Mangawhai Wastewater Treatment – Disposal Field

Irrigation Assessment

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1 Introduction

The Mangawhai Wastewater Treatment Plant and disposal systems has a current resource consent to dispose treated wastewater via irrigation of farmland owned by Kaipara District Council and leased to a third-party. Given the current and potential future demands on the treatment plant, options to future proof the system are being investigated. One option is to increase the irrigation application area. An assessment of the suitability of the soils of an additional 13 ha of land on the existing property has been undertaken. Figure 1 shows the location of the site, with the top orange block is the site that was investigated. The site is located 11 km from Mangawhai. Average annual rainfall is understood to be 1250 mm.

2 Assessing suitability for irrigation

There are several soil features which impact an irrigation system design. Soil texture influences the volumes of water can be held within a soil. A fine textured clay soil has a greater ability to hold water in its many small soil pores. These types of soils hold tightly onto water within its pores making more slowly available for plant uptake, these soils are often poorly drained. In addition, fine textured soils generally have low infiltration rates. In comparison, a course textured sand soil holds less water due to larger soil pores. However, this water, is more freely lost from the soil profile through drainage due to their greater infiltration rate. Because of this, when determining whether a block of land is suitable for irrigation, soil texture and water holding capacity are two important soil feature that are required to be considered.

The slope of the land is another important point that needs to be taken into consideration. This is because as the land get steeper the potential for water and nutrient loss increases due to the increased potential for run-off. Slope itself irrespective of how steep it is, however, cannot be used to determine whether a site is feasible for irrigation or not. Differences in slope will impact the design of an irrigation system and application rates of waste water applied. It is these factors which may make it unfeasible to apply irrigation.

The third point that needs to be considered in this case is the location of the block of land in comparison to the storage dam. The further away the block of land is to the storage and the greater the difference in elevation to more expensive the capital and maintenance cost on the irrigation system will be due to pumping costs.

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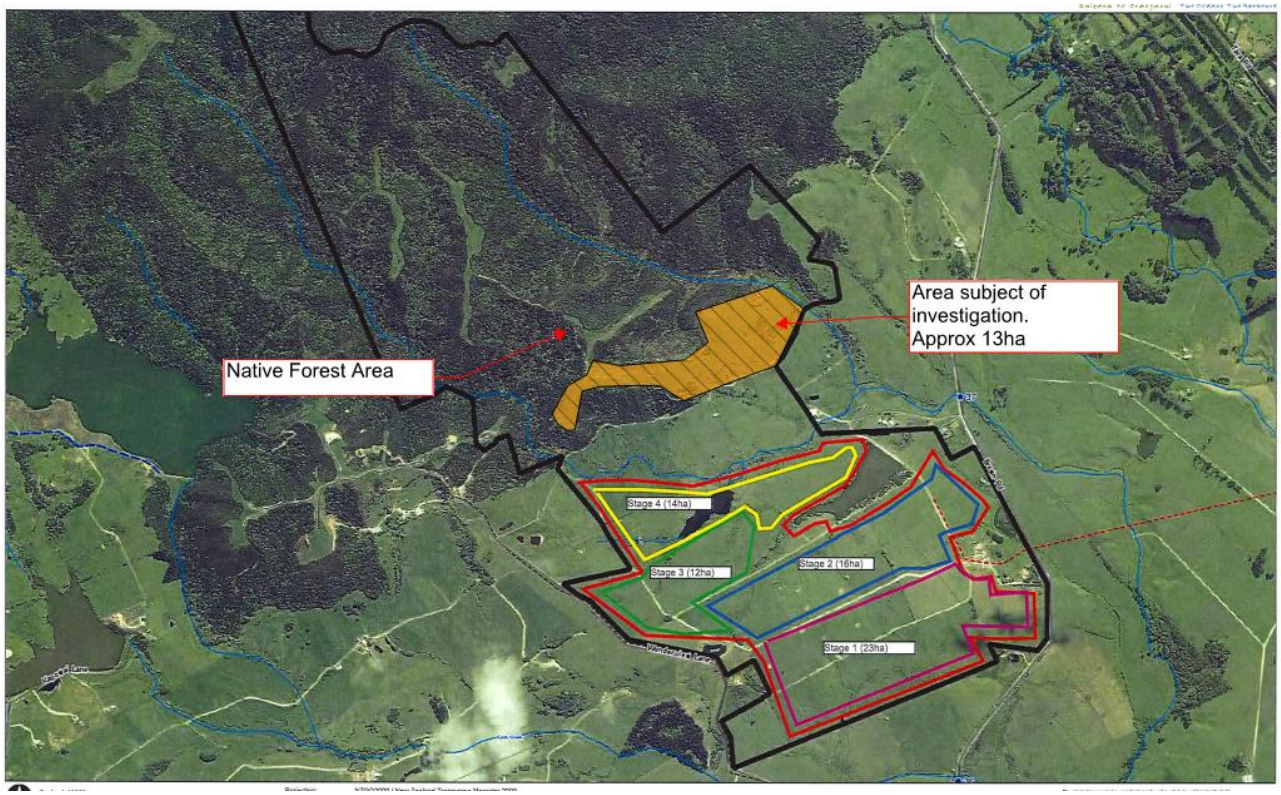

Figure 1 - Land application site map

3 Methodology

Prior to field work being undertaken existing soil surveys of the area and typical soil descriptions were reviewed. Aerial photography was sourced from Google Earth Pro.

Field work was undertaken on January 22nd to 24th 2019.

Soil profiles were exposed from holes dug by spade and augering; observations occurred at track cuttings and other places where the soil could easily be exposed. Representative profiles were described in general accordance with Milne et al 1995 and photographed. Figure 2 highlights where each soil hole was located.

Figure 2 - : Soil profile and feasible area map. Area within red is approx. 2.4 ha

Using the cell phone app Clinometer, several slope readings of the topography were taken.

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Following the first day of field work land management units, that is an area of land where similar land management would be required, of the site were determined so that representative samples could be collected for laboratory analysis. The laboratory analysis to be undertaken on the soil cores collected included: macroporosity, ksat, k-40, AWC, and RAWC.

Based on all field work and site observations the 13 ha site two land management units were identified. The distinguishing feature between the two units is the slope. The first unit was approximately 2.4 ha and has slopes less than 20°. The second land management unit has slopes greater than 20°.

3.1 Description of Land Management Units

Figure 3 below highlights the varying slopes across the 13 ha. An area of approximately 2.4 ha had slopes ranging between 0° and 20° and from this aspect this area could be suitable for irrigation. The soil survey undertaken focused on this area.

All areas highlighted in blue have a slope greater than 20°. This area covers 10.6 ha of the 13 ha block. Generally, land with slopes greater than 20° would not be suitable for irrigation due to increased risk of surface run off. Due to this a soil survey was not completed on this area.

Based on landforms it would be expected that similar soils to the 2.4 ha area would be found on the 10.6ha land management unit and would likely be the hill version of the soil found.

While on site, it was determined that the irrigation storage dam was 54 m above sea level while the highest point of the 13 ha block was 125 m above sea level. This is a 71 m difference in elevation.

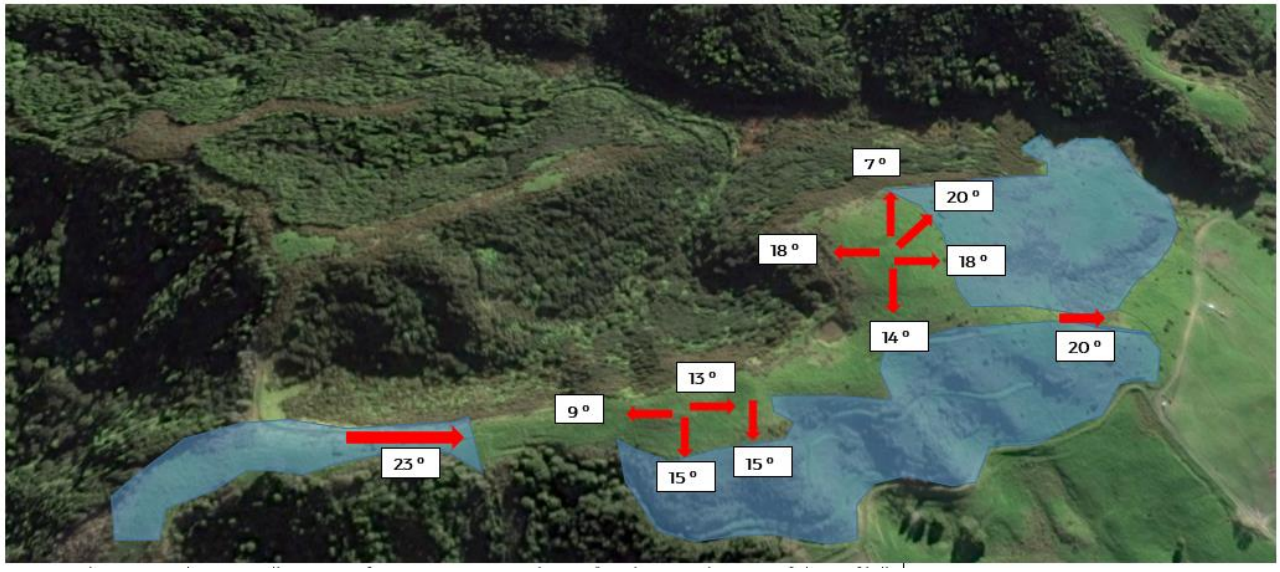

Figure 3 - Slope map

4 Soil Observations

Based on the field work two soil types were identified on the property. Both soils had silty clay top soils and subsoils. The nature of these soil in addition to the high rainfall of this location has the following implications for wastewater irrigation:

1. The number of suitable days through the year suitable for deferred irrigation is less than a free draining silt loam soil in a region where the rainfall is lower;
2. The application rate required to prevent nutrient and bacterial loss through run-off would need to be a low rate. The silty clay soil texture increases the risk of run-off compared to other soil textures due to lower infiltration capacity;

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Figure 4 highlights the areas where each soil type is located. A description and photo for each soil is presented below:

Soil Description	Photo
A 0-25 cm Silty clay 10 YR 2/2 very dark brown Crumb structure Moderately developed Very Friable No mottles or gleying Distinct boundary change B 25-40 cm Silty clay – very smooth 10 YR 4/2 dark greyish brown Crumb structure Weakly developed Distinct boundary change C 40+ cm Silty clay 10 YR 7/6 yellow Platety structure No Development Red on soil map	 

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A 0-15 cm Silty clay 10 YR 3/2 very dark grayish brown Crumb structure Moderately developed Very Friable No mottles or gleying Faint boundary change B 15-55 cm Silty clay loam/silty clay 10 YR 3/2 very dark grayish brown Crumb structure Weakly developed Distinct boundary change C 55+ cm Rock 10 YR 6/4 light yellowish brown Note: some topsoil missing, another hole of same soil had an A horizon of 0-25 cm. Track side cutting which was a lot drier than soil hole. Yellow on soil map	

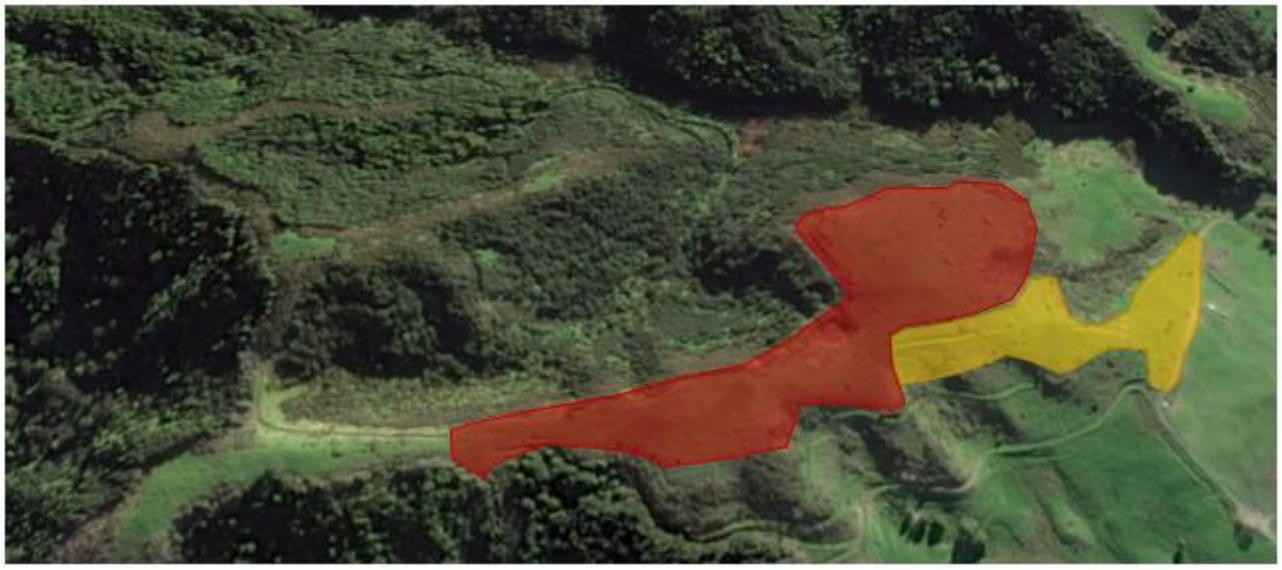

Figure 4 - Soil map

5 Conclusion

The 2.4 ha of land mapped with slopes less than 20° has physical characteristics that mean irrigation would need to be carefully managed. A low application rate technology would be required and there are likely to be fewer observed days of soil water deficits due to the likely high water holding capacity characteristics of the observed soil types.

In assessing feasibility of irrigation of the steeper slopes a major consideration is the need to ensure that effluent waste water infiltrates into the soil and up taken by plants to prevent run- off. To prevent runoff from steeper land a lower the daily application rate and potentially volume would need to be. Therefore, less waste water can be applied, and different technology might need to be used (low rate applicators).

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The location and elevation of the additional block has been considered as well.

1 Due to the difference in elevation between the storage dam and potential irrigation site, the cost of installing a system would be considerably more expensive per hectare than a system located on flat land. The reasons behind this being:

(a) A specialist irrigation system would be required,
(b) Access tracks would need to be constructed,
(c) The system is for this site long and skinny therefore an increase mainline cost, and
(d) Installing a system on steep slopes would be more time consuming.

2 The difficulty in maintaining system will be greater.

(a) Monitoring the system for faults and performance would require a sophisticated system to minimise the need for physical inspections, and
(b) Physical inspections and repair work will require considerable more time, effort and cost due to its location.

3 The large static lift between the pond and the 13 ha would result in there being an increase in power costs both in terms of capital and operations.

Taking into account all of the findings it is our opinion that it is not sustainable to irrigate to the 13 ha block. When all steep areas of the block are removed there is less than 2.4 ha of land suitable for land application. But due to the points outlined above it is our opinion that:

(a) Other neighbouring sites should be explored, so a proper comparison is able to be made, and
(b) The operation of the existing site be analysed to ensure the area is being effectively used.

As per client's request while during the site visit, a walkover on the native forest area has also been conducted to assess the feasibility of this area for irrigation purpose.

The area presented steep contours and presence of dense native vegetation. As per the above conclusion we believe the area to be not suitable for land disposal irrigation. And the same conclusion applied to this area too.

Given the findings above, laboratory testing of the soil cores collected was not undertaken.

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Photos taken during site visit

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