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Livestock Wintering Site Management

Using a Portable Low Application Rate Irrigation System to Manage Catch Basin Wastewater

Introduction

Catch basins, or containment ponds, are earthen storage basins that are designed to capture runoff from seasonal feeding sites to prevent the wastewater from contaminating water resources.

Catch basins must be emptied and the wastewater applied to land in a way that will not impact surface water or groundwater resources. This can be difficult or costly if there is insufficient land available nearby and the wastewater must be pumped and transported elsewhere.

A portable pod-based low application rate irrigation system can provide a relatively low-cost solution when other options are not available.

A catch basin captures runoff from seasonal livestock pens

What is a Low Application Rate Irrigation System?

The system consists of multiple sprinkler heads on a small diameter pipeline, each encased in a protective rigid plastic pod, which offers protection to the sprinkler when moving the system. These pod-based systems were initially developed in New Zealand to meet a need for a more flexible irrigation system in the dairy and livestock industry (K-line 2016).

The system requires a pump, a main above-ground pipeline to convey the effluent, and the pod-based pipeline and sprinkler head package.

The main pipeline of a pod-based system has multiple tap off points, allowing for frequent movements of the system thereby increasing the land base available for effluent application. Typically the system is moved by dragging the pod-based line with an all-terrain vehicle.

Example of a low application rate irrigation pod

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Why use a low application rate irrigation system?

The main benefit of using the irrigation system is that it provides a way to dispose of the effluent from a catch basin in an environmentally sustainable manner. This minimizes potential for nutrients and other contaminants like bacteria to pollute rivers and lakes. Maximizing crop production from the irrigation benefit may be secondary, especially in regions where other sources of water are available for irrigation. Other advantages include:

- Relatively inexpensive compared to pivot or big gun systems
- Ability to apply effluent over a longer time period to allow for slow absorption by the soil and a decreased potential for runoff
- Pod cover provides protective element to the sprinkler head
- Flexible system for many different applications and areas
- Strong but lightweight system and easy to move

What are some design considerations?

Some of the main design factors to consider include the proper selection of the pump station components and the pipe that will be used to move and convey the wastewater. These components must be selected to ensure the desired flowrate is delivered at the required pressure. Low application rate irrigation systems will include a rating of what inlet pressure is required to achieve a certain flowrate for a given number of sprinklers. Irrigation systems should be selected according to project requirements.

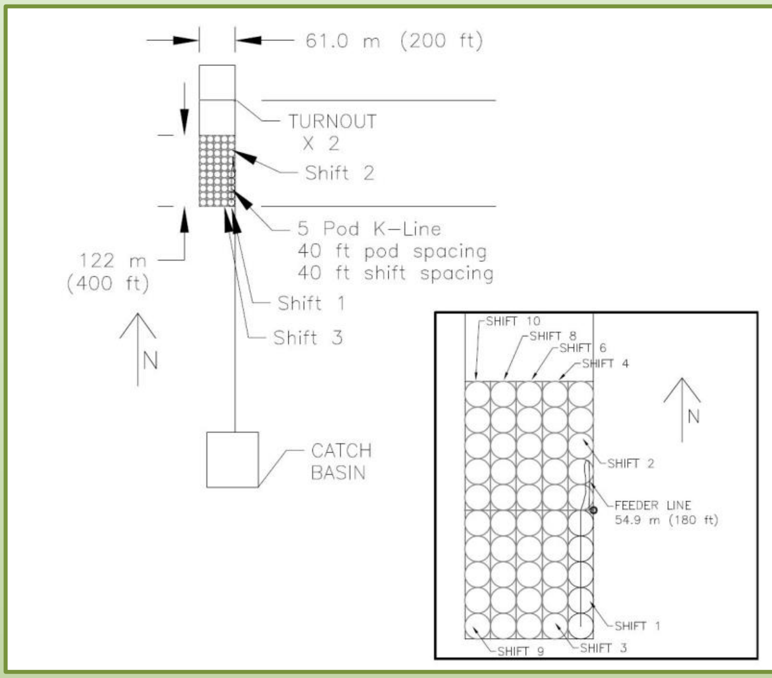
The desired flowrate should be determined by considering how much wastewater needs to be moved, how often, the amount of land available for application, the number and type of sprinklers that will be used, and the soil characteristics at the point of application. Soil infiltration and permeability rates vary between soil types, and should be taken into account to reduce the potential for runoff and nutrient loading. As well, regulations may exist on effluent application rates in some jurisdictions.

With the desired flowrate, system pressure requirements can be determined by taking into account the overall physical characteristics of the project, such as total distance and elevation differences from the wastewater source to the point of application. Generally, the further the distance and the larger the elevation increase, the larger the pump and/or pipe size will need to be.

Other factors to consider include but are not limited to:

- Inclusion of wastewater filter(s) on intake of pump system (wastewater solids content)
- Proximity to an adequate power supply for pumping requirements
- Number of system moves (shifts) required based on available land and wastewater quantity
- Irrigation system row spacing and sprinkler throw distance
- Application depth per irrigation event
- Total effluent volume annually applied

Example – Central Alberta 2014



An irrigation system was designed to apply effluent to a pasture that was approximately 1 km (0.6 mi) from a 1200 m^3 catch basin. The system was developed to irrigate a 61 m x 12 m (200 ft x 40 ft) transect during one shift, and was set up to irrigate two 61 m x 122 m (200 ft x 400 ft) fields that could be rotated every other year.

The system operated at a flow rate of 38-45 L/m (10-12 US gpm) at a pressure of 103 kPa (15 psi) at the start of the low application irrigation system. At these flow rates it took 7-8.5 hours to deliver 25 mm (1 in) of water over the 61 m x 12 m area that was irrigated during one shift.

Wastewater was applied at a rate such that water could infiltrate into the soil and that no runoff occurred from the site. Irrigation was scheduled as time permitted and did not occur during or immediately after rain. Over July and August 125 mm (5 in) of wastewater was applied to the irrigated sections, which meant that roughly 950 m^3 (209,000 gallons) of wastewater was emptied from the catch basin. To ensure that the salts did not affect plant growth, irrigation applications were limited to levels that did not increase the soil salinity by more than 1 dS/m from background levels at a soil depth of 0-15 cm (0-6 in). Gaps in coverage occurred when operating pressures decreased due to low water levels in the catch basin at the end of the trial.

Other Benefits

In the September following irrigation, the average yield of the forage in the irrigated section was 700 lbs/acre higher than in the non-irrigated section. This difference was still evident in the following June. The relative forage quality index and crude protein of the forage in the irrigated section were also higher than in the non-irrigated section in September and in the following June.

Irrigated area illustrating gaps in coverage and difference in productivity between irrigated and non-irrigated sections.

Soil Salinity

In the fall the average soil conductivity of the irrigated section was about 1 dS/m higher in the 0-15 cm (0-6 in) profile and approximately 0.4 dS/m higher in the 15-60 cm (6-24 in) profile compared to non-irrigated sections. Following spring melt, soil conductivity of the 0-15 cm and 15-60 cm profiles decreased by about 0.5 and 0.1dS/m, respectively.

What are some management considerations?

The conductivity of wintering site catch basin wastewater averages around 2300 µS/cm and can be as high as 6500 µS/cm. Repeated applications of saline wastewater to agricultural land can affect the physical and chemical properties of the soil as well as crop yield (Ayers and Westcot 1985). Soil conductivity may increase over time as the dissolved salts in the applied irrigation water concentrate through evapotranspiration. Rotating the irrigation system on the land will allow time for rain and snowmelt to leach salts below the root zone.

Rotation will also reduce the risk of building up high soil nutrient concentrations. At N and P concentrations ranging from 50-150 mg/L N and 10-50 mg/L P, every 25 mm (1 inch) of irrigation water applied per 4047 m^2 (acre) of land, equates to application rates of 12-38 kg/ha (11-34 lbs/acre) N and 2.2-12 kg/ha (2-11 lbs/acre) P. However, much of the N and P are not immediately available for plant growth as they are in organic forms or bound to particulates.

Are there any other considerations?

Contact your local municipal and provincial regulatory agencies for information regarding regulations or permitting requirements for irrigating with wastewater.

Further Reading

Ayers R.S. and Westcot D.W. 1985. Water Quality for Agriculture. FAO Irrigation Drainage Paper 29 Rev 1. Food and Agriculture Organization of the United Nations, Rome, Italy. http://www.fao.org/docrep/003/T0234E/T0234E00.htm#TOC

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