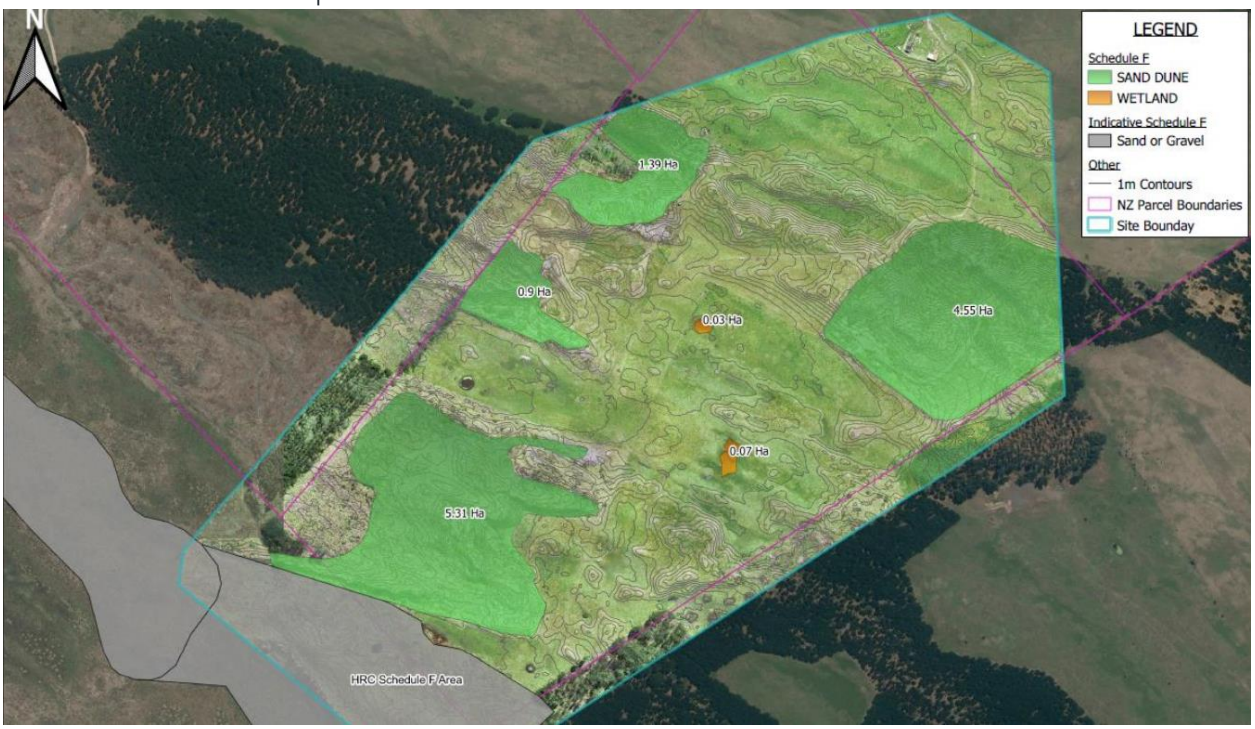
Memorandum

To	Adina Foley & Blair King
Copy	Tabitha Manderson
From	Simon Bradshaw
Office	Palmerston North
Date	27 October 2023
File/Ref	5-P1472.00
Subject	Ratana Wastewater Storage Options_v3

Storage Pond – Design Parameters and Assumptions

- Avoid impact on the sand dune locations identified in Ratana Wastewater Discharge Wetland Delineation Report dated December 2021



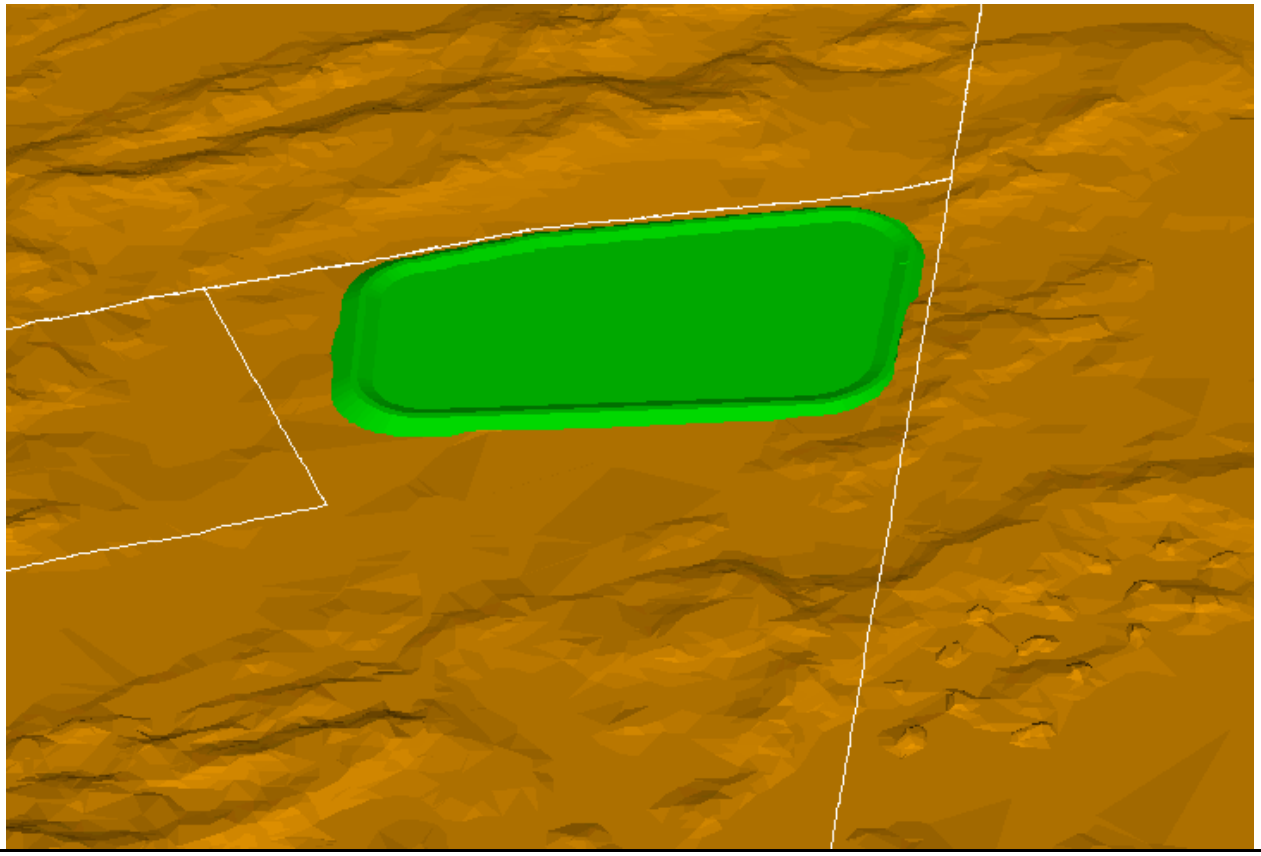
- Storage pond volume requirement 28,500m3 (from Ratana Wastewater Treatment Plant dated June 2021 [Preliminary Water Balance]). This was updated to 30,200m3 in the irrigation specimen design October 2023.
- Ground surface originally based on 2015/2016 LIDAR obtained from LINZ database. Ground surface was updated with drone DEM provided by Stringfellows August 2023. Dam 6 was outside the DEM
- Water depth to be a maximum of 3m within the storage pond.

WSP
Palmerston North
49 Victoria Avenue
PO Box 1472
Palmerston North 4410, New Zealand
+64 6 350 2500
wsp.com/nz

- Freeboard of 1m, allowing for 0.5m spillway and 0.5m wave lap.
- Base of pond no lower than 13.7 RLm (as advised by geotechnical engineer based on available information from the ground water monitoring data). Further advice was provided with respective to area within western portion of the site (i.e., between BH1 and BH4), where we can ignore readings from BH3 as it is beyond the extent of our pond location. Considering this, we can use a pond invert of 13.0 RLm for this area (0.5m above max water encountered in all other BHs).
- 3m crest width (for access)
    - Need to make allowance for vehicle access onto crest. Not considered in this concept stage
- Embankment batters 3 to 1 internal and 2 to 1 external (assumes tractor arm for maintenance on external batters)
- Footprint does not account for pump sheds and any other ancillary buildings.
- Earthworks are direct measure. No allowance for bulking or compaction factors.
- Concept design main consideration was geometry. This may be affected by other design considerations in later stages.

Storage Pond Concept Assessment Results

Dam 1



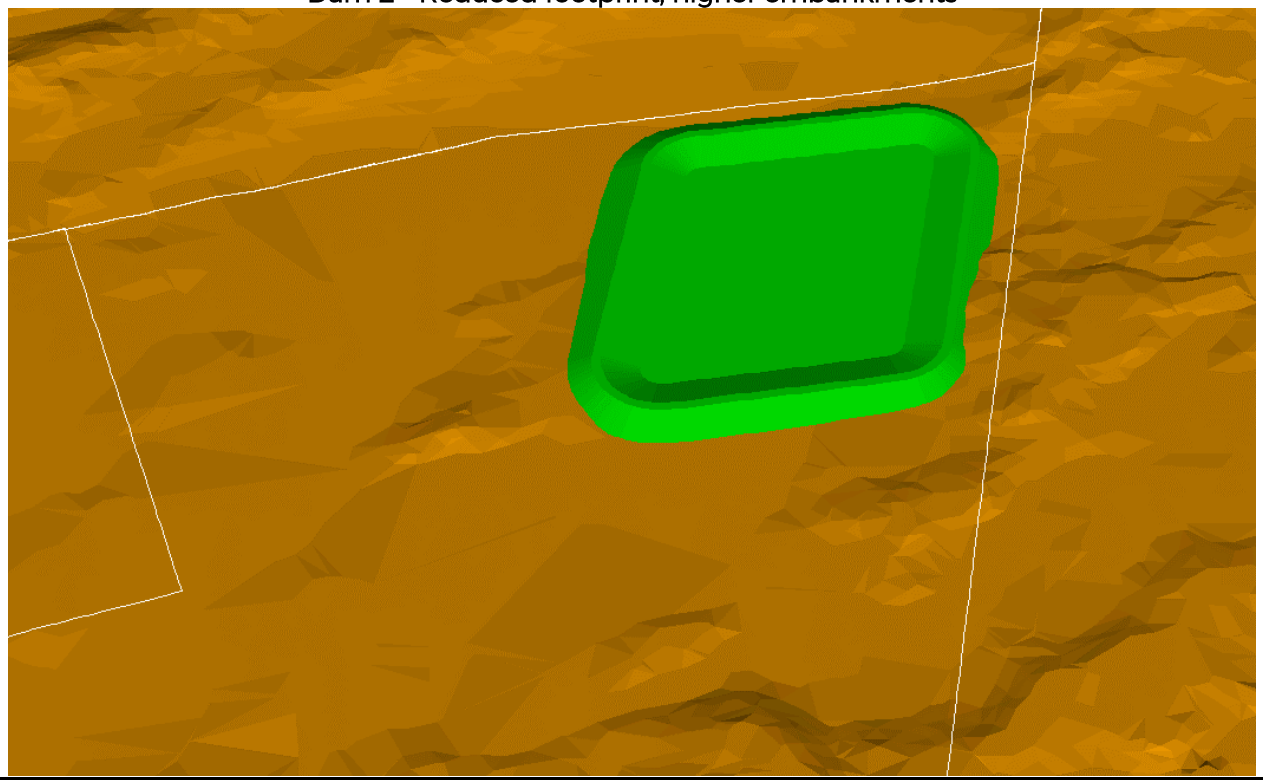
Pond Invert at 14 RLm

Earthworks	Measure	Notes
Cut to Fill (m3)	4700	Allows for 0.2m topsoil strip, as indicated by borehole logging on site
Imported Fill (m3)	46700	Ideally source a nearby borrow site

Storage		Notes
Embankment Level (RLm)	16	
Pond Water Max (RLm)	15.1	Allows for 500mm spillway and 400mm wave lap (i.e. 900mm freeboard)
Embankment Height (m)	4	Could cause consenting and operation challenges
Storage Vol (m3)	28900	
Pond Area incl embankments (m2)	35600	
Embankment Level (RLm)	16	
Pond Water Max (RLm)	15.1	Allows for 500mm spillway and 400mm wave lap (i.e. 900mm freeboard)

WSP
Palmerston North
49 Victoria Avenue
PO Box 1472
Palmerston North 4410, New Zealand
+64 6 350 2500
wsp.com/nz

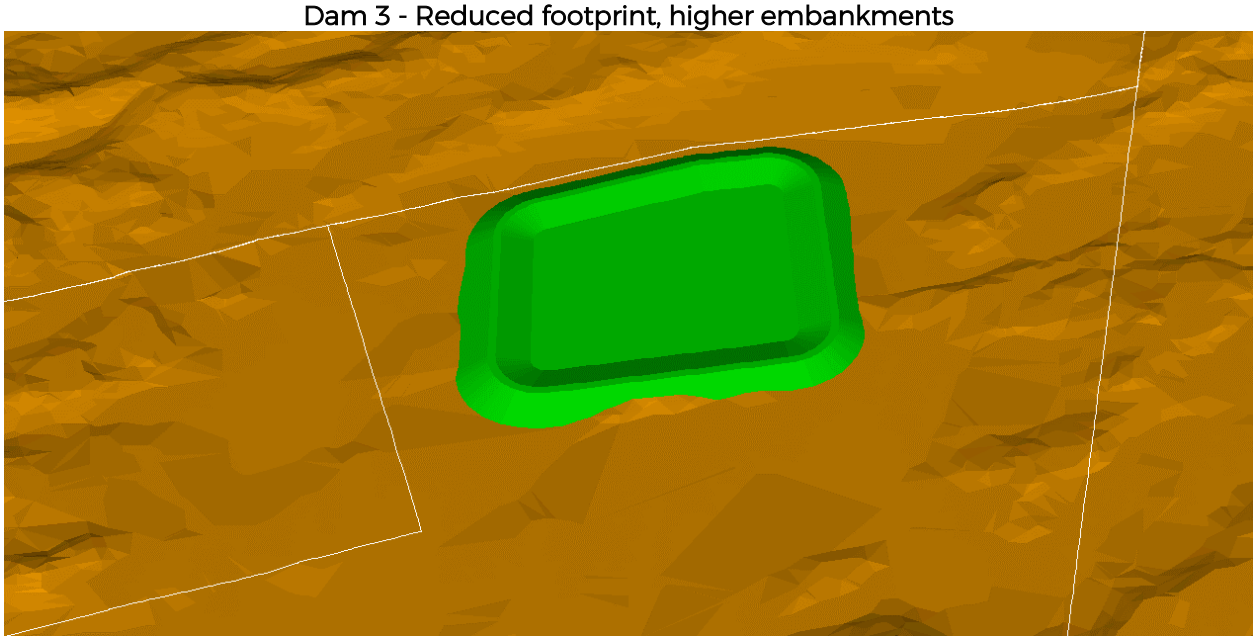
Dam 2 - Reduced footprint, higher embankments



Earthworks	Measure	Notes
Cut to Fill (m3)	4400	Allows for 0.2m topsoil strip, as indicated by borehole logging on site
Imported Fill (m3)	25700	Ideally source a nearby borrow site

Storage		Notes
Embankment Level (RLm)	17.7	
Max Pond Water (RLm)	16.7	Allows for 500mm spillway and 500mm wave lap (i.e. 1000mm freeboard)
Max Embankment Height (m)	6	Will require building consent
Pond invert (RLm)	13.7	Indicative level from ground water monitoring data (3 readings over the period 1 Sept 22 to 15 Sept 22)
Water depth (m)	3	3m and below does not require resource consent (see email from Horizons Duty planner)
Storage Vol (m3)	30,000	28,500m3 indicated in concept irrigation design
Pond Area incl. embankments (m2)	19,000	

Dam 3 - Reduced footprint, higher embankments



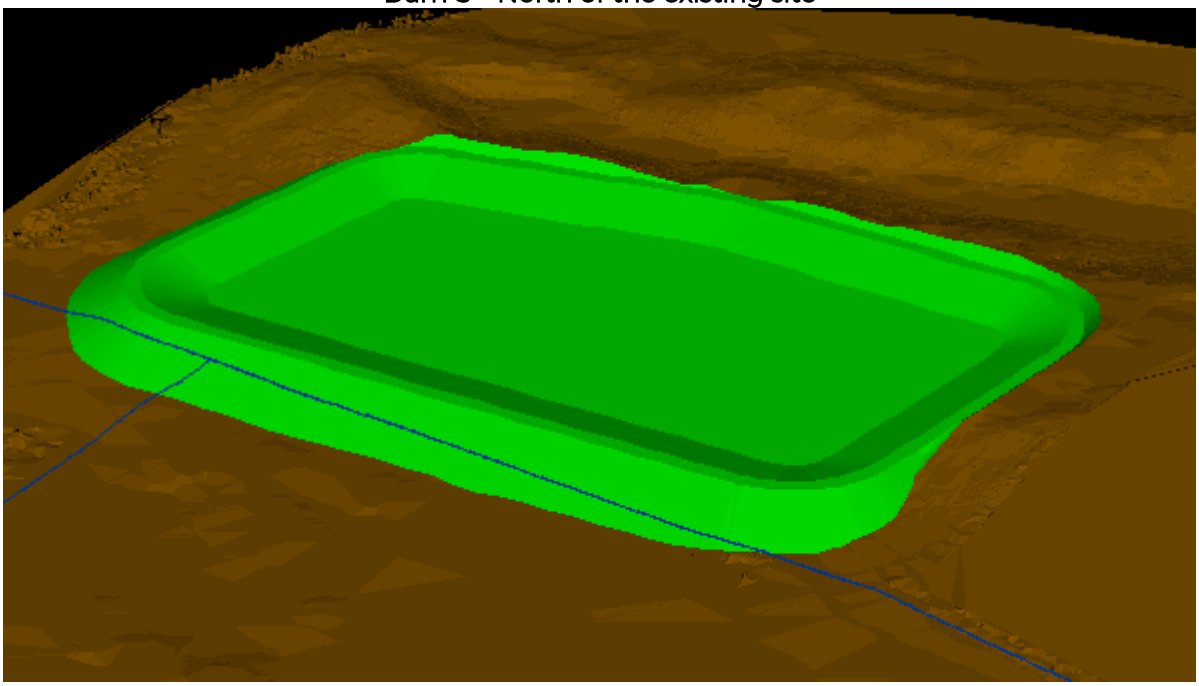
Earthworks	Measure	Notes
Cut to Fill (m3)	0	Allows for 0.2m topsoil strip, as indicated by borehole logging on site
Imported Fill (m3)	46,700	Ideally source a nearby borrow site

Storage		Notes
Embankment Level (RLm)	17.7	
Max Pond Water (RLm)	16.7	Allows for 500mm spillway and 500mm wave lap (i.e. 1000mm freeboard)
Max Embankment Height (m)	6	Will require building consent
Pond invert (RLm)	13.7	Indicative level from ground water monitoring data (3 readings over the period 1 Sept 22 to 15 Sept 22)
Water depth (m)	3	3m and below does not require resource consent (see email from Horizons Duty planner)
Storage Vol (m3)	30,000	28,500m3 indicated in concept irrigation design
Pond Area incl. embankments (m2)	20,000	

Some general notes applicable to scenarios Dam 2 and Dam 3 above:

- Minimum 5m offset from boundary to embankment toe has been maintained.
- Minimum 7m offset from eastern boundary maintained to allow for 5m wide swale with 1m offset if cut off drain from neighbouring irrigation is required.
- Both options are within the footprint of the original option presented below.
- The increased depth of water will has a positive effect on quality of wastewater stored.

Dam 5 – North of the existing site



Earthworks	Measure	Notes
Cut to Fill (m3)	23200	Allows for 0.2m topsoil strip, as indicated by borehole logging on site
Excess Cut (m3)	4400	Will likely be utilised in compaction and nearby low-lying areas

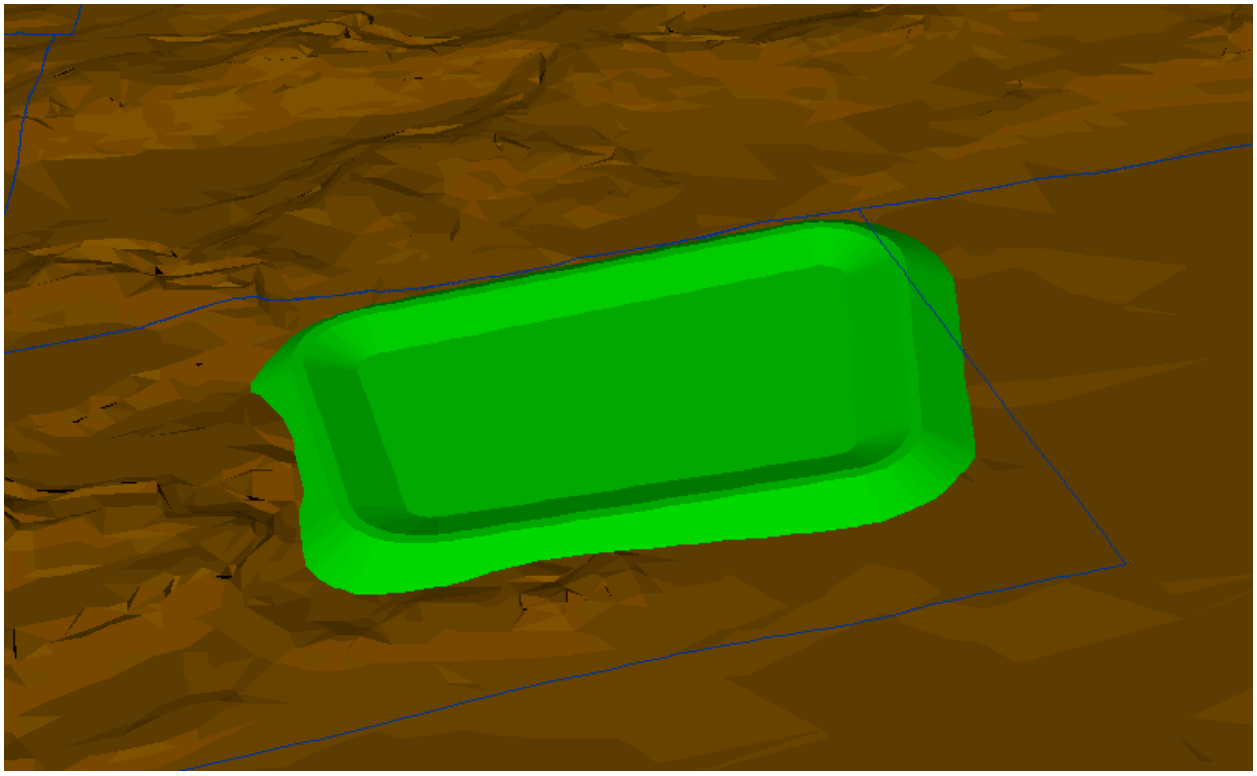
Storage		Notes
Embankment Level (RLm)	18.2	
Max Pond Water (RLm)	17.2	Allows for 500mm spillway and 500mm wave lap (i.e. 1000mm freeboard)
Max Embankment Height (m)	7	Will require building consent
Pond invert (RLm)	14.2	Above the level provide by Geotech team
Water depth (m)	3	3m and below does not require resource consent (see email from Horizons Duty planner)
Storage Vol (m3)	30,000	28,500m3 indicated in concept irrigation design
Pond Area incl. embankments (m2)	19000	

Some general notes applicable to scenario Dam 5 above:

- Land needs to be acquired.

WSP
Palmerston North
49 Victoria Avenue
PO Box 1472
Palmerston North 4410, New Zealand
+64 6 350 2500
wsp.com/nz

Dam 6 – Extra lot Purchased



Earthworks	Measure	Notes
Cut to Fill (m3)	3170	Allows for 0.2m topsoil strip, as indicated by borehole logging on site
Imported Fill (m3)	39,950	Ideally source a nearby borrow site i.e., adjacent hilltop in neighbouring property

Storage		Notes
Embankment Level (RLm)	17.0	
Max Pond Water (RLm)	16.0	Allows for 500mm spillway and 500mm wave lap (i.e. 1000mm freeboard)
Max Embankment Height (m)	7	Will require building consent
Pond invert (RLm)	13.0	Above the revised level provide by Geotech team for the area 3m and below does not require resource consent (see email from Horizons Duty planner)
Water depth (m)	3	
Storage Vol (m3)	30,900	28,500m3 indicated in concept irrigation design
Pond Area incl. embankments (m2)	21,000	

Further Considerations for All

- Confirm vehicle access to site.
- Geotechnical soil conditions not considered. This assessment is required and may redefine design parameters.

Summary table of the options considered to date is provided below.

Storage Pond Concept	Dam 1	Dam 2 - Reduced footprint, higher embankments	Dam 3	Dam 5 - North of the existing site	Dam 6 – Extra lot purchased
Cut to fill (m^3)	4,700	4,400	0	23,200	3170
Imported Fill	46700	25700	46,700	-	39,950
Excess Cut (m^3)	-	-	-	4400	
Embankment Level (RL m)	16	17.7	17.7	18.2	17
Max Pond Water (RL m)	15.1	16.7	16.7	17.2	16
Max Embankment Height (m)	4	6	6	7	7
Pond invert (RL m)	Not given	13.7	13.7	14.2	13
Water depth (m)	Not given	3	3	3	3
Storage Volume (m^3)	28,900	30,000	30,000	30,000	30,900
Pond Area incl embankments (m^2)	35,600	19,000	20,000	19,000	21,000
Notes		• Minimum 5m offset from boundary to embankment toe has been maintained. • Minimum 7m offset from eastern boundary maintained to allow for 5m wide swale with 1m offset if cut off drain from neighbouring irrigation is required. • Both options are within the footprint of the original option presented below. • The increased depth of water will have a positive effect on quality of wastewater stored.	• Minimum 5m offset from boundary to embankment toe has been maintained. • Minimum 7m offset from eastern boundary maintained to allow for 5m wide swale with 1m offset if cut off drain from neighbouring irrigation is required. • Both options are within the footprint of the original option presented below. • The increased depth of water will have a positive effect on quality of wastewater stored.	• Land needs to be acquired. • Refinement required to better balance out cut and fill.	• Allows 0.2m topsoil strip, as indicated by borehole logging on site. • Propose to use borrow from nearby hill in neighbouring property.

WSP
Palmerston North
49 Victoria Avenue
PO Box 1472
Palmerston North 4410, New Zealand
+64 6 350 2500
wsp.com/nz

Recommendation

The Client (RDC) confirmed that Dam 6 was the preferred site for storage.

WSP
Palmerston North
49 Victoria Avenue
PO Box 1472
Palmerston North 4410, New Zealand
+64 6 350 2500
wsp.com/nz