Technical Memo – ADDENDUM 1

MANGAWHAI WASTEWATER DISPOSAL OPTIONS STUDY

Additional Options (Revision 2 Final Draft)

Kaipara District Council

TO:	John Burt	**HG PROJECT NO :**	1012-135494-02
FROM:	Grant Pedersen / Angeli Paglinawan	**DATE:**	4 June 2015

1.0 INTRODUCTION

Harrison Grierson has carried out an independent review of the effluent disposal options for the communities of Mangawhai and Mangawhai Heads in 2014 (refer to HG Report *R001v3-AK135494-02-Eff dipsl opt-Report*, September 2014). The following is a summary of what has been completed in the 2014 report:

- Evaluated future population and wastewater flows to the design year 2044;
- Three land only disposal options by irrigation to Lincoln Downs Farm and other areas where necessary;
- Nine options for combined land and water disposal;
- Assessment of irrigation requirements at Lincoln Downs Farm based on MEDLI (Model of Effluent Disposal by Land Irrigation) effluent irrigation modelling;
- Preliminary Cost estimates for the 12 options; and
- Preliminary MCA (Multi-Criteria Analysis) and initial ranking of options.
- A preliminary list of favoured options for further investigation; Golf Course, Estuary discharge, Hakaru River (Options 9, 10, 11, 5 & 8).

Following review by the Council appointed Advisory Group and initial public consultation, Council has requested an Addendum to address variations to three selected options for further analysis and a more in-depth cost estimation. For the first options, irrigation to Lincoln Downs Farm would be discontinued, as part of Council's strategy:

1. Irrigation of effluent at the Golf course to the fairways, grass areas and bush areas adjacent to the fairways. Excess effluent would be disposed to the wetland. This will involve enhanced treatment of effluent during the winter months.
2. Disposal of effluent to the Estuary outfall near the boat ramp. This will involve enhanced treatment of effluent year round.
3. Disposal of effluent to the ocean outfall. The existing or similar effluent quality should be acceptable.

During a Workshop held on 11 May, the Advisory Group identified a further possible option:

4. Irrigation of effluent at Lincoln Downs Farm and at the Golf course to the fairways, grass areas and bush areas adjacent to the fairways. Excess effluent would be stored in the existing lagoon at Lincoln Downs Farm. The existing or similar effluent quality should be acceptable.

Projected numbers of dwellings were also revised by Council and new information provided 13 May 2015. The new projections are marginally different, with 3575 connected properties at 2044/45 compared with previous projection of 3460 properties in 2044. This difference is 3%, and a revision of flows and loads is not warranted at this stage. Using the new property projections, a total of 3460 properties would be connected by around 2043. The revised projections should be carried forward into later work.

The following items are excluded from this addendum:

- Ecological study
- Field survey
- Process modelling
- Hydrographic or marine surveys (Marine Chart NZ5219 will be used)

2.0 TREATMENT PLANT UPGRADING

For this assessment, both the predicted future flows and the proposed effluent quality considered applicable to the receiving environment for each option is taken into account. Accordingly, a different WWTP upgrade scenario and cost estimate is applicable to each discharge option.

- For the Estuary discharge, a very high quality with enhanced nutrient reduction would be considered necessary should this option be selected.
- For Golf Course disposal, the existing high quality effluent is considered applicable for irrigation to the golf course and a very high quality with enhanced nutrient reduction is considered necessary when most of the flow is being disposed of to the wetland.
- For the Ocean outfall discharge, a medium quality effluent is considered to be acceptable. Nutrient reduction may not be necessary, but a high level of disinfection will be required.
- For the Golf Course plus Lincoln Downs Farm disposal, the existing high effluent quality is acceptable for irrigation to the Golf Course and Lincoln Downs Farm.

The assumed effluent quality for reach option is summarised below.

TABLE 1: APPLICABLE EFFLUENT QUALITY

PARAMETER	UNIT	ESTUARY DISCHARGE OPTION	GOLF COURSE OPTION			OCEAN OUTFALL OPTIONS
			GOLF COURSE IRRIGATION	TO WETLAND	IRRIGATION GOLF COURSE AND LINCOLN DOWNS	
Effluent description		Enhanced nutrient removal	Nutrient removal	Enhanced nutrient removal	Nutrient removal	Secondary disinfected
BOD_5 average	mg/L	10	15	10	15	15
Amm-N average	mg/L	1	<5	1	<5	<5
TN average	mg/L	7	20	7	20	30
TP average	mg/L	2	10	2	10	12
E-coli median	MPN/100 ml	10	10	10	10	14

Note: All values are averages

The plant would be expanded and upgraded to meet or exceed the quality requirements above. In most cases, the actual average effluent quality achieved would be better than the values stated above, to ensure consent compliance is achieved.

For all options, the treatment plant will need upgrading to cater for future flows and loads. The cost for this upgrading is common to all options, and is therefore excluded from this assessment.

For the current flows and loads, it was found that the existing Mangawhai WWTP offers sufficient capacity however it is not designed for enhanced nutrient removal, as required for the Estuary discharge.

The plant would therefore require upgrading to meet the required quality for the wetland and estuary discharge options, and the same upgrading is applicable for both options. For the ocean outfall option, only an increase in the overall capacity would be required, as the dilution available for the ocean discharge would not require such a high effluent quality. For disposal to Lincoln Downs Farm and the Golf Course (no wetland disposal) the existing effluent quality is also acceptable.

A separate addendum to the report has been prepared by Harrison Grierson for the capacity assessment and upgrade costs of the WWTP – **Addendum 2** (refer to *M002v2-AK135494-02-WWTP Technical Memo*).

3.0 GOLF COURSE AND WETLAND OPTION

The golf course and wetland option is based on no irrigation to the Lincoln Downs Farm and discharging all effluent to the golf course by irrigation or wetland disposal. Effluent will be preferentially irrigated to the golf course fairways, general grass areas and some bush areas on the golf course. The tees and greens will continue to be irrigated with bore water as at present, and will not be irrigated with effluent. Effluent in excess of irrigation requirements will be disposed of to a constructed wetland.

During the winter period, the demand for irrigation will be less, and the excess effluent will be disposed of to a constructed wetland. This is summarised below:

SUMMER	WINTER
Most effluent to irrigation	Less effluent to irrigation
Less effluent to Wetland	Most effluent to Wetland
High Effluent Quality	Very High Effluent Quality
No enhanced nutrient removal	Enhanced nutrient removal

This option will include dripline irrigation to bush and grass areas around the edges of the fairways, dripline irrigation to the fairways and disposal of effluent to a constructed wetland at the golf course. Irrigation will be controlled to ensure that over-irrigation of the areas will not occur, as this could adversely affect the quality of the golf course playing surface.

The Golf Course has a total area of 55ha. Of this, 4.5ha are greens and tees, the wetland areas occupy around 2 ha, and the bore catchment is 6ha. This leaves 42.5ha, of which some areas are thick bush, boundaries, paths, built up areas (clubhouse, etc.). It is assumed 50% of the bush area may be able to be irrigated. In addition, there are open drains, paths, and odd-shaped areas not easily accessible. Subject to a detailed assessment of irrigation areas, pipeline routes and buffers zones, a conservative estimate of 30ha of net area available for irrigation is assumed.

MEDLI Modelling

The irrigation capacity of the net 30 ha of irrigable area at the golf course is detailed in the BMT WBM Letter Report dated 3 June 2015 (**Addendum 3**).

BMT WBM have modelled irrigation to satisfy plant water demand based on available information, climate records at the nearest site (Leigh) that had sufficient data to input into the MEDLI model (daily rainfall, pan evaporation, maximum temperature, minimum temperature, solar radiation).

While more intensive irrigation may be possible for some of the free-draining soils at the golf course, further soil testing, groundwater monitoring and hydrogeological modelling would be required to verify this.

3.1 MANGAWHAI WASTEWATER TREATMENT PLANT (WWTP) UPGRADE

The Mangawhai WWTP will need to be upgraded to achieve higher effluent quality for the Golf Course option. The upgrade will produce a very high quality effluent with enhanced nutrient removal for disposal to the wetland. This is achieved by dosing chemical (sugar to provide carbon for denitrification and alum to precipitate dissolved phosphorus).

The plant will be able to be operated with a lesser degree of nutrient removal (by turning off the chemical dosing) when most of the effluent is irrigated to the golf course land, so that nutrients are available for grass growth. This is necessary to provide nutrients and reduce the need for artificial fertiliser application (except for the tees and greens which are irrigated separately).

The treatment plant upgrade for the Golf Course option is detailed in **Addendum 2**, enhanced nutrient removal.

3.2 SUBSURFACE DRIP IRRIGATION

Effluent will be irrigated by subsurface drip irrigation to introduce the effluent 250-300mm below the surface. This virtually eliminates the risk of public contact with the effluent, which is important for a public golf course.

The emitters in Pressure Compensating Dripline have minute plastic valves that modulate to emit a constant flow with varying internal pressure within a working pressure range is 50 – 400kPa. Emitters are available at Dripper spacings of 0.3m, 0.45m and 0.6m, and a range of dripper flow rates from 1.5 to 3.4 L/h capacity.

Grass roots will grow deeper to seek the moisture from the dripline. Root intrusion is prevented by various physical and chemical barriers, including chemical impregnated into the material, or dosed into the line.

Irrigation Areas

Fairways need to be irrigated with dripline spaced closer together (0.5 to 0.6m) to avoid developing a 'striped' growth pattern.

In the grass areas outside of the fairways, the dripline spacing may be increased. To compensate, dripline with a closer emitter spacing and/or higher flowrate may be used to maintain the same irrigation rate.

In the bush areas, dripline may be laid at a shallower depth (if root growth makes burial difficult), or even on the surface. If laid on the surface, the public should be excluded from the area, to avoid damage to the driplines.

The Golf Course report an area of 40ha may be available for irrigation, after excluding the tees & greens, wetland and the bore area. In practice, however, the cost and difficulty of laying irrigation line to every part of the remaining area, and the likely need for buffer zones will result in a lower proportion of the land being available for irrigation. A conservative estimate of 30ha of irrigation area is assumed. A more detailed intensive site assessment may identify slightly more land for irrigation, which would allow more disposal.

The installation of driplines is costly, and this cost can be staged in proportion to effluent flow to improve cashflow.

TABLE 2: PRELIMINARY IRRIGATION AREAS

IRRIGATION AREAS	STAGE 1 AREA	STAGE 2 AREA	STAGE 3 AREA	TOTAL AREA
Fairways	6.9	3.5	0	10.4
Grass, Edge of fairways	9.6	0	6.6	16.2
Bush	1.0	0	2.4	3.4
Total	**17.5**	**3.5**	**9.0**	**30ha**

The current MEDLI model shows that plant water demand over 30ha does not have the capacity to irrigate all of the design flow even in summer (mainly due to the peak holiday loading) and certainly not in winter under ultimate flow conditions. At a later stage, a more detailed evaluation of soil conditions and groundwater mounding should be carried out to determine the risk of water breakout on the surface, which would be considered to be unacceptable for a golf course.

It is considered that the modelled volumetric irrigation capacities would be close (within 10%) of those applicable. It can be seen that there are several months per year where design flows could not be managed by irrigation in addition to a minor wetland discharge.

Further points to note:

1. Summer and winter effluent nutrient concentrations are well within plant nutrient demands. As a result crop uptake may not be optimised. Importantly, the greenkeepers would be looking to apply fertiliser to the fairways etc. beyond these effluent nutrient loads to maintain health grass cover.
2. Whilst summer nutrient concentrations could be lifted, there will be a limit based on potential for nutrient leaching whilst looking to maximise irrigation depths. There will still be a need for a high quality for the discharge of excess effluent to the wetland, particularly at the ultimate design (2044) flow.

3.3 CONSTRUCTED WETLAND

A wetland will be constructed in the golf course just north of the existing natural wetland. Excess effluent will be discharged to the wetland mainly during winter period.

An elongated surface flow constructed wetland is proposed for disposal of the remaining effluent that cannot be irrigated on the golf course fairways and grass area. The constructed wetland will discharge to a natural wetland that also receives surface drainage flow from the body of the golf course catchment. The wetlands are located in a low spot in the western side of the golf course.

The constructed wetland would be approximately 1ha overall area, and have a loading rate of 1.2 to 8.4cm/day, with an average of 5cm/day. There is not sufficient area within the Golf Course to adopt a lower loading rate for the effluent volume required.

Addendum 3, Section 1.3 considers wetland performance. The examples used relate to very low hydraulic loading rate of 0.14cm/day.

The treated effluent emerging from the constructed wetland will mix with the natural surface water flow in the natural wetland.

The fate of effluent discharging from the constructed wetland will be part soakage into groundwater, and part discharge to the estuary (particularly during winter), via an open drain channel that discharges to the north-west, upstream of the Molesworth Drive Bridge.

The wetland will do little to further polish the WWTP effluent, which is already very clean with low nutrient and bacterial levels. Bacterial levels will increase through the wetland, due to the flora and fauna in the wetland and most of this bacteria will therefore be of non-human origin. The natural background level of nutrient from wetlands is typically of the same order as the already low levels in the treatment plant effluent, and therefore should remain relatively unchanged or may increase slightly, due to plant and animal activity.

Due to irrigation capacity being highest in the summer and least in the winter, the flow to the wetlands will be low in the summer, and high in the winter, peaking in July. As this is also the wettest time of the year, proportionally more of the effluent discharged will end up being transported to the estuary than to ground. Although this study does not attempt to assess environmental effects, it is most likely that a high quality effluent, low in nutrients and human bacteria would be required.

Therefore, this is the primary reason why higher nutrient reduction is targeted for the winter months than summer, to reduce the overall nutrient load on the wetland.

TABLE 3: PRELIMINARY IRRIGATION AND WETLAND LOADINGS

MONTH	IRRIGATION	WETLAND	IRRIGATION RATE AVERAGE	EFFLUENT TOTAL NITROGEN	TN TO IRRIGATION	TN TO WETLAND
	m^3/d average	m^3/d average	mm/d	mg/L	kg/d	kg/d
Jan	615	490	2.0	14	8.6	6.9
Feb	448	97	1.5	14	6.3	1.4
Mar	355	151	1.2	14	5.0	2.1
Apr	257	303	0.9	6	1.5	1.8
May	144	389	0.5	6	0.9	2.3
Jun	58	582	0.2	6	0.3	3.5
Jul	45	647	0.1	6	0.3	3.9
Aug	57	673	0.2	6	0.3	4.0
Sep	137	542	0.5	6	0.8	3.3
Oct	256	443	0.9	14	3.6	6.2
Nov	341	208	1.1	14	4.8	2.9
Dec	498	246	1.7	14	7.0	3.4
Annual Totals	**98 ML/yr**	**144 ML/yr**	**328mm/yr**		**1210 kg/yr**	**1200 kg/yr**
Rate	3.3 ML/ha/yr	4.9cm/day			40kg/ha/yr	

For a typical average year, normal 2044 effluent flow, average weather conditions

The table above shows that average nutrient load on the irrigation and wetland systems at the design horizon (2044) based on likely nitrogen concentrations (lower than limit).

As mentioned by BMT WBM in Addendum 3, nutrient levels could be increased in summer for irrigation to meet crop demand. However, the effluent flow is very high in January, and therefore, quite a high flow is also discharged to the wetland then.

If nutrient removal was further relaxed to a TN of 20mg/L during summer, this would increase the nitrogen loading on the irrigation areas to 1600kg/yr and on the wetland to 1490kg/yr. In view of the high loading in January, this strategy is not favourable.

It should also be noted that relaxation of effluent quality requirements does not increase the WWTP capacity significantly (i.e. by more than 5%). Plant processes are governed by factors including hydraulic capacity, BOD removal, solids removal, aeration capacity and disinfection capacity.

The volume of effluent to irrigation and to the wetland (overflow) by month is shown in Figure 1 below. The volume shown as 'Overflow; indicates effluent unable to be irrigated, and therefore 'overflowing' to the wetland.

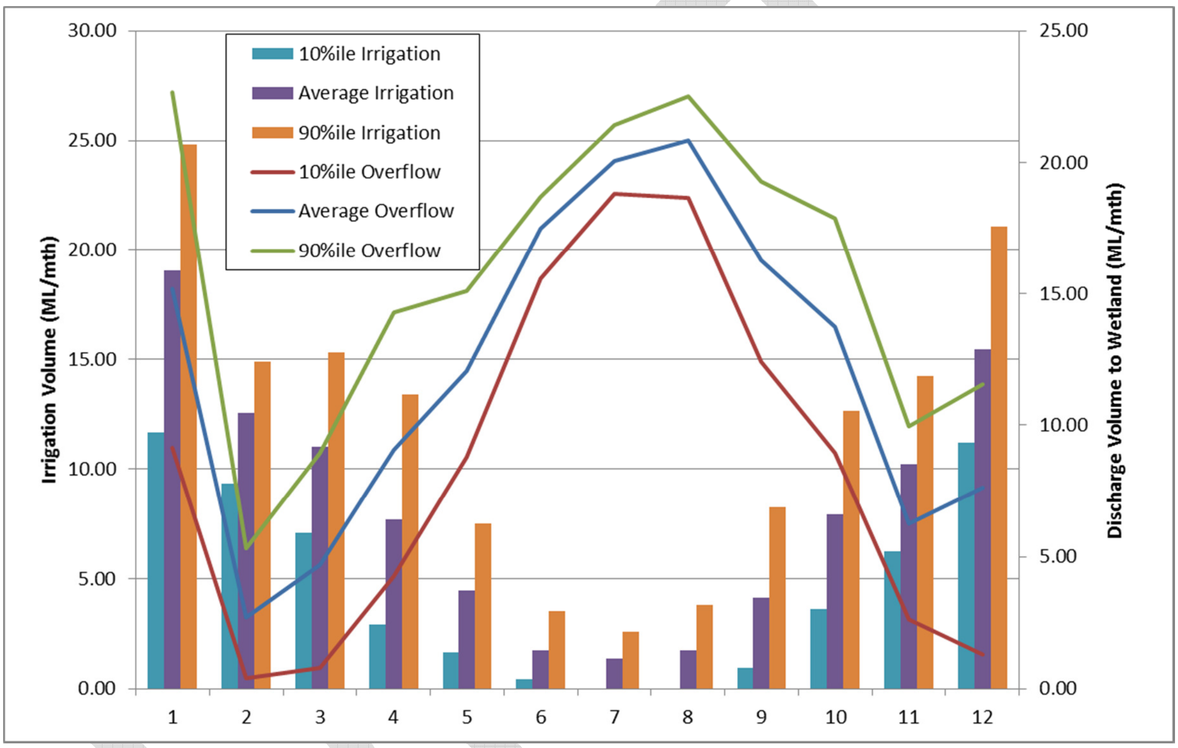

Figure 1: Irrigation and Wetland Discharge *(Source BMT WBM)* (Note that 90%ile irrigation (dry years) corresponds to 10% overflow)

It can be seen that, on average, flow to the wetland will peak in July when all climatic factors are adverse to irrigation. In individual years, this may vary according to climate conditions.

3.4 PIPELINES

A 250mm diameter pipeline would be constructed to convey effluent from the WWTP to the irrigation area and wetland.

At the golf course, the pipeline would divide into two branches, one to the irrigation main network, and the other to the wetland. Automated valves would control flow, and a flowmeter would be required on each line, to accurately measure the flow irrigated and the flow to the wetland for operational and reporting requirements.

Further automated valves would lead to each irrigation area. The golf course would be divided into 8 to 10 irrigation blocks of relatively similar size, with each block receiving flow for a set time period. The flow would be measured, enabling the flow and irrigation volume to each block to be recorded, ensuring even areal distribution of effluent.

As the irrigation is subsurface, irrigation could occur at any time of the day or night. Flow to the wetland could also occur at any time, and is best distributed evenly to avoid shock loading on the wetland.

The existing pumps at the WWTP have adequate capacity to convey the flows, but may require minor modification (impeller change and valves).

3.5 COST ESTIMATE

All estimates are subject to the same conditions as per the report:

- GST is excluded.
- Consenting and consultation are not included.
- Estimates are subject to more detailed engineering analysis being carried out in subsequent stages.
- Costs relating to the WWTP upgrade solely to increase capacity are not included.
- Estimates are in current costs (2015).

TABLE 4: PRELIMINARY COST ESTIMATE – GOLF COURSE OPTION

ITEM	STAGE 1	STAGE 2	STAGE 3	TOTAL
Preliminary and General	$ 747 800	$ 172 400	$ 119 800	$ 1 040 000
New Irrigation Areas	$ 1 420 000	$ 280 000	$ 768 000	$ 2 468 000
Pipelines	$ 220 100	$ 49 300	$ 30 600	$ 300 000
Storage Tank	$ 614 000	$ 40 000	$ 0	$ 654 000
Enhanced Nutrient Removal WWTP Upgrade	$ 1 701 000	$ 0	$ 0	$ 1 701 000
Modify Existing Pump Station	$ 250 000	$ 0	$ 0	$ 250 000
Wetland	$ 780 000	$ 780 000	$ 0	$ 1 560 000
Contingency (30%)	$ 1 719 900	$ 396 500	$ 275 500	$ 2 391 900
Engineering (12%)	$ 894 300	$ 206 200	$ 143 300	$ 1 243 800
Total	**$ 8 347 000**	**$ 1 924 000**	**$ 1 337 000**	**$ 11 608 000**

4.0 ESTUARY DISPOSAL OPTION

A new effluent pipeline would be constructed from the Mangawhai Wastewater Treatment Plant (WWTP) to the foreshore near the boat ramp either at the end of Alamar Crescent or North Avenue. There are two boat ramps located at the end of these roads. The deepest part of the channel is approximately 150 m from shore at both these locations. The proposal would be to install a short, buried polyethylene pipe outfall with a short in-channel diffuser located in the deep central part of the channel.

As this is a highly valued recreational area, the wastewater treatment plant would be upgraded to produce a very high quality effluent, with very low BOD, solids, nutrients and bacteria as detailed in Addendum 2. This is achieved by dosing chemical (sugar to provide carbon for denitrification and alum to precipitate dissolved phosphorus).

A high level of bacterial disinfection will also be required, as well as filtration. An upgrade to a membrane bioreactor is more cost effective in the long run, as it will produce a very high quality effluent and the works will mainly fit within the existing two SBR tanks at the WWTP.

The assessed effluent quality would need to be verified by a consent application and AEE process.

Tidal Discharge

To minimise effects, the proposal would involve discharging effluent for a limited period just after the turn of the high tide, so that the outgoing tidal current (which is relatively fast) will carry as much of the effluent out to sea as practical. The discharge would stop well prior to low tide, to reduce the amount of effluent remaining in the harbour.

Thus, the proposed discharge would occur 30 to 60 minutes after high tide, and continue for a maximum of 4 hours. To achieve discharge of peak future flows without excessive storage, a flow of approximately 135L/s would be required. Storage of effluent for up to 8.5 hours would be required between discharge events, which will require approximately 2ML additional at the design horizon. Storage would most economically be provided at the initial construction, as it is more expensive to build several smaller storage tanks.

For treated effluent storage, an above ground thank similar to the existing tank would be built.

4.1 PIPELINES

A 350mm diameter pipeline would be constructed to convey effluent from the WWTP to the ridge line on Molesworth Drive. From the ridge line a 300mm diameter pipeline would descend to the boat ramp and into the estuary, terminating in the channel. A short diffuser would be installed on the end of the pipeline to promote mixing. There are two options shown, the purple option would be favoured, being closer to the harbour mouth.

Figure 2: Potential Estuary Disposal routes

The existing pumps at the WWTP would need to be replaced with higher capacity, lower head pumps.

4.2 MANGAWHAI WASTEWATER TREATMENT PLANT (WWTP) UPGRADE

The WWTP will be upgraded to provide increased capacity and a higher quality effluent, as described in Addendum 2.

4.3 COST ESTIMATE

All estimates are subject to the same conditions as per the report:

- GST is excluded.
- Consenting and consultation are not included.

- Estimates are subject to more detailed engineering analysis being carried out in subsequent stages.
- Costs relating to the WWTP upgrade solely to increase capacity are not included.
- Estimates are in current costs (2015).

TABLE 5: PRELIMINARY COST ESTIMATE – ESTUARY OPTION

ITEM	STAGE 1	STAGE 2	STAGE 3	TOTAL
Preliminary and General	$ 647 000	$ 6 000	$ 0	$ 631 200
New Irrigation Areas	$ 0	$ 0	$ 0	$ 0
Pipelines	$ 1 437 800	$ 0	$ 0	$ 1 437 800
Storage Tank	$ 764 000	$ 40 000	$ 0	$ 804 000
Enhanced Nutrient Removal WWTP Upgrade	$ 1 701 000	$ 0	$ 0	$ 1 701 000
Pump Upgrade	$ 415 000	$ 0	$ 0	$ 415 000
Contingency (30%)	$ 1 490 000	$ 13 800	$ 0	$ 1 504 000
Engineering (12%)	$ 775 000	$ 7 200	$ 0	$ 782 000
Total	**7 230 000**	**$ 67 000**	**$ 0**	**$ 7 297 000**

5.0 OCEAN OUTFALL OPTION

This section describes the assumptions and methodology for the construction of an ocean outfall to serve the community of Mangawhai, based on a desk-top study.

The ocean outfall option involves discharging of treated effluent from the WWTP to the ocean approximately 1.6km beyond the shoreline to water 15 to 20m depth. Tidal effects may not need to be considered for this option. Conceptually, this option could consist of a low, continuous discharge year-round.

To improve the accuracy of the estimate, discussions were held with McConnell Dowell, a major contracting firm with extensive experience in construction of ocean outfalls in New Zealand and abroad.

After consideration of several possible outfall launching sites, the preferred option selected by the contractor was to lay the outfall in the central channel of the estuary, out through the entrance, and to approximately 1.6km offshore. The reasons for this selection are:

a) The need to develop a feasible construction methodology, having consideration to tide, ocean, storm and environmental factors. The pipe in the channel will be weighted to sink into the sand and therefore be protected from the effects of storms. Drilling through the ocean sand bar is risky, and the area is a sensitive environmental area. The area is also subject to storm disturbance, as occurred at Mangawhai from 1986 to 1990.

b) A significant part of ocean outfall costing involves an appropriate allowance for the many risks associated with ocean outfall construction. These include, unforeseen ground (sub-sea) conditions, inclement weather events, effects of ocean and tidal currents, equipment and material failure and unforeseen problems with the construction methodology.

It is considered that the above methodology provides a robust estimate for an ocean outfall cost without needing to advance the design to the tendering stage.

5.1 PIPELINE FROM MANGAWHAI WWTP TO OCEAN OUTFALL

For this option, a new pipeline from the WWTP will be installed through the Mangawhai Reserve, along Molesworth Drive. There are a number of potential routes that could be taken from Molesworth Drive to the Estuary.

From there, the pipeline would be installed in the centre channel of the estuary, out through the harbour mouth and approximately 1.5km to sea. This route is selected as it is likely to be a lower cost than the alternative land route, which would require trenching a further 3-4km through streets.

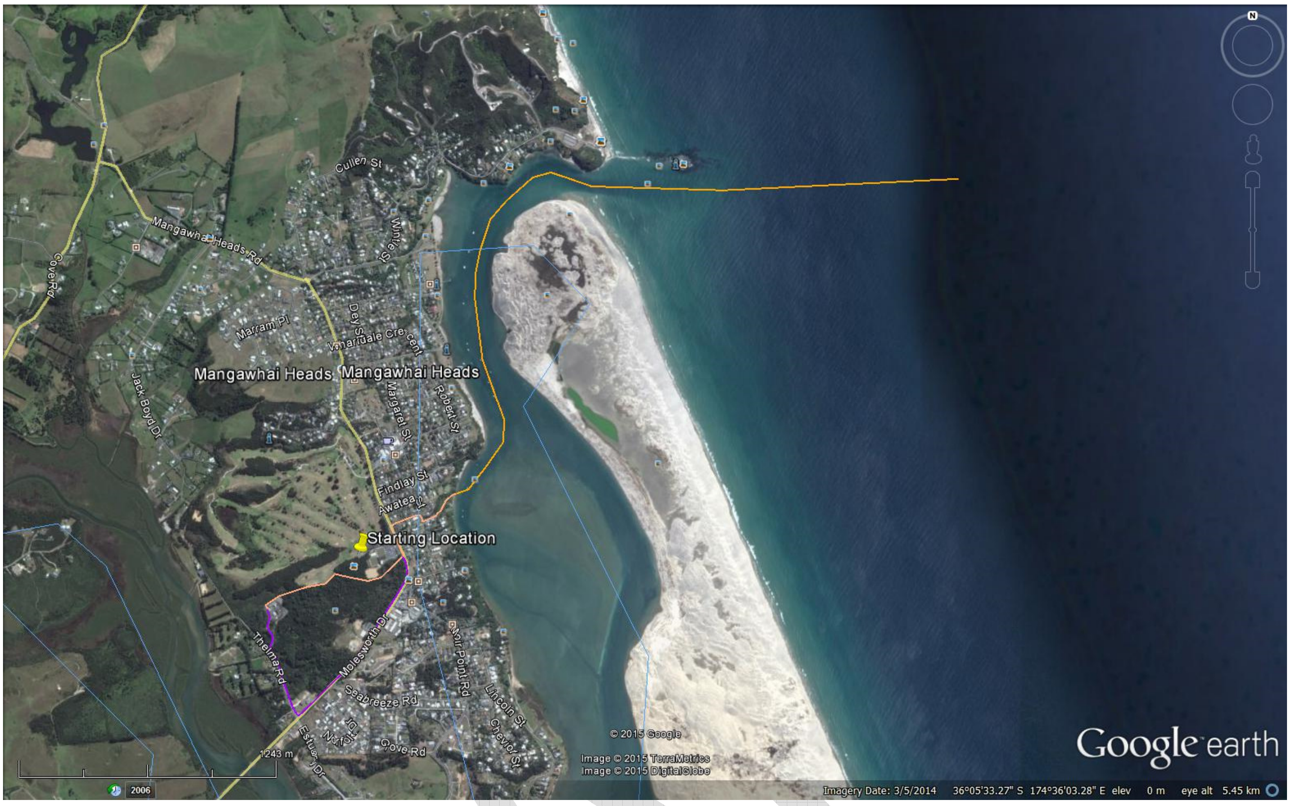

Figure 3: Potential Ocean Outfall Route

The pipeline would be able to discharge continuously, as the discharge would be beyond the influence of tidal flow back into the harbour. A flow of 25 to 30L/s would provide capacity for peak flows in 2044. Additional pumping would enable a flow of 35L/s to be discharged, which would provide some “future proofing” to allow flows beyond the Design Horizon to be discharged. This is an important consideration, as unlike other options, a small increase in capacity cannot be achieved with the additional of a little extra land.

5.2 MANGAWHAI WASTEWATER TREATMENT PLANT (WWTP) UPGRADE

The WWTP will be upgraded to provide increased capacity, however, an increase in effluent quality would not be required. In addition, filtration of the effluent may no longer be required for an ocean discharge, and the degree of nutrient removal may also be able to be reduced. Thus, the existing SBR treatment process would be acceptable without further filtration. Disinfection of the effluent would still be required, as the area is extensively used by recreational boat owners and fishermen.

5.3 COST ESTIMATE

All estimates are subject to the same conditions as per the report:

- GST is excluded.
- Consenting and consultation are not included.
- Estimates are subject to more detailed engineering analysis being carried out in subsequent stages.
- Costs relating to the WWTP upgrade solely to increase capacity are not included.
- Estimates are in current costs (2015).

TABLE 6: PRELIMINARY COST ESTIMATE – OCEAN OUTFALL OPTION				
ITEM	**STAGE 1**	**STAGE 2**	**STAGE 3**	**TOTAL**
Preliminary and General	$ 650 800	$ 6 000	$ 97 500	$ 754 300
Pipelines and outfall	$ 4 338 900	$ 0	$ 0	$ 4 338 900
Storage Tank	$ 0	$ 40 000	$ 450 000	$ 490 000
Upgrade WWTP	$ 0	$ 0	$ 0	$ 0
Pump Upgrade	$ 0	$ 0	$ 200 000	$ 200 000
Contingency (30%)	$ 1 496 900	$ 13 800	$ 224 300	$ 1 735 000
Engineering (12%)	$ 778 400	$ 7 200	$ 116 600	$ 902 200
Total	**$ 7 265 000**	**$ 67 000**	**$ 1 088 000**	**$ 8 420 000**

6.0 GOLF COURSE PLUS LINCOLN DOWNS FARM OPTION

This option is **NOT** evaluated in as much depth as the other options, as it has only been progressed recently. This brief summary is conceptual only, and is provided to show the potential approximate impacts and cost of this option.

This option is similar to the Golf Course only option:

- Irrigation at the Golf Course is as per the Golf Course Option
- Irrigation at Lincoln Downs Farm is retained, and expanded
- Excess effluent is stored in the existing 170ML lagoon at Lincoln Down Farm during the winter, or when irrigation capacity is insufficient
- No effluent is disposed of to the wetland

Effluent will be preferentially irrigated to the golf course.

The tees and greens will continue to be irrigated with bore water as at present.

All remaining effluent will be pumped to Lincoln Downs Farm and stored in the lagoon as at present.

Effluent is irrigated from the lagoon to the farm when climatic conditions permit. No effluent in the lagoon can pass back to the golf course.

MEDLI Modelling

MEDLI Modelling for this option will not be carried out at present. Further detailed soils investigation and groundwater monitoring and at both the Golf Course and Lincoln Downs Farm is required.

Based on the work done to date, approximately 100ML of effluent can be irrigated to the Golf Course in an average year, leaving 140ML to be irrigated at Lincoln Downs Farm.

At deficit irrigation rates, this would require the full 60ha of available irrigation area of Lincoln Downs Farm for irrigation, plus additional area. It is likely that additional irrigation could be carried out at the Golf Course, subject to further soils and groundwater testing and more in-depth analysis.

The accuracy of this estimate is therefore lower, and dependent on further work and modelling analysis. A contingency of 40% is therefore used.

6.1 MANGAWHAI WASTEWATER TREATMENT PLANT (WWTP) UPGRADE

The Mangawhai WWTP will not need to be upgraded to achieve higher effluent quality for the Golf Course plus Lincoln Downs Farm option.

6.2 PIPELINES

The pipe lines required would be similar to the Golf Course option. A pipeline to the Wetland may not be required.

The existing pumps at the WWTP should have adequate capacity to convey the flows to both the Golf Course and Lincoln Downs Farm, but may require minor modification (impeller change) and additional control valves.

6.3 COST ESTIMATE

A cost estimate for this option has NOT been carried out. All estimates are subject to the same conditions as per the report:

- GST is excluded.
- Consenting and consultation are not included.
- Estimates are subject to more detailed engineering analysis being carried out in subsequent stages.
- Costs relating to the WWTP upgrade solely to increase capacity are not included.
- Estimates are in current costs (2015).

TABLE 7: PRELIMINARY *INDICATIVE* COST ESTIMATE – GOLF COURSE OPTION + LINCOLN DOWNS FARM

ITEM	STAGE 1	STAGE 2	STAGE 3	TOTAL
Preliminary and General	$ 291 800	$ 108 500	$ 167 300	$ 567 600
New Irrigation Areas	$ 1 420 000	$ 280 000	$ 768 000	$ 2 468 000
Pipelines	$ 137 000	$ 49 300	$ 30 600	$ 217 000
Storage Tank	$ 14 000	$ 40 000	$ 0	$ 54 000
Upgrade WWTP	$ 0	$ 0	$ 0	$ 0
New Irrigation at Lincoln Downs Farm	$ 374 000	$ 354 000	$ 317 000	$ 1 045 000
Wetland	$ 0	$ 0	$ 0	$ 0
Contingency (40%)	$ 895 000	$ 332 000	$ 513 000	$ 1 740 000
Engineering (12%)	$ 376 000	$ 140 000	$ 215 000	$ 731 000
Total	**$ 3 508 000**	**$ 1 304 000**	**$ 2 012 000**	**$ 6 824 000**

7.0 SUMMARY

TABLE 8: COMPARISON OF ADDITIONAL OPTIONS

OPTION	PROS	CONS
Farm Irrigation (Status Quo)	Already established and consented No need to upgrade the effluent quality Staged development possible	Insufficient land area available for future needs. Operation not profitable Cannot sell farm
Golf Course + Wetland	Close to WWTP Golf Course want the water and nutrients Wetland may be able to take excess flows Staged development possible Could sell farm	Enhanced nutrient removal at the plant is required for wetland disposal High cost
Estuary	Relatively inexpensive Could sell farm	Very high quality effluent is required. Enhanced nutrient removal at the plant is required. Staging is not possible.
Ocean Outfall	No need to upgrade the effluent quality Could sell farm	High Cost Staging is not possible.

TABLE 8: COMPARISON OF ADDITIONAL OPTIONS		
OPTION	**PROS**	**CONS**
Farm Irrigation plus Golf Course	No need to upgrade the effluent quality Staged development possible Makes use of existing asset	Cannot sell farm

8.0 LIMITATIONS

The future population, flow and loads is based on the demographic profile of Mangawhai, where many properties are occupied on a seasonal basis. In addition, high occupancy occurs during holiday periods, particularly between Christmas and New Year, and extending during January. Should this population profile change in the future, flow and load figures may need to be re-assessed.

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