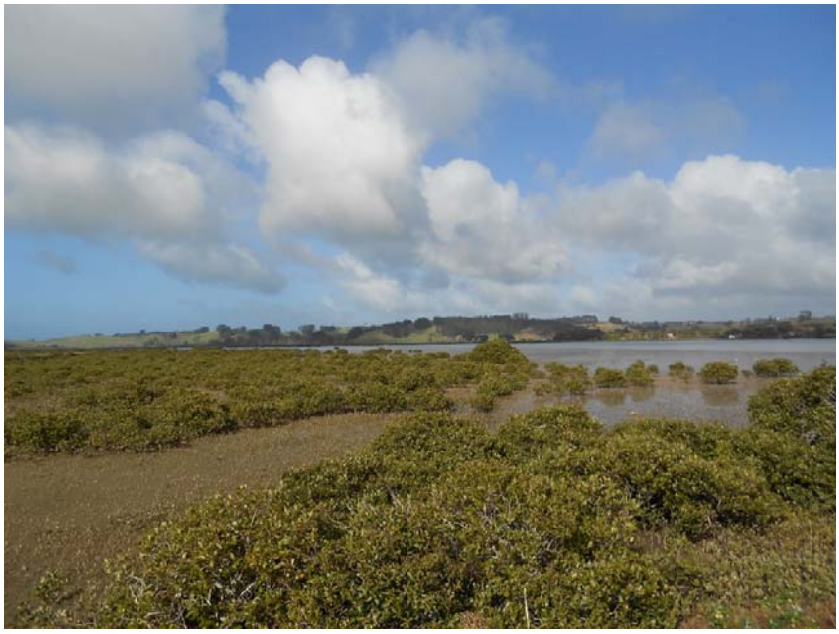
Aquatic Environmental Sciences

Input to Project Investigation Plan for the discharge of wastewater from the Omaha Wastewater Treatment Plant



Prepared for Watercare Services Ltd

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1. Background

Watercare Services Ltd (Watercare) have started the process of preparing an Assessment of Environmental Effects (AEE) for renewal of their consent for operation of the Omaha Wastewater Treatment plant. The existing consent expires in May 2015, a replacement application has been lodged and Watercare are now in the process of preparing a full AEE for submission in 2015.

A number of reports have been prepared on the monitoring programmes for the existing Omaha plant and the receiving environment (groundwater and the Whangateau Harbour). The quality of these reports and the work carried out varies and in some cases is dated, not reliable enough or sufficient to support a resource consent application. Watercare wants to ensure that the information presented in the Omaha AEE is robust and fit for purpose.

A review of existing information has been completed for Watercare by AES and a Consultative Group has been set up to provide input and participate in discussions on the effects of the WWTP on the Harbour, and to assist with the development of the AEE and resource consent application.

This document provides input to a draft Project Investigation Plan for discussion at the next Consultative Group meeting and includes:

- An overview of the process for developing a robust AEE
- A short commentary on what information is available on the ecology of the receiving environments
- Identification of gaps in our knowledge that are important in understanding the potential effects of the discharge and wider context (noting the CG input and others) for each component
- Identification of what work needs to be done to fill critical gaps in knowledge
- Identification of potential significant effects that will need to be addressed

The focus of this document is on ecological aspects of the environment that may be impacted by the discharge from the Omaha Wastewater Treatment Plant but with consideration of the wider environment, where required, for context.

The issues raised by the Consultative Group are documented in Appendix 1. Issues related to ecology are considered in this document and some further issues will be dealt with when considering mitigation and consent conditions.

2. Steps in process

Ecological aspects of an AEE must include a description of the existing environment and effects of the activity on that environment taking into account requirements under the RMA, national standards (where they exist) and regional plans. In the case of the discharge from the Omaha Wastewater Treatment Plant (WWTP) there is also a need to describe the effects of the existing discharge and potential future changes.

The main aim of this plan is to identify gaps and investigations that need to be carried out to provide a robust assessment of effects for Watercare's resource consent application and hearing. Where appropriate a staged approach with decision points is included in this report. The timeframes are dependent on at least the first stage of the workstreams being commissioned by mid-November and confirmation from the science providers.

3. Omaha WWTP receiving environment – Potential gaps in knowledge and work required

The Whangateau Harbour is highly regarded regionally, and in some cases nationally, as one of the highest quality estuaries. The estuary contains valued Kahikatea Forest/wetland, mudflats, mangrove forests, tidal channels, intertidal and subtidal habitats for wading and migrating birds. The Harbour is also highly valued regionally for shellfish gathering and as a fish nursery for the wider Hauraki Gulf.

Kelly (2009) provides a general description of the physical characteristics of the Harbour including its history, land development and classification. Diffuse Sources (2008) provides a more focused assessment of the areas potentially impacted by discharge onto land from the Omaha Wastewater Treatment Plant. The Whangateau Harbourcare website provides a good background to the Harbour environment and summarises their concerns for the future of the Harbour.

Detailed descriptions of the aquatic ecology of the Harbour are also provided in Kelly (2009). Information provided by Kelly (2009) has been reviewed and is taken into consideration in the identification of gaps in knowledge of the receiving environment. A number of PhD or Masters studies on the Whangateau Harbour have been carried out by students from the University of Auckland at the nearby Leigh Marine Laboratory. However many of these were carried out at least 5-10 years ago and may now be outdated or relate to parts of the Harbour unlikely to be impacted by Watercare's discharges. A number of observations on various ecological aspects have been reported by the Whangateau Harbourcare Group.

There is sufficient information available on some aspects to describe the existing environment and on which to base an assessment of effects. In some cases this can be covered by a review of existing information or obtaining data specific to the sites of interest from authors and the AC who commissioned much of the state of the environment work. In other cases studies and surveys were carried out over 5-10 years ago and need to be updated

with contemporary data, actual measurements and new understanding of ecological processes, as well as revised projections of population growth.

Potential significant gaps in our knowledge considered to be essential for a robust AEE are identified in the following section from reviews of reports, discussions with authors of reports, science experts and the Consultative Group. The main focus is on gaps in our understanding of the receiving environment but some further information is also required as the basis for the assessment of ecological effects. For ease of presentation these are divided up into ecological components but we need to recognize the importance of nutrient flows in linking the different environments. A summary of the gaps and work recommended is provided in Appendix 2. Most of the ecological issues are dealt with in this document but there will need to be more discussion with the Consultative Group on linking the work for the AEE with wider research programmes on the Whangateau as well as potential mitigation options and resource consent conditions once the assessment of ecological effects is drafted.

3.1 Nutrient processes in soils, surface and groundwater and wetlands

The potential impacts of the irrigation of treated wastewater on nutrient processes in soils, surface and groundwater and wetlands/forest is a key issue to be considered for the AEE. There is information available on potential nutrient transformations and loss processes but little verification or actual measurements. One issue is the placement of existing bores at both the Jones Rd and Omaha Golf Course. At the Golf Course site there are monitoring bores on the western margins of the Golf Course and some groundwater measurements were made at the edge of the Golf Course as part of the irrigation rate trial. For the purposes of an AEE, these measurements are likely to be insufficient and inadequate to be confident that significant inputs of nutrients (particularly nitrogen) are not currently entering the Harbour, or are likely to in the future with increased load.

The most important process is likely to be denitrification as this is the only process that removes nitrogen from the system (as nitrogen gas). It will be important that the capacity of the system is understood with potential further development and higher application rates. The reserves of readily available carbon play a major role in determining the capacity of the system to support denitrification and is a gap in our existing knowledge in this area.

Gaps in knowledge

- *Limited information on flow paths, transformations and losses of nutrients between the disposal sites and the Harbour.*
- *What is the fate of nutrients in surface waters between the irrigation areas and the Harbour edge?*
- *We have no site-specific measurements of nutrient processes and potential for transformation and losses of nutrients. This is required for quantifying the effects on downstream receiving environments.*

- *Very limited understanding of the capacity of the golf course, wetlands and forest, and plantation to process existing and potential increased loadings of nutrients, without affecting the existing high-value ecological communities.*

Work required

- *To gain a better understanding of changes in nutrient levels and flow paths from the disposal sites through either the Kahikatea Forest/Wetland (Omaha Golf Course site) or the Jones Rd site requires monitoring and surveying of new and existing monitoring bores and surface waters between the disposal areas and the Harbour.*
- *To better understand the nutrient processes and rates of transformation and losses at these sites (instead of relying on general literature values) requires some basic assays be undertaken.*
- *<u>The first priorities</u> and Stage 1 to be completed by the end of January 2015 will be the following tasks:*
    - *A preliminary visual survey of the area between the irrigation areas (Golf Course and the Jones Rd plantation) and the Harbour and surface drains between the irrigation areas and the Harbour with members of the Consultative Group..*
    - *Install at least 3-4 bores with an auger or post-hole borer along at least one transect from each site (Omaha Golf Course and Jones Rd) to the Harbour. This work should be done in conjunction with the groundwater studies recommended below (Section 3.2), and will depend on the bores being installed in time to complete assays below before December.*
    - *Undertake denitrifying enzyme activity (DEA) assays on duplicate soil and wetland cores from each of the sites and measure the increase in nitrous oxide over time as an estimate of denitrification rates. The initial set of samples will be taken over summer with as many assays carried out as possible in the irrigation areas and between these areas and the Harbour, over a 3 day period.*
    - *Undertake a survey of water quality in surface drains/streams between Jones Rd and the Harbour and any obvious flows from the Kahikatea Forest on the edge of the Golf Course. This survey will include at least 4 drains/streams and at least 4 sites down the waterways. Parameters to be measured are dissolved oxygen, temperature, clarity, pH, ammonia nitrogen, nitrite and nitrate nitrogen, dissolved reactive phosphorus and dissolved organic carbon. If the tracer trials are successful (see Microbial below, Section 3.3) then these would be used to confirm the origin of the contaminants. The final location for these sites will be chosen in consultation with members of the Consultative Group.*
    - *The DEA assays and water sampling of cores and surface drains will also be conducted on at least two control sites away from the influence of the WWTP.*
- *<u>The second stage</u> to be completed over autumn of 2015 or following a period of several cycles of irrigation on the dunes will involve:*

- *Resampling the bore sites for DEA as above and doing selective in situ denitrification measurements on the irrigation sites after an irrigation event.*

- *Sample the bore sites from the groundwater sites (see Section 3.2 below) and at least 4 sites in the irrigation areas at least monthly for redox potential (indicator of oxidation-reduction using a redox meter), readily available carbon measurements and nutrients (ammonia nitrogen, nitrite and nitrate nitrogen, dissolved reactive phosphorus) and dissolved organic carbon. This would involve at least 3 months of sampling once the bores/wells have been installed in the initial analyses but it is expected the monitoring would be ongoing and reviewed after 12 months.*
- *Following the first and second stages a longer-term monitoring programme for sampling the bore sites, ground and surface water will be developed as Stage 3 in consultation with the Consultative Group.*
- *The historic information, DEA assays, available carbon and redox measurements will be used in the assessment of effects and to assess the potential capacity of the system to process nutrients, with further data to be collected longer term as identified in the first stage. An assessment would also be made of the efficacy of the present plantations in Jones Rd to remove water and nutrients.*
- *It is expected that the initial assessment and technical reporting would be completed by the end of April.*

3.2 Groundwater

There is a description of the underlying geohydrology and aquifer system provided in various reports, including an indication of groundwater flows and pathways. While this may be sufficient as a general description some of the information and data may not be that reliable, may not reflect local knowledge and is not considered robust enough as the basis for an AEE.

At present the only indication of potential flow pathways and transport times for the Omaha Golf Course area are from boreholes/wells on the dunes, golf course and western side of the Golf Course. There have been no measurements between the Golf Course margins and the Harbour to confirm transport time and pathways (and transformation and losses of nutrients). Similarly there are only limited measurements from bore holes in the Jones Rd area. Flow pathways and travel times will be critical for the assessment of effects on the receiving waters and need to be verified for the AEE. It is generally agreed that most of the flows are towards the Harbour but there is potential for flows to the coast when irrigating on the dunes in winter.

Gaps in knowledge

- *Limited information on subsurface lithology, travel paths and rates*
- *Lack of confidence in earlier conceptual models for aquifers and groundwater, flow pathways and transport times need verification.*
- *A better understanding of water balances in the disposal fields and wetlands/forest.*

Work required

- *Obtain better information on the underlying geology such as lithology, presence of peat layers (will feed into nutrient work) and saline intrusion using Ground Penetrating Radar (GPR) and electromagnetic surveying (ES) respectively.*
- *Confirm and refine conceptual models of lithology, flow paths and water and nutrient balances in the irrigation areas and between Jones Rd irrigation area and the Golf Course and the Harbour edge.*
- *<u>The first stage</u>, to be completed by the end of December 2014 will involve:*
    - *Reviewing all existing groundwater data and information*
    - *Completing a field mapping exercise along the eastern and western shorelines of the Waikokopu Arm and use an additional 10 hand auger holes to investigate substrate to assist with piezometer installation planning (preliminary surveys were undertaken in August) and to provide samples for nutrient assays. Samples from these holes would be used for the nutrient assays above (Section 3.1)*
    - *Water level gauging, water quality sampling (for Nutrient Processes above) and physical condition assessments will be made for all existing wells/bores.*
    - *Complete Ground Penetrating Radar (GPR) transects to assess and map shallow subsurface lithology and peat layers within the Golf Course and Jones Rd existing irrigation areas. The GPR 'scans' the shallow lithology and is particularly useful for identifying peat layers. Indicative transects are shown in Figure 1. Final sites will be decided after the mapping exercise above.*
    - *Complete an electromagnetic survey (ES) to identify saline intrusion and geology changes around the Omaha Golf Course and area east of Jones Rd. The survey would be carried out over 2 days and will also aid with identifying drilling locations.*
    - *The results of these surveys will be reported back to the Consultative Group (in early Jan 2015) and the next stage confirmed within 3 weeks.*
- *<u>If required the second part of Stage 1 will involve:</u>*
    - *Completing GPR transects and an ES survey of the expanded area around the Golf Course (if this is considered necessary) as per Figure 1. These surveys would be completed by the end of January 2015 with sites to be confirmed after Stage 1 is completed.*
- *Based on the results of Stage 1 drilling and installation of piezometers and drill hole logs(to confirm peat layers and depths) would be completed by the end of March 2015, at up to 20 appropriate sites covering the existing irrigation areas (see Figure for indicative sites). It will be important that the final selection includes consideration of the depths of bores required. If it is required a further 7 sites would be included in a potential expanded areas around the Golf Course. Initially at least two bores would be placed in the area to the north of the present discharge area i.e*

the northern part of the Golf Course or other appropriate area to act as control sites.

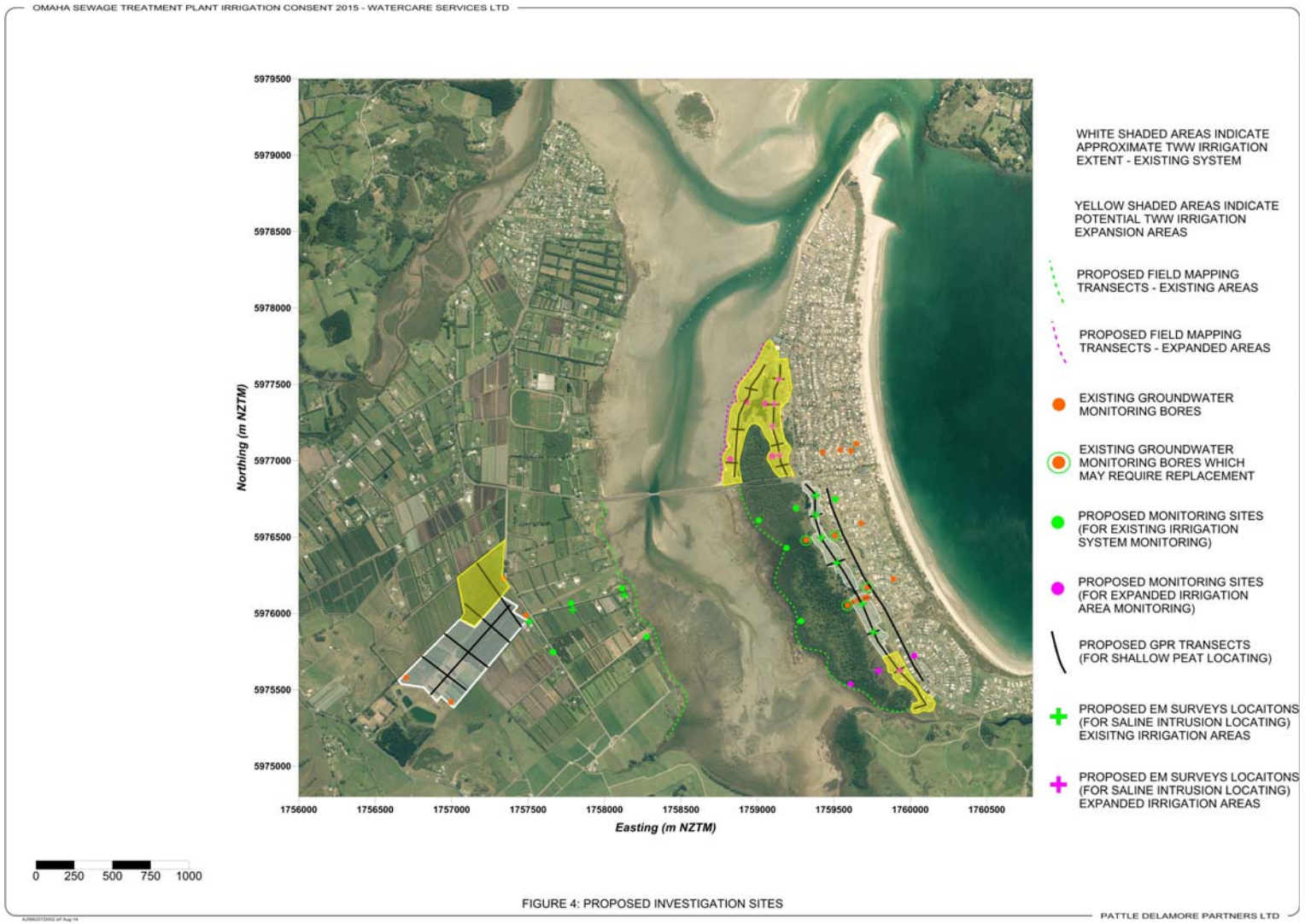

Figure 1. Proposed investigation sites (PDP).

Drilling would involve 'sonic' drilling (no drilling fluids) or push tubing.

- *By mid-April complete aquifer testing, groundwater level and water quality monitoring. Aquifer testing would involve standard falling and rising head testing, groundwater level would be measured manually and with automated level loggers at key sites. Water quality sampling would be carried out on all wells as described above (Section 3.1) and at last 3 months of data used in the initial assessment. It is anticipated that monitoring of the wells would be undertaken for at least 12 months to cover seasonal changes and then reviewed.*

- *<u>Stage 3</u> to be completed within 2 months of completing the initial field investigations, will involve completing:*

    - *Numerical modelling and calibration of flow and transport model*
    - *Modelling of nutrient balance under each irrigation area and the forested area and assessing capacity of systems for additional disposal*
    - *Technical reporting*
    - *(Water quality aspects will be covered under Nutrient Processes (as above))*
    - *The models may have to be further refined following the analyses of 12 months of groundwater data.*

3.3 Microbial and contaminants

There appears to be an adequate description of the key microbial characteristics (Faecal coliforms, E.coli) of the discharge and monthly monitoring as part of the regular AC monitoring at Ti Point. However, there has been no assessment of viruses or emerging contaminants that we are aware of. As the wastewater is considered to have very low levels of contaminants there should be sufficient information to describe the discharge, receiving environment and potential effects for bacteria but not necessarily other contaminants (viruses, pharmaceutical etc) and the potential impacts of these will need to be assessed as part of the assessment of effects.

Gaps in knowledge

- *Limited assessment of the potential for microbial contaminants (Faecal coliforms and bacteria) in the discharge to impact on the receiving waters of the Harbour and the relative importance of the discharge from the Omaha WWTP versus septic tanks.*
- *No assessment of the potential efficacy of the UV treatment in reducing the contaminants (including viruses and emerging contaminants) to an acceptable level for discharge onto land and their ultimate fate.*

Work required

- *<u>The first stage</u> to be completed by the end of December would involve:*
  - *A review of the current understanding and potential issues around emerging contaminants, including endochrine disrupters and other pharmaceuticals and care products. The review will include an assessment of potential risks from the discharge of treated wastewater for these contaminants, potential attenuation and losses from the WWTP and as the water moves through to the Whangateau Harbour and recommendations for any further work that is considered important for an assessment of effects.*
  - *A review of data on microbial contaminants (E.coli) in the discharge.*
  - *Measurements of E.coli will be taken as part of the surface water quality sampling described above for drains/streams, ground- and surface-water between the irrigation areas and the Harbour, as well as the Harbour water sampling (see below, Section 3.7).*
  - *A review of the literature and relevant reports will be undertaken to assess the efficacy of the UV treatment in reducing the microbial contaminants (including viruses) to an acceptable level for discharge onto land, based on previous studies.*
  - *An assessment will be made of potential tracers that will separate WWTP discharges from septic tanks (eg natural isotopes and fluorescent whitening agents). If this is deemed worthwhile then a trial would be run on septic tank and WWTP effluent at a selection of sites around the edge of the Harbour.*
- *Undertake sampling of heavy metals, once monthly for at least three months in the final treated wastewater. Metals to be sampled are Arsenic, Cadmium, Chromium, Copper, Nickel, Lead and Zinc (the same metals as sampled in 2007).*
- *If the review of microbial and emerging contaminants, in consultation with the Consultative Group, identifies a potential significant issue remains with the receiving environments then for Stage 2 at least 5 samples of the influent and effluent would initially be taken during periods of dry and wet weather to determine the level of viruses and key emerging contaminants present in the irrigated wastewater and efficacy of the system. For example, this could involve molecular testing for key viruses such as adenovirus and rotavirus. The requirement for further testing including wells and surface flows would then be reassessed.*
- *Stage 3 to be completed by the end of March would involve assessment of effects and reporting.*

3.4 Nutrient loadings

The Diffuse Sources (2008) report provides a good basis for assessing the potential relative contribution of the WWTP to the nutrient loadings to the Harbour and the Waikokopu Arm. However, while this may cover the loadings at the time some of the assumptions and land use

allocations need to be revisited with more up-to-date information and projections of future loadings.

Gaps in knowledge

- *No up-to-date assessment of the relative loadings based on current land-use and future projections of growth.*

Work required

- *Assess the relative loadings based on current land-use be updated along with the potential loads based on future projections provided by Watercare.*
- *The first stage, which has already been completed, was to assess current land-use from the most up-to-date information available and update the estimates of catchment N exports and loadings from the irrigation of wastewater. This assessment used the NZ River Environmental Classification database for boundaries, the NZ Land Cover Database (LCDB) to classify land-cover and use of MFE categories.*
- *The second stage of comparing loads from different sources will be completed when estimates of N removal have been completed based on new measurements (see nutrient processes above), any new potential areas for disposal have been identified and the number of septic tanks and potential input from them is confirmed. It is expected this work will be completed by the end of Feb 2015.*

3.5 Wetlands/Forest

There is limited information and descriptions of the existing forest and wetlands including some transects and quadrats established as part of a baseline study in 1999/2000. The Kahikatea Forest and associated wetland are highly valued and potential effects will need to be assessed. There is likely to be more data available as part of earlier applications for development of the area and as part of Rodney District and AC monitoring of wetlands/forests but this is yet to be sighted.

Gaps in knowledge

- *No collation of existing information and data on the wetland and forest. This information is presently spread over a number of organisations.*
- *No description of the existing state of the Forest/wetland (that we are aware of).*
- *Limited assessment of the potential changes in the wetland communities as a result of nutrient inputs and water level changes.*

Work required

- *<u>The first</u> priority and Stage 1, to be completed by mid-December 2014, is to:*
    - *Collate and review existing relevant information and data available from a number of agencies and previous reports, including the wider ecological context of the site.*
    - *Compile relevant digital data and prepare a base map using colour aerial photography.*
- *Depending on the results of the literature review it likely that a survey of the Forest/wetland area will be necessary as <u>Stage 2</u>. This would involve:*
    - *A site visit to identify, map and describe vegetation and habitats at a broad level and in particular map the extent and type of wetlands (related to nutrient status if possible).*
    - *Recording bird life, particularly in the wetlands, using observations and bird calls and collating information from the wider area from NZOS and other records.*
    - *Surveys of freshwater fish life, if suitable habitats are identified and are relevant to the assessment.*
- *Results from the surveys, reviews and relevant literature on the effects would be used to describe the ecological values, identify potential changes and ecological constraints due to nutrient loads and water levels and opportunities to avoid, minimize or mitigate effects if required. It is expected this work could be completed by the end of March 2015.*

3.6 Hydrodynamics of Harbour

The best hydrodynamic description of the harbor, including circulation patterns, comes from Titchener (1993). This study included data on currents, tides and circulation patterns but was largely focused on the tidal delta region.

The thesis by Titchener (1993) appears to be robust and sufficient to describe the existing environment for the tidal delta region of the main Harbour but not hydrodynamics of the wider Harbour and in particular the Waikokopu Arm. Although flushing is likely to be rapid (1-2 days) the issue of how much interchange there is between the area below the causeway (Waikokopu Arm) and the main Harbour needs further clarification through modelling.

Gaps in knowledge

- *There is no hydrodynamic model for the main Harbour and the area south of the causeway that will allow an assessment of the rate of exchange with the wider Harbour and dilution of any potential contaminants.*
- *Limited assessment of the potential impact of increased freshwater inputs to physical features of the Harbour (eg salinity).*

Work required

- *<u>The first</u> priority and Stage 1 will be to review Titchener (1993) and collate any other hydrodynamic data available (eg tidal stage, boundary conditions from models of the Hauraki Gulf). This should be completed by the end of November 2014.*
- *The description of the area south of the causeway is unlikely to be adequate to cover the Waikokopu Arm. Assuming this is the case and there is insufficient information available, and the present Hauraki Gulf hydrodynamic cells are too coarse for the Whangateau Harbour to assess dispersion of contaminants and mixing processes then it will be necessary to develop a high resolution hydrodynamic model (~25 m cells) for the Harbour, and in particular the Waikokopu Arm area. This would then be used to simulate a release from the Waikokopu Arm and follow its dispersion for ~ 7 days. Simulations would be run under different tide and wind conditions and may include other freshwater inputs.*
- *It is expected this work could be completed by mid-Feb 2015.*

3.7 Water quality in the Harbour

Measurements of water quality are presently limited to the monthly AC surveys at Ti Point. There has been some discussion over the effect of the causeway on hydrodynamics and exchange processes. Thus Watercare will need more robust information for this part of the Harbour as part of its AEE. An important question is whether the site at Ti Point is representative of the inner Harbour, in particular the Waikokopu Arm, and the degree of interchange between the Arm, the main Harbour and offshore. Issues with surface and groundwater inputs that may reach the Harbour are discussed earlier.

There is some information on contamination by heavy metals and PAHs in the main Harbour (including just north of the causeway) (Stewart 2005) and from recent AC monitoring, which can be summarized (Hewitt & Simpson 2012, AC data) for the area of interest.

Gaps in knowledge

- *Little, if any data on water quality in the Waikokopu Arm*
- *No up-to-date assessment of the potential capacity of receiving waters in terms of nutrient limitation for algal, macro-algal or plant growth.*

Work required

- *Since July 2014 Watercare have contracted Auckland Council to collect a water sample from the causeway as part of their monthly sampling of various Harbours in the Auckland area. Up until this time samples were only collected by AC at Ti Point. Samples are analysed for chlorophyll a (an indicator of algal biomass), nitrite, nitrate and ammonia-nitrogen, total nitrogen (TN), dissolved reactive phosphorus, total phosphorus, pH, total suspended sediments and turbidity as well as Enterococci.*

- *The dataset for Ti Point (1991-) and for the causeway (since July 2014) will be collated, analysed and reported as Stage 1 by mid-Jan 2015 and comparisons made between Ti Point and the causeway to see how representative the Ti Point location is and whether there are differences in the Waikokopu Arm. Recommendations will then be made whether this sampling should continue as part of longterm monitoring and what if any changes are required, including consideration of the number of sites and parameters measured.*
- *Reporting and assessment will be carried out as Stage 3 in April 2015.*

3.8 Benthic habitat and shoreline plants

The comprehensive surveys carried out by Boyd (1972) and more recently Townsend et al. (2010) provide good general descriptions of the benthic environment in the Whangateau Harbour and the areas that would be potentially impacted by the irrigation of treated wastewater, and in particular, parts of the Waikokopu Arm. The earlier maps provided by Hartill (2000) were updated in 2009 by Townsend et al. (2010). The latter study also provided information on sediment characteristics and recommendations on longer term monitoring sites. Monitoring by AC now includes three sites in the southern arm of the Harbour and the area potentially directly impacted by the irrigation of treated wastewater (Hewitt & Simpson 2012). Ongoing monitoring by the AC of the Whangateau Harbour is now in place with 6 monthly monitoring of the benthic community. In addition the Whangateau Harbourcare Group regularly monitor cockle numbers. The benthic data has been obtained from the AC and the most recent report on the benthic community and sediment characteristics is in preparation.

Based on the recent study by Townsend et al. (2010) and the ongoing monitoring it is considered that there should be enough information available to describe the existing receiving environment but with some updating required.

Gaps in knowledge

- *Analyses of the intertidal data collected over the last 3-4 years in the Waikokopu by AC. Data is also available on the likes of heavy metals at these sites but the site-specific data has not yet been examined and put into context.*
- *No recent description of the present state of the Harbour in the vicinity of the Omaha Golf Course and Jones Rd disposal fields. The habitat map is now 5 years old and needs to be updated and ground-truthed.*

Work required

- *<u>The first priority and Stage 1</u> is to analyse and summarise existing data from various reports and unpublished data relevant to the area potentially impacted by the irrigation of treated wastewater (including shellfish surveys). The raw data for the 3 sites in the Waikokopu Arm from 2010 until March 2013 has been obtained from the AC and collation of the last years data is underway. Six cores are taken from each site and analysed for faunal composition (including size of cockles, pips and wedge shells), sediments in the top 2cm are also collected and analysed for grain size, and heavy metals (iron, manganese, arsenic, cadmium, chromium, mercury, nickel, copper, lead and zinc). Collation and analyses of the data should be able to be completed by the end of December 2014.*
- *Once the data has been analysed and previous habitat maps examined the next priority will be to consider whether further surveys at a greater number of sites in the Waikokopu Arm is required to describe the existing state of the Arm. If not sufficient then a limited survey of the Harbour margins along the edge of the Jones Rd and Omaha Golf Course areas should be made to verify whether there have been changes in the habitat, dominant communities, including spread of mangroves, since the last surveys in 2009. The habitat maps would be based on Google maps and groundtruthing from these surveys.*
- *Depending on the outcome of Stage 1 if nuisance macroalgae or unexpected growths of the likes of mangroves are observed, that could possibly be as a result of the discharge of treated wastewater, then sampling and quantification of nutrients in the sediments would be surveyed and assessed as Stage 2.*
- *Stage 3 is the assessment and reporting which would be carried out in Feb/Mar 2015.*

3.9 Midges

Midge (non-biting) issues are common around ponded water associated with waste water treatment plants as well as a range of other standing water bodies including eutrophic lakes. Issues have been raised occasionally by local residents near the Omaha WWTP plant. At present the midge issue is dealt with by spraying the edge of the storage dam. The potential issues associated with midges and mitigation measures will be discussed as part of the assessment of effects.

3.10 Fish and birds

Kelly (2009) summarises what is known about fish populations in Whangateau Harbour based on early information from Grace (1971, 1972) and notes provided by Mark Morrison (NIWA). Observations are also made by local Ornithological Society members and the Omaha Shorebirds Protection Trust.

There appears to be sufficient information and data available on fish and bird populations and their use of the Harbour to describe the existing state and as a basis for an assessment of effects.

Gaps in knowledge

- *Assessment of the use of the Waikokopu Arm and its importance for birds and fish.*

Work required

- *In the first instance as Stage 1 all available information on fish and bird populations present in the Waikokopu Arm and surrounding environment (including NZOS, Shorebird Trust information) should be collated and an initial assessment made of the use of the Waikokopu Arm for various species. Discussions have already been held with Dr Mark Morrison regarding information on fish species and further discussions should be held and a field visit made with fish (Dr Roger Grace) and bird experts on the Consultative Group, NZOS and the Shorebird Trust. This could be completed by mid-January 2015.*
- *If there is a lack of information for the Waikokopu Arm then consideration should be given to some further observations as Stage 2 and carried out in conjunction with local groups.*
- *Reporting and assessment of effects would be carried out in Mar/Apr 2015.*

3.11 Disposal of septage

The disposal of septage at the Omaha WWTP was discontinued in early 2011. There are at least two privately-owned disposal sites operating in the Rodney area, both located in the Kaipara Harbour catchment. Concern has been raised about the effects of these disposal sites.

Work required

- *The resource consents for the operation of the private disposal systems will be obtained and reviewed, in conjunction with the Sustainable Catchment team from Auckland Council.*
- *Reporting back to the group as part of Stage 1 and determining next steps for Stage 2*

4.0 Assessment of Ecological Effects

A number of issues and potential impacts of spraying treated wastewater onto the Omaha Golf Course and the Jones Rd irrigation field have been identified by Watercare, its consultants, the Consultative Group and the Harbourcare Group. The main potential impacts that will need to be considered in the assessment of environmental effects are:

- Nutrient enrichment of the groundwater, surface flows, forest/wetland, and habitat of the shoreline and waters of the Whangateau Harbour. Such enrichment can result in growths of nuisance algae, increases in vegetation such as mangroves and sea lettuce, decreased water quality and estuarine health issues.
- Organic pollution which can increase oxygen demand in receiving waters and potentially result in anoxic conditions if severe.
- Bacterial and microbial pollution of ground and surface waters.
- Water level changes in the forest and wetlands as a result of increased water inputs to the Golf Course and Jones Rd plantation.
- Flow-on effects to higher levels in the food web in terrestrial and aquatic receiving environments including benthic invertebrate and plant communities, fish and birds.

The assessment of effects will be a desktop exercises based on:

1. The existing and new information gathered on the receiving environment
2. Develop quantitative models of groundwater and nutrient loadings and processes
3. Published and unpublished documents/publications on the potential effects of such activities
4. Expert opinion on potential effects and the sensitivities of the receiving environment to these impacts of the existing discharge and potential future discharges
5. Accepted national standards (eg. ANZECC, MFE, NPS-FM) and regional plans
6. Assessment of potential mitigation and monitoring requirements in consultation with the Consultative Group.

It is expected that the draft assessment of ecological effects will be completed by the end of June 2015.

5. List of relevant literature:

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Appendix 1. List of issues identified at Consultative Group meeting 13th September

WWTP	Covered in this plan	Approach to be proposed by end November 2014
Dune saturation	x	
Monitoring water quality	x	
Effectiveness of trees/irrigation	x	
Connections – current/growth	x	
All contaminants identified (emerging-tracers)	x	
Seepage underground from WWTP – ditches, sludge	x	
Truck damage to roads		Subject to discussions with AT
Insects	x	
Disaster plan – harbour		x
Population growth predictions		x
Consent conditions – regular review/reporting, monitoring	Based on investigation outcomes	
Pipe capacity Matakana		Can accommodate growth within area of benefit
Research plan – 20 years	Based on investigation outcomes	
Alternative discharge points	Based on investigation outcomes	
Stormwater inflows		x
Wetland contaminant removal, drains	x	
Septic to Kaipara	Stage 1	
Matakana industrial waste	Through testing for heavy metals	
Whangateau Harbour		
Septic tank leaching	With appropriate tracer	
Cockle etc impacts (birds)	x	
All sources contamination (monitor)	x	
Mangroves – nutrients (ditches from WWTP), small, sludge	x	
Water quality	x	

Cost of connection – subsidizing, compulsion		x
Taniko wetlands – impacts, longterm	x	
South of causeway	x	
Watercare testing	x	
Other		
Sea level rise – drainage impacts		x
Septic tanks Whangateau/Ti Point		x

Appendix 2. Summary of gaps in knowledge and work recommended

	Gaps in knowledge	Work required	Type of work
Nutrient processes Nutrient loadings	• Flow path direction and rate • Fate of surface waters • Measurements of process rates • Estimates of nutrient losses and transformations • Capacity of system • Up-to-date loadings cf other sources	• Install new wells and measure water quality, water levels • Measure water quality in drains and surface flows • Assay measurements for denitrification • Revise catchment loadings • Develop monitoring plan (in consultation with Consultative Group)	Surveys – short term and longterm monitoring Laboratory Desktop
Groundwater	• Lack of confidence in conceptual models, flow paths and rates • Water balances in irrigation fields and forest/wetland	• Install new wells and measure water quality, water levels etc • Map lithology, peat deposits and salinity layers using Ground Penetrating Radar and electromagnetic surveying. • Develop numerical model • Develop monitoring plan (in consultation with Consultative Group)	Surveys and long term monitoring Desktop
Microbial and contaminants	• Efficiency of WWTP to remove contaminants • Risk of emerging contaminants	• Review existing state of knowledge • Assess efficiency of system in removing contaminants • Investigate use of tracers to assess origin of contaminants including septic vs WWTP	Desktop Field measurements
Wetland/forest	• Description of present state • Assessment of effect of water balances and nutrient inputs	• Collate existing reports and data • Carry out a general survey of the forest for plant health etc • Assess whether increased hydraulic loading likely to impact on forest health	Desktop Field survey Desktop (and from modelliong)

Hydrodynamics of Harbour	• No Harbour-wide model • No assessment of freshwater input effects	• Develop a simple Harbour model that will allow an assessment of exchange with Waikokopu Arm, dilution processes and circulation patterns.	Desktop
Water quality of Harbour	• Little data except for AC monitoring at Ti Point • No recent assessment of capacity of Harbour for added nutrients	• Summarise water quality dataset for Ti Point • Monitor water quality at causeway	Desktop Monitoring
Benthic habitats and shoreline plants	• Analyses of data from AC surveys specific to this area • Up-to-date habitat map, identification of nuisance growths • Understanding of cause of cockle deaths	• Analyse survey data from AC monitoring • Carry out a general survey of the Waikokopu Arm using google maps, groundtruthing and comparison with previous habitat maps.	Desktop Surveys and desktop
Fish and birds	• Collation of all information for Harbour especially Arm • Assessment of use of the Waikokopu Arm for birds and fish	• Provide a description of all information on birds and fish utilisation of the Waikokopu Arm (with local Trust, NZOS, and HarbourCare)	Desktop, possibly some further observations