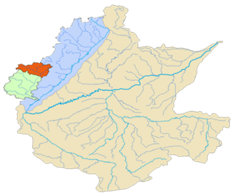

Agricultural Research Service
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National Soil Erosion Research Laboratory
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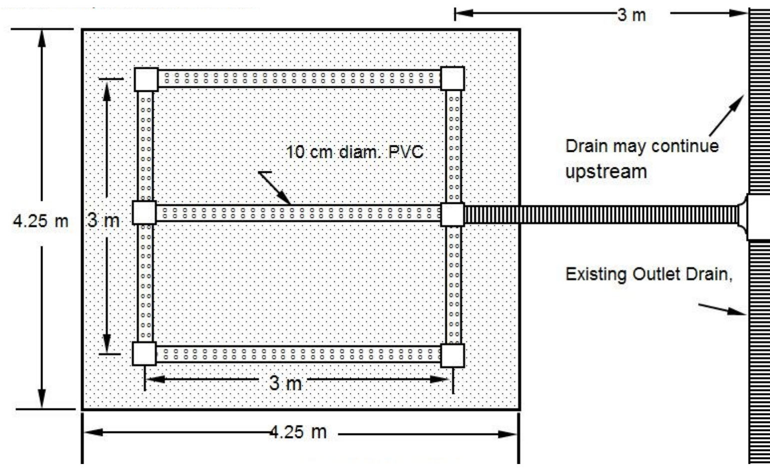
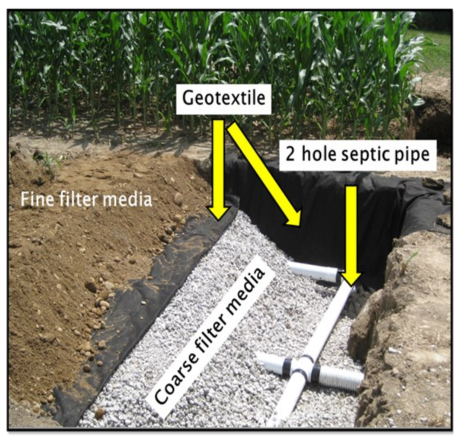
CEAP in the Cedar Creek Watershed

The Blind Inlet Issue

Welcome to the second issue of the *CEAP in the Cedar Creek Watershed* report. This publication is designed to keep cooperators, producers, and stakeholders up to date regarding the Conservation Effects Assessment Project (CEAP) taking place in the upper Cedar Creek Watershed. In this issue, we will be looking at surface inlet filter technology developed in the early 2000s. We will be telling the story of the Blind Inlet — the past, present, and future.





(Top) Drawing of the original blind inlet design. Hole is 15'x15' and 28" deep. Sand layer is 8". (Bottom left) Blind inlet during construction. (Bottom right) Blind inlet next to a tile riser at the field monitoring site. A gate value determines whether water drains through the tile riser or the blind inlet.

History of the Blind Inlet

When research started in the St. Joseph River watershed, the goal of the project was to study the impact of agriculture on drinking water sources. While researchers at the USDA-ARS National Soil Erosion Research Laboratory were able to quickly find cooperating producers to monitor agricultural drainage ditches that serve as tributaries to the St. Joseph River, it took a couple of years to identify suitable field monitoring sites in which: 1) the producer was willing to cooperate and commit to a long-term monitoring effort; 2) the monitored area was from a single field; and 3) water was delivered to the outlet of the field-scale watershed through dendritic (branching) flow-paths, allowing for monitoring of the surface runoff.

Windshield surveys of the study area revealed that much of the landscape did not have the expected dendritic flow-paths, rather it was a deranged (random) pattern of closed depressions (pot-holes). This eliminated many fields from consideration until researchers realized that there was such a large swath of the watershed represented by closed depressional areas. Most depressions in the watershed were either forested or farmed with supplemental surface drainage. Tile risers that stand up to 3 ft. above the soil surface typically indicate the presence of a closed depression. Tile risers often have many 1/2 to 1 in. holes drilled around the circumference of the pipe to ensure water can flow relatively unimpeded to the tile network. In this young glacial till landscape, many of the depressional areas are quite distant from the stream network. Thus, water that ponds in depressions during storm events is delivered directly to the stream through the subsurface tile lines.

Early results from the St. Joseph River watershed study demonstrated that the relative area of closed depressions was proportional to the amount of phosphorous conveyed to the agricultural ditches that were monitored (Smith et al., 2008). With the importance of this landscape feature in the region, it was decided that the study needed to include field scale monitoring of closed depressions. A pair of depressions was located with a willing cooperator and monitoring began in 2005. Since minimal treatment of the water occurs when drained through a tile riser, researchers sought to develop an alternative drainage structure that would filter fine sediment in runoff water while not increasing ponding in the field. As a result, the blind inlet was born.

The blind inlet consists of 4 elements, from top to bottom: a fine filter media (typically sand), soil separator/geotextile, coarse filter media (#4 limestone), and 2-hole collector pipes to deliver filtered runoff to the tile system. Surface water ponded in the depression must past through both the fine and coarse filter material before flowing to the tile drainage network. As water passes through these materials sediment and possibly nutrients would be filtered out.

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Current Blind Inlet Research

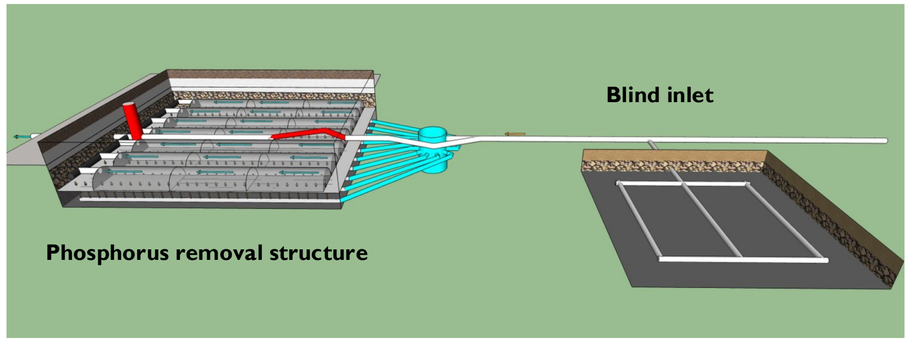
Do blind inlets increase ponding?

One of the main goals in developing the blind inlet was to filter sediment while not increasing ponding in fields. A recent study examined the occurrence of ponding events over 12 years in depressions with blind inlets and depressions with tile risers. Longer or more frequent ponding during the growing season may result in increased crop loss. Researchers found that blind inlets do not increase the frequency of ponding and in some cases decrease the length of ponding compared to a tile riser. The septic pipe installed in the bottom of the blind inlet can act as an additional subsurface tile line in the field resulting in greater water storage capacity. As a result, less ponding on the surface occurs.

How long do blind inlets work?

Monitoring of the original blind inlets since 2005 revealed that they can successfully drain ponded surface water from closed depressions for 8 to 10 years before sedimentation impedes the drainage capacity. It is important, however, to note that the longevity of the blind inlet will be greatly impacted by field management practices. The monitored fields were tilled annually, which is widely known to increase the risk of erosion and sediment loss from fields compared to no-till. It is possible that blind inlets would be effective for longer than 10 years in fields with reduced or no-tillage.

Ponding in a closed depression during a following a storm event.



Blind inlet version 2.0. Sediment and sediment-bound nutrients are trapped in the blind inlet similar to the original blind inlet design. Water and dissolved nutrients then flow into an underground phosphorus removal structure filled with steel slag before leaving the field through the tile drainage network

Do blind inlets trap sediment and nutrients?

Ongoing research efforts are calculating the amount of sediment and sediment-bound nutrients trapped over the lifespan of the blind inlet. Preliminary results suggest that blind inlets can trap significant amounts of sediment leading to improved downstream water quality. Recent research also suggests that blind inlets may reduce the amount of surface runoff from a closed depression potentially decreasing the loss of nutrients such as nitrogen and phosphorus. However, over time blind inlets could increase the risk of dissolved phosphorus losses. Sediment that accumulates on the surface of the blind inlet contains soil test phosphorus levels up to 5 times greater than the surrounding field.

Future of Blind Inlets

To address increasing concerns associated with dissolved phosphorus losses to Lake Erie, the Blind Inlet version 2.0 was developed and installed in the spring of 2018. Blind inlet 2.0 contains two components: the original blind inlet plus a phosphorus removal structure. Ponded surface water will first flow through the blind inlet filtering out sediment and sediment-bound nutrients. Once the water leaves the blind inlet, it is then routed to an underground phosphorus removal structure. A phosphorus removal structure is essentially a landscape-scale filter for trapping dissolved phosphorus in drainage water and can on many styles and forms. All phosphorus removal structures are recommended to include: 1) a sufficient amount of phosphorus sorption material, 2) high dissolved phosphorus concentration (0.2 mg/L) that is able to flow through the sorption material at a suitable flow rate, and 3) the sorption material can be removed or replaced once it is no longer effective.

For the phosphorus removal structure, researchers a testing a design where water is distributed through a bed of steel slag, which contains high concentrations of calcium and readily binds dissolved phosphorus. The water flows upward through the slag and then exits to the tile drainage network. The phosphorus removal structure was designed to remove 40% of the cumulative dissolved phosphorus load over a 25 year period. While the study is still in the first 6 months of monitoring, initial results show that the phosphorus removal structure is removing 100% of the dissolved phosphorus that was entering the structure.

Want more information?

CEAP website:

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/.

Real-time weather stations can be found at:

http://amarillo.nserl.purdue.edu