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# memorandum

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| TO | Tanvir Bamji | FROM | Oliver Hunt and Alan Pattle |
| | Watercare Services Ltd | DATE | 2 April 2024 |
| RE | Beachlands WWTP: Preliminary assessment of land area requirements for overland flow system expansion – Memorandum 1 | | |

## 1.0 Background

Watercare Services Ltd (**Watercare**) is currently undertaking technical assessments to inform a resource consent application for the discharge of treated wastewater from the Beachlands Wastewater Treatment Plant (**WWTP**). The consent will provide for projected population growth and an increase the capacity of the WWTP to 30,000PE. The Best Practicable Option ("BPO") for the discharge has been identified as the continued use and expansion of the existing overland flow system from the Beachlands WWTP which is used to create a diffuse discharge to the Te Puru Stream.

Watercare has engaged PDP to complete a preliminary assessment of the design of the existing overland flow system, to confirm the system can be expanded, and to identify potential expansion areas on the Watercare site at Beachlands. This memorandum has been prepared to detail the assessment and recommendations. The assessment confirms that the expansion of the overland flow system to service an increase in capacity to 30,000PE is feasible, and can be accommodated within land owned by Watercare at the Beachlands WWTP site.

## 2.0 Existing Discharge System

### 2.1 Construction

PDP has completed a detailed inspection of the existing overland flow system at the Beachlands WWTP site. Based on our inspection and discussion with the operators we understand the system functions as follows:

- The existing system consists of four dispersion zones each with three parallel series of PVC pipes elevated above the ground in the upslope section of the overland flow area covering an area of approximately 1.5 hectares. Wastewater flows through the pipes via gravity and is dispersed through holes drilled in the pipes.
- The length of overland flow slope between the distribution pipes and the pond edge ranges from approximately 50 – 100 m dependent on the location within the dispersal area and if the individual distribution pipe is at the top or the bottom of the array.
- The dispersal system does not utilise all zones or pipes within zones consistently. Most of the wastewater is discharged from the lower two sets of pipelines and the first three zones. Only at higher flows do all of the zones and pipelines provide discharge.

- Dependent on the position within the dispersal area, the average slope appears to vary between approximately 10-14% with an average fall over the length of the dispersal area of approximately 10 m[1].
- Following dispersal over land and through the vegetated discharge field and riparian plantings, the treated wastewater discharge enters a reach of the tributary which has been dammed. This has created a vegetated, gentle slope to the water's edge compared to the more steeply incised reaches of the stream both upstream and downstream of the farm pond.
- The overland flow system operates continuously/on demand. There are no systems or controls in place to periodically rest individual zones.
- Based on PDP's inspection on 19/03/24, the dispersal system is performing poorly with sub-optimal dispersion between the four zones, some areas had no visible wastewater discharge, and within the zones themselves with highly variable flows between adjacent orifices.
- The overland flow slope itself does not provide uniform sheet flow down the entire length of the slope. PDP observed rapid concentration and channelisation of wastewater within 5 – 10 m of the dispersal system. At the base of the slope, treated wastewater was observed to discharge into the pond in three discrete locations following its dispersal at the top of the slope.

It should be noted that the performance of the system is currently non-critical as further treatment past the point of discharge to the top of the overland flow system is not required to meet current consent limits.

## 3.0 Design Guidance

The Process Design Manual for Land Treatment of Municipal Wastewater Effluents (USEPA, 2006) provides detailed information on the design, construction, and typical performance of overland flow systems.

### 3.1 Sizing and Construction

There are a wide variety of layouts, distribution systems, application rates, slopes and slope lengths which are described by the USEPA. The existing system at the Beachlands WWTP generally falls outside the typical design parameters for overland flow systems. Critical differences in the design of the existing system include:

- Dispersal method – Dispersal systems typically employ either sprinklers at the top of the slope or a single dispersal pipe at the top of the slope.
- Slope length – Slope lengths typically do not exceed 60 m for overland flow systems.
- Slope gradient – Typical gradients for overland flow systems are 2-8% with 1-2% and 9-12% only recommended with additional earthworks to terrace the system.
- Slope uniformity – Overland flow slopes are generally graded to ensure a high degree of uniformity which promotes sheet flow.
- Planting/vegetation – Overland flow systems are generally planted with water tolerant grasses which are periodically harvested.

[1] Due to the tree cover over the majority of the dispersal area it is expected that the reliability of the available LIDAR data used in this assessment will be reduced.

- Loading rate examples for secondary treated wastewater vary from 0.09 to 0.28 $m^3/h$ for each metre of distribution pipework
- Operation – typically overland flow systems are operated intermittently to allow for rest periods.

Residence time on the slope is generally one of the most critical factors for contaminant removal. Given that the Beachlands system is both steeper and longer than a typical system the residence time may not be dissimilar to that recommended by the USEPA. The current loading rate is approximately 0.3 $m^3/hr.m$ if run continuously, meaning that the existing system is operated at the higher end of the examples provided in literature.

Generally the construction and operation of the existing overland flow system is at the high end of the specifications set out by the USEPA.

### 3.2 Expansion Requirements

The assessment of suitable areas based on the assumption that the required total "width" of the system at the projected design flow for 30,000pe, is three times the current width. The current system is loading at the higher end of examples provided in literature, therefore, it is expected that the increase in wastewater volumes will require at least an equivalent increase in discharge width. This correlates to approximately an additional 500 m of overland flow areas in terms of the width of the slope and approximately 4 ha of additional area based on the design parameters of the existing system, which would increase the entire overland flow system to 5.5 ha based on application rates that are the same or similar to the current scheme.

A larger area could be required if application rates are reduced to be more conservative. This will be confirmed as the design of the expanded system is completed. While 500 m additional is the minimum area and width we recommend allowing for, it would be prudent for the consent application to include all of the suitable areas to allow for flexibility in the design process.

For reference, at 30,000 PE, assuming an average flow of 5,400 $m^3$, an application rate of 0.1 $m^3/m/h$ which is at the bottom of the USEPA range (high strength wastewater, cold climate, sensitive receiving environment) would require a total width of 2,250 m and, assuming a slope length of 50 m, a total treatment area of 11.25 ha. Conversely, using an application rate of 0.5 $m^3/m/h$ which is at the top of the USEPA range (low strength wastewater, warm climate, low sensitivity receiving environment) would require a total width of 450 m and, assuming a slope length of 50 m, a total area of 2.25 ha.

The actual width and area required for the overland flow system will be confirmed during the detailed design phase. It is anticipated that the application rate will fall somewhere in the middle of the USEPA range as per the above 5.5 ha total.

### 3.3 Suitable Area Assessment

PDP has utilised topographical contours sourced from Auckland Council's Geomaps database to assess the slope in areas near the existing Beachlands WWTP. The assessment has excluded the current WWTP site and the existing overland flow system area.

Using gradient, the surrounding area has been divided into three different categories:

- 2-8% - Suitable, this land is most likely to be suitable for construction of an overland flow system without significant earthworks.
- 8-12% - Potentially suitable, the land could be suitable for construction of an overland flow system however some earthworks would likely be required.

- 12-16% - Marginal, based on the design of the existing system it may be possible to utilise parts of this land however significant earthworks could be required and the system would fall outside the usual design parameters for an overland flow system.

In all instances, further assessment would be required to confirm the nature of any specific sites selected as part of any detailed design process.

The results of this initial investigation are presented in Figure 1 attached to this memorandum. There are several areas inside the Watercare property which include land which may be suitable for expansion of the overland flow system. Three areas have been identified as potentially suitable:

- Area A – approx. 1.5 ha
- Area B1 – approx. 3 ha
- Area B2 – approx. 5.5 ha

Based on the assessment, PDP have drawn the following conclusions:

- There is insufficient land on the northern side of the stream and within land currently owned by Watercare to complete a full expansion of the overland flow system. However, there may be suitable land for an initial 50% expansion of the existing system (Area A, Figure 1).
- In combination with the Area A and the existing overland flow area, either B1 or B2 could provide enough suitable land;
- There is likely enough suitable land if both Area B1 and Area B2 (on the south side of the stream) are used. Dependent on the final design of the slopes, area B2 may be sufficient to provide the full expansion of the overland flow system.
- The total area available including 10 ha in areas A, B1 and B2 combined with 1.5 ha of existing overland flow area could provide sufficient treatment area even at the lowest end of the application rates set out the USEPA guidelines.

Overall, the preferred option is to retain the existing overland flow slope and construct a new overland flow slope or slopes in Area B2. The final total area requirements, including buffer areas and conveyance, will be confirmed during the detailed design phase of the process.

There is an important issue with all areas identified. As shown in Figure 1, with the exception of the modified area around the existing pond, all of the riparian areas along the streams near the WWTP are heavily incised with steep banks which are unlikely to be suitable for a direct diffuse discharge to the stream without a high risk of erosion. Some form of collection system may be needed at the bottom of each slope to capture the run-off from the slope and transport it into the stream or pond and the final discharge could be via overland flow through the riparian margin of the pond or stream.

## 4.0 Terrestrial Ecology

### 4.1 Relevance

Given the likelihood that some disturbance of the riparian strip and possibly in the treatment areas themselves will be required to facilitate discharge to the stream for any extension areas, an assessment of the terrestrial ecology has been undertaken to identify any key constraints.

### 4.2 Assessment

A PDP ecologist conducted a preliminary assessment of the terrestrial ecology at the site with a desktop review of existing ecological databases and a site visit on the 16th of February 2024. Vegetation was surveyed within the three areas being considered for the overland flow system expansion (A, B1 and B2), and within 100 m from the outer edge of the proposed areas.

Exotic pasture grassland occurs within the three possible overland flow treatment areas; indigenous shrubland dominates riparian margins of the stream, and areas of exotic trees are present. Wetlands were observed in the gullies adjacent to Areas B1 and B2, and within the stream riparian margins within 100 m of the proposed system.

Site conditions varied across the different vegetation types. The raupō reedland upstream of the current treatment area appeared to be relatively healthy, and the open water pond provides habitat for waterfowl. However, although stock were generally excluded from riparian margins and wetlands by fencing, some evidence of grazing occurred on the true left river bank on the western edge of the property. The spread of exotic vegetation at the site may alter connectivity of wetland areas in the future; for example, the regional pest plants crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*) were locally dominant, and woolly nightshade (*Solanum mauritianum*) was common throughout the shrub tier on stream banks. Actions to exclude stock, remove pest plants and exotic species, and replant in appropriate indigenous species could significantly improve the quality of this site.

Potential adverse effects associated with the proposed expansion options depend on the detailed designs and their site-specific effects on hydraulic and nutrient loading rates. Due to the presence of wetlands, wetland delineation should be completed for all wetlands on the site and an Ecological Impact Assessment (EcIA) is recommended.

## 5.0 Summary

Area B2 (Figure 1) has been identified as the preferred area for expansion of the Beachlands WWTP overland flow system in addition to retaining the existing area. The detailed design of the overland flow slope or slopes will be completed in future stages of work, however, it is acknowledged that due to the topography of the area south of the pond the expanded overland flow system may require some form of collection system to convey the discharge to the stream/pond and avoid erosion. This final discharge could take the form of high-rate overland/diffuse discharge through the riparian margin of the pond or stream.

This assessment confirms that the expansion of the overland flow system to service an increase in capacity to 30,000PE is feasible, and can be accommodated with land owned by Watercare at the Beachlands WWTP site.

## 6.0 References

Ministry for the Environment. (2022). *Wetland Delineation Protocols*. Ministry for the Environment. Wellington, New Zealand.

USEPA. (2006). *Process Design Manual Land Treatment of Municipal Wastewater Effluents.* Cincinnati: U.S. Environmental Protection Agency.

## 7.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Watercare Services Ltd and others (not directly contracted by PDP for the work), including Aquatic Environmental Sciences Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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**PATTLE DELAMORE PARTNERS LIMITED**

Yours faithfully

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# FIGURE 1: SUITABLE LAND AREA FOR AN EXPANSION OF THE BEACHLANDS WWTP OVERLAND FLOW SYSTEM

WATERCARE BEACHLANDS MARAETAI WWTP

**SOURCE:**
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LINZ, STATSNZ, NIWA, NATURAL EARTH, © OPENSTREETMAP CONTRIBUTORS., EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.
2. ELEVATION INFORMATION SOURCED FROM LINZ (AUCKLAND 1 M LIDAR 2016-2017).
3. WASTEWATER DISPERSAL PIPEWORK SOURCED FROM WATERCARE.

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