Memo

Subject Addendum to the Stormwater Management Strategy – No Regional Park Scenario

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Project McPherson PSP

1 Introduction

The McPherson PSP occupies approximately 946 ha of land 50 kilometres south east of Melbourne. This addendum to the previous Stormwater Management Strategy (Alluvium 2016) focuses on the northern portion, referred to previously as the Baillieu Creek section. The previous future urban structure (FUS) layout for the Baillieu Creek section featured a large regional park in the south-east corner of the site where the proposed constructed waterway outfalls to Cardinia Creek. An alternate scenario is now considered that removes the regional park and allows for development within its previous footprint. Figure 1 shows the indicative alternate FUS layout. The ultimate location for the regional park is to be determined by DELWP.

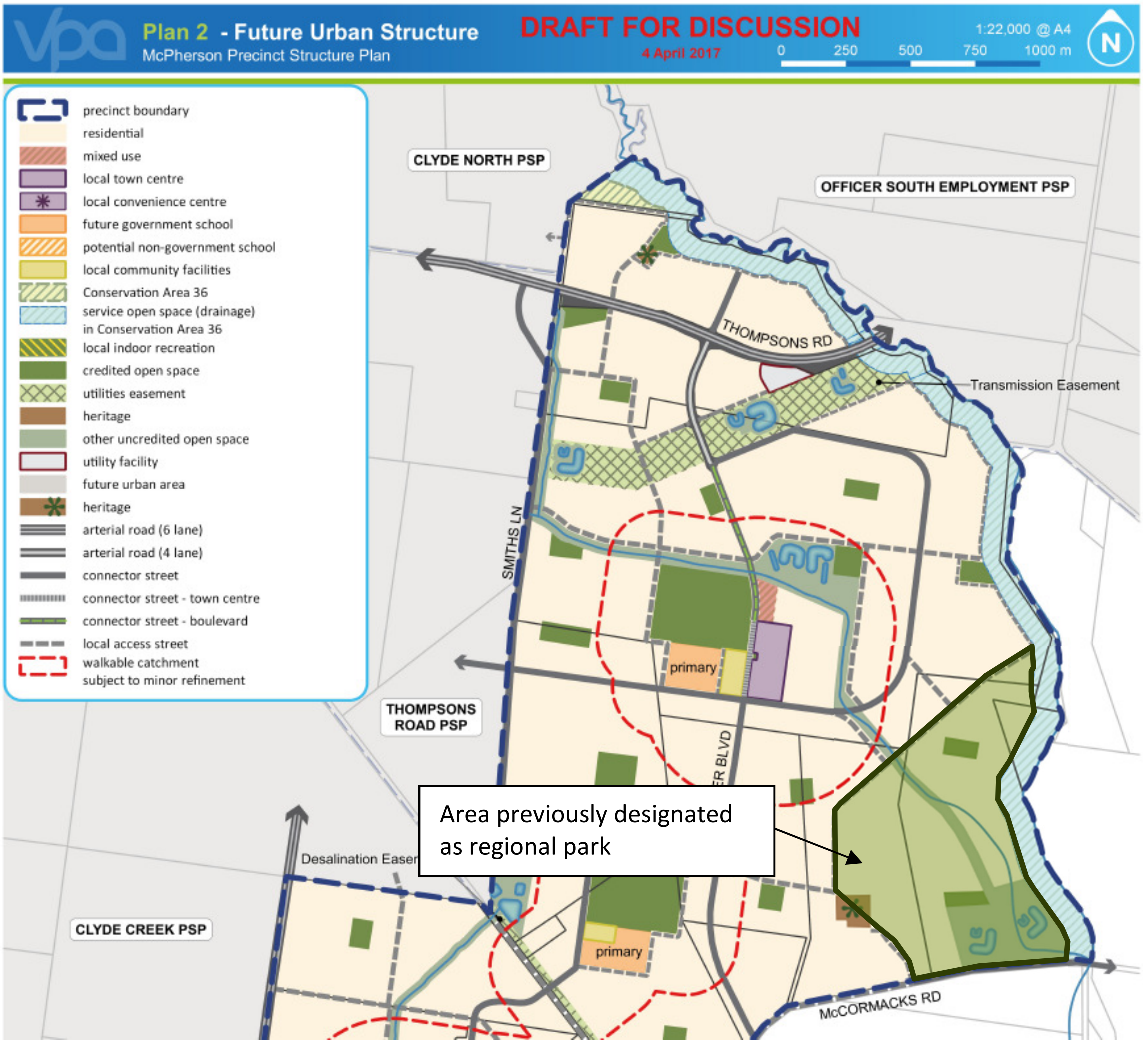

Figure 1. *Alternate FUS layout including no regional park and stormwater treatment assets in the south-east corner. Note this layout is in draft form and indicative only.*

This addendum is provided to supplement Alluvium's previous *Stormwater Management Strategy – McPherson Precinct Structure Plan (PSP 1055)* (Alluvium, 2016). This addendum investigates the effect of the alternate land use scenario on the design of stormwater quality treatment assets and proposed drainage corridors. Additional considerations include the presence of Areas of Strategic Importance (ASIs) for the Growling Grass Frog (GGF), and potential habitat sites for Dwarf Galaxias in existing pools along the Cardinia Creek floodplain.

2 Water quality treatment assets

2.1 Updated concept design

The alternate scenario, with replacement of the regional park with expanded development, will increase stormwater-driven pollutant loads outfalling to Cardinia Creek. Further, the location of proposed assets in the regional park site will need to be reconsidered to allow practical drainage from the urban catchment. As such, assets WL_L and WL_K are resized to accommodate the increased load. In this scenario, the updated drainage layout allows asset SB_10 to be consolidated into asset WL_L.

The alternate land use scenario was modelled in MUSIC (v6.2.1) to determine the treatment asset size. Table 1 shows the updated wetland design parameters given the alternate land use layout. Wetland velocity calculations and other checks for the updated designs are shown in Table 2 and Table 3 for assets WL_L and WL_K, respectively.

Table 1. WL_L and WL_K updated design parameters for the alternate scenario.

Asset	Contributing catchment (ha)	Treatment area (m^2)	Total footprint (m^2)	Inlet pond volume (m^3)	System performance (removal)			
					Total suspended solids (%)	Total phosphorus (%)	Total nitrogen (%)	Gross pollutants (%)
WL_K	85.5	20,000	57,700	6,000	85.7	73.1	51.7	100
WL_L	121.8	24,500	60,900	7,350	85.1	73.2	51.7	100

Table 2. WL_L updated velocity calculations and design checks.

	Parameter	Q3 month	Q1 year	Q5 year
Flow conditions	Design Flow (m^3/s)	1.09	2.52	5.43
	Flow depth (m)	0.35	0.35	0.35
Sediment pond	Width at NWL (m)	36	36	36
	Width at EDD (m)	40.2	40.2	40.2
	Average width (m)	38.1	38.1	38.1
	Flow Area (m^2)	13.3	13.3	13.3
	Flow Velocity (m/s)	0.08	0.19	0.41
	Check	< 0.5 OK	< 0.5 OK	< 0.5 OK
Macrophyte zone	Width at NWL (m)	60	60	60
	Width at EDD (m)	64.2	64.2	64.2
	Average width (m)	62.1	62.1	62.1
	Flow Area (m^2)	22	22	22
	Flow Velocity (m/s)	0.05	0.12	0.25
	Check	< 0.05 OK	< 0.5 OK	< 0.5 OK

Table 3. WL_K updated velocity calculations and design checks.

	Parameter	Q3 month	Q1 year	Q5 year
Flow conditions	Design Flow (m^3/s)	0.89	2.06	4.45
	Flow depth (m)	0.35	0.35	0.35
Sediment pond	Width at NWL (m)	28	28	28
	Width at EDD (m)	32.2	32.2	32.2
	Average width (m)	30.1	30.1	30.1
	Flow Area (m^2)	10.5	10.5	10.5
	Flow Velocity (m/s)	0.08	0.20	0.42
	Check	< 0.5 OK	< 0.5 OK	< 0.5 OK
Macrophyte zone	Width at NWL (m)	50	50	50
	Width at EDD (m)	54.2	54.2	54.2
	Average width (m)	52.1	52.1	52.1
	Flow Area (m^2)	18	18	18
	Flow Velocity (m/s)	0.05	0.11	0.24
	Check	< 0.05 OK	< 0.5 OK	< 0.5 OK

2.2 Sensitivity analysis

As agreed with Melbourne Water, the same MUSIC model parameters and rainfall inputs were used as for the previous SWMS. Melbourne Water have since updated their MUSIC modelling guidelines in 2016. The key differences between the two guidelines are:

- Rainfall template. The draft MUSIC guidelines (2016) calls for a 10-year rainfall simulation period to be used during the functional design stage of the wetland. The appropriate template for this site is the Koo Wee Rup rainfall station between the years of 1971-1980. The previous guidelines adopted the Koo Wee Rup rainfall station with a single reference year of 2004.
- Soil store parameters. The draft MUSIC guidelines (2016) requires a soil store of 120mm and a field capacity of 50mm for all source nodes. The previous guidelines adopted a soil store of 30mm and a field capacity of 20mm for residential areas, and soil store of 120mm and field capacity of 80mm for open space and conservation areas.

Rather than redesign all assets within the PSP in accordance with the new guidelines, a sensitivity test was undertaken comparing the treatment performance between the parameters recommended in each set of guidelines. Table 4 below gives the results, showing the combined effect of the original rainfall input and soil parameters compared to current guidelines. Treatment performance of the assets is improved using the expanded rainfall template and updated soil storage parameters. Note in Table 4, the sensitivity test is conducted using the identical MUSIC model as previously supplied to properly gauge the effect of changing soil parameters and rainfall template only.

Table 4. Sensitivity results comparing original MUSIC model results with updated soil parameters and rainfall template.

Asset	System Performance (Original model)				System Performance (2016 soil parameters and rainfall template)			
	Total Suspended Solids (%)	Total Phosphorous (%)	Total Nitrogen (%)	Gross Pollutant (%)	Total Suspended Solids (%)	Total Phosphorous (%)	Total Nitrogen (%)	Gross Pollutant (%)
WL_C	85.0	72.8	50.6	100	89.7	77.1	55.6	100
WL_E	84.1	72.0	50.6	100	89.4	76.8	54.8	100
WL_H	85.9	73.3	52.1	100	90.0	77.5	56.0	100
WL_F	83.8	71.4	49.6	100	88.2	75.2	53.1	100
WL_K	85.7	73.1	51.7	100	89.8	77.0	55.0	100
WL_L	85.1	73.2	51.7	100	88.2	75.1	52.8	100

3 Constructed waterway

3.1 Design flows

The alternate land use scenario includes a significant increase in the developable area, hence greater fractional impervious area in the ultimate developed condition. This effect was modelled in RORB to determine updated design flows at key points in the constructed waterway. The results are shown in Table 5. There is an increase in peak design flows from 25.6 to 28.8 m^3/s. Using an assumed compound cross-sectional profile and the same nominated design parameters as in the previous strategy, the hydraulic width of the 100-year ARI event is less than 40m. The resulting constructed corridor width as per Table 3 of Melbourne Water's Draft Constructed Waterway Corridor Guidelines is a minimum of 45 metres for active edges on both sides of the waterway. However the stormwater strategy has assumed only one active edge along the waterway, which results in an additional 5 metres of corridor width (ie 50 metres). Accordingly, no design revision of the constructed waterway is required to accommodate increased peak flow rates.

Table 5. Baillieu Creek RORB design flows.

Node*	Description	100-year ARI	5-year ARI	1-year ARI	3-month ARI
13	Downstream of BC 11&17	16.4	7.7	4.8	1.5
21	Downstream of BC 27	20.1	10.2	6.1	2.0
27	Downstream of BC 28	25.0	12.6	7.6	2.5
31	Baillieu Creek upstream of Cardinia Creek	28.8	14.6	8.8	2.9

*Refer to *Stormwater Management Strategy – McPherson Precinct Structure Plan (PSP 1055)* (Alluvium, 2016) for node locations and RORB model plan.

3.2 Bend sharpness

In the original strategy, the constructed waterway in the Baillieu Creek area featured a relatively sharp bend within the 110 Smiths Lane property (see Figure 2). Some concerns were raised by Melbourne Water as to potential high velocities and shear stresses at the location of the bend. Melbourne Water suggested their preference was for a gentler bend in line with previous draft versions of the strategy.

A review of the bend has been undertaken in line with the draft version of Melbourne Water's Constructed Waterway Design Manual. The manual describes appropriate design considerations for channel bends in section 3.3.3 of *Part D: Reach-scale Functional Design*. Bend sharpness is defined as the ratio of the bend radius of curvature to channel width:

$$Bend\ sharpness = \frac{Bend\ radius\ of\ curvature\ (m)}{Bend\ channel\ width\ (m)}$$

Bend sharpness should generally be in the range of 2-3 for constructed waterways. Sharper bends for sections of relatively uniform cross-section can lead to flow separation and increased energy losses.

The total constructed waterway corridor includes the core riparian zone and the vegetated buffer in addition to the waterway channel itself. Since constructed waterways are typically designed with some sinuosity in both the low and high flow channels, the actual channel planform can be curved around sharper sections of the total corridor. The proposed waterway corridor at the location of the tight bend has a hydraulic width of 33m. A small splay has been added to the southern boundary of the corridor at this location to allow a radius of curvature of approximately 75m in the high flow channel. The resulting bend sharpness is 2.3, within the acceptable range. Figure 2 demonstrates this arrangement.

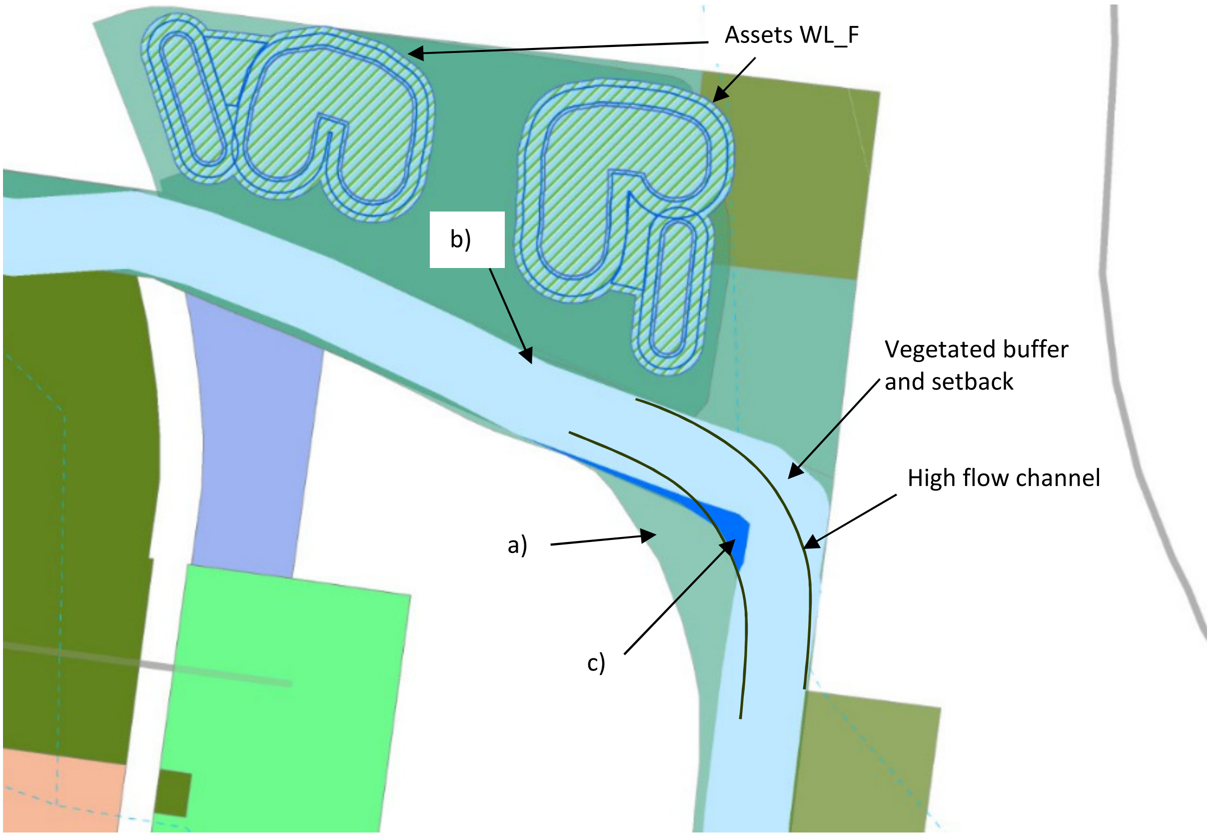

Figure 2. *a) Previous draft alignment (suggested by Melbourne Water), b) alignment with sharp curve (current PSP alignment), c) updated splay allowing channel radius of curvature of 75m.*

3.3 Growling Grass Frog Areas of Strategic Importance

The *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP, 2017) was released in April 2017, specifying Areas of Strategic Importance (ASIs) for the location of existing or future habitat for the Growling Grass Frog (GGF). Cardinia Creek features several locations designated ASI under the *Growling Grass Frog Masterplan for Melbourne's Growth Corridors* (DELWP, 2017), including two specific areas highlighted for future GGF habitat wetlands near the crossing of McCormacks Road.

This information was not available when completing the original stormwater strategy. A site inspection was undertaken in July 2017 to determine an appropriate revised location of the constructed waterway outlet to

Cardinia Creek. Accordingly, the proposed alignment of the constructed waterway has been modified to avoid direct impact on locations designated as a future habitat location or ASI, including a 50m buffer. Figure 3 shows the revised outlet location, just downstream of an existing bench/bar in Cardinia Creek. The existing GGF ASI overlay and new constructed waterway alignment is shown in Figure 4.

Figure 3. *Revised constructed waterway outlet location to Cardinia Creek downstream of bench/bar. Facing north-west from the west bank.*

Figure 4. *GGF ASIs along Cardinia Creek, with updated constructed waterway alignment and outline of treatment assets.*

Based upon the advice from VPA, no Dwarf Galaxias populations were discovered in the potential habitat sites, hence do not constrain the constructed waterway alignment.

4 Revised strategy maps

Figure 5 shows the revised strategy maps for the Baillieu Creek section of the PSP, including updated constructed waterway alignment and locations for assets WL_L and WL_K. Figure 6 shows the concept design plans for assets WL_L and WL_K.

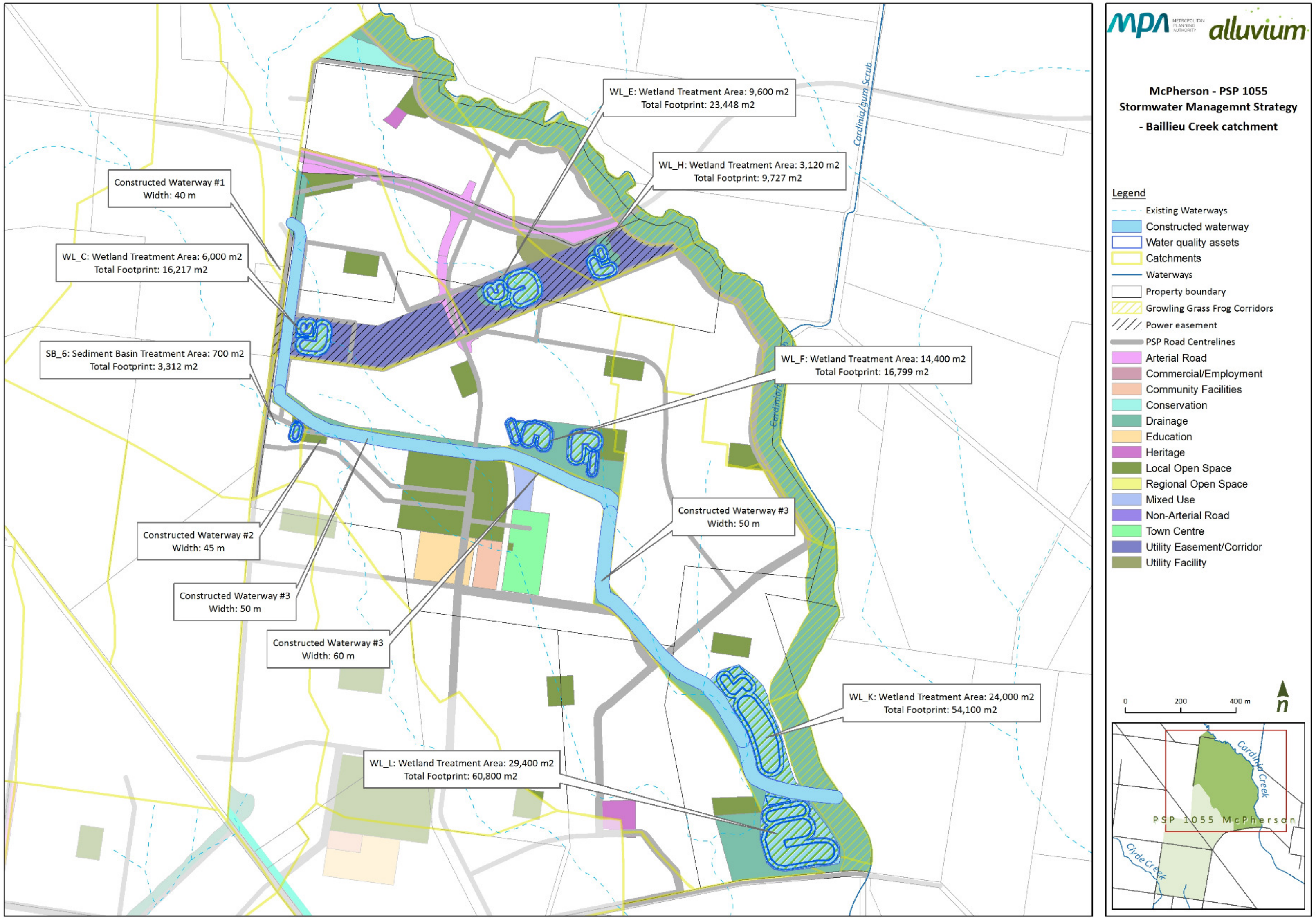

Figure 5. *Layout of McPherson PSP (Baillieu Creek northern section) stormwater management strategy.*

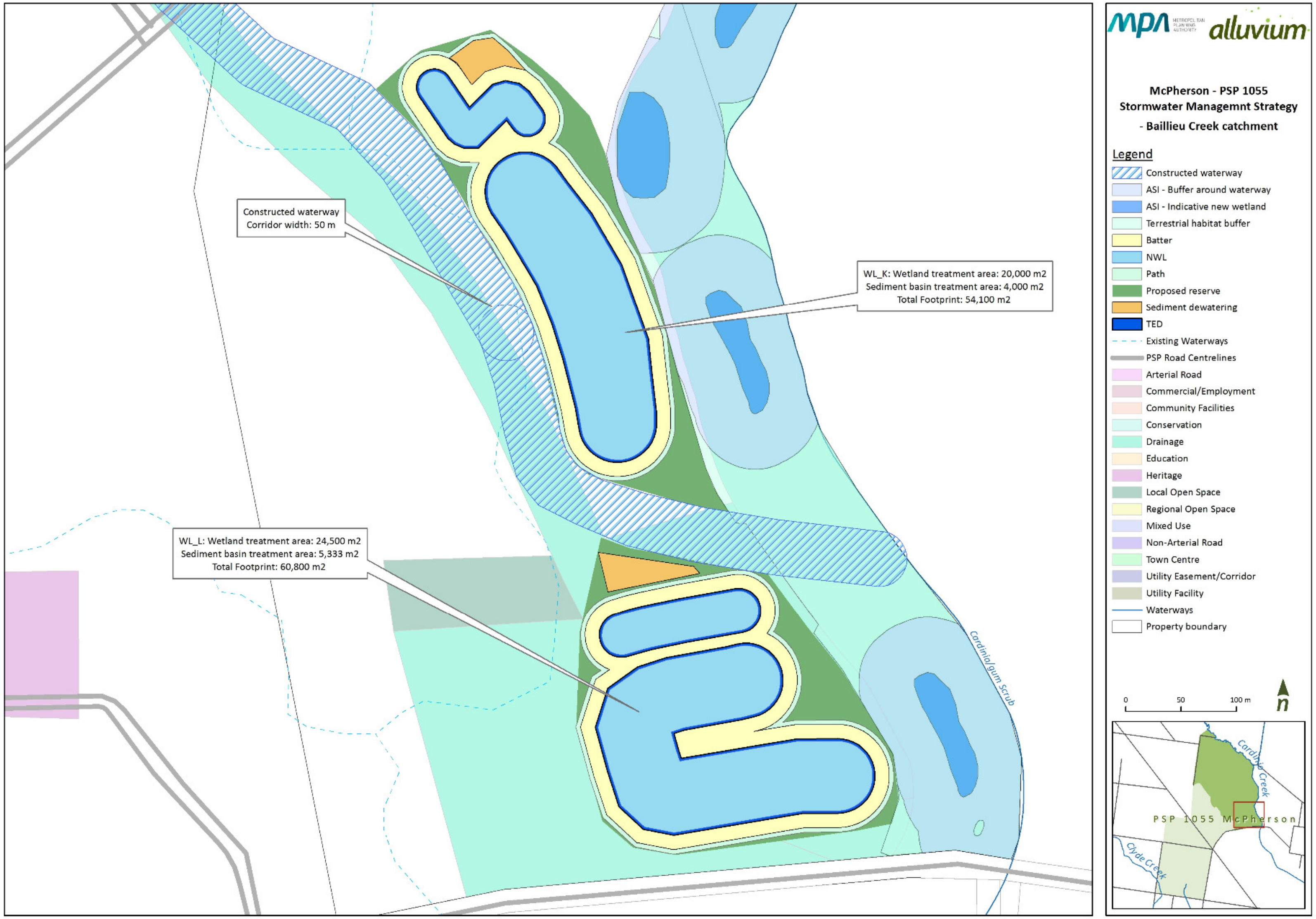

Figure 6. *Wetlands WL_L and WL_K concept design.*