Contract No. 3458
Operation and Maintenance of the Nelson Regional Sewerage System

Pond Management Plan v7

July 2017

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NRSS Pond Management Plan

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1 Introduction

This is a Pond Management Plan for Bell Island WWTP. Its purpose is to define how the facultative and maturation ponds should be best managed and operated to achieve the resource consent requirements of the plant. A Pond Management Plan is a requirement of resource consent NN000541 condition 13.

This plan should be read in conjunction with the Odour Management Plan, which is also needed to fulfil the requirements of resource consent NN000541.

1.1 Scope

This Pond Management Plan covers management of the three facultative oxidation ponds, F1, F2 and F3 and two maturation ponds, M1 and M5, located at the Bell Island Wastewater Treatment Plant (Bell Island WWTP). It does so by addressing management of incoming biological load, hydraulic loading and by management of biological treatment processes within the ponds. It also addresses contingencies that may affect performance.

The ultimate goal of this plan is to manage F1, F2, F3, M1 and M5 so that:

- treatment performance is satisfactory
- discharges to air and water comply with the resource consents for those discharges
- there are no adverse environmental effects from the pond operation
- early mitigation measures can be implemented if performance deteriorates.

A key adverse environmental effect is discharge of odour. As such, this plan is intrinsically linked to the Odour Management Plan.

This plan does not cover the operations or management of upstream processes or solids stream processes. It does however address these processes in as much as they affect and/or are influenced by the management of F1, F2, F3, M1 and M5.

In addition, a secondary goal of this plan is to optimize efficiency of the whole system, including processes other than F1, F2, F3, M1, and M5, to provide satisfactory overall performance at least cost.

This is not an Operations and Maintenance (O&M) Manual. O&M aspects will be covered separately under O&M Manual(s). This plan therefore does not cover:

- standard oxidation pond hydraulic aspects
- standard oxidation pond maintenance activities
- monitoring for consent compliance (it does however cover monitoring for management purposes)
- contingencies (except for those impacting on pond management).

2 Bell Island WWTP Plant Description

The following is a broad overview of the Bell Island WWTP, only sufficient to inform the Pond Management Plan. For detail, refer to the separate O&M Manual(s) for the plant.

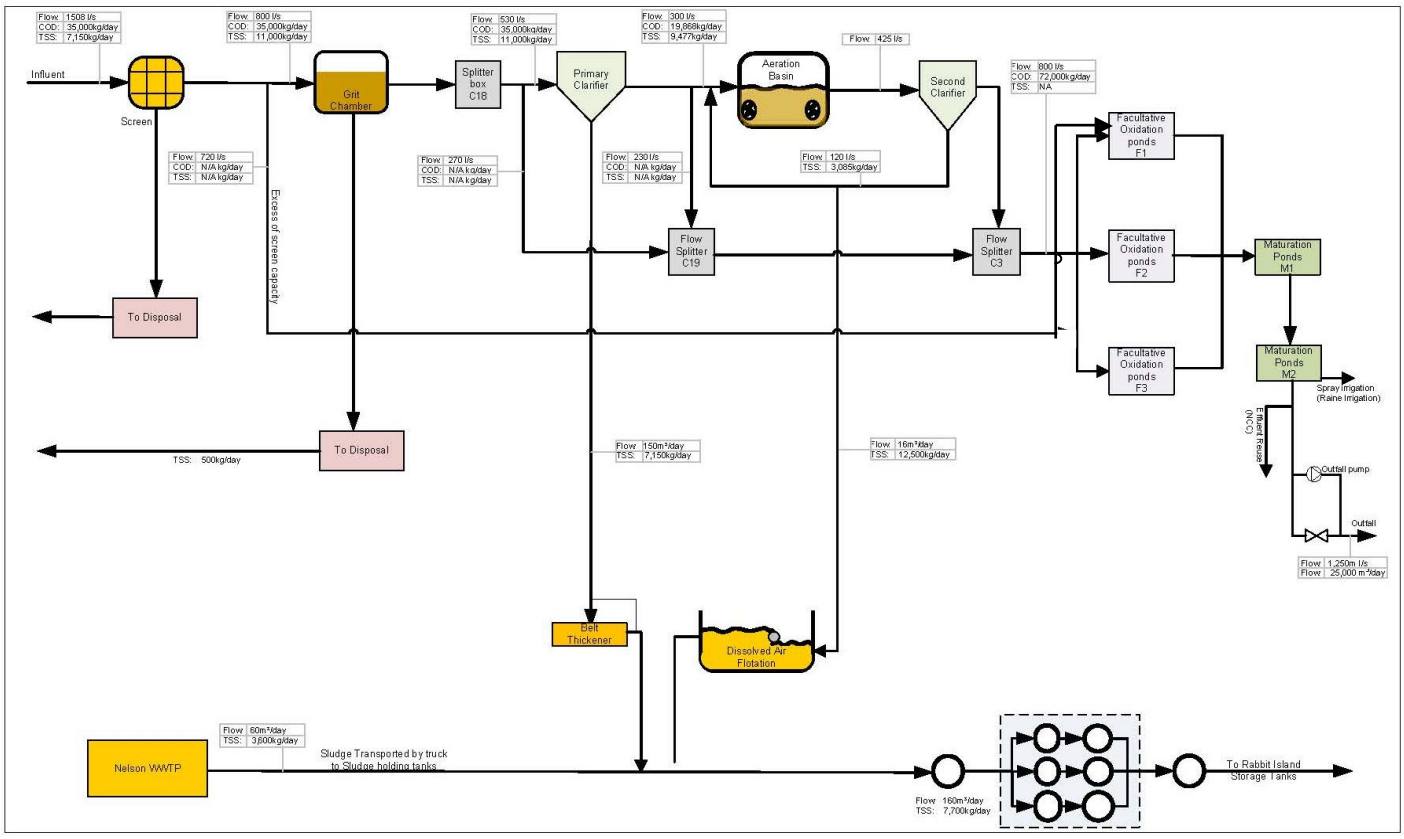


Figure 2-1: Treatment Flow at Bell Island WWTP[1]

- Flow entering the Bell Island WWTP passes through an inlet screen and a grit chamber.
  - flow in excess of grit chamber capacity bypasses directly to Pond F1.
- After the grit chamber flow is split either directly to F1, F2, and F3 or through an Activated Sludge (AS) Treatment stream.
- The AS stream comprises a primary clarifier, an activated sludge aeration basin and a secondary clarifier.
- A bypass line is provided to F1, F2 and F3 after the primary clarifier.
- An emergency bypass from the primary clarifier to F1 is provided.
- Flow to the F1, F2, and F3 is split, by manual stop-logs, to three ponds in parallel. Flow exiting F1, F2, and F3 passes through two maturation ponds (M1 and M5) in series, then on to the outfall discharge (with a fraction discharged to land).
- Solids from both the screen and grit chamber are sent to disposal.
- Sludge from the primary clarifier either passes through a belt thickener or is directly discharged to the sludge buffer tank that feeds the ATAD's.
- Activated sludge from the clarifier is split into Return Activated Sludge (RAS), returned to the aerator basin and Waste Activated Sludge (WAS).

[1] From: Request for Expressions of Interest, Nelson Regional Sewerage System, Operation and Maintenance; Nelson Regional Business Unit; September 2012.

- WAS is thickened by a Dissolved Air Flotation (DAF) system and combined with the primary sludge in the sludge holding tanks.
- Thickened sludge if produced at the Nelson North WWTP is tankered to Bell Is and stored in dedicated tanks before being combined with PC and DAF sludges in the sludge holding tank.
- Sludges are fed, via buffer storage to Autothermal Thermophilic Aerobic Digester (ATAD) units and into further buffer storage for disposal on Rabbit Island.

3 Consents

3.1 Discharge to Air

Consent "To discharge contaminants to air", consent number NN000541, is contained in Appendix A.

- Special condition 9 requires that the plant is managed to prevent or minimize the discharge of odours.
- Special condition 10 requires that there shall be no discharge to air that is objectionable or offensive beyond the boundary of the plant.
- Special condition 13 requires the preparation of an Odour Management Plan, and shall cover among other things:
    - operation of the aeration basin
    - operation of ATAD units
    - operation of bio filters
    - operation of oxidation ponds.

The Odour Management Plan and this Pond Management Plan collectively meet the special condition requirements.

3.2 Discharge to Water

Consent to "Discharge to the Waimea Inlet", consent number NN000539v2, is contained in Appendix B.

The special conditions amongst other things:

- set rate and volume of discharge
- authorise discharge for up to three hours after each high tide
- set standards for faecal coliform, biological oxygen demand (BOD), suspended solids (SS), nitrogen, phosphorous and a range of other chemical components
- set monitoring requirements
- prohibits certain effects on receiving waters
- requires various assessments and monitoring of the receiving environment.

This Pond Management Plan, in part, addresses the conditions of the resource consent.

4 Operating Philosophy

Pond load is managed by discrete characterisation of the influent to determine the BOD load (kg/day) on the facultative ponds (F1, F2 and F3). Loading of the ponds is determined by using the curve shown in Figure 5.1 as a guideline and the actual pond conditions and performance. Further discrete influent parameter measurements are made to verify that actual load is within an acceptable range that will not compromise the pond health and performance. Intensive manual monitoring of pond condition and activity takes place to:

- Verify that pond performance can actually cope with the loads determined by the loading assessment, and if not provide information for modification of the assessment method;
- Identify any existing problems with pond biological activity; and
- Identify long term plant loading patterns.

In this system there is an operator adjustable split of flow sent directly to the pond and flow sent to the activated sludge (AS) treatment process.

The flow to the activated sludge process and the flow bypassed to the ponds is measured and recorded.

The split is manually controlled according to the load curve and/or other manual intervention triggers. The flow split remains constant and is not changed as a result of sampled influent characteristics, temperature etc., or diurnal profile.

The AS treatment stream is used to reduce the organic load to F1, F2 and F3 to prevent overloading.

Further observational information (e.g. weather, pond colour, gassing etc.) are used as triggers for manual hydraulic and biological load intervention.

The management regime requires a highly competent operator/engineer-manager/specialist team with good understanding of the impacts of influent characteristics and performance of F1, F2, and F3, who can confer as required to make management decisions surrounding the ponds and overall process.

5 Load and Performance Management

The load and performance management process is:

1. Determine influent load characteristics.
2. Apply load to F1, F2, and F3 according to pond conditions and in reference to the pond load curve.
3. Verify that average weekly load entering F1, F2, and F3 is within the acceptable variation range and suitable for current pond performance. If not adjust load.
4. Monitor pond condition and activity to:

    - verify pond performance is satisfactory for load applied
    - identify other actual or potential pond problems.

5.1 Load Management by Load-Curve and Pond Performance

This section covers steps 1 to 4 in the management process above.

1. Determine influent load characteristics

Monitor F1, F2, and F3 influent characteristics by measuring and combining:

1. Characteristics of influent to the Bell Island WWTP.
2. Characteristics of flow exiting the primary clarifier.
3. Characteristics of flow exiting the AS stream from the secondary clarifier.

Sampling shall be by a daily 24 hour composite sample for SS and COD, weekly BOD and COD:BOD ratio.

Characteristics of flow exiting the primary clarifier are important, particularly if flow from here is directed straight to F1, F2, and F3. Clarification removes SS and its associated BOD. It therefore changes the ratio of soluble to non-soluble BOD entering F1, F2, and F3 with the soluble fraction increasing in relation to the

particulate. The BOD loading (soluble + particulate) needs to be monitored to ensure that the unit loads on F1, F2, and F3 are within the capability of the pond.

2. Derive a load curve and an acceptable variance range

The existing load curve has been derived for the Bell Is wastewater treatment plant by seasonalising the standard design criteria of 84 kgBOD/ha/day applied to oxidation ponds in New Zealand. The curve indicates pond loads at 110 kg/ha in January decreasing to 55 kg/ha in July then increasing back up to the January value but this is based on raw sewage composition rather than the blend of raw influent, settled effluent from the primary clarifier and clarified effluent from the secondary activated sludge process.

At any one time depending on the characteristics and the flow rate of the influent to the treatment plant and the performance of the primary clarifier and the secondary treatment system, the ponds will receive loading with changing ratios of raw, primary and secondary wastewater and variable ratios of soluble and non-soluble BOD.
As expected from the industrial contributor inputs process data from the plant also shows that the COD:BOD ratio of the influent varies seasonally although not always with the same timing year to year.

The loading curve is seen as a guideline for determining pond loading but at any time the pond conditions and performance has to be the prime consideration.

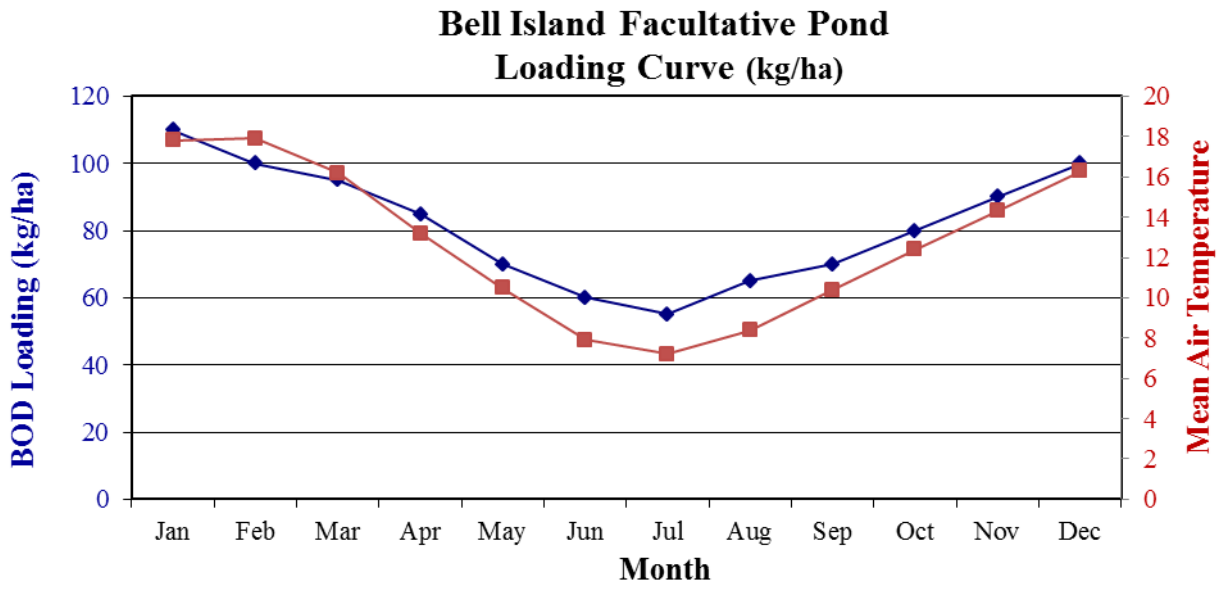


Figure 5-1: Existing Bell Island Facultative Oxidation Pond Loading Curve

The pond loading curve shown above is used as a guide only and is based on criteria accepted as representative for oxidation ponds in temperate climates. The following factors will be considered when evaluating pond loading requirements:

1. Actual performance of F1, F2, and F3.
2. Typical oxidation pond performance.
3. Local environment, latitude, temperature, sunshine, wind, rainfall.
4. Consideration of soluble/non-soluble BOD ratio, particularly for F1, F2, and F3 due to primary clarifier influence.

The installation of S::can at the inlet of the plant provides continuous and live monitoring allowing data to be better analysed for seasonal trends and in particular changes associated with industrial contributor seasonal start-ups and shut-downs.

3. Apply load to F1, F2, and F3 according to the load curve and pond conditions

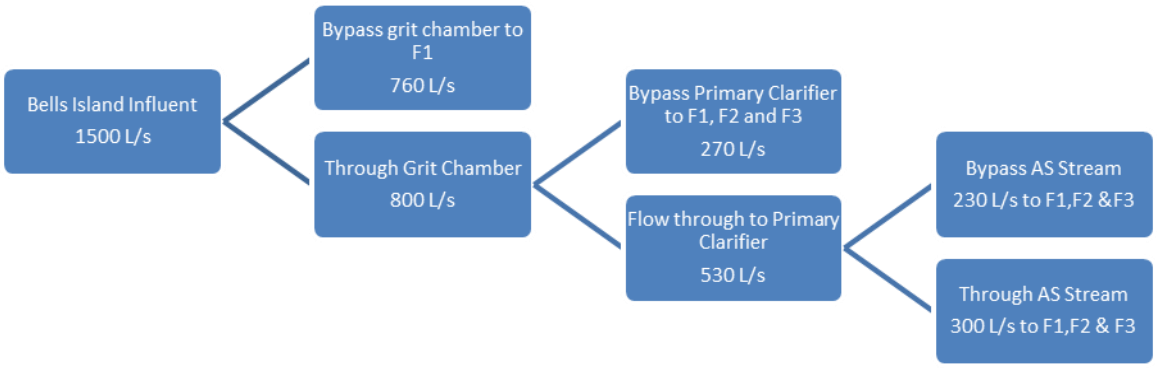
Adjust flow split to achieve the combination of flow/load entry to F1, F2, and F3 having regard to the pond curve and prevailing pond conditions/performance.

Control flow split by manual adjustment of penstocks:

- at splitter box upstream of primary clarifier
- at primary clarifier outlet channels.

Split adjustments should be made at least monthly and ideally weekly.

Typical flow splits are as follows:



4. Verify that actual load entering F1, F2, and F3 is within the acceptable variance range. If not adjust load.

Use characterisation of Bell Island WWTP influent, primary clarifier and AS/secondary clarifier effluent outflow to determine actual characteristics entering F1, F2, and F3.

Alternatively determine this directly by additional daily 24 hour composite sampling and testing for COD and SS, weekly BOD and SS at the C3 splitter chamber of the influent to the facultative ponds, the results should be analysed and interpreted at least weekly.

If the actual load entering F1, F2, and F3 is outside the acceptable range of the load curve or pond conditions at the time dictate otherwise, adjust flow splits to bring load into range as frequently as is necessary. The adjustment should be done in conjunction with the algal analysis results and daily dissolved oxygen concentrations in the ponds.

Carry out pond performance monitoring as described below and modify load management accordingly. This may mean adjustment of flow split outside of the loading curve parameters indicated at the time.

5.2 Pond Monitoring

Monitoring of pond conditions on a frequent basis is critical. It is not sufficient to rely on target loads from a load curve, even when actual load is verified to be within the notional target range.

All pond monitoring should be recorded on the pre-existing operator log sheets as has historically occurred.

The actual performance of the pond must be checked to ensure that its load capacity performance is within the notional target range. If it is not, then either the target range requires adjustment or there is a problem with pond health.

Pond monitoring objectives are.

- To verify that the target load can be treated by F1, F2, and F3 to the required treatment standards.
- To understand DO concentrations.
- To determine health of algae and type of algae in pond; (interpret the algal analysis report from Hydrobio Ltd.).
- To identify pond health issues in F1, F2, and F3.

First and foremost the discharge consent compliance monitoring results must be within the limits set by the resource consent. This set of measurements should be duplicated on the combined effluent from F1, F2, and F3 prior to the maturation ponds, not least to determine the influence and effectiveness of maturation. However frequency of compliance monitoring is monthly which is insufficient for effective pond management purpose.

The combined effluent from F1, F2, and F3 shall also be monitored weekly for BOD and SS. Results approaching the consent compliance limits (80%) shall be cause to adjust overall load, load split and/or other operating parameters of the ponds; pond water levels, aerators. This could be done on a monthly basis.

Pond performance shall also be directly monitored by:

1. Continuous monitoring of dissolved oxygen (DO), 24 hours per day in F1, F2, and F3.
2. Continuous monitoring of oxidation reduction potential (ORP) 24 hours per day in F1 (minimum).
3. Verification sampling and testing of DO in F1, F2, and F3 at 8.00am and 2.00pm, three times per week, Monday, Wednesday, Friday.
4. Measurement of algae concentrations in F1, F2, and F3, three times per week, Monday, Wednesday, Friday at 8.00am.
5. Measurement of algae concentrations in M1, and M5 once a week on Mondays.

Target DO's are:

- 8.00am >2.0 ppm
- 2.00pm >3.0 ppm.

6. If average DO levels falls below these target concentrations check for signs of poor pond health and the BOD loading on the ponds.
7. Microbiologist early warnings of factors/conditions likely to impact on pond performance.

Target ORP is:

- Diurnally, long stable oxidation periods with short reduction periods (overnight).

5.3 Activated Sludge Treatment

The Activated Sludge (AS) treatment system will be described in detail in the O&M Plan. This discussion is limited to the potential effects of the pond management regime on AS treatment.

The hydraulic flow split between the pond and the AS system is operator adjustable by opening or closing the penstocks on the outlet of the primary clarifier. As the incoming biological load changes the load applied to F1, F2, F3 and the AS will vary in proportion.

When biological load does vary, it will be necessary to manually intervene to adjust the flow split to manage pond load. On these occasions, the AS stream will experience a relatively sudden change in both flow and load.

The AS system is inherently capable of assimilating variable flow and load, however the operators should be mindful of control loop time-lags and make stepped changes to avoid control over-response.

5.4 Pond Aeration

F1 and F3 are provided with electric powered aeration comprising of a single HPE brush rotor aerator positioned at the pond inlet and four small AireO_2 aspirating aerators (three in F3) positioned off the waveband approximately midway along each of the four sides of the ponds.
Pond F2 has nine wind-powered Gurney Series 3 aerator/mixers positioned in a grid pattern over the pond. These Series 3 aerator/mixers were installed and became operational in April 2017.

Although the operating periods of the electric aerators can be controlled individually, commonly all are operated continuously and are set to create an anti-clockwise flow around each pond with the brush aerator directing the influent away from the discharge point of each pond.

The electric powered aerators are on a maintenance schedule and are serviced regularly or repaired where necessary to ensure the maximum mechanical aeration and mixing is available in each pond.

The Series 3 wind-powered aerator/mixers are very low maintenance and operate when wind speeds reach approximately 8kph. These aerators have been under evaluation since installation in April 2017. If proven successful in meeting the expected outcomes; raising DO levels, halting sludge build up, and ultimately reducing sludge levels in the pond, the Gurney proposal is for installation of similar numbers of Series 3 aerator/mixers in F1 and F3 and possibly two each in M1 and M5.

5.5 Pond Partitioning

Partitioning of the final maturation pond M5, initially by installing two PVC curtains at 60m centres across the pond starting from the outlet end, is to be undertaken in August 2017.

This initiative is to provide a zig-zag pathway preventing short circuiting of the flow as it progresses from the inlet to the discharge point and improving the quality of the discharge effluent. Depending on the outcome of the evaluation, both robustness of the PVC curtains and improvement of the discharge effluent, further curtains at 30m centres may be installed in M5.

5.6 Performance Review

Operational decisions are made and actioned manually, particularly, flow adjustments, based on a range of information available. Interpretation of this information and the resulting decisions must be based on a clear understanding of the objectives, the input parameters and the likely outcomes and actions. In addition the pond management team must anticipate short to medium trends, some of which are outside their control (e.g. weather, industrial load).

It is essential that a regular frequent and timely review of performance is carried out to reinforce competency and decision making.

A weekly performance review shall be held by the pond management team;

- Contract Supervisor
- Plant Supervisor – plant operators where appropriate
- Microbiologist
- Wastewater Specialist

A weekly pond performance report shall be compiled by the plant supervisor to incorporate consideration of the agenda items and any other issues that may have occurred during the week being reported. The report

will include summaries of pond monitoring and the latest sampling results for the effluent discharge – this report will be circulated in draft to the participants before finalising and submitting.

The agenda shall include:

1. Anticipation of influent load and flow taking into account industry liaison and weather.
2. Hydraulic flow split, current and proposed.
3. Match of actual load to target load.
4. Pond performance and consequences for improvement, mitigation, flow split and revision of target load curve.
5. AS performance issues.
6. Interpretation of algal analysis and dissolved oxygen concentrations.

The Wastewater Specialist will review the pond and plant data regularly and will confer with the Plant Supervisor/Operators on operational matters as required. The Wastewater Specialist will also review all monitoring data compiled in the monthly report and consider pond health, pond loading and pond performance trends.

5.7 Trouble Shooting

5.7.1 Troubleshooting DO Concentrations

- DO declining over two to three days shall trigger operator action to:
    - reduce pond load by flow split adjustment and to check for other signs of poor pond ill-health.

- DO below 1.0 ppm at any time shall trigger operator action:
    - If DO does not recover during the day reduce pond load by flow split adjustment and to check for other signs of poor pond ill-health.

- If midday DO concentrations are less than 3.0ppm:
    - an assessment of overall pond health in reference to the DO using pond loading, algal health including weather data should be made to determine whether it is necessary to reduce the pond load.

- Elevated DO minimums i.e. night-time DO concentrations of 3.0-4.0 ppm, and ORP readings indicating little diurnal change are indicative of :
    - under-loading.
        - Load flow splits shall be adjusted accordingly or if prevalent in only one pond then flow splits between ponds shall be adjusted.
    - excessive predation by grazers such as rotifers or similar
        - This, in conjunction with algal concentration measurement as described below, may be a trigger for investigation by a specialist pond biologist.

Pond loading can be reduced short term by:

- isolating individual ponds by gating at the splitter box
- pumping from the pond using a high capacity pump (100l/s).

Pond loading can be increased short term by:

- bypass periods where a pond is out of commission.

High minimum DO is also indicative of conditions that lead to excessive predation by grazers such as rotifers or similar.

5.7.2 Troubleshooting Algae Concentrations

The weekly reports from the Biologist will be used to trigger changes to the operation of the ponds. Operational changes will follow a course of action determined by the Wastewater Specialist after reviewing the weekly pond reports, and following discussions with the Biologist. The following shall be considered by the wastewater specialist:

- algal species variety and the potential for algal monoculture
- health of predominant algal species, population aging etc.
- the presence of parasitic fungi or similar, in particular *Pseudosphaerita Euglenae* counted as a percentile of 100 *Euglena* cells for each infected species
- predation by grazing of Brachionus rotifers or similar
- potential for pond toxicity levels.

- Where a parasite is seen to be causing death to the predominant algal species (i.e. >10% infection)
    - that pond (after considering other data such as DO) could be:
        - isolated using a gate at the splitter box
        - de-loaded using a high capacity pump
        - re-seeded from an uninfected pond.
- Where there is a clear indication of grazers present and algal numbers are adversely impacted:
    - Look at continuous pond DO monitoring and pond loading data to determine if pond is under loaded and has been constantly aerobic:
        - If yes increase pond load gradually so that once algae are re-established they are not subject to continual grazing which leads to cycles of bloom and bust.

- Monocultures present a risk of sudden die-off or over-grazing with a consequence of poor pond performance and odour generation, the following mitigation measures could be considered after discussion with the Biologist:
    - seed algae from an alternative pond with higher levels of green algae
    - increase load to discourage grazers
    - alternatively, limit load to the system, reducing the potential for malodour even if a risk was to occur.

5.7.3 Trouble Shooting Pond Toxicity

In some instances influent from industrial sources can cause toxicity, leading to the disruption of the main biological processes. Sulphides present in the incoming load to the ponds at levels >1ppm can cause toxicity. (Note that the presence of sulphur bacteria in the ponds is not related to sulphide toxicity).

Where toxicity is suspected:

- check s::can data / arrange for DCM to analyse influent data prior to suspected pond toxicity
- send 24 hour composite sample to Watercare for analysis; compounds to be analysed should be decided by the Wastewater Specialist after consultation with industry and Watercare
- maintain flow through pond system to flush through rather than isolation of the pond

5.7.4 Peak Flows / Storm Events

High flow through F1, F2 and F3 may result in the flushing of algae and nutrients into the maturation ponds M1 and M5.

Normal dry weather operating water level is considered to be R.L. 4.6 but this level could increase by at least 1 m during sustained storm events.

To maximise storage and prevent algae flush out the following mitigation measures will be implemented:

- manage pond levels as best as possible to limit the flushing of material through the system
- raise penstocks at the outlet of F1, F2, and F3 to prevent flushing during storm events
- installation of a notched weir plate at the outlet overflow weir (currently under investigation which will include a survey).

5.8 Pond Desludging

An annual survey of sludge depths using a tube sludge judge from a boat will be carried out on all ponds to provide an early indication of potential sludge build-up. The results of this sampling will indicate whether a comprehensive full sludge survey is required.

The annual sludge survey will consist of sludge and clear water depth measurement recorded at twelve sampling locations evenly spaced on the pond. These locations shall be recorded by GPS.

If a comprehensive survey is required this shall best duplicate previous comprehensive surveys that have been undertaken and shall include; measurement of sludge and clear water depths and the provision of coloured contour plans for these parameters, sludge sample analysis for dry solids and volatile solids reported as mg/l and sludge sample analysis for a suite of heavy metals reported as mg/kg.

Pond desludging is not considered a normal operational event, and after five years from the previous desludging event and with confirmation by tube sampling, a sludge survey should be carried out. The trigger level for desludging is when the sludge comes within one metre of the surface for greater than 10% of the pond area while the pond is at normal dry weather operating water level or when treatment capacity appears to be significantly reduced. Normal dry weather operating water level is considered to be R.L. 4.60.

When a sludge contour survey indicates a pond is at/near the trigger level, closely monitor pond performance and health while planning for desludging. It is noted that in 2016 the team reviewed the comprehensive pond sludge surveys carried out by Conhur in 2014 and 2015[2]. The team recommended that desludging (or significant sludge reduction) is scheduled for F2 within the next 2-3 years and is budgeted for F1 and F3 within the next 5-7 years. The team considered various interim options to defer F2 desludging, including raising the operating water level and unloading the pond in the context of the WWTP operation as a whole. The team agreed that the potential disadvantages (e.g. compromised pond health in F1 & F3) outweighed the potential advantages (e.g. reducing sludge accumulation in F2).

Note the information contained in Section 5.4 in regards evaluation of Gurney Series 3 wind-powered aerators in pond F2. The results of this evaluation may influence decisions on the desludging of ponds.

5.9 Inter Pond Transfers

Where the diversity (or density) of algae is limited then pond transfers allow the seeding of the pond (or ponds) with healthy culture from one of the other ponds, or the boosting of numbers of algae where algal populations are low.

Typically pond transfers are only undertaken when there is a clear deficit of algae in a particular pond to the extent where odour may develop.

Recirculation - an initiative to increase circulation through the final maturation pond M5 is currently in progress. The transfer/seeding pump is used to pump effluent from the discharge channel and discharge into either F1 or F3 facultative ponds. Pump periods are continuous provided fuel is able to be kept supplied to the pump.

The facultative pond for receipt of the effluent from M5 is selected on the basis of diversity and health of algal biota, or lack of such, at any one time. It seems that the receiving pond does show benefit from receiving effluent from M5.

[2] Report prepared by Nelmac titled “Pond Sludge Survey Interpretation Report”, 2016.

5.10 Contingency plans for remedying effects of odour occurrences

The Pond Management Plan has a number of levels of contingency for pond issues.

Level 1 – Decrease or increase the load on the ponds.

Using the gates in chamber C3 the flows can be reduced to one pond and increased to the others, reducing the oxygen demand in the poorly performing pond.

Level 2 – Isolate a pond.

Using the gates in chamber C3 to isolate the flow to a particular pond and stop flow entirely if the pond performance is poor.

Level 3 – Inter-pond transfers.

Where algae levels are depleted by predation, or where a monoculture becomes apparent transfers between ponds can be used to reduce the likelihood of operational issues.

In the event of a pond "crash" this transfer in combination with pond feed isolation can restart the ponds.

Level 4 – Maximise treatment within AS system.

In the event that all the ponds are performing poorly the activated sludge system should be operated to its maximum capacity and the load to the ponds should be reduced to a minimum. This further reduces the load (to 30 – 40 kg/ha) on the ponds, and also allows aerobic liquor to pass to the ponds rather than anoxic/anaerobic wastewater from the primary clarifier.

Level 5 - Provide supplementary aeration.

In the event that the load cannot be reduced further, consider the use of supplementary aeration to maintain an aerobic environment and prevent any odour emissions. An HPE brush rotor and four AireO2 aspirating aerators, redundant from F2, are available for supplementary aeration duties if required.

Seeding ponds with Sodium Nitrate is a recognised response and will provide supplementary oxygen and suppress the toxic effects of sulphide on the pond algae.

5.11 Complaints

For information on response procedures in the event of complaints about odour – refer to the Odour Management Plan Contingency Management.

6 Contingency Management

6.1 HAZOP Approach

A HAZOP (Hazard and Operability) approach was used and adopted for contingency management of the Bell Island WWTP as a whole and to pond management systems addressed by this plan.

An initial HAZOP for the plant was undertaken in September 2013 to identify potential issues with the operation of the plant. As changes to the plant are made, any future hazards and operation should be identified and reviewed.

6.2 Influent Characteristics

The following tabulates hazard/risk effects and mitigation measures to be considered in consultation with the Wastewater Specialist.

Hazard/Risk	Effect	Mitigation
High flow	Carryover of facultative process to maturation ponds.	Even F1, F2, and F3 flow, F1, F2, and F3 buffer storage. Maturation buffer storage.
	Overloading.	Refer high load hazard.
	Under-loading, algal die-off and/or predation.	Increase F1, F2, and F3 load by reducing AS load. Shut down F1, F2, and F3 individually.
High load	F1, F2, or F3 overloaded, algal die off, potential pond odour.	Maximise AS stream loading. Seed algae from other F ponds or M ponds if sustainable/suitable – advice from microbiologist. Add mechanical aeration to F1, F2, and F3 – refer 5.8 Level 5. Dose sodium nitrate
Toxic event	F1, F2, or F3 stress or failure. AS Stress or failure.	Maximise AS stream loading if possible. Shut down F1, F2, and F3 individually. Utilise pond buffer storage. Undertake algal seeding and sodium nitrate dosing. Note: Important to continue with mitigation measures until the microbiologist reports algae have re-established and communities are stable.

6.3 Activated Sludge Treatment Fault

This plan does not cover AS fault management, which will be addressed in the O&M Plan(s) for that process and equipment.

However, two scenarios are addressed with regard to pond management:

1. AS system is underperforming.
2. AS system has completely stopped.

It is irrelevant to pond management whether these faults are a result of failures in any of the Primary Clarifier Aeration Basin, Secondary Clarifier or RAS systems.

If AS system is underperforming, then total loads to the F1, F2, and F3 will increase. It may be beneficial to modulate flow to reduce load on AS until the fault is rectified.

Additional loads to F1, F2, and F3 can be mitigated by utilising buffer storage or by adding mechanical aeration to F1, F2, and F3. This approach also applies to a completely stopped AS stream.

6.4 Pond Performance

The following tabulates hazard/risk, effects and mitigation to be considered in consultation with the Wastewater Specialist and Biologist.

Hazard/Risk	Effect	Mitigation
DO in pond and/or at discharge declining or less than 1.0 ppm at. 2 pm.	Potential pond over load or pond health issues.	Adjust AS/ F1, F2, and F3 flow split. Investigate pond health. Use buffer storage. Consider supplementary aeration.
BOD in pond and or	Potential pond over load or pond health	Adjust AS/ F1, F2, and F3 flow split. Investigate

at the discharge increasing to 80% of median consent limit.	issue.	pond health. Use buffer storage. Consider supplementary aeration. cBOD and sBOD levels should be compared as the TBOD levels maybe being influenced by nitrification oxygen demand (NOD) or biomass (blue-greens) while the pond is actually in good condition and does not require mitigation measures related to loading. cBOD – <80% median consent for TBOD sBOD - <10g/m3
DO minimum (night-time) above 3.0-4.0 ppm.	Potential pond under load, or predation.	Adjust AS/ F1, F2, and F3 flow split. Consider cyclic shut down of individual ponds.
DO, temperature or BOD varies between individual ponds.	Potential under or over load of ponds with effects as above.	Adjust pond flow distribution.
Low Algal concentration.	Either under-loading with predation and die-off or algal health problem such as fungal infection.	Investigate cause and adjust AS/ F1, F2, and F3 loading as appropriate. Consider cyclic shut down of individual ponds to allow recovery. Use cross seeding to re-populate algae. Dose ponds with sodium nitrate.
Algae fungal infection.	Die-off leading to effective overloading and odour.	Identify fungi in pond monitoring. Consider cyclic shut down of individual ponds to allow recovery. Use cross-flow to repopulate algae. Dose ponds with sodium nitrate.
Low algae species variety or monoculture.	Potential for sudden die-off or predation leading to effective over load.	Identify in pond monitoring. Use cross-flow to repopulate algae variety, if variety available across F1, F2, and F3. Introduce algae from external sources.
Sludge build-up. Pond depth less than 1.0m for greater than 10% of area, any individual pond.	Reduced pond capacity and potential short circuiting leading to effective over loading.	Consider redistribution of sludge across pond or between F1, F2, and F3. Consider delivery of sludge to onsite solids stream within limits of spare capacity and consent*. Refer 6.2 for other mitigation measures.
Toxicity	Refer to Section 6.2.	Refer to Section 6.2.

* Consideration of NZ guidelines for biosolids heavy metals limits.

7 Personnel

The Pond Management Team comprises of:

- Contract Manager
- Plant Supervisor – plant operators where appropriate
- Microbiologist
- Wastewater Specialist

The Pond Management Team is responsible for providing advice to the operations team on pond management after considering all the data available and any effects of the wastewater treatment plant on the loadings to the ponds.

The Pond Management Team will confer weekly to discuss pond operational health and any other issues that could affect operations. These weekly discussions aid in maintaining communication for the overall plant as

well. A brief summary of the pond health and any planned actions will be sent to the NCC Contract Supervisor with copy to the NRSBU Engineering Advisor as soon as practicable after the meeting (also refer 5.4).

7.1 Contract Manager

The Contract Manager is the representative of the Contractor (Nelmac Ltd) responsible for the overall operation and management of the NRSS operations and maintenance under NCC Contract 3458 encompassing the Bell Is wastewater treatment plant and associated reticulation systems.

The Contract Manager is usually contactable 24 hours, seven days a week and will liaise with the Plant Supervisor and other members of the pond management team to ensure contractual terms and conditions are met.

The Contract Manager will coordinate dissemination of the weekly performance review and pond report to all parties including the contract Principal's representative and will be responsible for receiving and distributing all contractual communication regarding the NRSS operations and maintenance.

The O&M Contractor's Contract Manager is:

Lindsay Bell – Contract Manager Treatment
Phone: 03 562 071
Mobile: 0274 476 764
Email: lbell@nelmac.co.nz

7.2 Plant Operators

Plant Operators are responsible for the day to day monitoring of the pond DO, collecting samples, monitoring the weather, and monitoring the colour of the ponds. O&M staff undertake daily surveillance making observational notes to electronic worksheets stored on the plant PC that are accessible by the NRSBU Contract Supervisor when required.

The Plant Operators act as the core operational team, one of whom is assigned to monitor the pond and its physical attributes. The team rotates the responsibility for the algae and DO monitoring on a weekly basis. The aeration system is also checked on the same schedule.

The Plant Supervisor will brief the Plant Operators as to daily operational and communication requirements (written communications including a copy of the current Pond Management Plan).

Plant Operators should not make changes to plant operations without first conferring with the Plant Supervisor in consultation with the Wastewater Specialist and the Microbiologist, if it relates to the pond management, who will inform them where serious issues are possible, or as appropriate. Specific intervention measures are recorded in the site diary, and in the operational log.

The Plant Operators are as follows:

Steve Richardson – Senior Operator
Phone: 03 541 0289
Mobile: 021 953 089
Email: BellsAdmin@ncc.govt.nz

David Wratt – Plant Operator
Phone: 03 541 0289
Mobile: 0272 463 734
Email: BellsAdmin@ncc.govt.nz

David MacDonald – Plant Operator
Phone: 03 541 0289
Mobile: 0278 396 801
Email: BellsAdmin@ncc.govt.nz

Phil Benvin – Casual Plant Operator
Phone: 03 541 0289
Mobile: 0278 399 464
Email: BellsAdmin@ncc.govt.nz

7.3 Plant Supervisor

The Plant Supervisor oversees the Plant Operators and together they assess the health of the system daily.

The Plant Supervisor is responsibility for the day to day operations of the Bell Is treatment plant and associated regional reticulation systems and is contactable 24 hours, seven days a week. He will advise the Plant Operators of any necessary actions should plant difficulties arise.

The Plant Supervisor must have adequate time and resources available to undertake the necessary tasks. This includes ensuring that pond operational data is electronically updated on a regular basis and is available to all members of the Pond Management Team as required.

The Plant Supervisor is:

Allan Jones – Plant Supervisor
Phone: 03 541 0289
Mobile: 021 845 810
Email: ajones@nelmac.co.nz

7.4 Specialists

The Wastewater Specialist is:

Kirsten Norquay – MWH Dunedin
Address: Level 3, John Wickliffe House, 265 Princes Street, Dunedin
Phone: 03 474 3097
Mobile: 021 296 7573
Email: kirsten.g.norquay@stantec.com

The Microbiologist is:

Gemma Tolich Allen – Hydrobio
32A Owens Road, Epsom, Auckland
Mobile: 021 052 6973
Email: gemma@hydrobio.co.nz

The Microbiologist receives pond samples and information on the pond characteristics, and analyses the samples for algal species, health and density. Other microbiology features are also noted and reported where appropriate. This analysis is undertaken within two days of receipt of the samples. The results are compiled into a report and these are used by the Pond Management Team as part of the decision making for the pond control.

8 Plan Control and Revision

Version	Status	Date	QA	Distribution
v2	Draft for Tender	March 2013	Prepared by: A McGaughran Checked by: R Lester Reviewed by: Rainer Hoffmann Approved by: Lindsay Bell	MWH proposal file Nelmac Contract 3458 Tender
v3	For Client Comment	November 2013	Prepared by: Celia Schofield Checked by: Michael Tan Reviewed by: Rainer Hoffmann Approved by: Lindsay Bell	MWH file Nelmac NCC Bell Is WWTP
v4	Final	January 2014	Prepared by: Avik Halder Checked by: Gemma Allen Reviewed by: Rainer Hoffmann Approved by: Lindsay Bell	MWH file Nelmac NCC Bell Is WWTP
v5	Update	July 2015	Updated by: Lindsay Bell Reviewed by: PMT Approved by: Lindsay Bell	Nelmac File MWH NCC Bell Is WWTP
v6	Update	June 2016	Updated by: Lindsay Bell Reviewed by: PMT Approved by: Lindsay Bell	Nelmac File MWH NCC Bell Is WWTP
V7	Update	July 2017	Updated by: Lindsay Bell Reviewed by: PMT Approved by: Lindsay Bell	Nelmac File MWH NCC Bell Is WWTP

Appendix A: Discharge to Air Consent

Appendix B: Discharge to the Waimea Inlet Consent

Appendix C: Discharge to Land Consent