REGIONAL BIOSOLIDS STRATEGY
LOWER NORTH ISLAND

Report 1: Gaps Analysis; Investigating Knowledge Gaps for Sludge in the Lower North Island

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Regional Biosolids Strategy – Lower North Island

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1 SUMMARY

Background

In the lower North Island, there is an estimated 80,000 tonnes of sludge (at 20% solids) produced from oxidation ponds (every 30-50 years) and additional sludge from 5 high rate treatment plants. Most of this sludge ends up in landfills. Landfilling is not a long-term management option and is becoming more difficult due to increased levies, space required and transportation distances. There is an increasing community expectation of a need to develop sustainable use options. Management of solids is especially difficult for smaller communities where limitations because of lesser economies of scale can stifle the development and creation of workable solutions. All territorial authorities are facing the same problem – what to do with their biosolids.

Ten lower North Island councils are working in partnership to develop a collaborative biosolids strategy that includes the potential collective management of sludge and beneficial use programmes. The strategy is led and co-ordinated by Lowe Environmental Impact (LEI) and The Institute of Environmental Science and Research Ltd (ESR).

The first step in the project is to undertake a stock take and gaps analysis to determine the scale of the current sludge problem for each district. The project partners will then work together to determine potential collective solutions including processing, end-uses, consenting and stakeholder engagement processes. Some of the potential solutions will be trialled (e.g. field trials of composting). The outcome will be a 'tool box' of different scenarios that provides a model of operation that can be applied in other regions around New Zealand.

The purpose of this report is to:

- examine the availability of information held by councils regarding the sludge and biosolids in their district;
- provide a summary of the information; and
- identify gaps in the available data which need to be filled to allow the sludge volume and quality of the area covered by the partner councils to be properly quantified.

To do this, information was collected on volumes and characteristics of sludge in the region as well as the current regulatory environment and limitations. This data was used to extrapolate likely sludge quantity and quality to the national level.

Information Collection

A comprehensive survey template was emailed to each council partner. This was followed up with emails and phone calls to collect the data on sludge quantity and quality in each district. Of the eight council partners involved in the project, six filled out the survey and a further two were interviewed by telephone. Most data sets were incomplete and accessing external data sources was required, including online sources, consultants (e.g. LEI) and resource consents. The ninth Council involved in the project is Horizons Regional Council, who are not responsible for any wastewater treatment plants, and so were not required to respond.

Findings

The main finding of the "Gaps Analysis" is that for many councils, information on sludge volumes and quality is simply not available, mainly because it has never been investigated. Below is a summary of the information collected.

Across the Lower North Island there are 46 wastewater treatment plants (WWTPs); 37 are oxidation ponds (some with additional treatment such as screening and/or maturation cells), four are small advanced treatment plants (Waiouru, Whakapapa, Pipiriki and Mangaweka), and five are larger advanced treatment plants serving bigger populations that discharge sludge on a continual basis. The five larger plants are: Paraparaumu (KCDC); Levin (HDC), Palmerston North (PNCC); Feilding (MDC) and Whanganui (WDC) that produce a variety of digested sludge and have reasonable data on sludge volumes (excluding Palmerston North), quality and end-use. Sludge produced at the five larger plants is either disposed to landfill (Paraparaumu, Levin, Whanganui), stockpiled on site (Feilding, Whanganui) or composted (Palmerston North and Feilding). There is very limited information on trace elements and organic contaminants content, with data only available for one plant (Levin). Most plants have information on heavy metals. Sludge quality is variable with large inputs of trade waste into some plants.

Of the 37 oxidation ponds in the region, there is no data available on sludge quantity for 32 ponds, and variable, scattered data on quality with little consistency for what has been measured. Councils which have undertaken desludging operations recently tended to have a more detailed record of sludge quality and quantity i.e. Masterton District Council have data on the sludge from their decommissioned ponds and Tararua District Council have data for the sludge in sludge cells at Woodville.

The oxidation pond systems vary in design configuration depending on population size; some towns have a sequence of ponds while other smaller localities have a single pond system. The ponds are of variable size, with not all having inlet screens. Information supplied suggests that eleven of the ponds, accounting for a third of the plants reviewed, do not accumulate sludge, or if they do, it is at a very slow rate. An additional third (11) of the ponds have been desludged in the last 5 years. The final third have never been desludged.

For those ponds that have been desludged, the sludge is either stored on-site or landfilled. For most small towns with oxidation ponds, trade waste inputs are negligible, and it is probable that the concentrations of inorganic contaminants (e.g. heavy metals) would be low. However, nutrient content and the degree of sludge stabilisation will depend on the age of the pond and the time since emptying etc.; further analysis, as well as confirmatory heavy metal analysis, will be undertaken in the next part of the project (Task 1b Site visits and field investigations).

Extrapolation to National Picture

Extrapolation of the information on sludge volumes and quality collected from the 8 councils involved in this project to give a national picture is difficult. This is partly because there is very little data available. This lack of data is likely to be similar across New Zealand and we estimate there could be around 800 oxidation ponds in New Zealand. As these limitations will be common in all districts and regions, we would expect similar levels of landfilling and mono-filling to be occurring at a national level.

Beneficial use of sludge and biosolids is not widely practiced (at only one plant reviewed). A potential roadblock is likely to be that producers consider biosolids use other than disposal (landfill, monofill, construction fill) to be expensive and resource intensive with significant expenditure attributable to planning, applying for, and ongoing monitoring associated with resource consent requirements.

Regulatory Environment

National guidelines exist (Guidelines for the Safe Application of Biosolids to Land in New Zealand, NZWWA, 2003), to assist producers, dischargers and regulators (regional councils) to manage the discharge of treated domestic sewage to land in New Zealand. These guidelines have no legal status and the application of biosolids to land is regulated by the Resource Management Act (RMA) (1991). Within the guidelines are standard or nationally-agreed criteria for monitoring the contaminant loading of biosolids and receiving soils. The Guidelines propose a grading system whereby biosolids are assigned a stabilisation (microbiological) grade 'A' or 'B', and a chemical contaminant grade 'a' or 'b'.

The NZWWA (2003) guidelines were proposed to be a living document to allow for updates as new information became available. Led by WaterNZ and involving industry (WasteMinz, and The Land Treatment Collective) and research (The Centre for Integrated Biowaste Research) partners, a new generic technical guideline is currently being drafted containing quality criteria for beneficial re-use of all organic wastes.

The partner councils involved in this project span the Horizons (Manawatu/Wanganui) and Greater Wellington (GW) regions. Discharges of biosolids to land are allowed by rules in each regional council's regional plan. For GW and Horizons, specific rules apply to the discharge of biosolids, but not to sludge. It is possible to apply biosolids as a permitted activity (not requiring resource consent) if an Aa grade (based on NZ Biosolid Guidelines, NZWWA, 2003) can be achieved. However, it is uncommon in smaller areas (compared to Auckland or Wellington) to maintain a testing programme that complies with and demonstrates Aa grade requirements. It is reasonable to anticipate that all discharges from pond treatment systems will not be classed as an Aa grade biosolid and will therefore require a discharge consent. Consent application requirements are likely to include provision of information on material characterisation, the discharge site and mitigation and management plans.

Conditions of consent generally reflect the risk of the consented activity as perceived by the consenting authority. In practice, conditions for new consents are often modelled on existing resource consents, and may have more, but seldom less restrictive conditions than have been applied elsewhere previously.

Summary

Key outcomes of the report are:

- Less information is held by councils regarding pond sludge than anticipated prior to undertaking this exercise;
- Often information available is based on estimates for one or more of the calculation parameters;
- Continuous process plants (the larger plants), with discharge from the treatment system on a daily basis, tend to have adequate records of quantity, and produce volumes in the order of 35 to 160 L/person/y dry weight of sludge. Variability is likely due to industrial loads and process differences (e.g. digestion), but further investigation is required to confirm this;
- Copper and zinc are the components of most concern, and most commonly measured. Other trace element data is not collected. Organic compounds and pathogen content is not commonly monitored; and
- Insufficient information is available to determine pond sludge quantity relationships with certainty, however the limited information available suggests in ponds that are not desludged, accumulated volumes are in the order of 1.0 to 1.5 m^3/person dry weight of sludge. Where ponds have been desludged, the rate of accumulation may be in the order

of 10 L/person/y dry weight of sludge. Additional investigation is required to reduce uncertainty around these figures.

Several knowledge gaps have been identified and are detailed in this report. These include:

- Total quantity of sludge in 32 ponds;
- Rate of sludge accumulation in oxidation ponds.
- Quality of sludge from oxidation ponds and other treatment plants in terms of nutrients (e.g. N, P, K, C), heavy metals (e.g. Cu, Zn) and organic contaminants (e.g. PAHs).

To obtain a clearer understanding of the scale of the sludge issue (i.e. quantity and quality) in the region, further investigations need to be undertaken. It is clear from the gaps analysis that the largest knowledge gaps relate to oxidation ponds; very little data exists on the sludge volumes and quality in oxidation ponds across the region, thus oxidation ponds will be the focus of further investigations. It is recommended that the next phase of this project, Task 1b Site visits and field investigations, focus on this issue and approach it in two ways:

1. Collect qualitative information on sludge volumes and quality using data such as age of the pond, if it has been emptied before, population and pond size. This type of information will allow estimates to be made on the volume of sludge likely to be in the pond and the possible quality.
2. Quantitative information collected by undertaking field work to assess sludge levels within a representative number of ponds and full analysis of sludge to determine composition for a range of variables (e.g. organic Matter, Dry Matter, Volatile Solids, Copper, Phosphorus, Zinc, pH, Total Nitrogen, Ammonium-N, Nitrite-N, Nitrate-N, Nitrate-N + Nitrite-N, Total Carbon and *Escherichia coli*). It is recommended that field work is restricted to those ponds likely to require de-sludging in the next 5 years, for example, Foxton and Marton, as these locations will have more urgent requirements for the information gained. This data can then be used as a baseline for planning further stages of this project.

2 INTRODUCTION

In the lower North Island, there is an estimated 80,000 tonnes of sludge (at 20% solids) produced from oxidation ponds (every 30-50 years) and additional sludge from 5 high rate treatment plants. Most of this sludge ends up in landfills. Landfilling is not a long-term management option and is becoming more difficult due to increased levies, space required and transportation distances. There is an increasing community expectation of a need to develop sustainable use options. Management of solids is especially difficult for smaller communities where limitations because of lesser economies of scale can stifle the development and creation of workable solutions. All territorial authorities are facing the same problem – what to do with their biosolids.

This project aims to develop a collective biosolids strategy and use programme in the lower North Island. The strategy will provide economies of scale and alternatives for discharge and beneficial use of biosolids which are affordable, sustainable and provide targeted solutions that are consistent with national waste minimisation strategies.

The Lowe Environmental Impact (LEI) / Institute of Environmental Science and Research Ltd (ESR) team (**Project Team**) will work with 9 councils in the Lower North Island to determine pathways to work together that will form the basis of a regional strategy. Firstly, a stock take and gaps analysis will determine the scale of the current sludge problem for each district; then a collective approach will be used to determine potential collective solutions including processing, end-uses, consenting and stakeholder engagement processes. Some of the potential solutions will be trialled (e.g. field trials of composting). The outcome will be a 'tool box' of different scenarios that provides a model of operation that can be applied in other regions around New Zealand.

The **Project Team** have organised the work activities into project Stages and Tasks. This document forms the basis of the proposed work for Stage 1: Gaps Analysis; Task 1a: Desk top study.

The purpose of this initial task is to determine the scale of the sludge issue within each district. A 'gaps analysis' has been undertaken to determine this and involved identifying:

- What is happening now?
- Volumes and characteristics of sludge in the region;
- Regulatory environment and limitations; and
- Relativity to the national picture.

3 METHODOLOGY

A questionnaire (Appendix A) was developed by the **Project Team** to collate the information required to undertake the gaps Analysis. Members of the Technical Group were contacted via email with follow-up phone calls if required.

The members of the Technical Group and their contact information are given in Appendix B.

Where necessary, further information was gathered from external parties such as consultancies.

4 WHAT IS HAPPENING NOW? - VOLUMES AND CHARACTERISTICS OF SLUDGE IN THE REGION

4.1 Individual council data

Of the eight council partners involved in this part of the project, six filled out the survey and a further two were interviewed by telephone. Most data sets provided were incomplete and accessing other data sources was required. It is interesting to note that for many of the councils in the region, data was held by external parties such as consultants (e.g. LEI). Much of the information required could be sourced from resource consents. Below is a summary of the information collected for each district.

In the tables below the sludge volumes are expressed as "sludge/yr (m^3 DW)" – most information provided was in the form of estimates of sludge volume and solids content (assumed to be 3%).

4.1.1 Manawatu District Council/ Rangitikei District Council

Name	Type	Details	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Manawatu						
Rongotea	Oxidation pond	Two stage pond system with sub-surface wetlands	600	15 m^3 (500 m^3 @ 3% solids)	Fielding	Emptied 2015
Kimbolton	Oxidation pond	Built in 1975, single pond with floating wetland, UV and discharge to surface water	200	NA	NA	Solids sit in septic tank, pond deals with effluent only, minimal sludge in pond
Cheltenham	Oxidation pond	Single pond	66	NA	NA	As above
Awahuri	Oxidation pond	Single pond	20	NA	NA	As above
Sanson	Oxidation pond	Two oxidation ponds in series, wastewater discharged to land and to surface water	540	Approx. 60 m^3 (approx. 200 m^3 @3% solids on site needs removal)	Fielding	Never been emptied, needs de-sludging.

Name	Type	Details	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Fielding	WWTP	Complex plant, clarifiers, oxidation ponds etc	16,250	2, 280 m^{3*}	On-site stock-pile and composting facility.	No analysis on current sludge quality, daily production of alum, and digester sludge, sludge in anaerobic pond. 2008 data showed sludge met grade B requirements for Zn and Cu and grade A for Cd, Cr, Hg, Ni, Pb, As.
Ohakea	Oxidation pond	Concrete lined oxidation pond, sludge processing, clarifier and sludge digester, some sludge goes back into oxidation pond to enhance pond activity	249	365 m^3	Sludge drying beds – removed on regular basis – likely goes to Bonny Glen landfill	Run by defence force
Halcombe	Oxidation pond	Built 1977 two ponds, high sludge accumulation.	534	1.5 m^3	Fielding	Desludged in 2015
Rangitikei						
Duddings Lake	Oxidation pond	Single pond	No permanent population	NA	NA	Solids sit in septic tank, pond deals with effluent only, minimal sludge in pond
Bulls	Oxidation pond	Screen, two pond system, overflow weir to a grass-covered drain running through a paddock towards the Rangitikei River	12,000	90m^3 in the first pond, 2nd pond unknown	Fielding	Desludged in 2016

Name	Type	Details	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Marton	Oxidation pond	Three ponds in sequence, anaerobic covered pond with interlocked floating wetland and two aerobic lagoons.	4,000 but due to trade waste pop eqv. 20,000	No data	Fielding	Ponds never been emptied. Significant trade waste: pet food factory, malting factory and leachate from Bonny Glen landfill.
Koitiata	Oxidation pond	Single pond	105	No data	Sand dunes	Never desludged, likely mix and pump to sand dunes
Mangaweka	WWTP	Modular treatment system, discharge into surface water	147	No data	No data	Likely taken to Marton ponds
Hunterville	WWTP, and ponds	Front end treatment system, two oxidation ponds	429	10 m^3 after 4 years, estimated to accumulate 4.5 m^3 / yr	Fielding	Desludged in 2015
Ratana	Oxidation pond	Single pond	327	No data	Fielding	Never been desludged but will need to be soon.
Taihape	Oxidation pond	Built 1976, Single pond with aerators, wastewater discharged to into the river	1,670	No data	Fielding	Never been desludged but will need to be soon.

* 4 m^3 alum sludge (800 m^3 @ 0.5% solids) per day, 2 m^3 digester sludge (100 m^3 @ 2% solids) per day; 90 m^3 anaerobic lagoon (3000 m^3 @3% solids) per year

Notes:
The Fielding WWTP serves a population of approximately 16,000, receiving water from urban catchment and local industry (7,000 m^3 average inflow per day). Trade waste consists of a meat processing plant, stock truck effluent station, stock sales yards, a factory that skins animals and a factory that produces pharmaceuticals from blood products from the freezing works. The WWTP plant produces three types of sludge, alum, digester and sludge from the anaerobic lagoon. The sludge is stock piled on site and will be composted over time. There is no analytical data available on sludge quality, although this analysis is underway.

The Bulls WWTP consists of a debris removal screen at the plant inlet to remove gross solids, followed by two oxidation ponds in series. The effluent discharged from the second pond passes along a wide grassed open drain across a paddock which flows into the riparian margin of the Rangitikei River. The plant average daily flow is 515 m^3 /day. A sedimentation survey for the first pond at Bulls WWTP (2013) indicated that total volume of sludge in this pond was estimated to be 13,811 m^3, but information from Chris Pepper (Manuatu District Council) estimates the pond to contain 3,000 m^3 at 3% (90 m^3 dry weight), data is variable. It is likely that the first pond is 50% full, there is no data on sludge volumes in the 2nd pond and no data on sludge quality.

4.1.2 Tararua District Council

Name	Type	Treatment	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Dannevirke	Oxidation pond	Six ponds, followed by discharge to surface water	2,100	No data	Sludge cells on site	Desludged recently
Pahiatua,	Oxidation pond	Three oxidation (facultative) ponds and discharge to surface water	2,500	No data	Sludge cells on site	The ponds were desludged in 2002-2003.
Woodville	Oxidation ponds	Two pond oxidation system, followed by two maturation cells, chemical dosing for P reduction and UV disinfection prior to discharge via a farm drain to surface water.	1,401	Pond 2 estimated to contain 20 m^3 (approx. 687 m^3 @3% solids) Total sludge component has been estimated to be 57 m^3 (approx. 1,925 m^3 @3% solids)	Sludge cells on site	Pond 1 was lined and desludged in 2008/2009
Norsewood	Oxidation ponds	Two oxidation ponds	330	NA	NA	Overflow of septic tank effluent only. Likely very little sludge
Ormondville	Oxidation ponds	Two oxidation ponds	422	NA	NA	Overflow of septic tanks effluent only. Likely very little sludge
Eketahuna	Oxidation ponds	Two oxidation ponds and discharge to surface water.	441	No data provided	Biotubes on site	Desludged recently, stored in biotubes on site to dewater, after which Dannevirke sludge cells.

Pongaroa	Oxidation ponds	Two oxidation ponds	300	NA	NA	Overflow of septic tanks effluent only. Likely very little sludge

Notes:
All seven WWTP's in the Tararua district have some form of pond system. Norsewood, Ormondville and Pongaroa receive septic tank effluent only and very little sludge is accumulated in the ponds. The septic tank sludge is emptied (frequency unknown) and sent to the Dannevirke ponds.

Several of the ponds have been emptied recently (Dannevirke, Pahiatua and Woodville), and the sludge is stored in sludge cells (monofills) on-site. Once the cells are full they will be covered and grassed and left for 12 months. The Eketahuna plant has been desludged and the sludge has been put into biotubes on site to dewater. Once dewatered the sludge will be taken to Dannevirke and placed in the sludge cells. It is possible that there is data on sludge quality and volumes from both Dannevirke and Woodville WWTPs, total sludge on site at Woodville is estimated to be 1,925m^3 wet weight.

4.1.3 Palmerston North City Council

Name	Type	Treatment	Population	Sludge/yr (m^3 DW)	Disposal/end-use
Totara Road	Anaerobic digestion	Screening, primary sedimentation, digestion, aeration lagoons, clarifier, UV, wetlands, discharge to Manawatu river.	74,945	2312 m^3/yr (14,452 m^3/yr at 16% DM)	Mixed with greenwaste and composted at Awapuni Resource Recovery Site, used to top landfill

Notes:
Totara Road WWTP serves a population of 74,945, receiving water from urban (70%) and industry (30%), and discharging 32,400 m^3/day. The sludge from primary sedimentation is digested and dewatered (24% DW), and then co-composted with the sludge from the clarifier. Alum sludge (14% DW) is also co-composted.

The primary digested sludge has high levels of *E. coli* (3,500,000 MPN/g) and other pathogens, but low levels of Cu (1.7 mg/kg wt) and Zn (7 mg/kg wt) and very low levels of organic contaminants. P and N are also low. The alum sludge has very low levels of *E. coli,* all metals except for Cu which are higher than the digested sludge. The alum sludge would meet Grade a for all contaminants except for Zn (690 mg/kg). An average volume of 14,452 m^3/year (at 16% DM) of Alum Sludge is produced at Totara Road plant (average over the last 5 years).

4.1.4 Horowhenua

Name	Type	Details	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Levin	Anaerobic digestion; tertiary treated wastewater	Trickling Filter; primary sedimentation tank, sludge thickener, anaerobic digestion, dewatering (press)	20,600	3,292 m^3	Landfill	Sludge continually produced. Includes a number of trade waste customers.
Foxton	Oxidation pond	Three oxidation ponds, land and river disposal discharge of wastewater, which will cease when discharge to land by spray irrigation of farm pasture commences.	2,500	2,580 m^3 (approximate)		Accumulated since 1975, 3 years ago sludge volume was estimated at 14,333 m^3 Programmed for de-sludging next 12-18 months, Trade waste includes meat works and poultry farming.
Foxton Beach	Oxidation pond	One oxidation pond; land and river disposal discharge of wastewater via a rapid infiltration basin and dykes. Construction 1981	1,641	NA	Levin Landfill	De-sludged April-June 2013; 700m^3 DW (247 tonnes sludge) programmed de-sludging 2028.
Shannon	Oxidation pond	One oxidation pond with floating wetland; land (90%) and discharge to surface water. Construction 1970-72	1,500	NA	Onsite - geobag	De-sludged November 2015; sludge stored in geobags for eventual disposal to landfill. Won't need de-sludging for another 20 years
Tokomaru	Oxidation pond	One oxidation pond, wastewater discharged to wetland and	552	Size of pond required to estimate volume of sludge	Onsite – 3 x geobags	Desludged April 2016; sludge stored in geobags with eventual

Name	Type	Details	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
		then discharge to surface water Constructed 1970's				plan to dispose to landfill – bottom of ponds not well sealed
Waitarere Beach	Oxidation pond	Two anaerobic and then aerobic pond. Only has small capacity and is anaerobic to treat faster but it also will accumulate more sludge faster. Part of top of anaerobic pond has floating vegetation that provides seal needs to be emptied every 5-10 years. Discharges to land by spray irrigation of the forest.	585 permanent residents but summer population is about 2,000	Anaerobic pond volume is 750 m3.	Levin Landfil	Oxidation pond nothing in it, anaerobic pond emptied 2013/14. Approx. 300m^3 removed.
Mangaore	No treatment	Just wet well – connects into Shannon system				

Notes:
Horowhenua have six WWTPs with oxidation ponds; one larger plant at Mako Mako Road, Levin, produces 11 m^3 of anaerobically pressed sludge per day with a water content of approximately 18 %. Currently the sludge is landfilled due to high Zn concentration (3,000 mg/Kg). The wastewater is urban, so they are investigating the origin of Zn. Water discharged is 7,500 m^3/day. There is no data currently available on sludge quality (e.g. pathogens, other metals, nutrients, or organics). There are a number of trade waste customers in the Levin catchment including; meat works, landfill leachate, food processing, eel farming, cardboard processing and manufacturing, electroplating, textile processing and industrial chemical waste.

4.1.5 Masterton

Name	Type	Treatment	Population	Sludge/yr (m³ DW)	Disposal/end-use
Homebush	Oxidation pond	Storage, oxidation pond land and discharge to surface water	25,000	??	Recently build ponds. On-site mono-fill and in-situ in decommissioned ponds
Riversdale	Oxidation pond	Storage, oxidation pond and land disposal of wastewater	seasonal	No data	
Castlepoint	Oxidation pond	Storage, oxidation pond and discharge to surface water	197 (seasonal)	No data	
Tinui	Oxidation pond	Storage, oxidation pond inflitration	150	No data	

Notes:
There are three small WWTPs in the region (Riversdale, Tinui and Castlepoint); and one larger WWTP at Homebush. Riversdale and Castlepoint have seasonal flows.

Homebush WWTP serves a population of 25,000, receiving urban WW, and discharging 14,000 m^3/day. Approximately 35,000 m^3 of sludge (40% moisture) from old decommissioned ponds is stored on-site in a purpose-built mono-fill. An estimated further 15,000 m^3 (wet) of sludge remains in decommissioned ponds. The sludge in-situ has variable characteristics, maximum values of P 2,200 mg/kg, ammonium 650 mg/kg, *E. coli* 35,000 cfu/g, Cu 800 mg/kg and Zn 960 mg/kg. No data on other pathogens or organic compounds.

The sludge in the old ponds at Homebush has been dealt with on site and the sludge in the new ponds is approximately 15-20 years from needing management.

4.1.6 Whanganui District Council

Name	Type	Treatment	Population	Sludge/yr (m³ DW)	Disposal/end-use
Airport Road	Activated sludge	Contact stabilisation, dewatering and thermal drying	42,150	9,500 m³	On-site in a pond. No final plans once on-site storage is full (approx. 3 yrs) land-fill.

Notes:
Airport Road WWTP serves a population of 42,150, receiving water mainly from meat works (55%), tannery (26%), and dairy (12%), and discharging 26,000 m^3/day. The plant produces 61 m^3 of dewatered (20% DS) per day, which is then thermally dried at 450 °C. Sludge is a mixture of primary and waste activated sludge, which is centrifuged and dried to 90% dry matter and stored on-site in a pond. No volatile solids, or pathogens are detected. There is no information on the sludge quality. On site storage is estimated to be full within three years.

4.1.7 Ruapehu District Council

	Type	Treatment	Population	Sludge/yr m^3 DW	Disposal/end-use
National park	Oxidation pond	Primary and secondary lagoon and tertiary wetland	240	No data	Presume sludge accumulated at bottom of pond
Ohakune	Oxidation pond	Septage system, Inlet screen, two stage lagoons with aerators, stone media lagoon, UV, land passage	1,500	No data	Presume sludge accumulated at bottom of pond
Pipiriki		Septic tank supernatant, wastewater pump station, two rapid sand filtration, irrigation to land	20	No data	Solid waste removed at septic tank stage, likely little sludge accumulated.
Raetihi	Oxidation pond	Three ponds, primary and secondary lagoons, stone media lagoon	749	No data	Presume sludge accumulated at bottom of pond
Rangataua	Oxidation pond	WWPS, primary and secondary lagoon, Tertiary wetlands	1344 (2006 data)	No data	Presume sludge accumulated at bottom of pond
Taumarunui	Oxidation pond	10 WWPS, inlet screen, aeration lagoon, secondary lagoon, wetland, UV	4,870	No data	Sludge from Primary & secondary ponds removed as required and applied to land
Waiouru	MBR plant	Screen, clarifier, Sequence Batch Reactor (SBR), trickling filter, clarifier, UV and discharge to surface water	890	No data	Geotubes stored on site
Whakapapa		Pasveer Ditch, Clarification, Filtration. UV treatment	200	No data	Sludge removed at clarification stage and sent to landfill

Notes:
There are 8 WWTPs in the district. Wastewater is mainly urban, with minimal industrial activity, wastewater is treated in various lagoons, some plants have UV (Whakapapa, Taumarunui and

Ohakune), all plants produce tertiary treated WW; total discharge of 2,595 m^3/day. Sludge is not produced yet from most of the WWTP.

Pipiriki serves a population of 20 and is based on septic tanks; there is no available information about the septic tank sludge.

National Park (DOC) serves a population of 200. Urban wastewater is treated by ditch, clarification, filtration and UV. Sludge is removed at clarification and sent to landfill. There is no information on the production volumes or characteristics.

Taumarunui WWTP is a combination of 10 WWTPs, and serves a population of 4,870. It receives wastewater mainly from urban origin with minimal industrial input. Water is treated in various lagoons and UV, and discharged at a rate of 1,667 m^3/day. The sludge from primary and secondary ponds is removed and sprayed onto a 3.6 ha property at a rate <100 mm/week (exact production not known). Data from sludge sampled in 2012 and 2016 shows maximum values are: volatile solids 53%, total nitrogen 3.2%, total P 1.2%. Maximum values of trace elements are lower than current NZWWA (2013) limits for land application for Grade b: 2.3 mg Cd/kg, 46 mg Cr/kg, 460 mg Cu/kg, 120 mg Pb/kg, 2.5 mg Hg/kg, 24 mg Ni/kg, 1300 mg Zn/kg. There is no data for pathogens or organic contaminants.

4.1.8 Kapiti Coast District Council

Name	Type	Treatment	Population	Sludge/yr (m^3 DW)	Disposal/ end-use	Comment
Paraparaumu	Activated sludge	Solid sludge separated from effluent after secondary treatment. Pumped through a Dissolved Air Flotation thickener, put through centrifuge for dewatering and thermal drying	49,000	930 m^3	Landfill	Currently transported to Silverstream landfill
	Oxidation Pond	Historical storage of sludge from 1993-2002. Sludge remaining in 6 ponds – S2 and P1-P5		S2 – 4100m^3 P1-P5 – 3200m^3	Likely landfill	Sludge in pond was tested in 2012. Sludge was determined to be mature and suitable for removal. Average 61% solids and 16% volatile solids. All heavy metals were well below biosolids guideline limits.
Ōtaki		Aerated lagoon, clarifier, oxidation ponds, anaerobic digester	6,000	No data	Landfill	Regularly desludged, dewatered and taken to Paraparaumu plant for processing

Notes:

Paraparaumu WWTP serves a population of 49,000. The plant produces 1,740 m^3/year of sludge, which equates to 930 m^3/year after drying in a centrifuge. Dry matter is 74 %. Biosolids are landfilled, but the Council are currently undertaking a project to investigate alternatives. There is very little trade waste input into the plant (mostly light industry with three larger inputs from a Fonterra cheese factory, Tuatara brewery and a third). Concentration of N is 4.7 % and P 2.8 %.

Trace elements are also analysed and none were found to be at high concentrations. No data for organic compounds was provided. Paraparaumu also has sludge on site from historical oxidation pond storage. This sludge is the product of thickened DAF sludge (S1) and dewatered sludge (P1-P5) with the total volume present on site approximated to be 7300m^3 at an average of 61% dry solids.

4.2 Regional Summary

Across the Lower North Island there are 47 WWTPs, of which 37 are oxidation ponds, four small treatment plants that are not oxidation ponds (Waiouru, Whakapapa, Pipiriki and Mangaweka); five are larger more complex plants serving bigger populations that produce a variety of digested sludges on a continual basis. The five more complex plants are: Paraparaumu (KCDC); Levin (HDC), Totara Road (PNCC); Fielding (MDC) and Airport Road (Whanganui) (Figure 1). These plants produce a variety of digested sludge with volumes in the order of 35 to 160 L/ person/y dry weight of sludge (summary given below in Table 4.2). There is reasonable data on sludge volumes, quality and end-use, however, there is very limited information on organic contaminants with data only available for one plant (Levin). Sludge quality is variable with large inputs of trade waste into some plants (e.g. Whanganui, 80% average daily load).

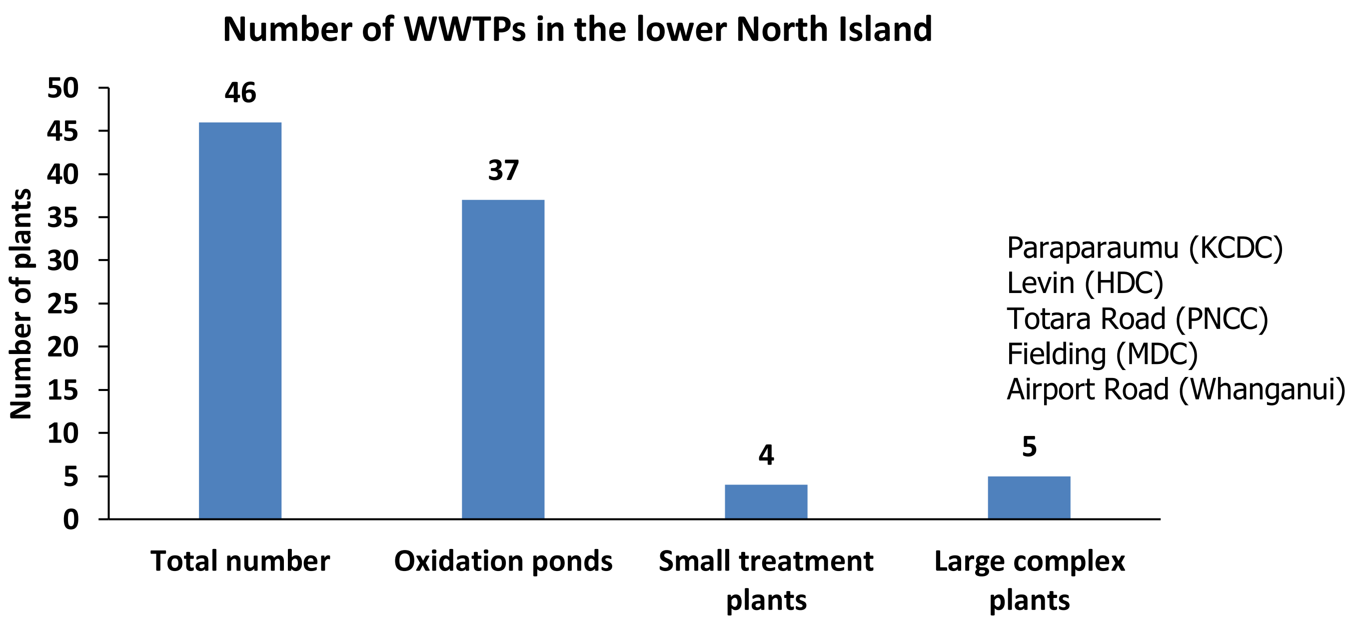

Figure 4.1. Summary of WWTPs in the lower North Island

Table 4.2 Summary of sludge management in larger plants in the region

Plant	Volume sludge (DW) produced/yr	Quality	Data gaps	Disposal/End-use	Trade waste
Paraparaumu (KCDC)	1740 m^3	High ammonia.	EOCs	Landfill	x
Levin (HDC)	3,292 m^3	High Zn	No data on pathogens, other metals, nutrients, or EOCs	Landfill/stored on site	✓
Totara Road (PNCC)	No data	High Zn in alum sludge, high pathogens in primary sludge	NA	Landfill cover	✓
Fielding (MDC)	2,280 m^3	Meets grade B requirements for Zn and Cu and grade A for other chemical components (2008 report).	No data on pathogens. Insufficient information to reliably determine N loading rates.	On-site stock piling and composting	✓
Airport Road (Whanganui)	5,621 m^3	No data	No data	On-site mono-fill	✓

For the oxidation ponds, there is very limited data on sludge quantity or quality. Storage on-site in sludge cells or monofil is the most common end-use disposal option for sludge. Masterton District Council have data on the sludge from their decommissioned ponds and Tararua have data from the sludge in sludge cells at Woodville. Of the 37 oxidation ponds, information provided suggests 30% do not accumulate sludge, or if they do it is at a very slow rate; 33% have been emptied in the last 5 years and 36% have never been desludged (Figure 4.2). The limited information available suggests in ponds that are not desludged, accumulated volumes are in the order of 1.0 to 1.5 m^3/person dry weight of sludge. Where ponds have been desludged, the rate of accumulation may be in the order of 10 L/person/y dry weight of sludge.

The oxidation ponds in the study area are reported to be of variable size, some are screened and some are not. Manawatu/Rangitikei are undertaking a programme of desludging and 4 of the 10 ponds that accumulate sludge have recently been desludged with the sludge taken to Fielding WWTP where it will be stored on-site with the aim of composting it. Tararua have also undertaken a desluging programme, and of the 5 ponds that accumulate sludge, there is only one pond left to be desludged. The sludge has either been stored on-site in sludge cells, or in one case is stored in biotubes to dewater.

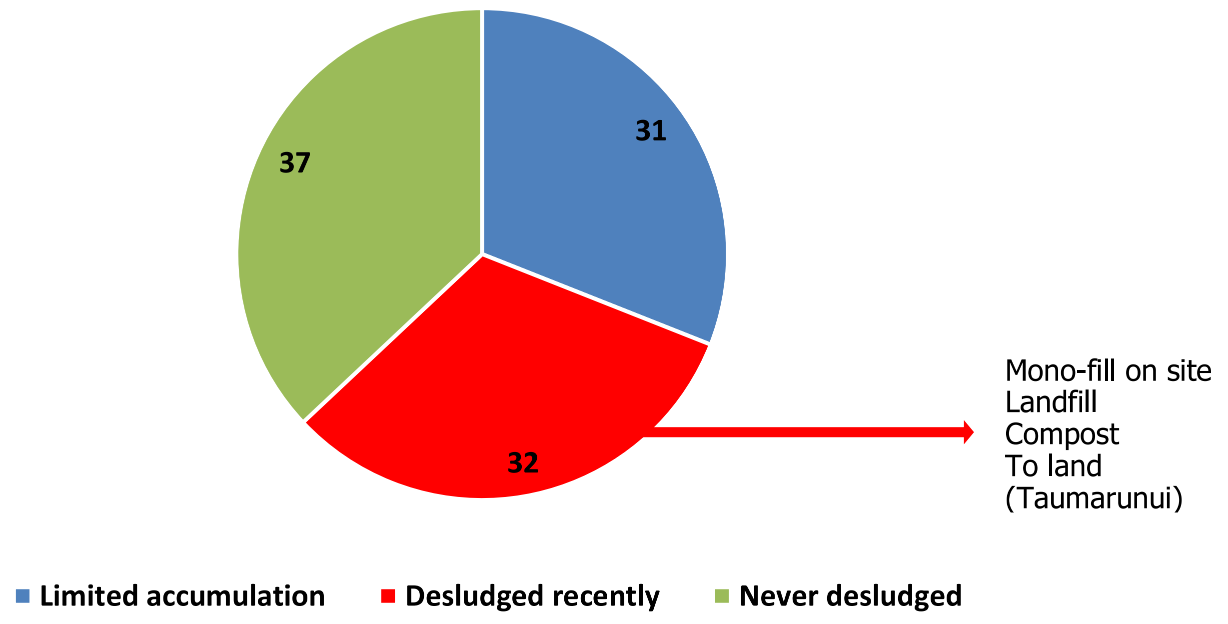

Figure 4.2. Current state of oxidation ponds in the lower North Island

4.3 End-use/disposal

The sludges from the five larger treatment plants are either land-filled or stored on site (as sludge or compost). All the councils that took part in the survey indicated that they have explored/or are currently exploring beneficial re-use and diversion from landfill as part of their sludge management strategy. For some, the issue is urgent as the sludge is being used to top landfills (Totara Road) or their on-site storage has a finite life.

The data collected suggests only one instance where sludge is applied to land; that is the Taumarunui oxidation pond sludge. Two councils (PNCC and Manawatu/Rangitikei) compost their sludge with green waste but there is no current beneficial re-use of this composted product. For PNCC this is due to high Zn and for Manawatu/Rangitikei they are still trialling the composting system.

5 REGULATORY ENVIRONMENT AND LIMITATIONS

5.1 General

As noted in Section 4 above, beneficial use of biosolids or biosolids products is not widely practiced through the investigation area (none, except for Tamaranui). It has been the observation of the project team, over a number years, that biosolids producers consider biosolids use other than disposal (landfill, monofill, construction fill) to be expensive and resource intensive. Much of the resource expenditure is time, attributable to the planning, applying for, and ongoing monitoring associated with resource consent requirements.

This section examines the information required to meet resource consent requirements and compares to the more commonly practiced disposal methods. The section describes limitations due to regulatory requirements, and why they exist. The aim of this section is to provide a list of areas in the resource consent process where better information, processes or a collaborative approach can make beneficial use simpler to consent for partner councils, including for regional councils tasked with assessing consent applications. This will direct further investigation for the Collective Biosolids Strategy.

5.2 Regional Rules

The partner councils involved in this project spans the Horizons (Manawatu/Wanganui) and Greater Wellington regions. Discharges to land are allowed by rules in each regional council's regional plan. Rules relevant to the discharge of biosolids and sludge are described below.

5.2.1 Greater Wellington Regional Council

At the time of writing this report the Proposed Natural Resources Plan (PNRP) is not yet entirely operative, so consent applications would need to consider the applicability of the operative 1999 Regional Plan for Discharges to Land (RPDL). This RPDL does not have any mention of biosolids, no definition, and no specific provision. It makes provision (under its Rule 8) for discharges containing human sewage (including sewage sludge and sewage compost) to be a Discretionary activity.

The PNRP rules would be given precedence in applying for consent to discharge biosolids and sludge to land and are as follows:

Aa biosolids, covered by Rule R77 of the Proposed Natural Resources Plan, is a **Permitted** activity, subject to the following;

(a) the biosolids carry the registered Biosolids Quality Mark (BQM) accreditation, and
(b) biosolids application rates shall not exceed a three-year average of 200kg total N/ha/year, or 600kg N/ha/year with no repeat within three years, and
(c) soil pH where the biosolids are discharged is not less than pH 5.5, and
(d) the discharge is not located within 20m of a surface water body, coastal marine area, gully, or bore used for water abstraction for potable supply, and
(e) the discharge is not located within a community drinking water supply protection area as shown on Map 26, Map 27a, Map 27b, or Map 27c, and
(f) the discharge of odour is not offensive or objectionable beyond the boundary of the property.

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It is not possible to comply with this rule since no Biosolids Quality Mark programme exists. The next rule to consider is:

The discharge of other biosolids (Ab, Ba, Bb) to land are covered by Rule R78 which is a **Restricted Discretionary** activity, subject to the following; (a) the discharge is not located within a community drinking water supply protection area as shown on Map 26, Map 27a, Map 27b, or Map 27c, and (b) the discharge shall not result in the creation of contaminated land. Matters for discretion for these other biosolids are: 1. Application rate, volume and location including in relation to: (i) presence of subsurface drainage (ii)nutrient capacity of the soil 2. Effects on soil health 3. Storage period and volume for deferred application during periods of prolonged wet weather 4. Effects on groundwater quality 5. Set back distances from surface water bodies, coastal marine area, and water supply bores 6. Discharge of odour 7. Methods for the incorporation of biosolids into soil 8. Effects on soil pH 9. Nitrogen loading rate Notification: In respect of Rule R78 applications are precluded from public notification (unless special circumstances exist).

If a product doesn't meet the definition of biosolids, it is sludge and resource consent can be sought under a default rule; Rule R92 (**restricted discretionary**, within water supply areas) or R93 (**discretionary**).

5.2.2 Horizons

Provisions for biosolids application to land in the Horizons One Plan are as follows:

Aa biosolids and compost discharge to land are covered by Rule 14-7, making the discharge a **Permitted** activity, subject to the following conditions; (a) There must be no direct *discharge*^ or run-off into any surface *water body*^ or its *bed*^ or *artificial watercourse**. (b) For *compost** the material must not contain any human or animal pathogens, or any *hazardous substances**. (c) For *grade Aa biosolids** the *discharge*^ must comply with the requirements for *grade Aa biosolids** as included with Chapters 4 and 7 of Volume 1 and Chapters 8 (including monitoring requirements) and 9 of Volume 2 of the Guidelines for the Safe Application of Biosolids to Land in New Zealand (New Zealand Water and Waste Association, August 2003). (d) The *discharge*^ must comply with the following separation distances: (i) 50 m from *rare habitats**, *threatened habitats** and *at-risk habitats** (ii) 20 m from *bores**, surface *water bodies*^, *artificial watercourses** and the *coastal marine area*^ (iii) 50 m from any *historic heritage*^ identified in any *district plan*^ or *regional plan*^. (e) A nutrient budget undertaken using the OVERSEER® model, which takes into account all other sources of nitrogen and which is designed to minimise nitrogen leaching rates, must be used to plan and carry out the *discharge*^ of the *grade Aa biosolids** or *compost**. If a *nutrient management plan** is required under Rules 14-1 to 14-4

then the nutrient budget required by this *condition*^ must be consistent with it and the activity must be carried out in accordance with it. (f) The *discharge*^ must not result in any offensive or objectionable odour or dust beyond the *property** boundary. (g) The discharger must keep the following records: (i) a daily record of the *discharge*^ volume and location (ii) a monthly (or more frequent) analysis of the nitrogen concentration of a *discharge*^ sample and make these records available to the Regional Council upon request.

For Ab, Ba or Bb biosolids the following applies:

Other biosolids (Ab, Ba, Bb) are covered by Rule 14-8, making the discharge a **Restricted Discretionary** activity, subject to the following conditions; (a) There must be no direct *discharge*^ or run-off into any surface *water body*^ or its *bed*^ or *artificial watercourse**. (b) The material must have undergone stabilisation processes to achieve at least B grade as defined by the Guidelines for the Safe Application of Biosolids to Land in New Zealand (New Zealand Water and Waste Association, August 2003). *Hazardous substances** must not exceed b grade limits as given by the Guidelines for the Safe Application of Biosolids to Land in New Zealand (New Zealand Water and Waste Association, August 2003). (c) The *discharge*^ must comply with the following separation distances: (i) 150 m from residential buildings, public places and amenity areas where people congregate, education facilities and public roads (ii) 50 m from *property** boundaries (iii) 50 m from *rare habitats**, *threatened habitats** and *at-risk habitats** (iv) 20 m from *bores**, surface *water bodies*^, *artificial watercourses** and the *coastal marine area*^ (v) 50 m from any *historic heritage*^ identified in any *district plan*^ or *regional plan*^. (d) A nutrient budget undertaken using the OVERSEER® model, which takes into account all other sources of nitrogen and which is designed to minimise nitrogen leaching rates, must be used to plan and carry out the *biosolids** *discharge*^. If a *nutrient management plan** is required under Rules 14-1 to 14-4 then the nutrient budget required by this *condition*^ must be consistent with it and the activity must be carried out in accordance with it. (e) The *discharge*^ must not result in any offensive or objectionable odour or dust beyond the *property** boundary. Matters for discretion for other biosolids are: (a) the rate of *discharge*^ and frequency of *discharge*^ to control nutrient and contaminant loading rates (b) maintenance of vegetative cover in the area of *discharge*^ (c) avoiding, remedying or mitigating the effects of odour or dust (d) contingency measures, including for events of mechanical failure and prolonged wet weather (e) monitoring and information requirements (f) duration of consent (g) review of consent *conditions*^

(h) compliance monitoring (i) the matters in Policy 14-9 (which relates to pig and poultry farm litter).

If a product doesn't meet the definition of biosolids, it is sludge and resource consent can be sought under a catch-all Rule 14-30 (**discretionary**).

5.2.3 Adjacent Regional Council Areas

GWRC and Horizons are abutted to areas overseen by Taranaki Regional Council (TRC), Waikato Regional Council (WRC) and Hawke's Bay Regional Council (HBRC) which may be considered for discharge to land of biosolids or biosolids products from the investigation area. Of these, only WRC has rules specific to biosolids. WRC rules are similar to the Horizons One Plan rules. For TRC and HBRC, biosolids are treated the same as sludge and are assessed against the default discharge to land rule, like those given above.

5.3 Information Requirements for Resource Consent Application

The information needed to prepare a resource consent application to be assessed against the rules in the section above includes (but is not limited to):

- Material characterisation – qualitative evaluation of source material including contaminants of concern, quantity (wet and dry), quality (moisture content, nutrient content (in particular nitrogen), contaminant content, microbiological quality). This information can be obtained from laboratory testing, and physical measurements at the site where the biosolids are stored;
- Information about the discharge site – background levels of contaminants in soils, depth to groundwater, location and quality/values of surface water; and
- Mitigation and management plans – how the material will be applied, how the site will be managed to remove or retain nutrients and contaminants, and keep animals and humans accessing the site safe.

Some of this information can be based on estimates and literature values. For testing, there is a minimum number of samples needed to be representative of the material tested, however a lesser number may be analysed at the resource consent application stage. If estimates, or limited sampling are used for preparation of a resource consent application, this may result in consent conditions which include a lot of testing and/or environmental monitoring i.e. the consent may be granted, but with a high requirement to demonstrate its safety before, during and after the discharge occurs.

5.4 Typical Consent Condition Monitoring Requirements

Conditions of consent generally reflect the risk of the consented activity as perceived by the consenting authority. Where an activity, in this case discharge of biosolids or sludge to land, has a poorly understood risk, or a higher risk for non-compliance if not managed correctly, then the conditions of consent are likely to be more stringent and onerous.

The extent of monitoring required may be influenced by:

- Paucity of information in the consent application;
- Uncertainty that the proposed methods of storing or applying biosolids will be followed or can be achieved; and
- Concerns that effects may occur that have not been anticipated.

The number of samples and frequency of sampling is likely to increase with increased uncertainty about the activity.

In theory, demonstrating that a material is biosolids should provide a high degree of certainty about its beneficial use. Similarly, where a material does not meet the definition of biosolids (therefore described as sludge), by identifying how the material differs from biosolids enables the potential for adverse effects to be estimated with some certainty. This appears to suggest that consent conditions should not be too onerous.

In practice however, conditions for new consents often are modelled on existing resource consents, and may have more but seldom less, restrictive conditions. In this case, conditions are likely to require record keeping and monitoring of source material.

Overall there is similarity between the two regions, with local differences in buffer margin width. Both refer to the 2003 Guidelines, but not to any replacement document. Wellington wants BQM, while Horizons wants OVERSEER models. Wellington's non-notification is attractive.

5.5 Biosolids Guidelines

Guidelines for the Safe Application of Biosolids to Land in New Zealand (NZWWA, 2003) contain information and recommendations to assist producers, dischargers and regulators (regional councils) to manage the discharge of treated domestic sewage to land in New Zealand. The term 'Biosolids' is used in the New Zealand guidelines (and internationally) to separate treated sewage sludge from raw sewage sludges and other wastes including animal manures, food processing and abattoir wastes. Biosolids are defined as "sewage sludges or sewage sludge mixed with other materials that have been treated and/or stabilised to the extent that they are able to be safely and beneficially applied to land" (NZWWA, 2003).

The current biosolids guidelines have no legal status and the application of biosolids to land is regulated by the RMA (1991).

Within the guidelines are standard or nationally-agreed criteria for monitoring the contaminant loading of sludges and biosolids and receiving soils. The guidelines propose a grading system whereby biosolids are assigned a stabilisation (microbiological) grade 'A' or 'B', and a chemical contaminant grade 'a' or 'b'. An 'A' grade biosolid is one in which pathogens and vector-attracting compounds, such as volatile solids, have been substantially reduced or removed by an "acceptable" pathogen reduction process. Grade 'B' biosolids have a lesser degree of stabilisation and will contain pathogens. To achieve contaminant Grade 'a' the concentrations of all the contaminants (i.e. metals and organochlorine compounds) within the biosolids must be at, or below, specified limits. A biosolid is classified as Grade 'b' even if only one of the contaminants exceeds the limit specified for a Grade 'a' biosolid.

5.5.1 Update of the biosolids guidelines

Led by WaterNZ and involving industry (WasteMinz, and The Land Treatment Collective) and research (The Centre for Integrated Biowaste Research) partners, a new technical guide is being drafted that recognises the commonalities of all organic waste, and describes quality criteria for beneficial re-use. This guideline will supersede, update and reference existing guidelines and standards including the NZ Biosolids Guidelines and the NZS4454 Composting Standards. More information on the new Guideline can be found on the WaterNZ website.

6 RELATIVITY TO THE NATIONAL PICTURE

This gaps analysis has identified that there is very little data on the volume and quality of sludges in oxidation ponds in the Lower North Island. This situation is likely to be similar across New Zealand. Larger, more complex treatment plants that produce sludge continually are much more likely to have data on sludge volume and quality (e.g. Paraparaumu, Levin, Palmerston North, Feilding and Whanganui). Thus, in terms of information gaps, oxidation ponds are the biggest issue. In this study, 37 oxidation ponds were identified, which if extrapolated to a national level there could be over 800 ponds systems.

Assumptions can be made from the data that is held by council's, for example; age of the pond, if it has been emptied before, population and pond size. This type of information will allow estimates to be made on the volume of sludge likely to be in the pond and the possible quality. Task 1b of this project will aim to fill these knowledge gaps and we will develop a methodology to form part of the "tool box" to give a more complete picture for national waste management surveys.

Data on end-use of sludge was collected in this 'Gaps Analysis" – of the 8 sludge producing councils surveyed, current and/or future sludge management was landfill or mono-filling on–site. This was due to sludge being considered to be of a quality that would be difficult to beneficially re-use (for example, high concentrations of contaminants, inadequate processing). As these limitations will be common in all districts and regions, it would be reasonable to expect similar levels of landfilling and mono-filling to be occurring at a national level.

During this study, it was also determined that a lot of the data on sludge management is most easily accessed outside of the council's. For example, for Manawatu, Rangitiki and Horowhenua, LEI holds a significant amount of information in client reports and it was quicker and easier to access this information source than for council partners to find it. It is unclear why this is the case; it could be due to staff turn-over at councils and loss of institutional knowledge.

7 CONCLUSIONS

The objective of this project is to develop a collective biosolids strategy and end use programme for the lower North Island. This report outlines the first steps of this project in which a "Gaps analysis" was undertaken to identify the gaps between the current situation and future aims. Information was collected on volumes and characteristics of sludge in the region using data obtained from a comprehensive survey template, emails and phone calls with partner council members. Whilst the data obtained served as a good starting point for this project, most data were incomplete and needs further investigation.

A summary of the information obtained is as follows. Across the Lower North Island there are 46 wastewater treatment plants (WWTPs); 37 of which are sludge lagoons/oxidation ponds, four are small treatment plants that are not oxidation ponds and five are larger more complex plants serving bigger populations that produce sludge on a continual basis. The five larger plants (Paraparaumu (KCDC); Levin (HDC), Totara Road (PNCC); Fielding (MDC) and Airport Road (Whanganui)) produce a variety of digested sludge and have reasonable data on sludge volumes quality and end-use. There is very limited information on organic contaminants content with data only available for one (Levin). Sludge quality is variable with large inputs of trade waste into some plants.

The oxidation pond systems vary, as does the accumulation rate and length of time since desludging. A third of the ponds have been desludged in the last 5 years, a third have never been desludged, and the final third do not accumulate sludge at a very fast rate. For those ponds that have been desludged, the sludge is either stored on-site or landfilled.

It was noted that for most small-town communities with oxidation ponds, trade waste inputs are negligible. Based on this, it is likely that the heavy metal content of sludge from these communities would be similar, whilst nutrients/stabilisation will depend on age of ponds, time since emptied etc.

Extrapolation of the information on sludge volumes and quality collected from the 8 councils involved in this project to give a national picture is difficult. This is partly because there is very little data available. This lack of data is likely to be similar across New Zealand and we estimate there could be around 800 oxidation ponds in New Zealand. As these limitations will be common in all districts and regions, we would expect similar levels of landfilling and mono-filling to be occurring at a national level.

Beneficial use of sludge and biosolids is not widely practiced (and only at one plant reviewed). A potential roadblock is likely to be that producers consider biosolids use other than disposal (landfill, monofill, construction fill) to be expensive and resource intensive with significant expenditure attributable to planning, applying for, and ongoing monitoring associated with resource consent requirements.

The partner councils involved in this project span the Horizons (Manawatu/Wanganui) and Greater Wellington (GW) regions. Discharges to land are allowed by rules in each regional council's regional plan. For GW and Horizons, specific rules apply to the discharge of biosolids, but not to sludge. It is possible to apply biosolids as a permitted activity if Aa grade (based on NZWWA 2003 Biosolid Guidelines) can be achieved. It is uncommon in smaller areas (compared to Auckland or Wellington) to maintain a testing programme that complies with Aa grade. It is reasonable to anticipate that all discharges from pond treatment systems will require a discharge consent and this may be a restricted discretionary or discretionary consent. Consent application requirements are likely to include provision of information on material characterisation, the discharge site and mitigation and management plans.

The primary finding of this "Gaps Analysis" report is that for many councils, information on sludge volumes and quality is not available. Of 37 oxidation ponds in the region, no quantity information was available for 32 and variable scattered data was available on quality, with little consistency between plants for what has been measured.

Key outcomes of the report are:

- Less information is held by councils regarding pond sludge than anticipated prior undertaking to this exercise;
- Often information available is based on estimates for one or more of the calculation parameters;
- Continuous process plants (the larger plants), with discharge from the treatment system on a daily basis tend to have adequate records of quantity, and produce volumes in the order of 35 to 160 L/person/y dry weight of sludge. Variability is likely due to industrial loads and process differences, but further investigation is required to confirm this;
- Copper and zinc are the components of most concern, and most commonly measured. Other trace element data is not collected. Organic compounds and pathogen content is not commonly monitored; and
- Insufficient information is available to determine pond sludge quantity relationships with certainty, however the limited information available suggests in ponds that are not desludged, accumulated volumes are in the order of 1.0 to 1.5 m^3/person dry weight of sludge. Where ponds have been desludged, the rate of accumulation may be in the order of 10 L/person/y dry weight of sludge. Additional investigation is required to reduce uncertainty around these figures.

To fill the knowledge gaps identified in this report it has been concluded that investigations should be undertaken to assess both the volume and quality of sludge for a selection of representative WWTPs, with a focus on oxidation pond sludges, in the region. It is recommended that T1b focus on this issue and approach it by first collecting qualitative information on sludge volumes and quality using data such as age of the pond, time since desludging, population and pond size. Followed by a quantitative approach focussing on three of the main WWTP's; Foxton, Marton and a pond from the Ruaphehu District. Data obtained from these will include full analysis of sludge to determine organic Matter, Dry Matter, Volatile Solids, Copper, Phosphorus, Zinc, pH, Total Nitrogen, Ammonium-N, Nitrite-N, Nitrate-N, Nitrate-N + Nitrite-N, Total Carbon and Escherichia coli. This data will be used as a baseline for the future stages of this project.

8 APPENDICES

Appendix A: Questionnaire to collate the information required for gaps analysis.
Appendix B: Contact details for Project Technical Group.

APPENDIX A

Questionnaire to collate the information required for gaps analysis.

Current operations

Council: ______________________________

Contact name: ______________________________

Contact details: **[T]:** ______________________________

[M]: ______________________________

[E]: ______________________________

Number of treatment plants: ______________________________

Plant name	Location	Type	Volume of wastewater treated	Type of treatment process	Volume of wastewater produced	Type of wastewater produced (e.g. primary. Secondary, tertiary treated)	Type of sludge produced (e.g. primary. Grade Aa, Grade Bb etc)	Volume of sludge produced	
								Daily/weekly/monthly	Annually

Sludge characteristics

Plant name						
Location						
Organic Matter g/100g dry wt						
Dry Matter g/100g						
Volatile Solids g/100g dry wt						
Ash g/100g dry wt						
Total Recoverable Phosphorus mg/kg dry wt						
Total Nitrogen g/100g dry wt						

Ammonium-N mg/kg dry wt						
Nitrite-N mg/kg dry wt						
Nitrate-N mg/kg dry wt						
Nitrate-N + Nitrite-N mg/kg dry wt						
Total Carbon g/100g dry wt						
Escherichia coli **MPN / g**						
Total Recoverable Copper mg/kg dry wt						
Total Recoverable Zinc mg/kg dry wt						

Future sludge management

Why do you do what you do?	
Have you explored alternatives?	
What alternatives have you explored?	
What are the future plans for sludge management?	
• **District plans?**	

• **National policy**	
If there are planned changes in sludge management, why? **E.g. landfill will be full/closed**	

APPENDIX B

Contact details for Project Technical Group.

Table A1: Contact details for Project Technical Group

Affiliation	Name	Title	Email	Landline	Mobile
Manawatu District Council/ Rangitikei District Council	Chris Pepper	Senior Project Engineer	Chris.Pepper@mdc.govt.nz	06 323 0000	029 2014836
Tararua District Council	Dave Watson	Utilities Manager	dave.watson@tararuadc.govt.nz	06 374 4099	027 451 8639
Whanganui District Council	Arno Benadie	Senior Wastewater Engineer	arno.benadie@whanganui.govt.nz	06 349 0001	027 2896484
Masterton District Council	Phil Evans	Senior Advisor Waste Water Strategy and Compliance	philipe@mstn.govt.nz	06 3706284	0276720211
Kapiti Coast District Council	Glen O'Conner	Solid Waste Services Manager	glen.Oconnor@kapiticoast.govt.nz	04 2964 739	0275555739
Horowhenua District Council	Ryan Hughes	Engineering Officer	RyanH@horowhenua.govt.nz	06 366 0999	
Ruapehu District Council	Anne-Marie Westcott	Environmental Manager	annem@ruapehu.govt.nz	07 895 8188	
Horizons Regional Council	Robert Rose	Consents Monitoring Officer	robert.rose@horizons.govt.nz	06 9522862	0212477341
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Ministry for the Environment
Manatū Mō Te Taiao

Lowe Environmental Impact

ESR
Science for Communities

Kāpiti Coast District Council
Me Huri Whakamuri, Ka Titiro Whakamua

Manawatu District Council

Whanganui District Council
Te Kaunihera a Rohe o Whanganui

horizons regional council

Palmerston North City Council

Tararua District Council

Ruapehu District Council

Masterton District Council
Te Kaunihera ā-Rohe o Whakaoriori

Rangitīkei District Council
Making this place home.

Centre for Integrated Biowaste Research

Massey University
Te Kunenga ki Pūrehuroa
University of New Zealand

Horowhenua District Council