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**Omaha WWTP Consultative Group
Point Wells Bowling Club, 27 February 2016**

Omaha WWTP - Groundwater Assessment Results

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Presentation Outline

- Investigations
- Conceptual Model of Groundwater Systems
- Assessment and analysis of future treated wastewater irrigation
- Findings
- Effects on Groundwater Users
- Where to from here



Stage 1 (Feb 2015) Completed Investigations

- Coastline area survey
- 'Land Drain' inspections
- 14x auger holes
- ~4 km of Ground Penetrating Radar (GPR) surveys
- ~3.1 km of Electro-Magnetic (EM) surveys
- 6x groundwater quality samples

Inform Conceptual Model

2



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Stage 2 Completed Investigations

- Installed 23x additional groundwater monitoring wells
- Groundwater level gauging and chemistry sampling
- Major Drains - flow gauging and surveying
- Omaha Taniko Wetland – shallow geological investigation
- Soil infiltration capacity testing
- Soil permeability testing

Inform Conceptual Model

3



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Stage 1 Completed Investigations



4



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Stage 2 Completed Investigations – Omaha Flats



6



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Stage 2 Completed Investigations – Mangatawhiri Spit



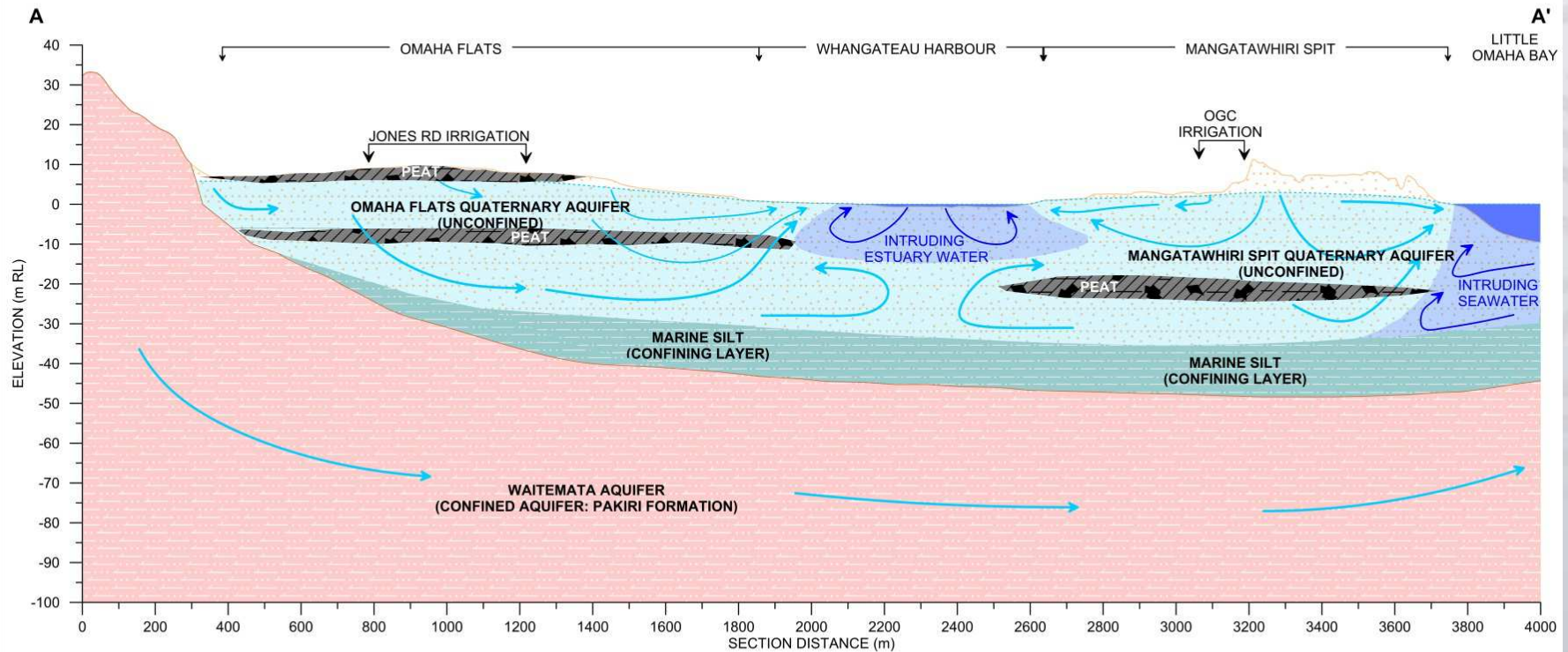
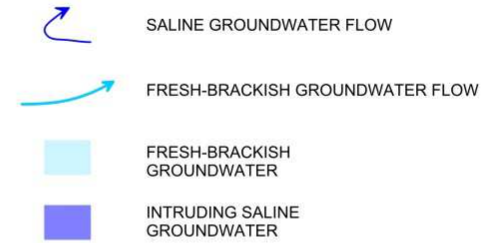
7



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Finalised Conceptual Model



Modelling Approach

- Develop Computerised 3D groundwater models (MODFLOW)
 - Calibrate models - using existing data + data gained in Stage 1 & 2 - to match existing conditions.
 - Run the scenarios through the models to provide assessment of effects.
- Apply to current discharge
 - Use recent irrigation data (2010-2014)
 - Ran the 'Existing' system loadings through the entire climate data series from 1969 to 2014 within the models



'Existing' System – Irrigation Volumes

Irrigation Block	Season	Volume (m ³)	Block Irrigation Rate (mm/day)	Proportion of Total
JRS Eucalypt	Summer	16,210	1.4	35%
	Winter	40,836	2.5	
JRS Natives	Summer	9,576	1.8	17%
	Winter	18,410	2.4	
OBGC Fairways	Summer	49,100	5.7	30%
	Winter	0	0.0	
OBGC Dunes	Summer	0	0.0	18%
	Winter	30,000	22.5	
Summer Total		74,886	-	46%
Winter Total		89,246	-	54%
Annual Total		164,132	-	100%

- Based on existing irrigation rates from 2010 to 2014



Where does it go? - 'Existing' System 'Water Balance'

Irrigation site	Rainfall + Irrigation: Evapotranspiration + Interception %	Run Off % (From Rainfall only*)	Seepage to Groundwater	Discharge to Omaha River Arm %	Discharge to Waikokopu Creek Arm %	Discharge to Omaha Beach %
Jones Road Site	64	3		3	30	N/A
Omaha Beach Golf Course	45	2		N/A	42 - 53	0 - 11
Omaha Dunes**	0	N/A		N/A	0 - 10	90 - 100

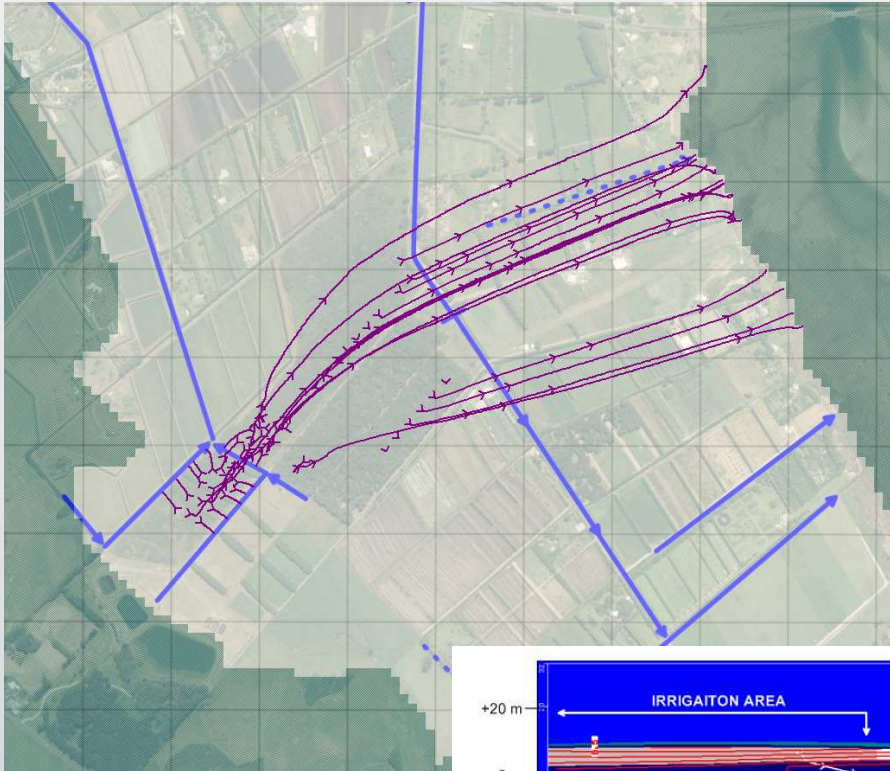
*Run off from rainfall only. WSL do not irrigate during high intensity rainfall or surface inundation

**Omaha Dunes – Irrigation % presented only, model assumes no ET or interception of Dune irrigation.

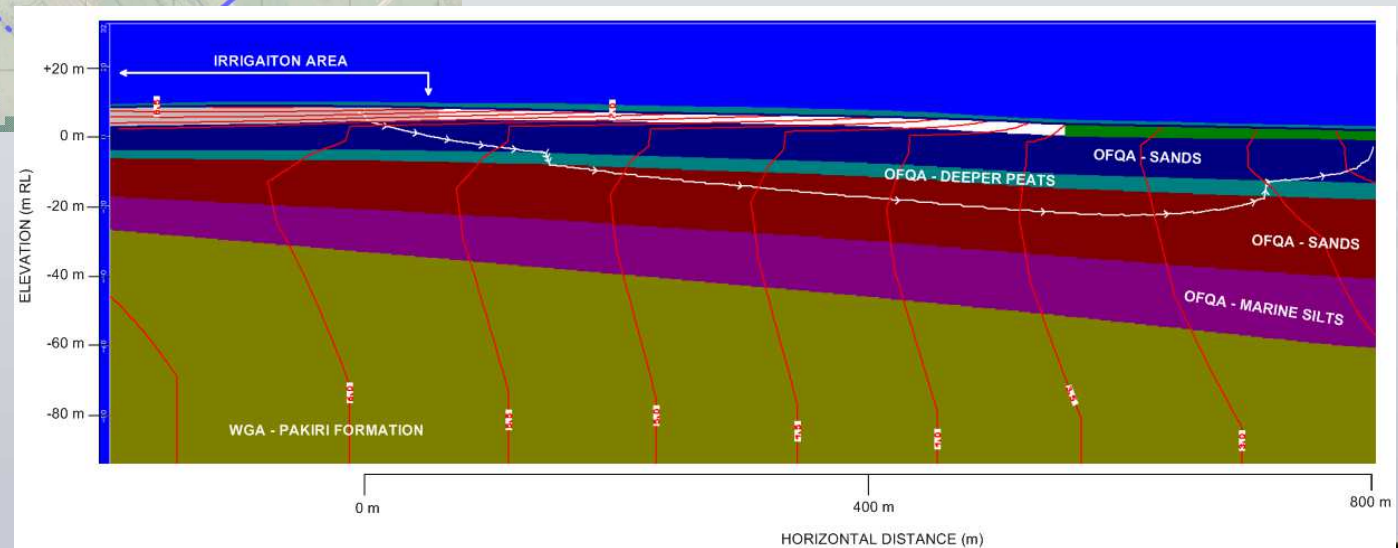
- JRS average travel time to Waikokopu Arm = 19 to 22 years
- JRS average travel time to Omaha River Arm = 6 months to 2 years
- Mangatawhiri Spit average travel time to Waikokopu Arm = 18 to 25 years
- Mangatawhiri Spit average travel time to Omaha Bay = 25 to 35 years



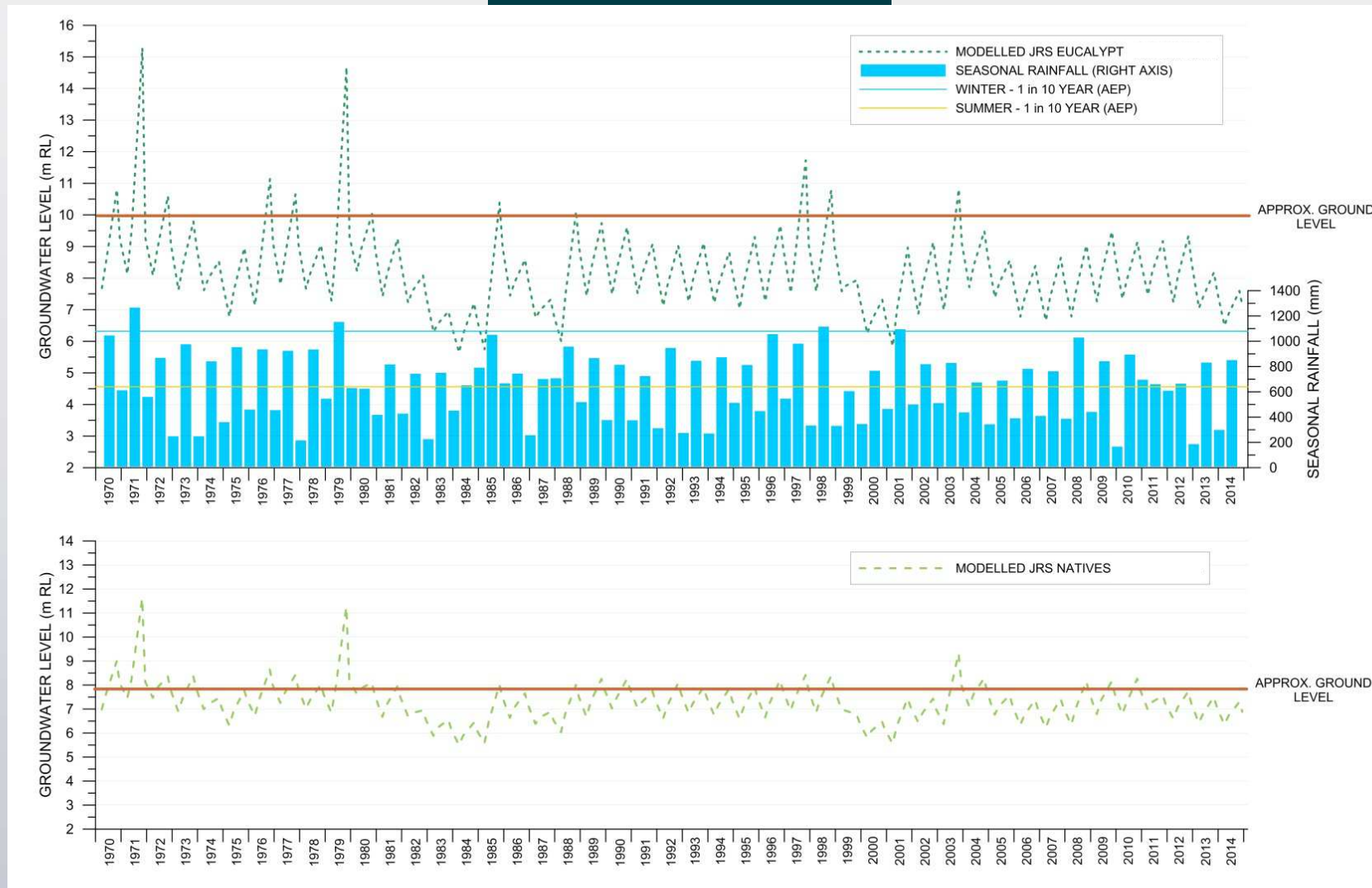
Seepage to groundwater from JRS



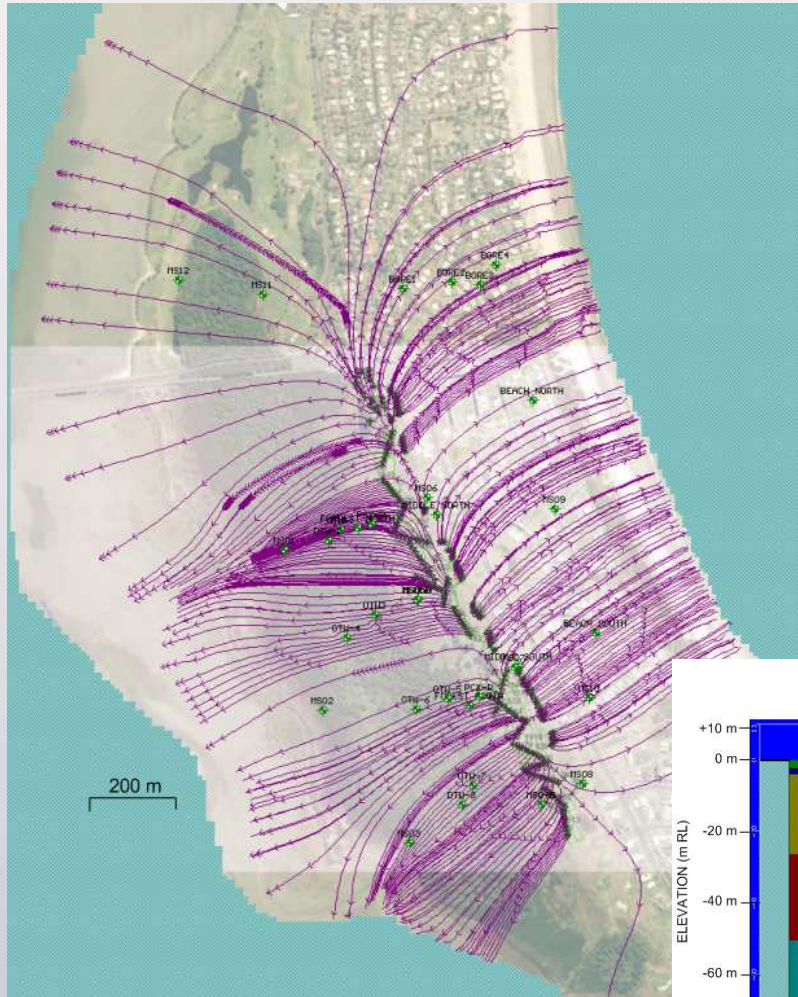
- Majority of recharge migrates downwards & then eastward to Waikokopu Arm
- Plan = Arrows spaced at 5 year intervals
- Vertical Slice = Arrows spaced at 1 year intervals



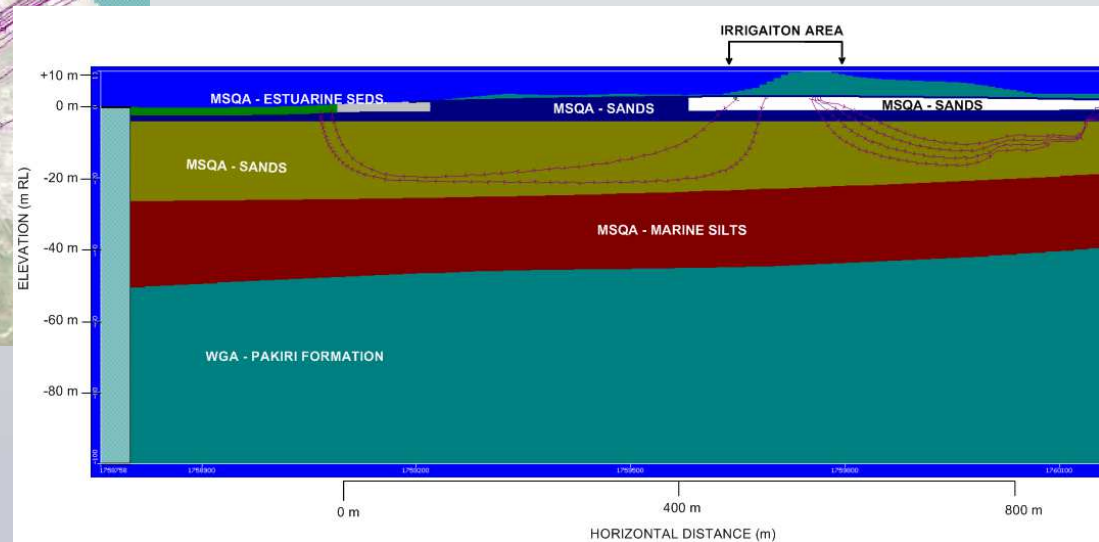
During wet winters, irrigation at Omaha WWTP is not always possible



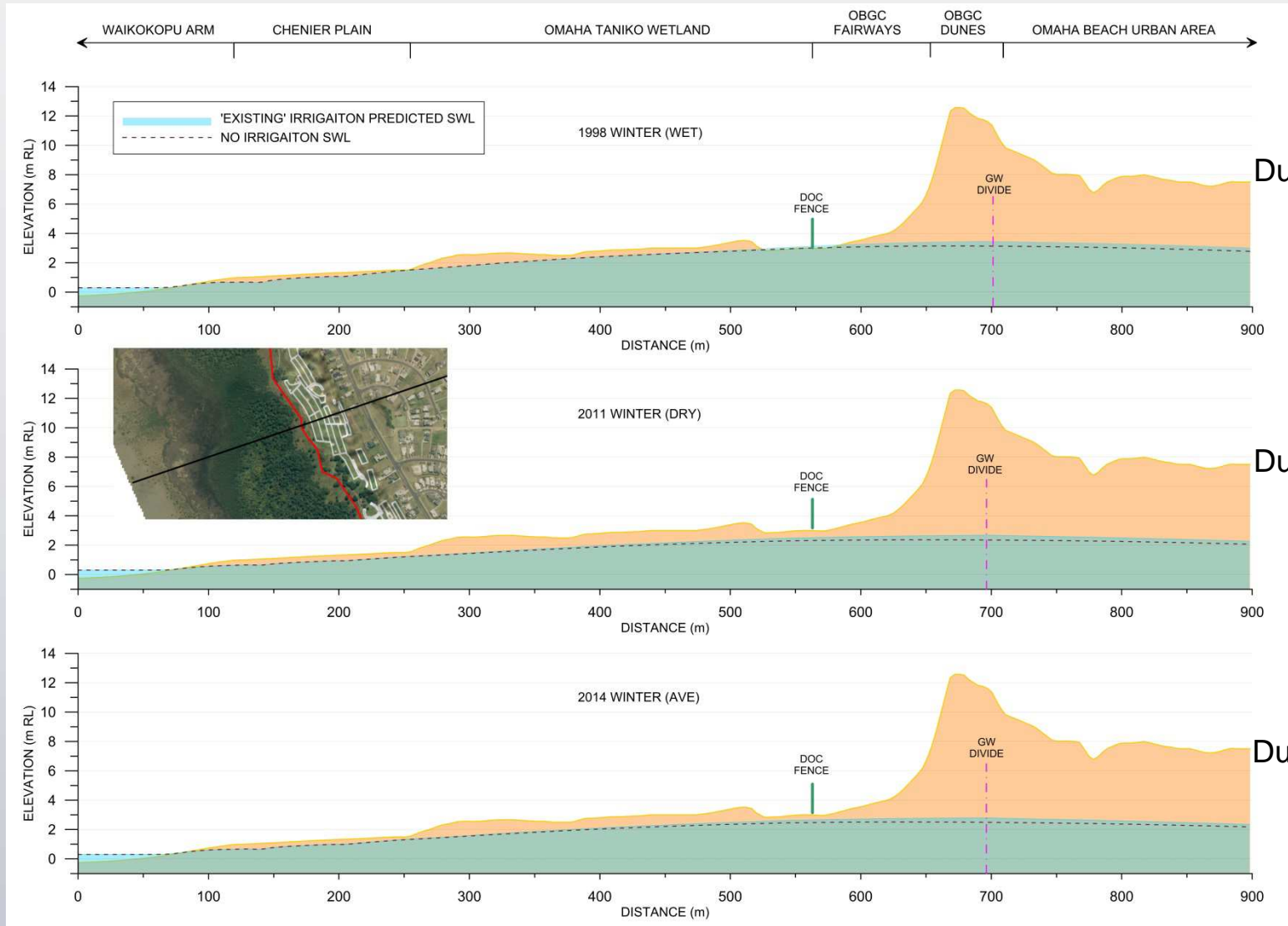
Seepage to groundwater at Mangatawhiri Spit



- Majority of summer irrigation migrating downwards then westward towards Waikokopu Arm
- Majority of winter irrigation migrating downwards then eastward towards Omaha Bay
- Plan = Arrows spaced at 10 year intervals
- Vertical Slice = Arrows spaced at 1 year intervals



Predicted effect of golf course irrigation on water level at Mangatawhiri Spit



Key finding of existing irrigation rates

- The irrigation system (utilising Jones Road, the Omaha Beach Golf Course fairways, and when necessary, the dunes) is entirely suitable to deal with existing irrigation volumes (164,000 m³/year) across the full hydrographic record (rainfall and groundwater levels)
- The current system at Jones Road is being used at close to its capacity and therefore the existing area would need to be expanded to accommodate increased irrigation volumes



If the current system is sustainable, what is the capacity?

- Watercare owns additional unirrigated land at Jones Road
- Some of this land is low lying and is not suitable
- However, there is ~9.1 ha of land at an even higher elevation than the existing irrigated land that is therefore suitable for irrigation.



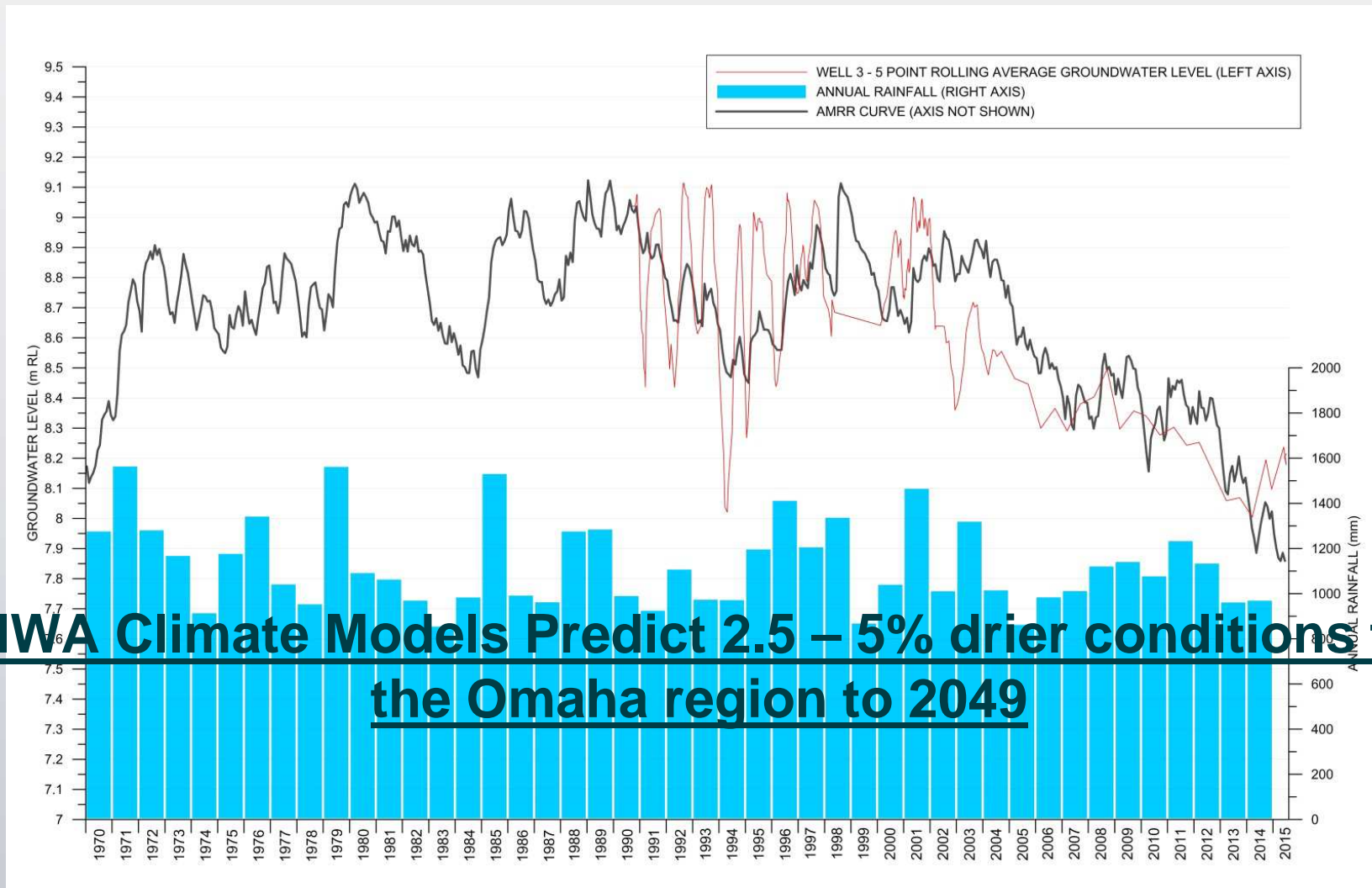
Assumptions for testing capacity

- No additional summer irrigation of the Omaha Beach Golf Course

- Irrigation must not:
 1. raise water table to ground surface on Jones Road Site; and
 2. raise water level above 3.5m RL at golf course - almost entire golf course area remains playable.



Rainfall & Hydrograph Analysis



NIWA Climate Models Predict 2.5 – 5% drier conditions for the Omaha region to 2049



'Future' System – Irrigation Volumes

To maintain groundwater levels below ground surface levels at the Jones Road Site, adjustments to the above figures were made as follows:

- For wet winters (determined as 1970, 1971, 1973, 1979, 1985, 1996, 1998, 2001)
 - OBGC Dune irrigation volume was increased to 153,195 m³, JRS irrigation blocks were decreased to 0 m³.

- For drier winters (determined as 1980, 1984, 1999, 2005, 2011, 2012)
 - OBGC Dune irrigation volume was decreased to 58,735 m³. The residual was assimilated by increasing the JRS irrigation volumes to the blocks, pro-rata to area.



'Future' System– Mangatawhiri Spit Predictions – 'Wet' Winter



- Dune Irrigation = 153,195 m³
- Blue = groundwater at surface - 'Future' system irrigation
- White = groundwater at surface - no irrigation
- Black = 3.5 m RL topographic contour
- Red = OBGC irrigation blocks
- Note: Potential for exacerbation of saturated ground conditions in isolated areas >3.5 m RL, for ~2 months toward the end of a wet winter.



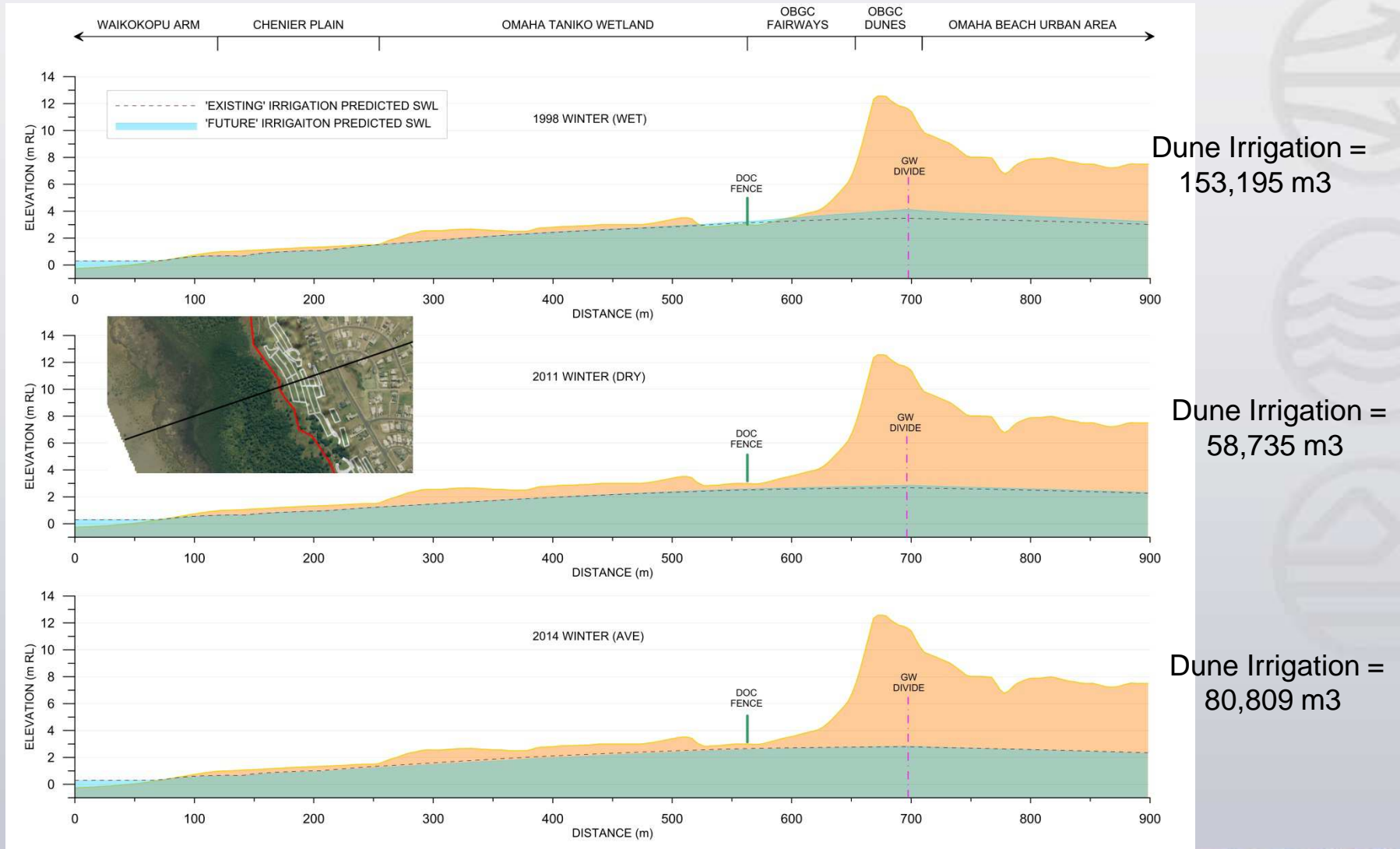
'Future' System– Mangatawhiri Spit Predictions – 'Wet' Winter



- Dune Irrigation = 153,195 m³
- Blue = groundwater within 0.2 m of ground surface under 'Future' system irrigation
- White = groundwater within 0.2 m of ground surface under no irrigation
- Black = 3.5 m RL topographic contour
- Red = OBGC irrigation blocks



Future' System– Mangatawhiri Spit Predicted Effects



'Future' System (Average Winter) – Irrigation Volumes

Irrigation Block	Season ¹	Volume (m ³)	Block Irrigation Rate (mm/day)	Proportion of Total
JRS Eucalypt	Summer	36,054	3.1	21%
	Winter	27,686	1.7	
JRS Natives	Summer	19,501	3.7	10%
	Winter	9,211	1.2	
JRS Additional	Summer	42,150	3.1	26%
	Winter	35,390	1.8	
OBGC Fairways	Summer	49,100	5.7	16%
	Winter	0	0.0	
OBGC Dunes	Summer	0	0.0	27%
	Winter	80,908	60.6	
Summer Total ²		146,805	-	49%
Winter Total ³		153,195	-	51%
Annual Total		300,000	-	100%

- Equates to an increase of ~91% of irrigation rates from 'Existing' system
- Includes dam storage hold and release of 11,520 m³.

24



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'Future' System (Wet Winter) – Irrigation Volumes

Irrigation Block	Season ¹	Volume (m ³)	Block Irrigation Rate (mm/day)	Proportion of Total
JRS Eucalypt	Summer	36,054	3.1	12%
	Winter	0	0	
JRS Natives	Summer	19,501	3.7	7%
	Winter	0	0	
JRS Additional	Summer	42,150	3.1	14%
	Winter	0	0	
OBGC Fairways	Summer	49,100	5.7	16%
	Winter	0	0.0	
OBGC Dunes	Summer	0	0.0	51%
	Winter	153,195	114.7	
Summer Total ²		146,805	-	49%
Winter Total ³		153,195	-	51%
Annual Total		300,000	-	100%

- Includes dam storage hold and release of 11,520 m3.



Where does it go? - 'Future' System - 'Water Balance'

Irrigation site	Rainfall + Irrigation: Evapotranspiration + Interception %	Run Off % (From Rainfall only*)	Seepage to Groundwater	Discharge to Omaha River Arm %	Discharge to Waikokopu Creek Arm %	Discharge to Omaha Beach %
Jones Road Site	66	3		2	29	N/A
Omaha Beach Golf Course	45	2		N/A	48 -53	0 - 5
Omaha Dunes**	0	N/A		N/A	10 – 45	55 - 90

*Run off from rainfall only. WSL do not irrigate during high intensity rainfall or surface inundation

**Omaha Dunes – Irrigation % presented only, model assumes no ET or interception of Dune irrigation.

- JRS travel times remain essentially the same as 'Existing' system
- Mangatawhiri Spit average travel time to Waikokopu Arm ~15% faster than 'Existing' system
- Mangatawhiri Spit average travel time to Omaha Bay ~10% faster than 'Existing' system







Key Finding – ‘Future’ System

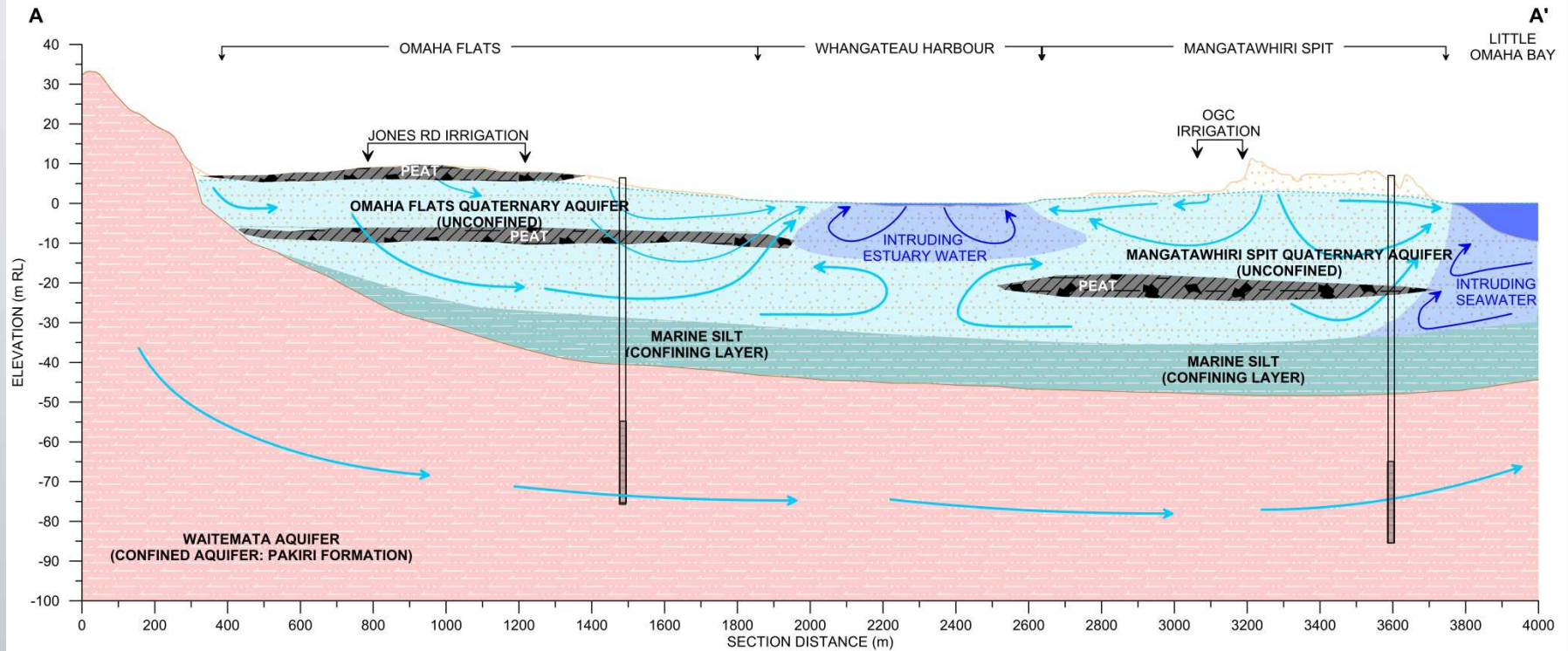
- We have concluded that the capacity of the irrigation system with the additional 9.1 ha at Jones Road is 300,000 m³ per year, approximately double the current discharge



Other Groundwater Users



-  SALINE GROUNDWATER FLOW
-  FRESH-BRACKISH GROUNDWATER FLOW
-  FRESH-BRACKISH GROUNDWATER
-  INTRUDING SALINE GROUNDWATER



Other Groundwater Users

Omaha Flats:

- Number of current registered groundwater takes (>15)
- All takes from the Waitemata Group Aquifer (Pakiri Formation)
- Most takes of relatively low volume/rate i.e <15,000 m³/year
- Only 1 take within 400m of Jones Road Site irrigation blocks

Mangatawhiri Spit:

- Three (3) current registered groundwater takes (1x Surf Club, 2x Golf Club)
- Takes from Waitemata Group Aquifer (Pakiri Formation) and Waipapa Group (Greywacke)



Other Groundwater Users

Potential effects predicted to be negligible:

- Waitemata Group Aquifer is well confined from the near surface groundwater (Omaha Flats & Mangatawhiri Spit Quaternary Aquifers).
- The takes are unlikely to have potential to 'reverse' the natural upward head gradient.
- Aquifer essentially fully allocated – no / little room for additional takes





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