Addendum: Specific information for prioritised sites

Between the Domes Catchment Group

Prepared for Thriving Southland

October 2022

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* Addendum to: Sukias, J.P.S., Tanner, C.C. (2022). Assessment of sites for on-farm pollution mitigation actions: Between the Domes Catchment Group. NIWA Client Report 2022209HN prepared for Thriving Southland. July 2022.

Contents

1 Drummond Farm Constructed Wetland

The farm owner, Greg Drummond has confirmed the catchment area for the proposed constructed wetland is ~30 ha. As the farm is primarily a cropping farm, nutrient leaching rates from the catchment are expected to be relatively high. Undergrounding the incoming drain will reduce surface-flows and associated sediment and particulate phosphorus inputs to the wetland. The field in which wetland construction is proposed is 0.58 ha in area, although due to existing drainage lines and wet pasture areas, the available area is 0.50 ha (~1.7 % of contributing catchment, Figure 1). In Southland conditions we would expect the wetland to provide total nitrogen removal of between 18 and 30% of incoming levels based on these areas. Total phosphorus removal would likely fall between 24 and 44%, depending on its form[1].

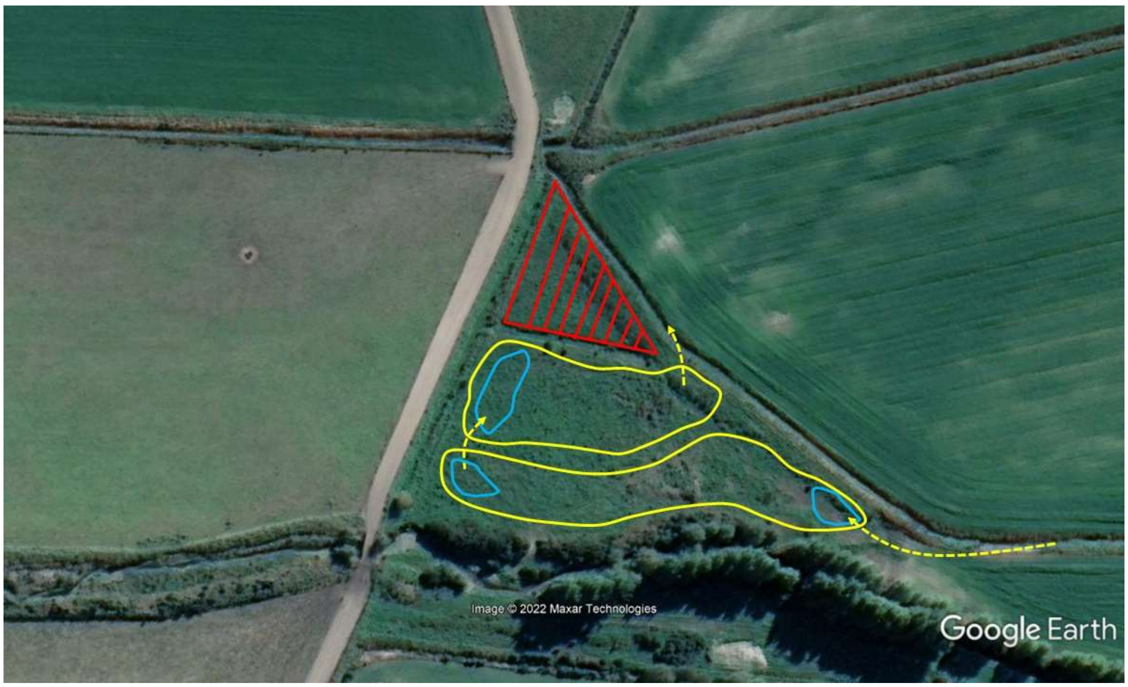

Figure 1: The proposed wetland areas. The proposed wetland is divided into two cells outlined in yellow. Inflow, outflow and inter-cell connections are shown as dashed yellow arrows. Zones outlined in blue are deeper areas (1-1.5 m) for improved flow distribution and capture of any residual solids. The red hatched triangle is an area identified by the farmer as not available for wetland construction.

There needs to be sufficient fall between the drain and the wetland base that water naturally flows into the wetland, with a depth of 30 cm (standard depth – shallow planted areas). The drain elevation is ~268 m according to Google Earth. The distance from the drain to the nearest wetland input point is 50-60 m with a fall of approximately 2 m, giving a gradient of ~4% (this does not take into account the depth of the drain itself). These levels should be checked on-site by a suitably qualified excavator operator or surveyor. A conceptual set of drain and wetland heights is shown below (Figure 2).

[1] Dissolved or particulate phosphorus.

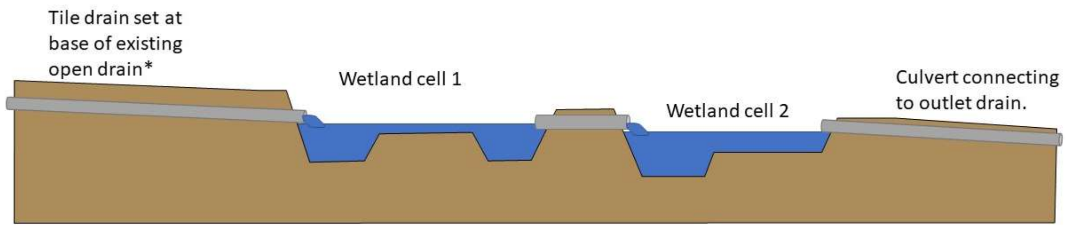

Figure 2: Conceptual "falls" from existing drain into wetland cell 1 and throughout the system. Depths and relative sizes of deep and shallow areas not to scale.

The proposed wetland should be constructed in two cells with a width to length ratio of between 4:1 and 10:1 to optimise flow. The edges of the wetland are gently curved to give a more natural shape. The wetland will need to be excavated deeper than the final operating depth, allowing for some free-board as well as a layer (15 -20 cm) of soil (50:50 top soil and subsoil mix) which will sit in the base of the wetland for planting the wetland plants into.

We recommend that the shallow areas of the wetland be planted with the native bullrush, raupo (*Typha orientalis*), as this will provide abundant leaf litter required for denitrification. The edges of the wetland can be planted with a variety of herbaceous native riparian species such as Carex, flax and toitoi to enhance their natural appearance and biodiversity values. Taller shrubs and trees can be planted on the outer edge of the bunds and surrounding areas.

Within the wetland, non-planted deeper areas (0.5-1.0 m) at the inlet of both cells and the outlet of cell 1 are used to encourage flow to spread across the full width of the wetland, avoiding "dead" zones in the corners[2]. A conceptual diagram showing plants locations and depths is shown in Figure 3. We encourage all those involved in wetland construction and planting to consult the Constructed Wetland Practitioners Guide[3] (Tanner et al. 2022), freely available for download from the internet.

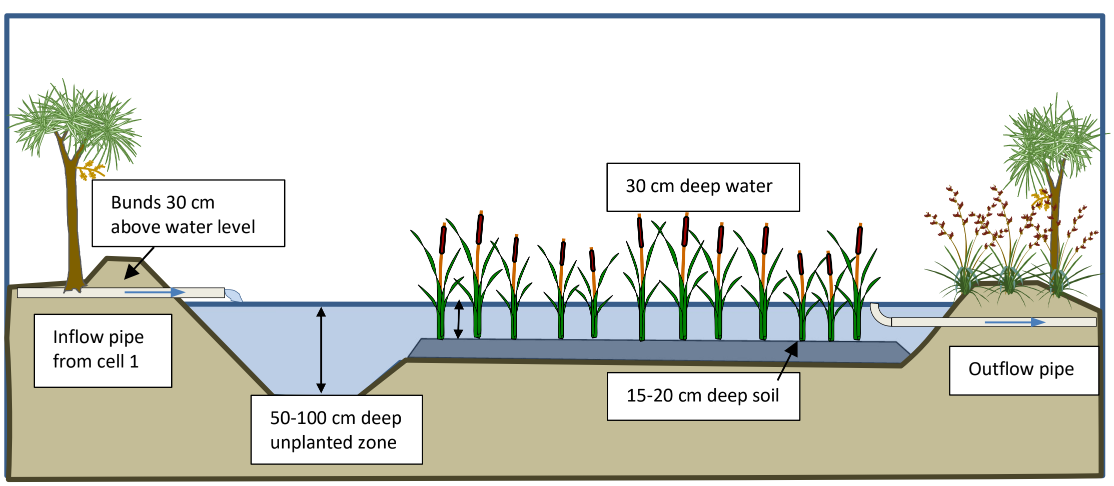

Figure 3: Relative wetland zone depths. Longitudinal section through cell 2. (Not to scale).

[2] Note that reference to deeper zone plants in Table 1 is for other types of wetlands.
[3] Go to https://niwa.co.nz/sites/niwa.co.nz/files/wetland%20practitioner%20Guide-web.pdf for a download or search "wetland practitioners" on the NIWA website. Or https://www.dairynz.co.nz/media/5795688/wetland-practitioner-guide-web-aug-2022.pdf

A PVC outlet pipe with a 90° bend which can be freely rotated (i.e. not fixed) will enable water level adjustment. During plant establishment, the bend is turned flat, so water depths are only 5-10 cm deep. After plants are established, the bend is rotated upwards so that operational water depths are 30 cm. If necessary, a short extension can be added to the bend so that this depth is achieved.

The following is a general sequence for constructing such a wetland.

- Spray weeds in and around the site 4-6 weeks before construction with a low residue, translocated herbicide such as glyphosate.
- Clear construction area of vegetation, rocky debris and a few centimetres of topsoil. Place in waste area.
- Scrape off clean topsoil and place in a reserve area. This will be used later as a planting medium in the wetland and surrounding amenity areas.
- Peg out dimensions of the wetland.
- Excavate general wetland area down to a depth of 50 cm below the final wetland water level*. If there is doubt as to whether the wetland will hold water, then a compacted clay layer may need to be added to seal the base.
- Excavate the deep areas at outflow points, and the inflow to cell 1. The removed subsoil can be used to create bunds around the edges of the wetland cells. Bunds should be track-rolled in layers of 5-10 cm to compact them, making the bunds structurally sound and water-tight.
- Excavate locations where culverts are to be placed (except the inflow and final outflow culverts. These are done once the wetland is ready to be flooded). These should be carefully placed to ensure the water depth of the shallow areas of the wetland are at 30 cm (see note below regarding returning planting media/topsoil to the wetlands).
- Add culverts and re-pack soil over and around the culverts. As leaking around culverts between cells can lead to erosion, it is preferable to use soil with as high a clay content as possible. Collars can also be placed around culvert pipes to minimise water tracking along the outsides of the culvert, but these are often difficult to source commercially.
- If available, a 90° bend can be attached to the culvert pipes. This can be rotated to raise lower the level of the wetland during construction, plant establishment and final operational depth of the wetlands.
- Return a 15-20 cm layer of topsoil to the shallow areas of the wetlands and level so that a final water depth of 30 cm is maintained in these areas. Ideally his should be lightly compressed. Do not add this layer within the deep excavated areas. Also spread soil topsoil over surrounding amenity areas for planting with riparian plants.
- Install the outlet culvert pipe and then the inlet culvert pipe.
- Adjust water depths (with rotating 90° bend) so that shallow areas are just inundated (≤10cm).
- Plant with wetland plants, preferably in spring or early summer, allowing time for the new plants to establish before autumn.
- As plants grow, gradually raise water levels to a final operating level of 30 cm

2 Saunders Farm. Stagg Creek Wetland

The original concept proposed by NIWA, building on concepts outlined by the farm owner, was to enhance the existing wetland by creating bunds across the flow path, flowing down beside Stagg Creek. As noted in the main body of the report, this is likely to require regional council approval/consenting. On further consideration, given the large area of the wetland relative to its contributing catchment, we think that earthworks in the wetland are not necessary, and planting alone will provide a suitable, more cost-effective outcome. Therefore we have limited our advice to recommendations on key wetland species and appropriate water depths for their establishment in this area. The "key" wetland plants, as noted in Table 1, are those larger robust species which tend to dominate wetlands and their riparian zones, and which once established will have a good chance of holding their own against the weeds. A large sized wetland with variable water depths such as this is likely to develop various diverse niche habitats that are suitable for inclusion of a wide range of native species, including rarer species that are not commonly available from wetland suppliers.

A major challenge for this site will be managing invasive weeds sufficiently to enable establishment of natives (Figure 4 and Figure 5). In particular, broom, gorse and blackberry in the drier areas (Figure 6) and willows in the wet areas will require careful management. Information on suitable control methods for these pest weed species is available on the Environment Southland Pest Hub website. In drier areas, planting of taller-growing native tree saplings may best be carried out using the gorse and broom as nurse species. Establishment of a canopy of taller growing native trees should eventually shade out these woody shrub species[4]. In wetter, low elevation areas pasture grasses and common herbaceous weeds are likely to be the main problem. Use of grass-specific selective herbicides or careful spot spraying may be required to establish further wetland plantings[5]. In all cases, care should be taken to only use herbicides suitable for use near waterways. Establishment of dense growths of robust riparian species, such as harakeke (native flax), around the wetland will help keep weeds from invading from the margins.

Funding may be available to protect existing wetlands or restoration work on private land. Ask your local DOC office or regional council about current funding available to assist with stream restoration or riparian protection. In addition, the QEII Trust helps private landowners to protect significant natural and cultural features on their land, in perpetuity, through open-space covenants. Contact them for legal protection advice and possible funding for fencing.

[4] https://www.doc.govt.nz/documents/science-and-technical/drds336entire.pdf
[5] https://pesthub.es.govt.nz/?pwsystem=true&sort=alpha

Figure 4: View of Saunders Farm wetland area from the south looking northwest towards Stag Creek. Dense growths of rushes and sedges are present in the centre of the wetland. In the background, a dense dark green band of broom is visible growing along the stop-bank and tall riparian willows mark the edge of Stag Creek, Willows are starting to invade within the wetland, and weeds such as gorse and broom are common in drier zones

Figure 5: View of Saunders farm wetland from the north towards Stag Creek. This area is drier and is largely covered in invasive broom

Figure 6: Dense growths of broom (left foreground) and gorse (right middle) in a section of the Saunders farm wetland.

3 Patterson Farm Wetland Swale

Enhancement of the wetland swale and pond on the Patterson farm can be achieved by addition of native wetland sedges (*Carex* species) within the swale along with purei (*Carex secta*) harakeke (native flax), toitoi and/or shrub species in the riparian margins. Taller shrubs and trees could also be included if this was compatible with farming operations. Suitable species lists are provided in Table 1. The shallow areas of the swale have some existing vegetation which could be enhanced with interplanting with key wetland sedge species, as well as riparian planting around the edges (Figure 7). Benching along the edges of the deeper ponded areas will enable the establishment of a band of fringing emergent vegetation (Figure 8).

Immediately after planting, in-wetland plants are at risk of being pulled out by pukeko, or damaged by other waterfowl. Plants that have been "grown-up" into larger pots are more difficult for pukeko to up-root, and thus are often worth the extra expense. Larger plants can be planted at 1 m spacings, whereas smaller plants should be planted closer (0.5-0.75 m spacing).

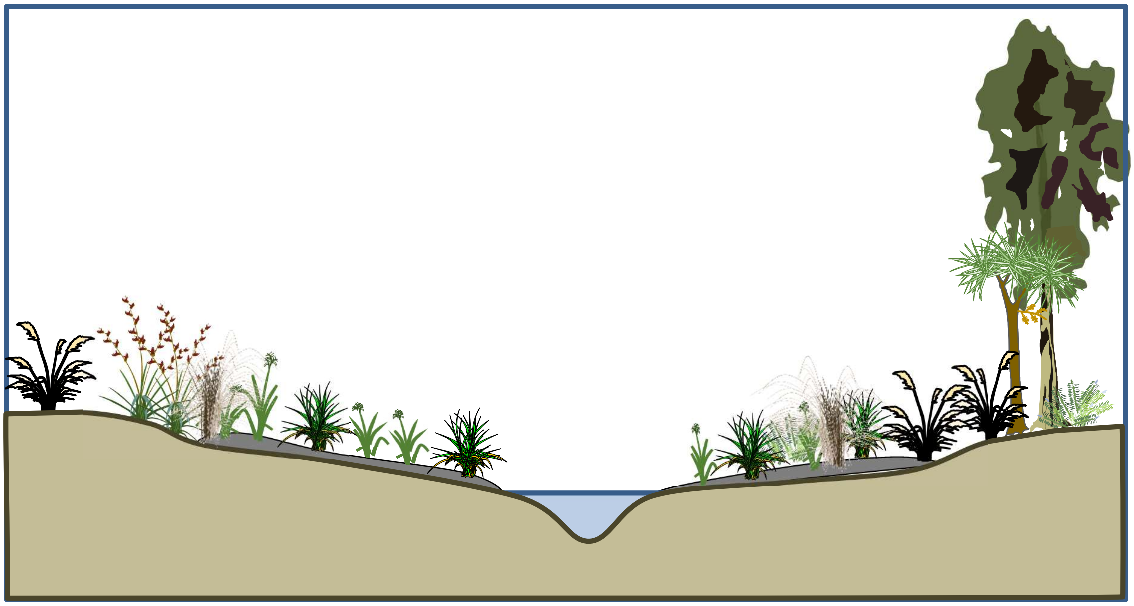

Figure 7: Restoration planting in the shallow zone and riparian areas of the swale. The left side represents planting of the swale without larger trees. The right side represents planting with taller growing native trees.

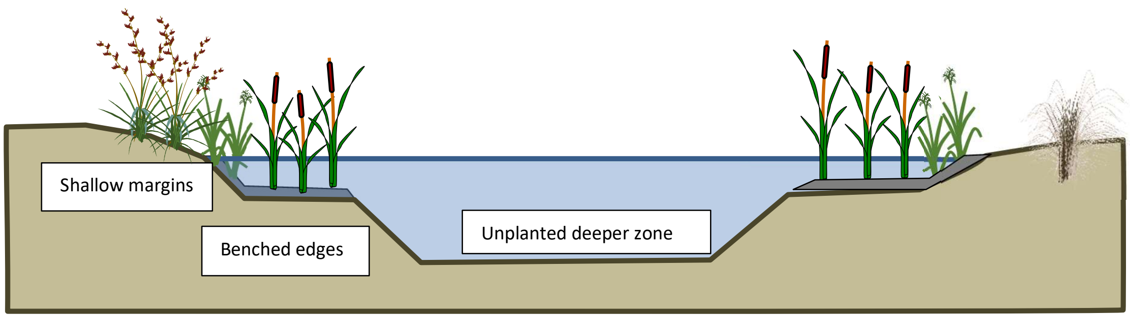

Figure 8: Potential benching and riparian planting along edges of deeper pond zones.

4 General planting guide for all sites

Table 1: General planting guide.

Scientific name	Common name	Depth zones
Main species – Shallow wetland zone		
Carex virgata	Rautahi	Dry ground down to 0.3 m deep.
Carex secta	Purei	Dry ground down to 0.3 m deep.
Shallow edges		
Carex geminata	Rautahi	Dry ground down to 0.1 m deep.
Carex lessoniana	Rautahi	Dry ground down to 0.1 m deep.
Deeper wetland zones		
Eleocharis sphacelata	Spike rush	0.2-0.3 m below water surface. (Note: this plant prefers deeper water than noted here, but initial propagules struggle initially in deeper water. Plant in this shallower zone and, once established, it will spread to deeper areas.)
Typha orientalis	Raupo	0.1-0.5 m below the water surface. Plant initial propagules at 0.1-0.3 m. Once established it will spread to deeper areas.
Drier riparian zones		
Austroderia richardii	Toetoe	Occasionally wet/damp ground
Cordyline australis	Cabbage tree	Occasionally wet/damp ground
Phormium tenax	Flax, harakeke	Occasionally wet/damp ground
Chionochloa rubra	Red tussock	Dryer margins
Melicytus ramiflorus	Mahoe	Dryer margins
Plagianthus regius	Ribbonwood	Dryer margins
Myrsine australis	Mapou, Matipou	Dryer margins

Hedycarya arborea?	Pigeonwood	Dryer margins
Other dry margin species		
Groundcovers		
Libertia ixiodes	NZ iris	Dryer margins
Astelia fragrans	Bush lily	Dryer margins
Blechnum fluviatile	Kiwakiwa	Dryer margins
Phormium cookianum	Mountain flax	Dryer margins
Muehlenbeckia axillaris	Creeping pohuehue	Dryer margins
Shrubs and trees		
Coprosma propinqua	Mingimingi	Dryer margins
Veronica salicifolia	Koromiko	Dryer margins. Previously known as *Hebe salicifolia*.
Sophora species	Kowhai	Dryer margins

Note: Occasional species may only be available from specialist native plant nurseries. Also Spike Rush may be difficult to source.

Reference:

Tanner, C., Depree, C., Sukias, J., Wright-Stow, A., Burger, D., Goeller, B. (2022) Wetland Practitioners Guide: Wetland Design and Performance Estimates: 40p. https://niwa.co.nz/sites/niwa.co.nz/files/wetland%20practitioner%20Guide-web.pdf