe has too much resistance, making the pump less effective. The duration of irrigations could be less with greater ability to pump water back uphill.

Several factors determine the storage capacity needed:

- Runoff volume and rate
- The required level of water control at the point where the tailwater is returned to the irrigation system
- Capacity of the storage facility to regulate fluctuating flows—If a float valve is part of the system, a small sump with frequently cycling pumping plants may be adequate. For systems unable to regulate flows, the collection basin will need to be larger.
- Presence of chemicals in runoff water—If extra retention time is needed for breakdown of chemicals, the sedimentation pond will need to be larger. Retention times depend on the particular chemical present.
- Sediment load in the runoff water—Additional storage capacity may be required to provide time for sediment deposition. Retention times depend on soil type.
- Reliability of the energy source—If the energy source for the pumpback system is subject to interruption, storage capacity should be adequate to store the complete runoff from a single irrigation set.

Figure 4. Growers often use tailwater recovery systems with two sedimentation ponds. The first pond is used principally to capture sediment, and the second pond is used principally to provide water storage for stable irrigation.

- Rainfall collection—If the system is used to collect rainfall runoff for use as an irrigation water source, sedimentation pond capacity must be adequate to accommodate rainfall input.

Likewise, the needed capacity of the conveyance facilities (pipelines and pumping system) depends on a number of factors:

- Expected runoff rate
- Sedimentation pond storage capacity
- Irrigation system management, e.g., whether the return flow is used as an independent irrigation supply or as a supplement to the primary irrigation water supply

Sedimentation pond design

Install the pump on a float that goes up and down with the level of water in the reservoir pond. Growers have found that the float needs to be hinged to the bank so that very high and low water levels are accommodated (Figure 5, page 4). A float that will not accommodate very high water risks inundating the motor and pump, requiring costly repairs or replacement.

A key consideration in pond design is management of sediment. Sediment traps may be needed. You'll need to plan for periodic sediment removal without affecting the integrity of the pond.

The sedimentation pond will need to be protected from erosion. Inlets can protect the side slopes and the collection facility.

Protection from storm events may be needed. In some cases, a dike, ditch, or water control structure is required to limit the entrance of rainfall runoff.

If the storage facility is expected to receive chemical-laden waters, seepage must be controlled. Possible methods include natural soil liners, soil additives, and commercial liners.

Keep in mind that sedimentation ponds can present a hazard to children, livestock, and wildlife, especially in the case of chemical-laden water. Waterfowl can be at risk, since they may be attracted to the pond. Protective measures may be needed.

How will my irrigation management be affected?

You may need to modify your daily irrigation management to be compatible with the sedimentation pond and pumpback system. Planning will be required to ensure that the system is not overloaded. The key is to limit tailwater volumes as much as possible. This minimizes the capacity required for collection, storage, and transportation facilities. Also, make sure that nutrient and pest management measures limit chemical-laden tailwater as much as practical.

Good irrigation management is necessary to make optimal use of return flows. You will need to anticipate a place to apply recovered water.

When irrigating fields served by a tailwater recovery system, growers report that it takes less time and total hours worked to irrigate a field.

What maintenance is required?

Like all irrigation system components, a tailwater recovery and pumpback system requires maintenance for continued smooth operation. In addition to routine inspection, testing, and maintenance of pipelines, pumping plant components, and other mechanical components, the collection pond will require periodic cleaning, regrading, and removal of sediment.

Figure 4. Jerry Wilcox of Vale, Oregon demonstrates a pump on a float in a sedimentation pond on his farm. The float is hinged at the bank of the pond so that the float always keeps the pump at the proper height above the water level.

Growers report that sediment has to be removed every 5 to 10 years. The soil trapped in the sedimentation pond can be used to replace soil lost from the top of surface-irrigated fields.

Where can I get help?

Your local county SWCD or USDA NRCS office can assist with design and specifications of a system to meet your needs. Cost-share funds may be available through the Environmental Quality Incentive Program (EQIP).

Offices in Ontario, Oregon are:

- *USDA NRCS Ontario Field Office*: 541-889-7637
- *Malheur County SWCD*: 541-889-2588

Elsewhere, local offices can be located online:

- *USDA service centers*: http://offices.sc.egov.usda.gov/locator/app
- *Conservation districts in Oregon*: http://www.oacd.org/map.shtml
- *Conservation districts nationwide*: http://www.nacdnet.org/about/districts/locate/

All photos by C.C. Shock