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Hihi Wastewater Treatment Plant

20 December 2019

CONFIDENTIAL



Business Risk Assessment Workshop
4 December 2019

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Disclaimers and Limitations

This report has been prepared by WSP exclusively for Far North District Council in relation to the summary report from the High WWTP Business Risk Workshop of 4 December and in accordance with the findings of the workshop. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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1 Background

Hihi is a small community in Far North District of New Zealand. The approximate population is 200 people in winter, rising to approximately 400 in summer, and for 2 weeks of the year, peak holiday period, population is as high as 600 people.

The treatment works consists of an inlet pump station lifting flows to an activated sludge plant aerated by coarse aeration. This then feeds a secondary activated sludge reactor before flowing to a clarifier. Clarified effluent is pumped through sand filters and UV before discharge to a wetland. Overflow from the wetland area passes to the local stream which after passing through the community discharges onto a bathing beach.

The existing works was constructed about 30 years ago using precast concrete tanks and PVC above ground pipework. It has been documented that the plant was only expected to be a temporary system, and as a result many of the assets have significantly deteriorated and at the end of asset life.

The Resource Consent for the current discharge is due for renewal by 2023 and new consent standards are expected for the discharge.

Linked to asset condition and process capacity for current loads, the plant has been identified by WSP 2018, to be underperforming and exceedance of consented parameters can occur.

To assist Far North District Council with the business case for the upgrade of the Hihi Wastewater Treatment Plant a Business Risk workshop was held on 4th December 2019. The root cause workshop's aim was to capture all the issues of the Hihi WWTP, and by use of a risk rating (probability and impact) understand the effect of the issues. The issues and risks in the workshop focussed on business risk only. Operational or process risk while discussed in the workshop were not captured as they will not add value to development of the business case. A separate root cause workshop can be held for operational and process risks if deemed necessary.

The workshop was attended by representatives from FNDC, Broadspectrum, Hoskins Civil and WSP.

2 Root Cause Workshop

2.1 Procedure

The workshop of 4th December, at Kaikohe, has been attended by the following personnel

Attendee	Role	Organisation
Bill Down	Project Manager	FNDC
Stephen Little	Far North Waters	FNDC
Jody Kelly	Business Case Author	JKProjects
Mark Keehn	Asset Manager	FNDC
Tommy Gordon	Ops Supervisor	Far North Waters
Greg Timplerley	Operations	Far North Waters
Kevin Hoskin	Business Case Author	Hoskin civils
Larey Marie Mulder	Facilitator	WSP
Andrew Springer	Technical Lead	WSP

This has provided a range of experiences and understanding of the plant and its issues sufficient to identify the key issues and evaluate the risk associated with each issue.

The assessment has been undertaken in a step wise approach. Information on the plant and performance are presented in the workshop slide pack in Appendix C.

Project Background.

Review of flow and loads, historic performance data, overview of plant

Plant Issues

A systematic review of the whole plant capturing issues.

Root Cause

A systematic review of the plant issues to identify the root cause of issues occurring. Information to support each cause must be demonstrated.

Business Risk

To enable prioritisation of the problems on the site, many of which have common causes, for each issue and cause, a risk review is undertaken. This considers the Risk to Far North District Council over a long term operational period and reflects the impact of do nothing. This includes the impacts and risks to Safety, Compliance, Customer Relations, Pollution, Prosecution, Nuisance, Flooding, Bathing Waters and disposal of biosolids. The Probability and Impact Tables used in the workshop are provided below.

Prioritisation

Identified risks are mapped onto a risk matrix to identify the critical risks to the business and those of lower priority. As budgetary constraints will need long term consideration, low priority risks may be deselected for resolution.

Outline Solution.

Based on the prioritisation a short review of options can be undertaken that addresses the key issues. This forms the basis of options studies.

The outcome of the workshop presented in this report is a collaboration of all stakeholders and understanding of all issues. Risk to the long-term operation of Far North District Council is understood and the need for investment can be presented in the business case.

2.2 Likelihood

Table 2-1 Wastewater business risk Likelihood matrix

	Time	Description	Frequency
Very High	<1 year	Almost certain	Nearly continuous
High	1 – 5 years	Likely	Common
Medium	5 – 10 years	Probable	Occasional
Low	10 – 20 years	Unlikely	Infrequent
Very Low	>20 years	Rare	Rare

2.3 Impact

The wastewater business risk impact matrix used to assign an impact level to the identified issues is shown in Table 2-2. For more details and guidance on the wastewater business impacts see Appendix A

Table 2-2 Wastewater business risk impact matrix

Impact	Pollution	Prosecution	Customer Relations	Health & Safety	Compliance/Consent	Solids Disposal	Nuisance	Wastewater Flooding	Bathing Water
Very High	Category 1	Repeat	Public Enquiry	Fatality	Multiple Failures>90%-tile/Upper Tier Failure	Loss of Sludge Disposal/Special Landfill Required/Loss of Treatment Facility Impact Multiple Sites	Enforcement Notice	Road Flooding	Beach Closure
High	Category 2	Standard	Sustained National Media	Severe Injury/Permanent Disability/Long Term Health Effect	Average Condition Exceeded/Failure of Reporting or Other Condition/Breach of Flow	Temporary Disposal to Landfill Due to Fail of Equipment or Service/Loss of Treatment Facility Single Site	Threat of Abatement Notice	Internal Flooding > 5 Domestic or Commercial or 1 Amenity	Beach Classified as Poor
Medium	Category 3	Mitigated	Regional Media Attention	Notifiable Incident – no injury/Short Term Health Effect/Minor Bones	Single Sample Exceedance/Not Failed Look Up	HACCUP Failure – Temporary Loss of Agricultural Disposal	Residents Group	Internal Flood of Domestic Dwelling	Drop in Beach Quality
Low	Category 4	Warning	MP/Local Action Group/Local Press	Notifiable Injury/Lost Time>2 days/Hospital Treatment Required	Exceed Operating Target	Compromise of Treatment – Loss of Efficiency/Quality	Multiple Complaints	External Commercial or Agricultural	Sample Failure
Very Low	Near miss – minor spill no impact	-	Social Media	Minor Injury/Lost Time>1 day/Local First Aid	Single Sample Over Annual Average	Unable to Remove Sludge from Site	Customer Complaint	External Flooding of Gardens	Target Failure

2.4 Risk Level

		IMPACT				
		Very Low	Low	Medium	High	Very High
LIKELIHOOD	Very High					
	High					
	Medium					
	Low					
	Very Low					

For the evaluation the prioritisation of risks was based on the above matrix.

3 Issues and Causes Identified

During the root cause workshop, 61 issues were identified by workshop attendees. Several the issues were either linked or a variation of issue already identified. For the sake of completeness all 61 issues are listed below. In Appendix B a full table is available of the issues, causes and the assigned probability and impact.

1. Site boundary/designation
2. High total suspended solids after treatment
3. Elevated E-coli after treatment
4. Elevated ammonia (NH₃) after treatment
5. Unable to control Nocardia presence
6. Reduced dissolved oxygen (DO) - wetlands discharge
7. Clarifier capacity
8. Mixed liquor suspended solids (MLSS) uncontrollable
9. Unscreened wastewater
10. Pump station floods due to insufficient capacity
11. Fat, oil and grease (FOG) problems *
12. Insufficient flow buffering
13. Drainage of storm tanks
14. Bypass secondary treatment during heavy rain events
15. Bypass sand filters during heavy rain events
16. Structural failure of baffle in main reactor
17. Leaking main reactor
18. Manual handling of screenings *
19. Rag blockage of effluent pumps *
20. Inadequate aeration (too little and too much)
21. No online monitoring of process
22. Maintenance access (main reactor)
23. All tanks at end of life
24. Secondary reactor structure poor condition
25. Secondary reactor has no access
26. Secondary reactor poor aeration
27. PVC pipe failure and/or cracking

28. Base of clarifier worn by scraper
29. Clarifier scraper unreliable and poor condition
30. Clarifier tank structure poor
31. WAS tank structure poor *
32. WAS tank maintenance access
33. WAS tank capacity
34. WAS tank aeration insufficient *
35. Effluent tank at capacity (also used for sand filter back wash)
36. Sludge accumulation in effluent tank
37. Effluent tank maintenance access
38. Effluent tank structure poor *
39. Effluent pumps access poor
40. Welded plastic pipework on effluent pumps
41. Proximity of pumps to electrics
42. Maintainability of blowers (access)
43. Noise complaints
44. No redundancy on blowers (single unit)
45. Limited critical spares for blower
46. Single UV reactor
47. No redundancy on sand filters
48. Welded plastic pipework on sand filters
49. Limited Maintenance access to sand filters
50. No feedback on sand filters actuated valves
51. SCADA (Red Lion) no longer supported
52. Sand filter and UV building no air conditioning or venting
53. Sand filters and UV building too small – access issues *
54. No welfare facility on site (no potable water on site)
55. Sludge build-up in wetlands
56. Hill stability with history of slips impacting on wetland
57. Flooding of wetlands *
58. Wetland maintenance
59. Air locking of effluent pumps
60. Insufficient water for washdown
61. Use of recycled water for washdown

* Items marked are duplication of previous issues and risks and so have been removed from further evaluation. For example, 38, Effluent tank structure poor is also covered in the issue no 23, all tanks at end of asset life.

4 Risk Level of Issues

The following table presents the relative risk ratings from the workshop. Moderation of scoring has occurred and is documented separately. As example, Risk 5, Nocardia presence, a safety risk was identified as VH, H, which indicates that the event is already occurring and severe injury is resulting. Clearly no one is being permanently injured every year, so a lower risk rating is applied. This has been reduced to M L. That is within 10 years, minor injury resulting in short lost time incident may occur.

Risks that duplicate as of the same cause have been omitted for clarity.

		IMPACT				
		Very Low	Low	Medium	High	Very High
LIKELIHOOD	Very High		21, 43	46	2, 5a, 5c, 7, 8, 9b, 10, 12, 20, 28, 33, 36	1, 4a, 6, 14, 15
	High		4c, 9a, 16, 22, 25, 32, 37, 39, 42, 55a, 55c, 56a, 56c, 61	50, 52a, 54	17, 26, 29, 30, 44, 45, 47, 49, 51, 52b, 60	3, 55b, 55d, 56b, 56d
	Medium		41b, 5b	27, 40, 48	18b, 18c, 18d, 18e, 35, 59	4b, 18a, 23, 24, 41a,
	Low					
	Very Low					

5 Summary of Main Issues and Risks

The following is a short summary of the main issues and their causes.

The original WWTP at Hihi was constructed 30 years ago for a lower population approx. 200 people. It has insufficient flow and load treatment capacity for current demand with peak population of 400-600 people.

The plant is not robust against seasonal variation and suffers poor solids settlement and insufficient nitrification as a result.

Peak flows to the site were designed at 2.5 l/s but current treatment pumps deliver approximately 4 l/s. Additionally storm pump will operate in high wet well conditions. Flooding occurs in very high flows as all pump capacity is exceeded.

The consent conditions for Ammonia and DO are exceeded periodically in the stream.

To deal with high flow deficiency, flow bypasses secondary treatment and sand filtration against the consent conditions.

Poorly disinfected effluent is discharged in bypass condition to the wetland and will pass through the stream to a popular bathing beach.

The WWTP extends outside of the lawful designated area, so does not meet planning requirements.

The assets constructed 30 years ago were “low budget solution” and have reached the end of their asset life. This includes key tanks and mechanical scraper mechanism of the clarifier.

Structural failure has occurred of an internal baffle in the main reactor. The concrete tanks are leaking in several places. Significant Leaks will require at least a 1 week shut down of the whole plant to “patch repair”. Catastrophic failure will take the whole plant out of service until a new plant can be built (estimated minimum of 6 months) and will require tankering of all flows in this time.

Many assets have poor accessibility that limits maintenance. This accessibility impedes removal of assets without major work and as no standby on critical assets will require a whole works shutdown. As example, to change the blower the roof of the blower building must be removed and no secondary treatment is possible in this time.

There is insufficient standby equipment to provide continuously high-quality effluent.

The wetland requires maintenance as it has been impacted by the shortfalls of the plant and sludge carry through.

Land slips are known at the wetland site and there is evidence of further recent movement in the bank. This will impact on treatment and cause loss of wetlands with consequential impact on stream, stream ecology and bathing beach.

6 Outline Solution

A brief discussion was held discussing some of the options considered, but was agreed that a further workshop to discuss options and risk should be undertaken in January 2020.

Options developed previously for Hihi considered

- Moving Bed Bioreactor (MBBR)
- Conventional Activated Sludge (ASP)
- Membrane Bioreactor (MBR)

These options were identified as fitting within the current operational boundary and with phasing could be constructed while maintaining treatment quality.

Additional options were raised including;

- New Location near Hihi – although expected to be not affordable
- Pump to Mangonui catchment under harbour.

7 Actions

- WSP to circulate Draft Report before Christmas
- FNDC to discuss potential consent conditions with NRC.
- FNDC to designate land for WWTP.

Appendix A

Wastewater Business Risk

Impact Guidance Notes

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Wastewater Business Risk Guidance Notes.

Pollution

Caused by wastewater or the other Wastes from Assets

- Category 1** Major Incident involves one or more of the following
- Potential or actual persistent major effect (> 7 days) on water quality or aquatic life
 - Extensive fish kill (> 100 fish any size)
 - Public exposure to a toxic/dangerous Substance
 - Major adverse effect on amenity value, agriculture, or commerce
 - Major adverse effect on site of conservation importance
 - Or closure of licensed potable water, or industrial or agricultural abstraction
- Category 2** Significant Incident which involves one or more of the following
- Significant effect on water quality or aquatic life
 - Significant fish kill (10- 100 fish any size)
 - Significant adverse effect on amenity value, agriculture or commerce
 - Contamination of watercourse bed
 - Significant adverse effect on site of conservation importance
 - Precautionary notice to licensed abstraction points and necessary closure of unlicensed abstraction points
- Category 3** Minor incident resulting in localised environmental impact only.
- Precautionary closure of unlicensed abstraction necessary
 - < 10 fish kill
 - Minor impact to amenity value, agriculture or commerce
 - Local contamination of watercourse bed.
- Category 4** No evidence of impact to the environment or abstraction
- Near Miss** Minor event, no adverse impact
- WWTP spill to ground
 - Includes spill of waste to ground,

Minor spills to watercourse < 2 m³

Pollution events that if not caught early would have more severe consequence

For each pollution there is a likelihood for Prosecution. This is likely at lower Likelihood as not all incidents create prosecution.

An incident is an event even if Regional Council are not aware.

Use actual occurrences to determine frequency based on events per year

Customer Relations

Public enquiry

Official investigation into serious accident/disaster. May have resulted in multiple deaths.

Sustained National Media Interest

Sustained widespread high-level PR even for a duration of 2 weeks or more

Media Discontent

Adverse media attention (regional radio and television) at aimed at organisation

MP/Pressure Group/ Local Authority

Local papers, radio station, local MP, pressure groups such as community action group.

Complaint

Verbal, electronic or written complaint that requires response. (Comments on Facebook count as one per conversation not per comment).

Consider likelihood in rating. Example. Number of complaints per year.

Prosecution

Failure to comply with legislated agreement or other legal requirement that results in enforcement action.

Repeat Prosecution

Where we have poor historical performance, where it can be viewed we have had opportunity to correct something to prevent further pollution/compliance or adverse environmental effects.

Failure of Resource Consent based on flow or Quality leading to prosecution in last 5 years

Failure involved

- o < 60% of routine proactive maintenance activities completed.
- 0 5 monthly emergency callouts
- 0 1 unresolved issue on items of equipment or equipment off line with direct impact on compliance (e.g. duty and standby out of service)
-

Standard Prosecution

Where we have adequate historical performance including

No mitigation possible (event outside of reasonable measures e.g. Oil spill to drain from road accident)

Failure involved

- 1 sample failure in the last 5 years
- >60% of proactive maintenance activities completed
- < 4 monthly emergency callouts
- 1 unresolved issue on items of equipment or equipment off line that have direct impact (e.g. only duty working)

Mitigated Prosecution

Where we can demonstrate good historical performance to provide mitigating circumstances that should be considered.

Mitigations include

- No sample failure through operational monitoring in last 5 years
- 75% of routine maintenance activities completed (proactive)
- < 2 monthly callouts to site
- Or no unresolved issues on items of equipment or equipment off line that have a direct impact on compliance.

Likelihood should reflect number of incidents.

Warning

Regional Council or other legal enforcement organisation representative gives precautionary warning for events in breach of agreement or legislation. No fines, but action required to mitigate cause of issue.

Health and Safety

It is assumed that when considering risks that operators, visitors and unwanted guests are considered in the safety measures in place. Likelihood may vary depending on frequency of visit.

Many conditions can kill, but many only may kill. Chose most likely outcome. As Example, a trip on an uneven path may result in head injury and permanent disability. Most likely outcome is minor injury requiring local first aid. Or with lower likelihood, broken finger.

Fatality

Death direct from organisation asset or activity.

Severe Injury

Breaking major bone (e.g. leg, arm skull)

Multiple fracture of minor bones (wrist, finger, toes)

Permanent disablement

Long term health disability e.g. occupational asthma

Infection due to Work

Notifiable Incident

Major Incident but no serious injury OR

Short term health effect

Minor Bone fracture

Eye injury,

Note that Worksafe include all categories as Notifiable.

Lost Time

Lost time up to 7 days Medical treatment above first aid or hospital treatment required

Minor Injury

Lost time <1 day, local first Aid

Compliance

Historic Compliance is assessed on all routine monitoring. However, when specific events occur, then the expected impact on compliance if caught should be considered. Assume for all events that a sample will be taken, as most sampling is at random.

Multiple Failures	Failures of Look Up table 90% or 95%ile
	Exceedance of Upper Tier Standards (Maximum)
Average Exceedance	Exceedance of annual average
	Failure of Reporting
	Flow non- Compliance
	Failure of any technical condition in consent
At Risk	Multiple Sample Fails but not exceeding permitted number from look up table. One More sample fail will FAIL Works
Single Sample	Single sample failed limits (not maximum)
	Not exceeding look up table permit samples per year
Exceed Targets	Sample exceeding operational targets
	Sample exceeding annual average, but not failing average condition

Nuisance

Enforcement	Formal enforcement to resolve problem. Failure will result in prosecution.
Abatement measures	Threat or issue of abatement notice. Abatement may be by internal control measures.
Action Group	Recognition of escalation of issue when residents form group to get action.
	Escalation of written complaint to MP.

Multiple Complaints

More than 5 complaints in writing or to call Centre.

Single letter to CEO.

Complaint

Written or verbal complaint from individual (not passing comment).

Wastewater Flooding

Road Flooding: Area Wide with impact on multiple people. Possible road closure and loss of access to properties.

Internal Domestic: Internal Domestic Flooding, affecting more than 5 properties (1 property 10 times per year is single flooding, but likelihood VH) Flooding of Public amenity, commercial premises or other with loss of revenue.

Internal Domestic: Single Domestic Property or flooding of commercial premise that will not cause loss of revenue.

External Flooding: Flooding of external premises either commercial or agricultural that causes loss of revenue for property owner.

External Flood: Flooding of gardens and local areas with no impact on multiple people.

Check with Reputation Risk, Nuisance, PR, Pollution and Compliance

Bathing Waters

Routine monitoring is used as measure of failure. If not routinely monitored. Consider history of events in the area. Events that will certainly impact from historical information or test of reasonableness should be rated based on experience. E.g. Historically a pump station has overflowed causing 3 bathing water failures. Despite improvements, pump station could fail. Result is repeat discharge that is known to cause failure.

Beach Closure

Beach Closure, any duration as a result of wastewater. >100 bathers impacted.

Beach Classified as Poor

Beach shown as poor due to multiple monitoring failures. Indicator > 3 bad samples in any year. OR Reported Illness directly linked to discharge. OR Potential impact on non-designated bathing water. < 20 Bathers impacted.

Drop in Classification

Deterioration in quality. Multiple bathing water failures. Damage to reputation and tourism if this beach gains poor water standards.

Sample Failure	Single bathing water exceedance of standards.
Target Failure	Exceedance of sample over recreational water standards.

Biosolids Compliance

Sludge treatment is considered to be the treatment of sludge to reduce suspended solids

And reduction of pathogens. Plants that only thicken and or dewater sludge for export are not treatment sites.

Loss of Disposal Route	Loss of treatment. Only suitable for specialist landfill disposal. (Do not use if Landfill is normal route) OR, Loss of Regional Facility impacting on multiple plants.
HACCUP Failure	Failure of control points. Sludge cannot be disposed of normal route (e.g. to land) due to temporary poor quality. OR loss of small treatment facility impacting single site.
Compromise of Treatment	Loss of efficiency or quality. Normal disposal route applicable.
Unable to move sludge from site.	Unable to move sludge from site in normal manner. Example, sludge transfer pump failure preventing loading of tanker.

Appendix B

Wastewater Business Risk

Issues & Causes with Impact & Probability

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	Issues	Causes	Probability	Impact	Type of Risk
1	Site boundary/designation	Upgrades made without proper approval of designation of land.	VH	VH	Unlawful
2	High TSS from treatment	Poor settlement, SF capacity insufficient, Bypass stormwater flows, hydraulic capacity, short term elevation of sludge blanket	VH	H	Compliance
3	Elevated E-coli	Process related, poor upstream treatment and treatment bypassing - exact cause can't be identified	H	VH	Compliance
4a	Elevated NH3	Plant overloaded at peak population, insufficient aeration, alkalinity, MLSS control poor. Peak period results show high ammonia in stream > 20 mg/l (consent 2)	VH	VH	Compliance
4b	Elevated NH3	Plant overloaded at peak population, insufficient aeration, alkalinity, MLSS control poor. Prosecution due to noncompliance and pollution	M	VH	Prosecution
4c	Elevated NH3	Plant overloaded at peak population, insufficient aeration, alkalinity, MLSS control poor- Local bad publicity	H	L	Customer Relations
5a	Nocardia Presence	Poor process control (MLSS, O2) Presence of FOG leading to filament foam and odours	VH	H	Nuisance
5b	Nocardia Presence	Poor process control (MLSS, O2) Presence of FOG leading to filaments and poor sludge settlement.	M	L	Safety
5c	Nocardia Presence	Poor process control (MLSS, O2) Presence of FOG leading to filaments and poor sludge settlement. TSS loss may be managed but lower MLSS concentration may impact on other quality	VH	H	Compliance
6	Reduced DO at Wetlands- Environmental	Process over loading, poor Aeration, carry through of load to wetlands and sludge accumulation. Absolute limit in consent. Occurring now	VH	VH	Compliance
7	Clarifier Capacity	Design for lower flow 2.5 l/s (Sizing). Runs at 4 l/s On/Off Operation leading to poor settlement and flush out of TSS in light rain	VH	H	Compliance
8	MLSS Uncontrollable	Restrictions on sludge Tank manual controls, no routine testing undertaken. Poor MLSS control leads to TSS loss or insufficient biomass for load and poor effluent	VH	H	Compliance
9a	No screening	No screen installed so pump blockage occurs. Manual Clearing Required of pumps and coarse screen regularly	H	L	Safety
9b	No screening	No screen installed so pump blockage occurs	VH	H	Compliance
10	Pump Station Floods	Incoming Flow greater than treatment and storage capacity and takes return liquors. History and evidence of occurring and leaving site to reserve	VH	H	Flooding
12	Insufficient Flow Buffering	Storage only in wet well (< 5 m3) and 125 m3 storm tanks. Flows to works greater than storage available so requires pushing more flow than treatment can manage leading to compliance issues	VH	H	Compliance
13	Manual Drainage and cleaning of Storm Tanks	Flat Bottom Tanks Manual operation. No report issues			
14	Bypass biological treatment during heavy rains	Insufficient treatment capacity during peak flows Consent requires flow to be treated.	VH	VH	Compliance
15	Bypass Sand Filters During heavy rains	Sand Filters don't have capacity for solids. Effluent pumps can't deliver against extra head. Impacts on quality of BOD, TSS, NH3 and E coli. Consent requires flow to be treated.	VH	VH	Compliance

16	Structural Failure of main reactor Baffle	In tank corrosion insufficient design of baffle. Baffle partially failed already. Expect < 5 years life. May damage aeration. Baffle failure may cause short term compliance, rectified by moving inlet pipe and new aeration pipes	H	L	Compliance
17	Leaking Main Reactor	Age & Condition of Reactor leading to failure of tank- most likely small leakage- Reactor out for 1 week for repair	H	H	Compliance
18a	Failure of main Reactor	Age & Condition of Reactor leading to failure of tank- Catastrophic Failure- plant out of service for months. Known problem not addressed in timely manner will result in prosecution.	M	VH	Prosecution
18b	Failure of main Reactor	Age & Condition of Reactor - catastrophic failure of tank impacts on beach	M	VH	Bathing water
18c	Failure of main Reactor	Age & Condition of Reactor catastrophic failure leading to injury	M	H	Safety
18d	Failure of main Reactor	Age & Condition of Reactor - catastrophic failure of tank impacts on beach	M	H	Pollution
18e	Failure of main Reactor	Age & Condition of Reactor - catastrophic failure of tank impacts on beach	M	H	Customer Relations
20	Inadequate Aeration too much & too little	Coarse aeration with no control - occasional blockage of coarse diffusers. Leading to variable ammonia and BOD performance and Settability of sludge.	VH	H	Compliance
21	No online Monitoring	Never designed for it. Have tried DO but failed as was covered with rag.	VH	L	Compliance
22	Maintenance access (main reactor)	No Manway - Top Access for confined space entry. Currently avoid entry and not maintain.	H	L	Safety
23	All Tanks at end for life	Design life reached (end of life 30 years+) All tanks critical to process so failure impacts treatment.	M	VH	Compliance
24	2nd Reactor Structure Poor condition	Aged Asset (Age & Condition)	M	VH	Compliance,
25	2nd Reactor Access	No Platform for access, no Manway. No maintenance undertaken.	H	L	Safety
26	2nd Reactor poor aeration	Coarse Aeration with no access for maintenance	H	H	Compliance
27	Pipe PVC Failure/cracking	Sunlight exposure of pipes will lead to short term loss of process.	M	M	Compliance
28	Base of Clarifier Worn	Long Term use of scraper. Results in rising sludge and elevates TSS in effluent	VH	H	Compliance
29	Scraper unreliable/ poor condition	Aged asset no redundancy /unable to access & Maintain	H	H	Compliance
30	Clarifier Structure poor condition	Age and Condition - top of concrete wall is delaminating. Loss of tank is catastrophic as no back up on site.	H	H	Compliance
32	WAS tank Maintenance Access	Inspection Hatch only no manway/no personnel entry	H	L	Safety
33	WAS tank Capacity	Insufficient for Wastage @peak loads	VH	H	Compliance
35	Effluent Tank @ Capacity (Also used for sand filter backwash)	Hydraulic Constraints following install of sand filters	M	H	Compliance
36	Sludge accumulation in effluent Tank	Solids carry-over, Difficult to clean	VH	H	Compliance
37	Effluent Tank maintenance access	No Manway - Top Access for confined space entry. Currently avoid entry and not maintain.	H	L	Compliance
39	Effluent Pump access	Building too Small for Equipment maintenance and access and lifting.	H	L	Safety
40	Welded pipe work on effluent pumps	Was Easier to construct but risk of damage in maintenance.	M	M	Compliance
41a	Proximity of Pump to electrics	Building too small. Water spray from leaks direct to electrical components. Will take out critical processes.	M	VH	Compliance

41b	Proximity of Pump to electrics	Building too small Water spray direct to electrical components. Will take out critical processes. Risk management of not working on pumps with live power in room(tbc)	M	L	<i>Safety</i>
42	Maintainability of Blowers access	Building too small see 39- requires roof removal for removal of blower.	H	L	<i>Safety</i>
43	Noise Complaints	No Cooling Fan for Blower room - If Blower room open noise issue. - Bubbling Water Currently get summer complaints	VH	L	<i>Nuisance</i>
44	No Redundancy on blowers (Single unit)	Insufficient budget and space when built with short expected Life of Plant (replacement planned!)	H	H	<i>Compliance</i>
45	Limited Critical spares for Blower	Not purchased when new as expected short life before replacement. Rely on supplier support.	H	H	<i>Compliance</i>
46	Single UV reactor	Cost Constraints noncompliance during maintenance or equipment failure- lamps have built in spare capacity. Can shut flow down in most conditions (3 days in dry off peak flows), so risk is based on failure before maintenance.	VH	M	<i>Compliance</i>
47	No Redundancy on sand filters	Cost Constraints and space limitations. Age of asset will require critical maintenance in near future requiring shutdown	H	H	<i>Compliance</i>
48	Welded pipe work on Sand filters	Easier/ to construct. Prevents some insitu maintenance and increase risk of pipe damage.	M	M	<i>Compliance</i>
49	Maintenance access to sandfilters/UV	Insufficient building Space- unable to maintain fully. Will require significant shutdown if required	H	H	<i>Compliance</i>
50	No Feedback on SF valves	M&E failures not detected or known leading to poor effluent.	H	M	<i>Compliance</i>
51	Scada no longer Supported (Red Lion)	Original Budget choice and expected life of plant (New plant was expected). Reliability will impact on control of tertiary plant and pumping with impact on compliance. Approx. 2 weeks to replace.	H	H	<i>Compliance</i>
52a	SF/ UV Building no AC/venting	Over temperature as not considered in design unsafe working environment.	H	M	<i>Safety</i>
52b	SF/ UV Building no AC/venting	Over temperature impacting on equipment, e.g. UV shuts down at 45C.	H	H	<i>Compliance</i>
54	No welfare facility on site (no potable water on site)	No provision on site. Nearest public facility in Mangonui 11km away	H	M	<i>Safety</i>
55a	Sludge build-up in wetlands	Solids carry-over (see no2)- No routine maintenance leading to odours in hot weather	H	L	<i>Customer Relations</i>
55b	Sludge build-up in wetlands	Solids carry-over (see no2)- No routine maintenance so solids carry over and low DO. Occurring Now, exceeding max condition in consent. Managed by periodic desludging around outlets	H	VH	<i>Compliance</i>
55c	Sludge build-up in wetlands	Bypass of sandfilters gives poor effluent- so occasional discharge of higher E coli. Sludge accumulation reduces retention and natural disinfection.	H	L	<i>Bathing water</i>
55d	Sludge build-up in wetlands	Solids carry-over (see no2)- No routine maintenance impact on local stream ecology and fishery	H	VH	<i>Pollution</i>
56a	Wetland Hill stability	Water Ingress in embankment leading to slip. Causes local flooding of site and unconsented wastewater discharge. High E Coli released. Currently can flood from previous slip	H	L	<i>Bathing water</i>
56b	Wetland Hill stability	Water Ingress in embankment leading to slip. Causes local flooding of site and unconsented wastewater discharge. Impact on compliance. Can flood now due to previous slip.	H	VH	<i>Compliance</i>

56c	Wetland Hill stability	Water Ingress in embankment leading to slip. Causes local flooding of site and unconsented wastewater discharge Customer complaints received	H	L	<i>Customer Relations</i>
56d	Wetland Hill stability	Water Ingress in embankment leading to slip. Causes local flooding of site and unconsented wastewater discharge. Current flooding due to previous slip.	H	VH	<i>Pollution</i>
58	Wetlands Maintenance	Wetland requires extensive desludge and maintenance. _ Deferred due to plant upgrades. Leads to impacts from Sludge as 55	-	-	
59	Air locking of effluent pumps	Air Entrainment into pump. Effluent Tank too small leading to overheating of water and damage to plastic pipes.	M	H	<i>Manifold Breaking</i>
60	Insufficient water for washdown	Roof tank of 1 m3 is small. Limits washdown	H	H	<i>Compliance</i>
61	Use of recycled water for washdown	Use of recycled effluent increasing risk of aerosols and health.	H	L	<i>Safety</i>

Highlighted sections are moderated scores to provide consistency in scoring.

Appendix C

Workshop Slides

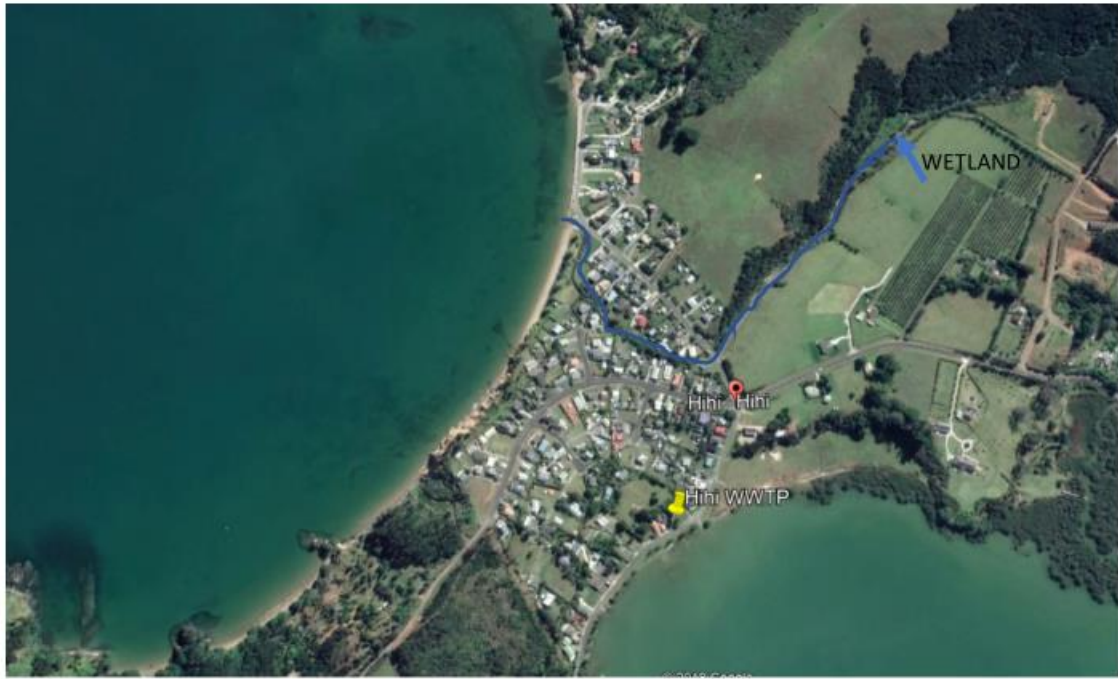
Hihi WWTP

Root Cause Workshop 4 December 2019

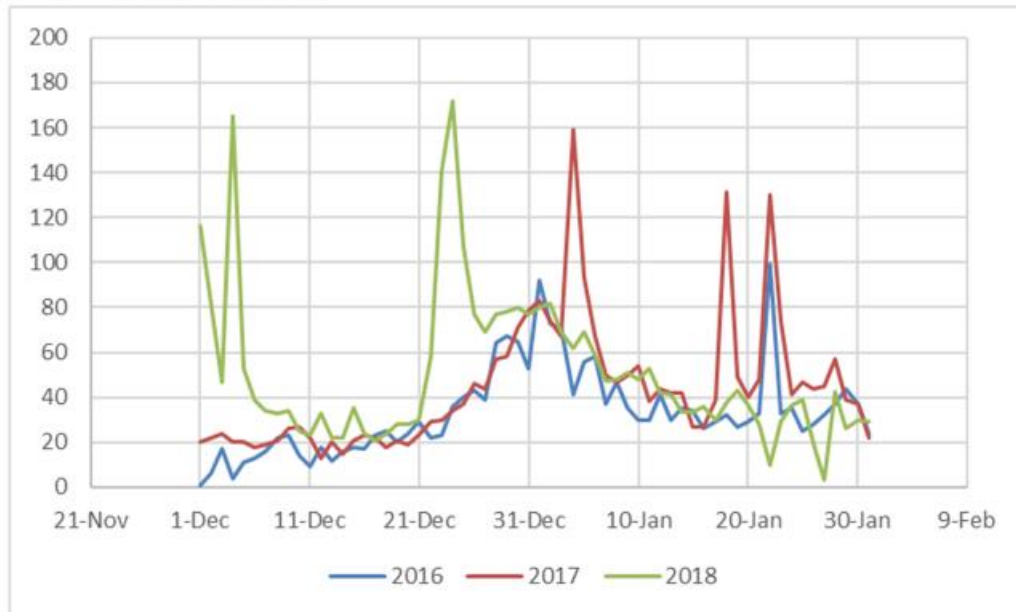


AGENDA

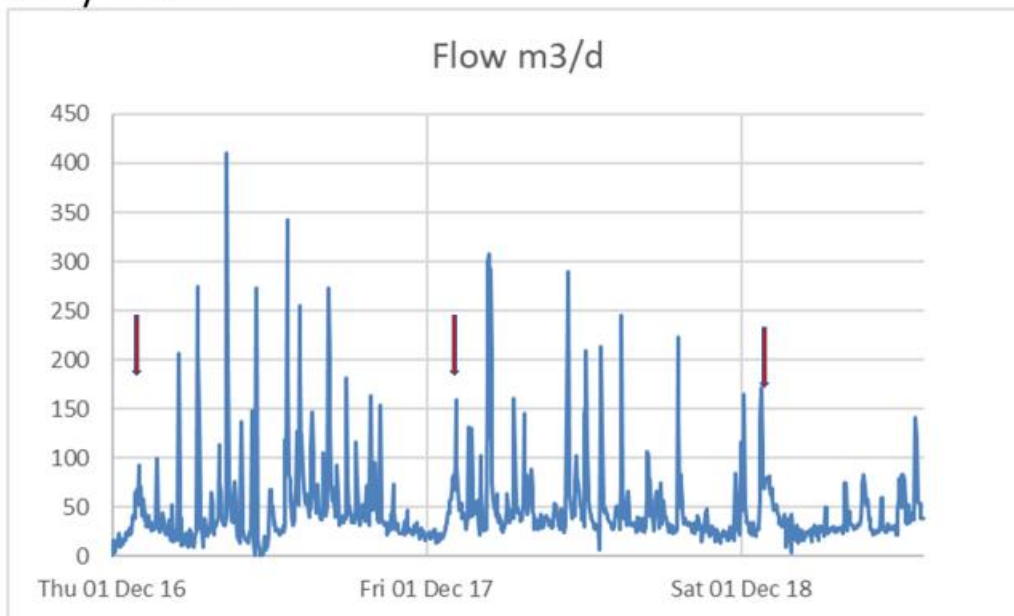
- Introductions
- The Plant – short overview
- Flow and Load
- Compliance
- Issues
- Cause of Issues
- Risk From Issues
- Prioritisation



Dec- Jan Flows



Daily Flow



Design Flows

Parameter	Value
Off-peak Average Dry Weather Flow (Off-Peak ADWF)	35 m ³ /d
Peak Average Dry Weather Flow (Peak ADWF)	85 m ³ /d
Peak Wet Weather Flow (PWWF)	750 m ³ /d *

Christmas Holiday Influent

Date	28/12/2016	03/01/2018
Type	Not Indicated	Composite
TSS	660	350
VSS	610	
CBOD5	580	280
TBOD		340
COD	1200	
COD dissolved	330	
COD Floc	330	
COD on TSS	210	
Total Nitrogen		140
N Dissolved	110	
TKN	140	
Nitrate	-	
Nitrite		
Ammonia	100	
Total Phosphorus	16	17
DR Phosphorus	12	
pH	8	
Alkalinity	480	



Influent Concentrations

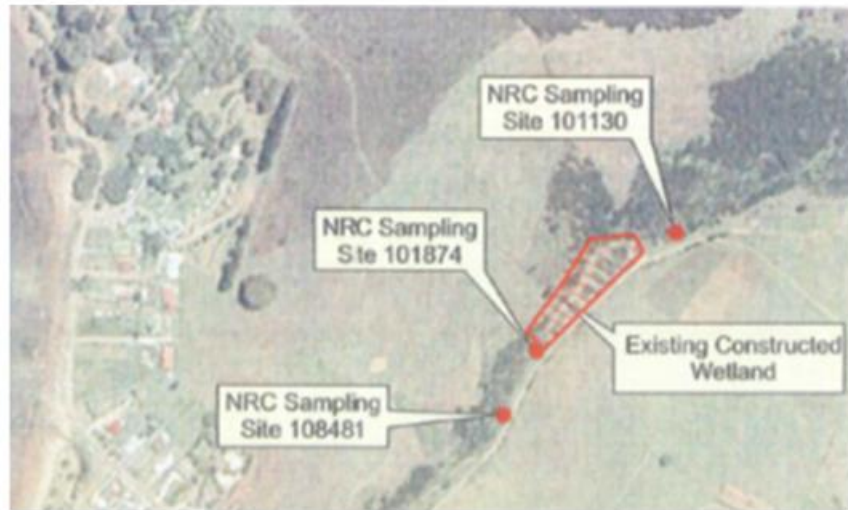
Parameter	Units	Design Report	Off Peak	Peak DWF
BOD	g/m ³	500	499	400
TSS	g/m ³	N/D	802	312
COD	g/m ³	1,000	997	800
TKN	g N/m ³	N/D	140	
T Phosphorus	g P/ m ³	N/D	17	
Alkalinity	g CO ₃ Ca/m ³	N/D	480	

Derived Load for Design

Parameter	Units	Off Peak	Peak DWF	Peak WWF
BOD	kg/d	17.5	42.5	42.5
TSS	kg/d	17.5	42.5	42.5
COD	kg/d	35	85.5	85.5
TKN	kg/d	4.9	11.9	11.9
T Phosphorus	kg/d	0.60	1.45	1.45



Current Consent

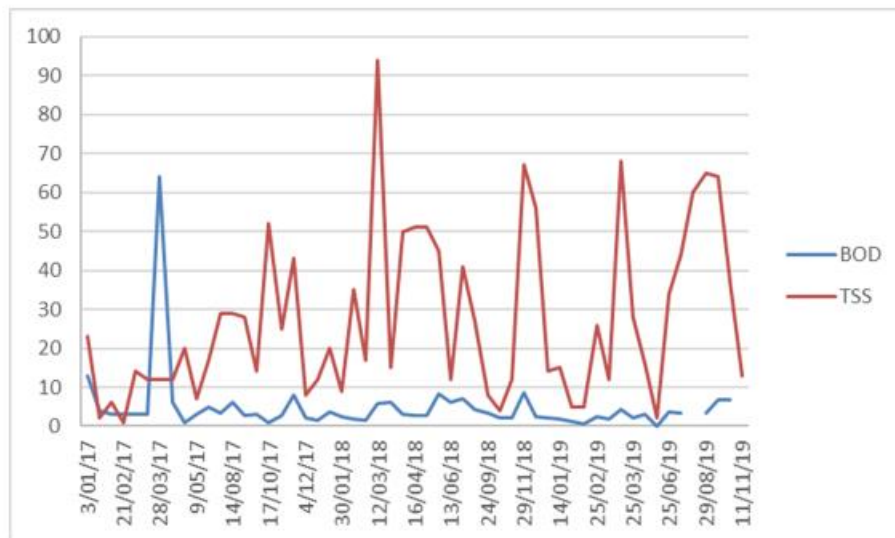


Consent

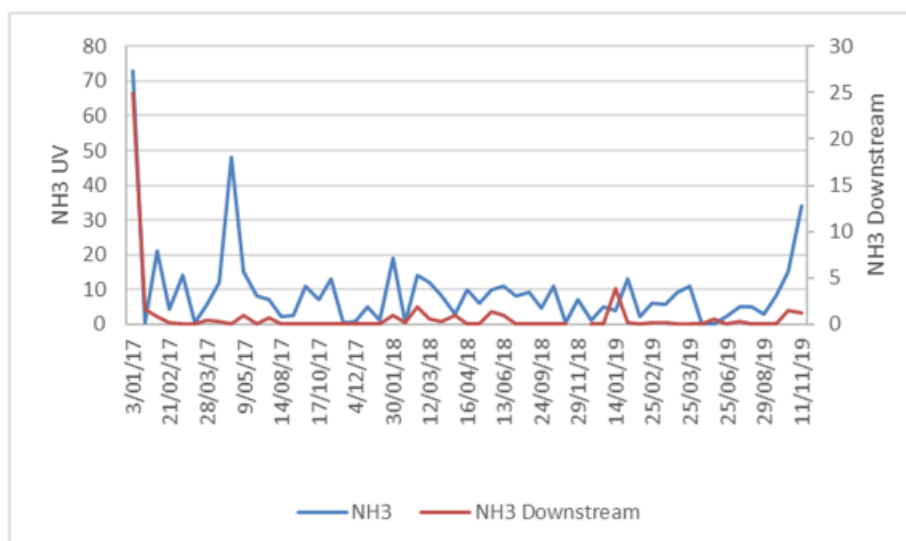
- Flow shall not exceed 250 m³/d as 30 day rolling Average
- < 130 E coli/ 100 ml – at Works effluent 95%ile
- < 50 E coli / 100 ml – at Works effluent Median
- Downstream “Shall not Exceed”
 - pH 6.5- 9.0
 - NH₃ 0.18 – 2.57 depending on pH
 - At pH 7.0 that's 2 mg/l NH₃.
 - DO decrease < 20%
 - Temperature no change > 3 C
 - Hue change < 10 Munsell Units/ Clarity 35%



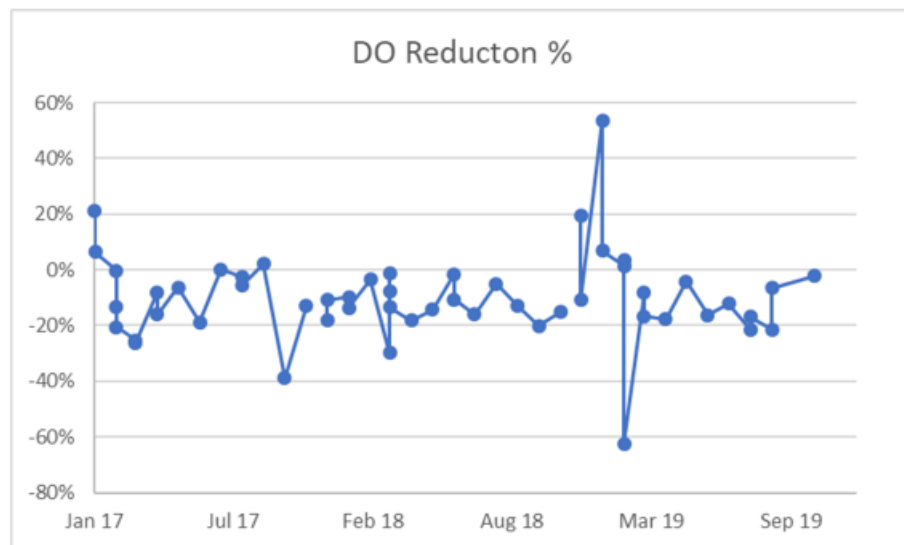
BOD and TSS – at UV



NH3 at UV and Downstream



DO impact – No more than 20% reduction



Plant Capacity

- Inlet Pump Station About 4 l/s - tbc
- Main Reactor 200 people
- Clarifier 2.5 l/s upflow.



Issues



Cleaning of storm Tanks

Issues -



Inlet Pump Station



Main Reactor

Manual Screen

Cracked Intermediate Wall

Outlet Pipe





Clarifier



Sand Filter Feed Pump



Sand Filter Pipes





Wetland



Overflow Pond



Plant Issues

- Inlet Works –evidence of overfill of PS
- Capacity of storm pump unknown
- Influent diverted when storm tank full – not flow through
- Cleaning of storm tanks
- Tank Structure
- Inefficient Aeration – insufficient for peak loads ?
- Wash out of undersized clarifier
- Bypass of Treatment- storm flows bypass secondary and filtration – Poor Disinfection- Low Transmissivity
- Wetlands – condition
- Wetlands – Sludge odours?



Plant Issues

- No site welfare
- Coarse Screen Manually raked
- FE tank has small operating band causing air locking of tertiary feed pump
- Tertiary pipework is welded so unable to maintain
- Air Locking of tertiary pumps
- Unable to remove sandfilter without building change
- Insufficient water for washdown
- Aged Scada

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