HIGH RATE LAND PASSAGE STRUCTURES FOR ATTENTUATION AT HIGH RISK LAND APPLICATION PERIODS

Hamish Lowe & Sian Cass

Lowe Environmental Impact Limited
PO Box 4667, Palmerston North 4462
Email: hamish@lei.co.nz

Abstract
High Rate Land Passage Structures (HRLPS) have been designed as an alternative to direct discharge of treated wastewater to surface water. A piped discharge directly to a waterway has been the historical means of surface water discharged used by many councils and industry. Alternatively land application of wastewater is combined with surface water discharge. Land application occurs when the soil requires irrigation and surface water discharge occurs when the soil is saturated and there is a high risk the nutrient load from the wastewater would drain directly to groundwater.

Consultation with local iwi and the wider community has demanded improvements to municipal and industrial wastewater management. From these consultations structural designs have been prepared to increase the land passage of treated wastewater before it is discharged to surface water. Every site is different and a variety of options for land passage and discharge are presented to iwi and the community for their consideration.

HRLP and discharge structures are designed within the constraints of the site and aim to spread the wastewater evenly over the structure with preferential flows being avoided, thereby maximising residence time and providing for greater contact with the land and vegetation. There is no significant treatment effect but there are significant cultural and social benefits.

Keywords: High Rate Land Passage, wastewater discharge, iwi, community

Background

High Rate Land Passage Structures (HRLPS) have been designed as an alternative to direct discharge of treated wastewater to surface water. A piped discharge directly to a waterway has been the historical means of surface water discharged used by many councils and industry. Alternatively land application of wastewater is combined with surface water discharge. Land application occurs when the soil requires irrigation and surface water discharge occurs when the soil is saturated and there is a high risk the nutrient load from the wastewater would drain directly to groundwater.

Consultation with local iwi and the wider community has demanded improvements to municipal and industrial wastewater management. While solutions can be developed to treat the wastewater to result in it having no environmental effect, the direct discharge can have an impact on the waterway's mauri. Having a land passage component is preferred by tangata whenua as it provides for passage over and through Papatūānuku and assists with the principles of tikanga maori and kaitiakitanga.

Structural designs have been prepared to increase the land passage of treated wastewater before it is discharged to surface water. Every site is different and a variety of options for land passage and discharge are presented to iwi and the community for their consideration. The options typically chosen are not necessarily the cheapest but the ones that take the slowest passage through land before the wastewater enters surface water.

Principles of Design

HRLPS of discharge from the wastewater treatment plant allows infiltration through and over the land (papatuanuku), with the extent of through rather than over land dependent on the material and vegetation used. The process potentially increases aeration and may improve water quality before it leaves the HRLPS and enters ground and surface water. The extent of improvement is dependent on flow rate and how long the water resides within the system.

Treated wastewater should be spread evenly over the HRLPS with preferential flows being avoided, thereby maximising residence time and providing for greater contact with the land and vegetation. Vegetation incorporated into the system allows for uptake of both the water and any nutrients in it. The roots, and micro-organisms around the roots, assist with removing contaminants and assisting to cleanse the water.

HRLPS Designs

HRLPS design begins with what is possible for the site. The design will be prepared with consideration of the following:

- Land area available;
- Slope of the area;
- Soil characteristics;
- Embankment stability to the water source;
- Current land use;
- Ability to maintain the structure;
- Amount of use it will get throughout the year.

The following options are examples of what have been offered to communities, along with simply piping the discharge. The community selects a combination of the land passage and discharge structures. Table 1 below provides graphics for the descriptions that follow.

Planted Open Drain

This option involves a modest enhancement of a drain that conveys wastewater from the WWTP to a discharge point on the river. It would involve some contouring, fencing and planting in suitable species to slow the passage of wastewater, ensuring that all of the discharge achieved earth contact before reaching the river.

High Rate Land Passage

HRLP involves a gentle cascade of several earth basins, separated by gravel berms and again planted up with suitable plant species. This would cost more than a planted drain but would provide for a longer time of direct contact of the discharged wastewater with the earth before it meets the surface water source.

Slow Rate Land Passage
This option involves the complete replacement of the existing drain with a wide, meandering managed wetland, with discharged wastewater winding slowly over a much greater length of passage before reaching the river. This option would require a greater land area and would involve a substantially larger planted area than any other option considered. It would be more expensive to construct than the other options considered, and would bring a greater requirement for ongoing active management of the planted wetland vegetation, but would optimise the opportunity for interaction between the wastewater and the earth before reaching the river/surface water.

Long Swale Land Passage
This design combines a form of the planted open drain with the HRLP. It involves piping the wastewater from the WWTP to a discharge structure. The wastewater is evenly spread along a rock structure and into a vegetated area. From the vegetated area the wastewater follows a long gently sloping swale to the river/surface water. The wastewater is slowed and spread widely before it makes contact with the earth. This option was prepared for a site with a suitable contour and land area that could create a long 350 m swale passage.

Discharge Structures
Once treated wastewater has exited the WWTP, and has passed over land to the river margin, there is still a requirement for some structure to secure the river discharge point. Which-ever of the land passage options is adopted, it will still need an appropriate discharge structure. Four options for this have been developed, which are described as follows.

Subsurface Diffuser
This option would bring wastewater into a diffuser pipe running parallel with the river and discharge it within a partially buried rock-filled structure placed into the river bank. Its main advantage over a piped discharge would be the improved physical stability of the structure; as it would be better able to cope with flood erosion, and would also ensure that there is no visible surface entry point of wastewater to the river. However, there would be a maintenance requirement to ensure it did not silt up.

Rock-Filled Channel
This option would provide a greater degree of physical security than the subsurface structure, involving the installation of a concrete channel to be filled with coarse gravel, through which discharged wastewater would travel from the land passage facility to the river. It would cost more than the subsurface option, but would not silt up. It would provide better security against possible flood damage than the current system, and would provide a better visual screening of the discharge.

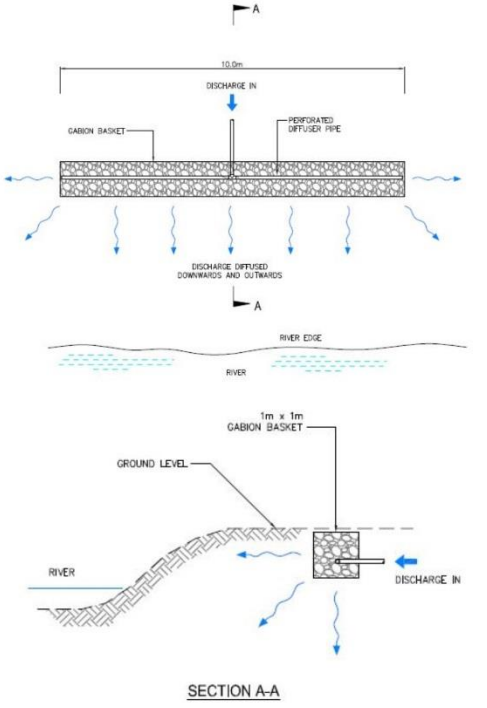
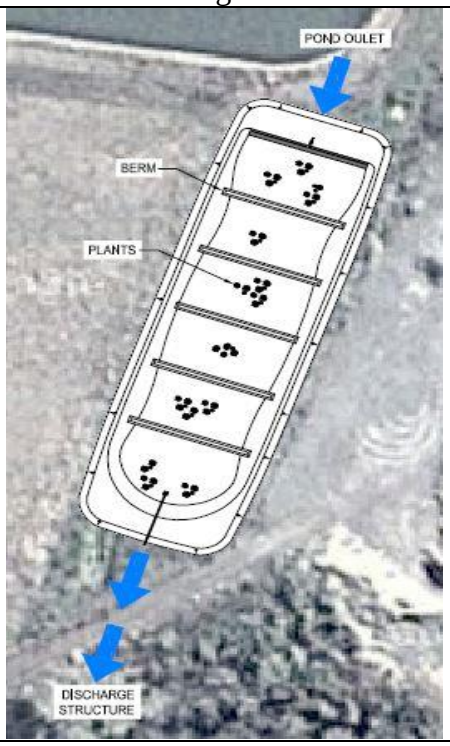
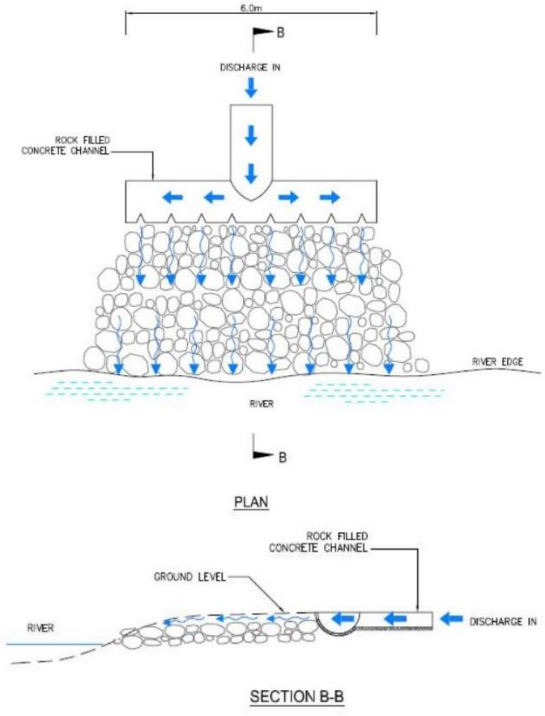
Soakage System
The soakage system is a set of rapid infiltration galleries. Several of these would be constructed (four are shown in Table 1) in the area between the WWTP and the river, involving large pits backfilled with coarse gravel. This system would function much like a septic tank disposal trench.

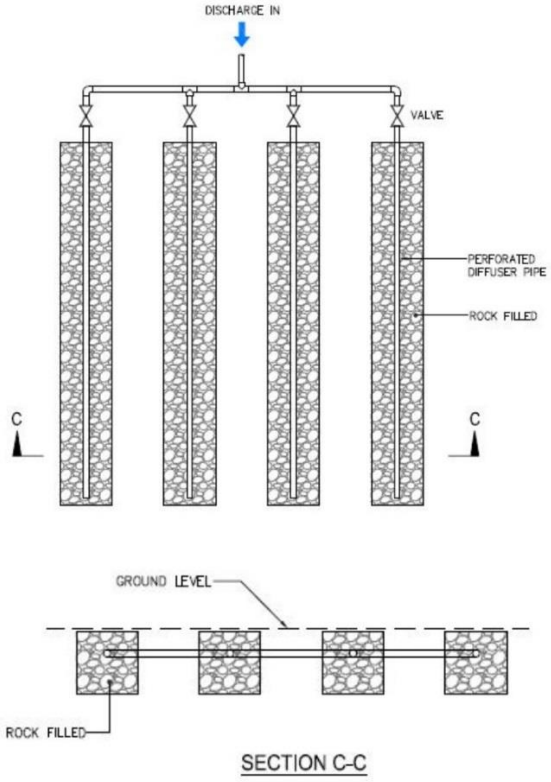
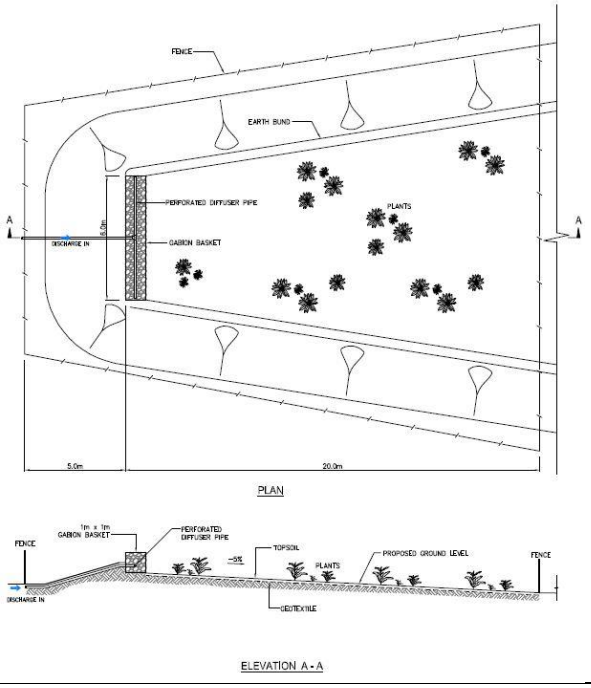
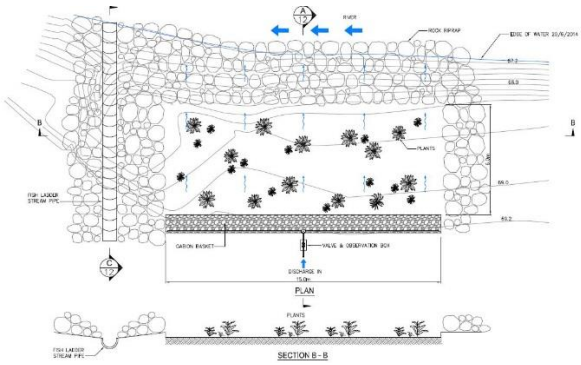
The advantage of this system could be that a direct discharge to the river could be avoided, if all the wastewater soaks away instead. Disadvantages would centre on potential problems maintaining the rate of soakage against possible build-up of algae between the rocks and amongst the gravel.

Vegetated Rock Discharge

This structure is similar to the structure used before the long swale in the land passage. The wastewater is evenly spread along a rock filled basket that spills into a vegetated area for further earth contact. From the vegetation the river embankment is stabilised using rip rap for the discharge to filter through before it enters the surface water.

Table 1: Land Passage and Surface Water Discharge Examples

Land Passage	Discharge
Planted Drain	Subsurface Diffuser
	
High Rate Land Passage	Rock Filled Channel
	

Slow Rate Land Passage	Soakage System
	
Long Swale Land Passage	**Vegetated Rock Discharge**
	

Maintenance

The function of the land passage and discharge systems is dependent on maintenance. Two aspects of the systems require attention. The use of wastewater creates a biofilm on the surface of structures that requires time to dry and slough off or be flushed with clean water. When land application is combined with these structures there are plenty of times when a

clean-up of the structures can occur. Alternatively when structures are used full time the system requires options to turn the wastewater supply on and off to allow for this drying to occur. This is a specific design consideration highlighted in the Soakage System.

The second maintenance criteria is to create consistent vegetation. If vegetation dies the wastewater tends to take the preferential pathway where there is no vegetation and can scour a channel. If grasses and weeds enter the system, these tend to die off in different seasonal conditions, therefore require removal to encourage the selected plant species to survive and create a consistent vegetated area.

Treatment Effects

The treatment effects of the land passage systems is expected to be minimal. The structures are primarily for cultural purposes not technical gains such as nutrient reduction.

Conclusion

HRLP and discharge structures are designed within the constraints of the site and aim to spread the wastewater evenly over the structure with preferential flows being avoided, thereby maximising residence time and providing for greater contact with the land and vegetation. There is no significant treatment effect but there are significant cultural and social benefits.