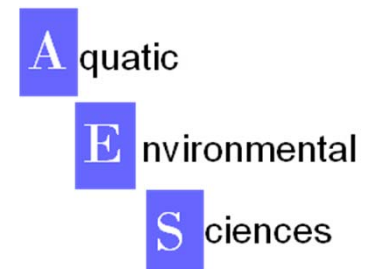




# Investigation Plan for the Omaha WWTP – Stage 2 update

Dr Mark James, Aquatic Environmental Sciences Ltd



### **Preparation of a robust assessment of effects for reconsenting of Omaha WWTP requires:**

1. Description of the existing environment
2. Assessment of the effects of the discharge

#### **1. Review existing information and gaps (Sept/Oct 2014):**

Limited or no information on:

- Subsurface lithology, flow paths and fate of water and nutrients from discharge – need water and nutrient balances
- Groundwater characteristics, nutrient processes or capacity for nutrient removal
- Microbial contaminants, nothing on viruses or emerging contaminants

## Background – cont.

- Forest and wetlands ecology
- No hydrodynamics of Harbour
- Water quality of Harbour
- Dated information on benthic habitat, birds

## **2. Investigation plan (Nov 2014 – discussed with CG)**

### **Stage 1 (Nov 2014 – Feb 2015)**

- Review existing information in more detail
- Limited number of shallow bores installed for subsurface lithology, denitrifying activity
- Initiate water quality sampling of Waikokopu Arm and drains
- Map lithology using ground penetrating radar and electromagnetic survey

## Background – cont.

- Review data on microbial contaminants
- Develop hydrodynamic model
- Review and update information on benthic habitat, birds and fish
- Results discussed with Consultative Group

**Stage 2** – discussed for each workstream below

### **Stage 3**

- Continue sampling bores and drains
- Complete and run models of water and nutrient balances
- Assessment of effects and reporting

## Groundwater – Stage 2

**What are the groundwater flows and pathways between the irrigation areas and the Whangateau Harbour?**

### **Stage 2 tasks:**

- Log geological information from bore locations
- Install 13 new bores (1/3 through @8th June)
- Hydraulic testing of existing and new bores
- Collate rainfall and irrigation data
- Map and survey drainage system  
(completed but not written up yet)
- Water quality sampling of bores





WHITE SHADED AREAS INDICATE APPROXIMATE TWW IRRIGATION EXTENT - EXISTING SYSTEM

MARKED & CLEARED BORE LOCATIONS - black

EXISTING GROUNDWATER MONITORING BORES - white

PROPOSED BORE LOCATIONS - blue

FIGURE 1: PROPOSED & MARKED/CLEARED GROUNDWATER MONITORING BORE SITES



APPROXIMATE LOCATIONS OF GROUNDWATER MONITORING BORES & DRAIN FLOW SURVEYS

0 m 250 m 500m 750m

## Nutrient processes and loadings – Stage 2

**What are flow pathways, transformations and losses for nutrients in soils, wetlands, groundwater and final fate?**

### **Stage 2 tasks:**

- Fill gaps in coverage of kahikatea forest, golf course and regenerating forest as well as new PDP bores and soil nutrients
- Undertake Denitrifying Enzyme Activity assays – measures capacity for  $\text{NO}_3 \text{ N} \longrightarrow \text{N}_2$  (need anoxia and available carbon)
- Undertake nitrification assays ( $\text{NH}_4\text{-N} \longrightarrow \text{NO}_3 \text{ N}$ )
- Conceptualise high level model of nutrient balance and fate
- Complete analyses of nutrient loadings to Harbour when assays completed

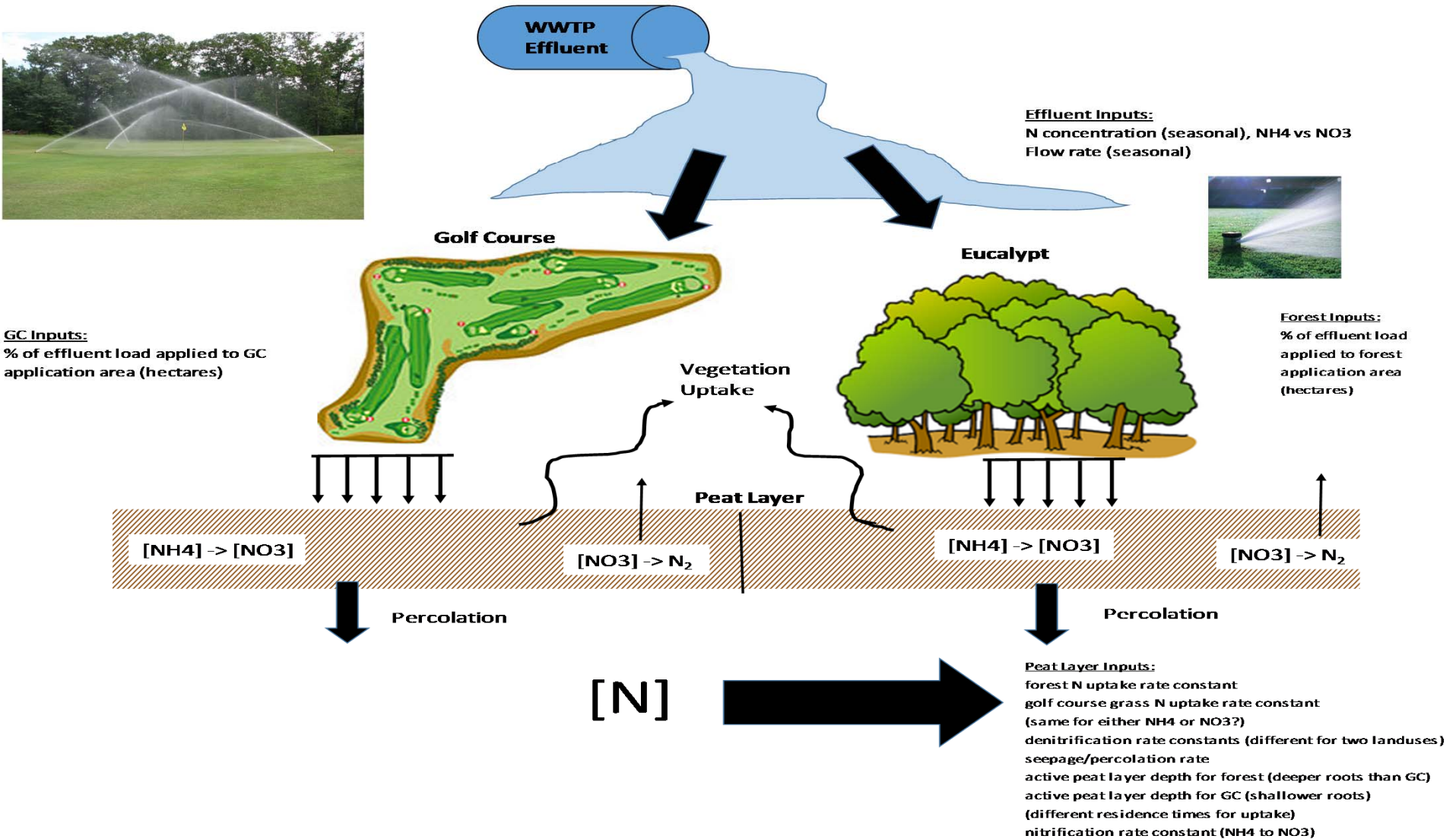


## Nutrient processes and loadings – Stage 2 cont.

### Progress

- Field work completed, most of lab analyses completed, waiting for samples from new bores
- Background review and schematic plan for model completed
- Model concept:
  - Nitrifying and denitrifying rates, soil data (carbon and nutrients)
  - Uptake rates on golf course and forest
  - Flow paths from irrigation areas – harbour
  - Input from turf specialist (golf course) and Scion (Eucalypts), initial estimate of leaching from GC is 40 kgN/ha/y
  - Will be used to predict fate of nutrients and can illustrate effect of management changes

# Omaha Beach Nitrogen Accounting Model



## Microbial and contaminants – Stage 2

### **Potential for microbial contamination, efficiency of the WWTP?**

- Site visit by NIWA in February 2015 to view treatment processes and discharge sites
- Collate discharge and bore data and review existing data and information
- Sampling of WWTP inflow, UV treated effluent: (about to start)
  - E.coli
  - FRNA (bacteriophage, indicator for viruses)
  - Adenovirus
  - Norovirus
  - Weekly for 5 weeks
- **Emerging contaminants (Michael Stewart presentation)**

## Wetland /Forests - Stage 2

### Kahikitea Forest and wetland values

#### Stage 2 tasks:

- Conduct survey (little information available), recording vegetation, fauna

#### Results:

- No indications of poor plant health, likely N limited
- No surface water in forest/wetlands (summer)
- Eels and mosquito fish and 16 bird species including fernbird recorded
- Need more information on groundwater/nutrients to assess effects (still to come)
- Site visit during winter (surface water?)



## Hydrodynamics – Stage 2

### What are exchange rates with main harbour and open ocean?

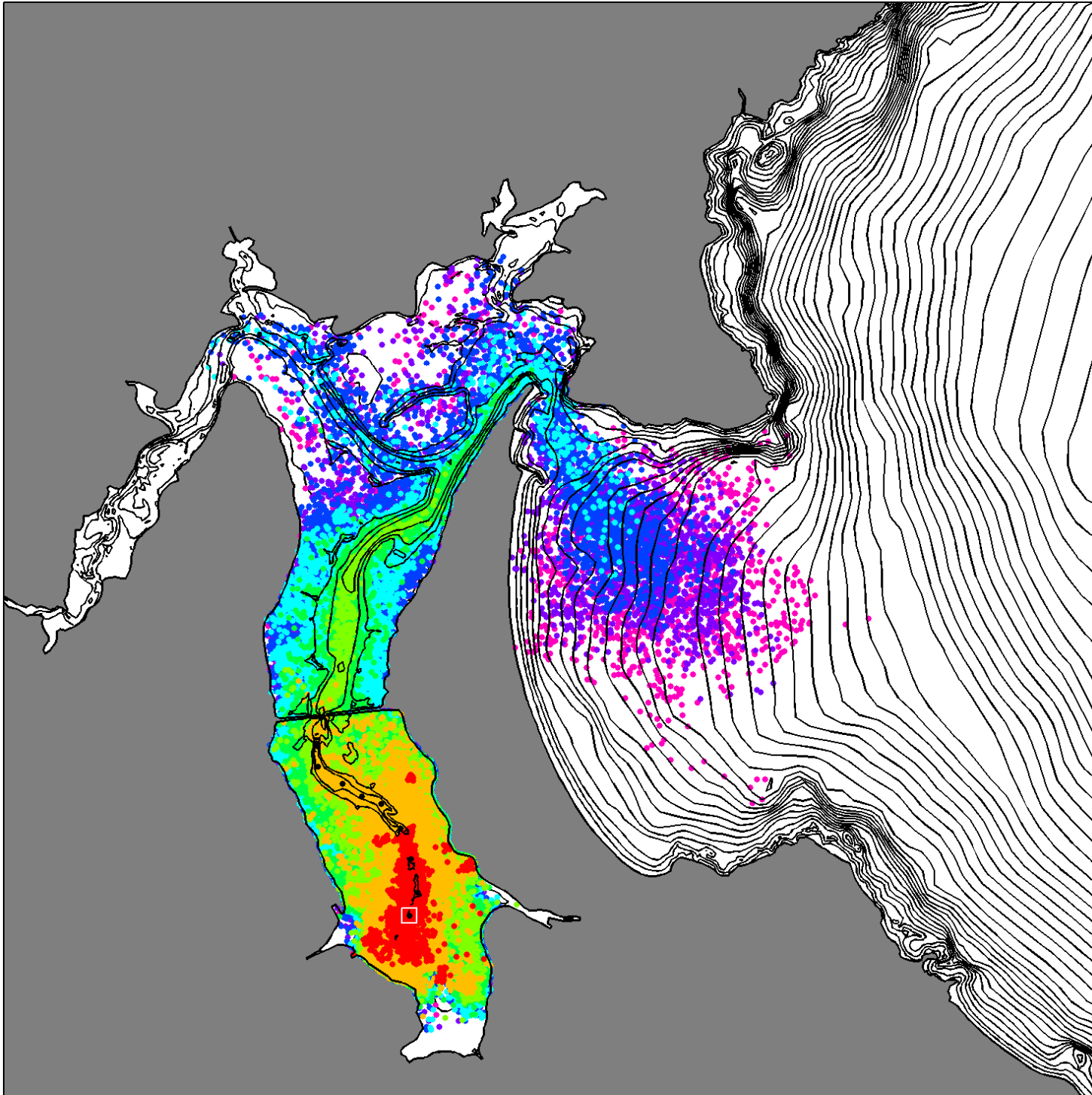
#### Stage 2 tasks:

- Complete development of a hydrodynamic model of circulation and dispersion:
  - Add stream to model
  - Assess degree of exchange and flushing from Harbour

#### Results:

- Hydrodynamic model completed
- Particles in upper Waikokopu Arm potentially take several tidal cycles to flush out of harbour
- Tidally driven dispersion depends on release site in Arm, excursions greater during spring tide
- Inclusion of stream inputs – increase flows on ebb to north and out of Harbour and reduce flows on flood phase

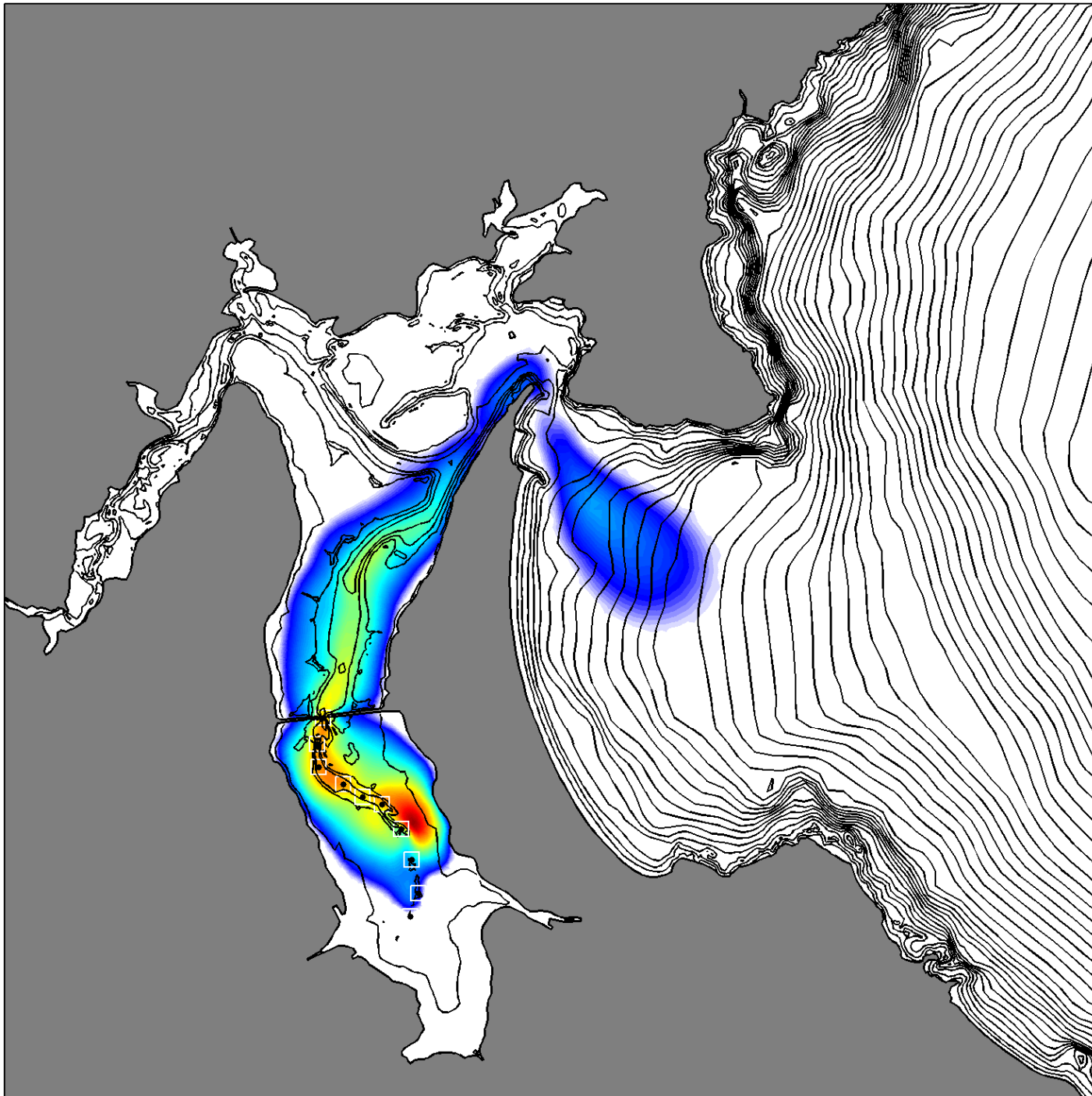
**Stage 3** – run model with realistic nutrient inputs



Dispersion of particles at different ages with tide and stream flows over 7 days – release from head of Arm

Red <1 hr

Purple <96 hr



Particle concentrations  
during 7 day period

Red = 1  
Dark blue =  
significantly diluted

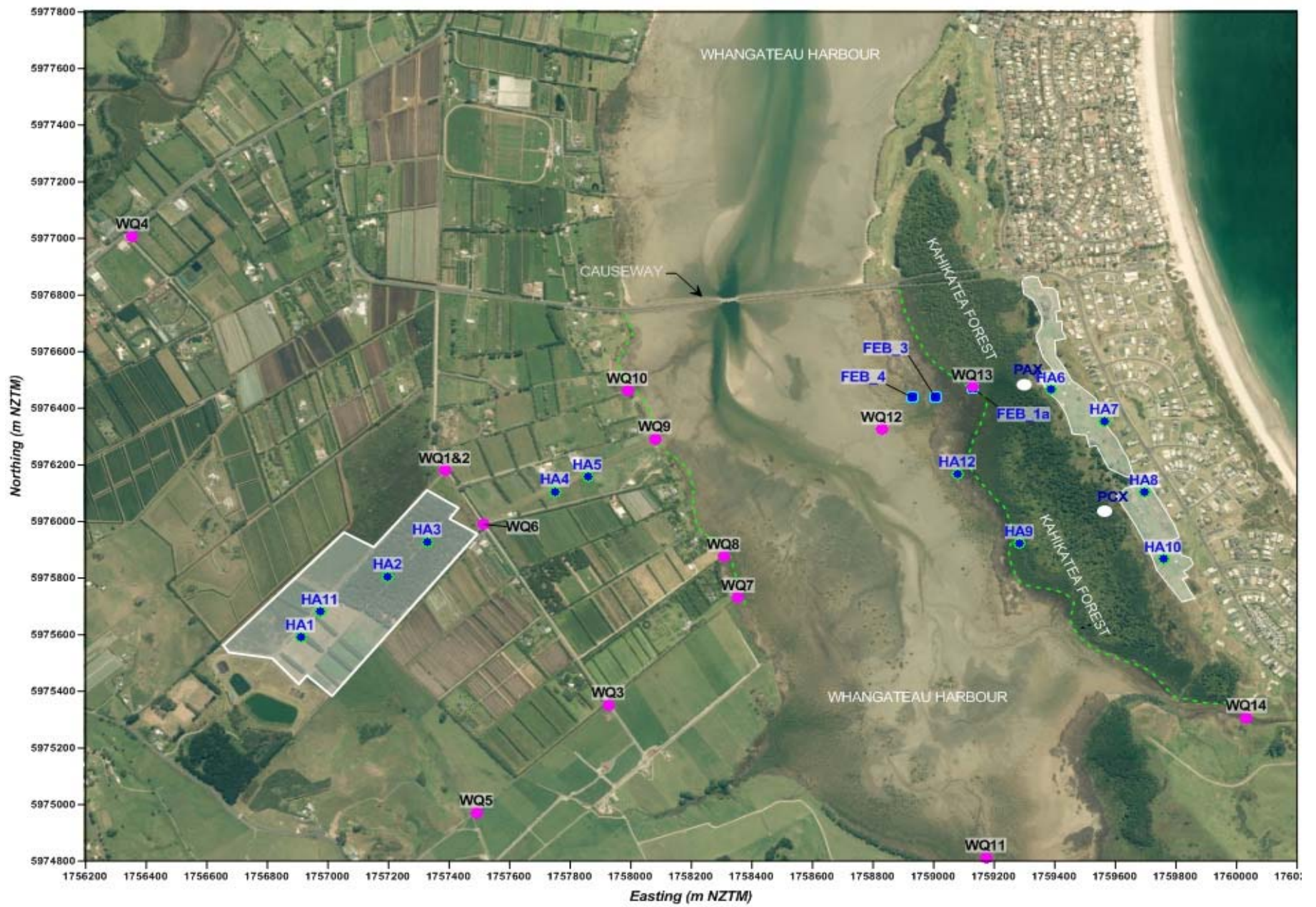
## Water quality surface waters – Stage 2

### **Obtain more information on water quality in surface waters to assess potential effects of WWTP**

#### **Stage 2 tasks:**

- Continue sample collection:
  - Ti Point (since 1991)
  - Causeway (since July 2014)
  - Drains (since Jan 2015)
  
- Collate data





## Water quality surface waters – Stage 2 cont.

### **Results (to April):**

- Some sites not flowing or dry (low DO, pH)
- Ammonia-N, Nitrate/nitrite, TN and DRP generally low
- TP can be slightly high at times at Sites 5 (ctl to south) and 12 (eastern side of Whangateau)
- Total suspended solids and turbidity can be high at times at Sites 5, 7 (drain at edge Whangateau) and 12
- E.coli can be high at times at Sites 5, 8 (drain at edge Whangateau) and 14 (stream entering southern part of harbour)
- Need longer time series

## Benthic habitats – Stage 2



### What is present status of benthic habitats in Arm?

Changes in habitat and communities mapped (presented in Feb)

- Shape and extent of mangrove and seagrass patches have changed in some places

#### Stage 2:

- Recommended assessment of state of cockles, mangroves with regard to nutrient limitation, sensitivities to enrichment
  - Cockles – AC collecting abundance and size structure at 4 sites 6 monthly
  - Mangrove nutrient status (under discussion with NIWA)
  - Input from NIWA on sensitivities of macrofauna and flora - completed

### What is present state of bird and fish life in Harbour?

#### Stage 2:

- Consider further bird survey (completed)

#### Results:

- Bird survey undertaken in March 2015
  - 16 indigenous birds observed, bar-tailed godwit most common (many may not have been feeding)
  - SIPO and NZ dotterel also common (foraging on tidal flats)
  - Good habitat but mangroves expanding

	Stage 2 tasks	30 June	31 July	31 August
Nutrients	Complete assays			
	Model concept and inputs			
Groundwater	Bore installation			
	Initial data collection – hydrology, water samples			
	Map & survey drainage			
	Geological understanding			
Microbial	Collate all data			
	Collect data on virus, emerging contaminants			
Forest/wetlands	Survey completed			
	Winter visit			
Hydrodynamics	Draft report completed			
Water quality	Drains 6 month data collated			
	Causeway 12 months collated			
Birds	Survey completed			

## Stage 3 – work plan

### **Forestry management strategies**

- Initial discussions with Scion
- Require nutrient and water balances (other workstreams)

## Stage 3 – work plan

- **Assessment of effects**
  - **Flow pathways and groundwater models**
  - **Nutrient pathways, transformations and fate**
  - **Microbial contaminants (including ECs) and potential risks**
  - **Water quality of inputs in context of harbour, national standards**
  - **Potential effects on forest/wetlands**
  - **Potential effects on benthic habitat, birds, fish**
  - **Monitoring plan, potential mitigation if required**

End - questions





Figure 1. Vegetation and habitat types of the receiving environment for the Omaha Wastewater Treatment Plant discharge, Omaha.

(Sheet 1 of 2)

**Wildlands**  
www.wildlands.co.nz

Scale: 1:3,500  
Date: 15/01/2015  
Cartographer: FM  
Format: A3

**Data Acknowledgment**  
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Date: E:\g\Omaha\WTP\envd  
File: Haver\_Vegetation\_Sheet 1.mxd



Figure 1. Vegetation and habitat types of the receiving environment for the Omaha Wastewater Treatment Plant discharge, Omaha.

(Sheet 2 of 2)

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A - Backfilling by mangroves

B – Seagrass expanding northwards

C – Expansion of seagrass patches

D – Seagrass patches expanded, mangroves expanding seaward

E – Backfilling with scattered mangroves

F – Mangroves expanded

G – increase in mangroves

# Water quality surface waters – Stage 2 cont.

Site	Amm-N	Nitrate/nitrite mg/l	TN	DRP	TP	TSS	Turbidity NTU	E.coli cfu/100 ml
4 NW of Jones Rd (ctl)	0.03-0.07	0.002-0.004	1.0-1.2	0.008-0.010	0.026-0.029	4.5-27	1.8-4.9	7.0-54.0
5 Sth Jones Rd (ctl)	0.01-0.065	0.01	0.35-1.2	0.008-0.019	0.043-0.40	12-130	12.0-60.0	150-760
7 Harbour (1) - sth	0.021-0.057	0.002-0.013	0.31-0.47	0.004-0.014	0.040-0.049	20-63	7.9-28	160-530
8 Harbour (2)	0.056-0.066	0.002-0.013	0.21-0.87	0.002	0.01-0.03	18-20	3.7-4.3	380-2400
10 Harbour (3)	0.043-0.12	0.018-0.12	0.35-0.53	0.002-0.007	0.007-0.019	14-24	4.2-12.0	99-830
11 Stream 1 Head of Arm	0.010-0.045	0.004	0.05-0.27	0.005-0.010	0.015-0.050	12.0-31.0	1.7-4.9	34-170
12 Harbour east	0.013-0.047	0.004	0.19-0.92	0.005-0.012	0.021-0.11	17-58	5.9-21	25-130
14 Stream 2 Head of Arm	0.017-0.027	0.004	0.18-0.37	0.011-0.022	0.032-0.050	10.0-32	3.5-5.4	520-1200
16 Drain to nth Jones Rd	0.041-0.10	0.004	0.52-0.74	0.008-0.011	0.044-0.059	14-16	12.0-14	18-62
Causeway	0.005-0.013	0.002-0.062	<0.01	0.003-0.008	0.007-0.012	<12		<10
AC Std	<0.089	<0.105			<0.062	<25	<7.7	