LC EPC
INQUIRY INTO THE PROTECTIONS WITHIN THE VICTORIAN PLANNING FRAMEWORK
SUBMISSION 32 -ATTACHMENT 1
RECEIVED 24 JANUARY 2022

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Report

Karaaf Wetlands Catchment – Ecological and Stormwater Assessment

The Sands Owners Corporation

15 October 2021

6 DISCUSSION AND RECOMMENDATIONS

6.1 Overview

The following discussion highlights the analysis and findings of this investigation. Six (6) key recommendations have been put forward as a result, as detailed in Section 6.5.

While the analysis was completed based on the proposed full development to the catchment, a significant area is yet to be developed. As development continues within the catchment there is still time for solutions to be implemented to manage the stormwater issues created by urbanisation and prevent further impacts to the Karaaf Wetlands and Thompson Creek Estuary.

The recommendations listed below relate to key issues identified, and seek to address inadequacies in current surface water management within the catchment, with the intent of ensuring the ongoing protection and preservation of the downstream natural environment. The recommendations relate to the following key areas:

- Water volume management (Annual Water Cycle)
- Sediment and water quality management
- Water quality asset performance, maintenance and remediation
- Ongoing catchment monitoring
- Formal recognition and protection of Karaaf Wetlands and Thompson Creek Estuary

6.2 Volume Management

Risks associated with urban runoff were identified through the planning processes of both the Sands Development and Torquay North Precinct. These risks formed the basis of environmental management and surface water management plans for this area.

Whilst the Sands site did undertake a water balance as part of a surface water management assessment at the time, the focus of the assessment was on management of volume to enable irrigation of the site as part of an integrated water strategy. Although limited in its analysis, the strategy also looked to minimise the impact of freshwater flows from the development into the Karaaf Wetlands during the dry season.

During development, construction in Torquay North, regulatory controls did not require that volume management (in terms of annualised quantity) be included as part of the surface water assessment. There is also no evidence that any water balance assessment of the downstream receiving waters was undertaken or that any update to existing annualised volumes assessment completed.

It is important to distinguish annualised water volume management from stormwater retardation management, which is used to control peak flows within a catchment during significant storm events. Flood management/retardation does not remove volume from the system. As development occurs within a catchment, the increase in impervious area causes increases in peak flow and total surface water runoff volume. The greater total volume of runoff, by way of the formal stormwater networks, makes its way to natural receiving waterways. In the case the Karaaf Wetlands and Thompson Creek, changing the natural hydrologic regimes of the natural waterways. Stormwater management is a treatment method used to temporarily store water to manage peak flows, which is used within this system; however, this water still ultimately drains through the system after the peak of the storm event has subsided.

The MUSIC modelling presented in Section 4 of this report quantified the impact of the increase in impervious surfaces within the developed catchment at the point where the developed catchment discharges into the Karaaf Wetlands. This assessment used information regarding existing and proposed wetlands, lakes and development to quantify the likely volume of water discharging at an average monthly and yearly basis to the

Karaaf Wetlands. The assessment highlighted the significance of the increase in total annual flow volumes from the developed upstream catchment of the Karaaf Wetlands. With the catchment fully developed (in line with the Torquay North development plans), volumes are expected to increase by close to 228%. This change in volume occurs throughout the year as shown in Figure 6-1 below. The annual discharge from this catchment prior to development was estimated to be 475 ML/Yr, ignoring any reuse or diversion of runoff which might occur this increases to 1560 ML/Yr. The estimated increase is slightly reduced when including the associated use and diversion of water from both the Dunes and Sands development sites. The total annual volume decreases from 1560ML/Yr to 1360ML/Yr, which subsequently attributed to an increase in volume of around 193%.

TABLE 6-1 DISCHARGING VOLUME BREAKDOWN

Flow Component	Average Total Flow Pre-Development (ML/year)	Average Flow Post-Development without Reuse (ML/year)	Average Flow Post-Development with Current Reuse (ML/year)
Baseflow	228 (48%)	186 (12%)	183 (13%)
Surface Runoff	248 (52%)	1,374 (88%)	1,210 (87%)
Total Inflow	475	1,560	1,393

Concerns have been raised in relation to the ongoing reuse and diversion operation activities within this catchment with both the Dunes and Sands development relying on diversion of flow to and from Pintail dam, which may no longer be possible. The measurable reuse within the system, associated with the Golf Course remains the primary volume reduction mitigation measure within the catchment.

The impacts associated with increases in volume discharging to the downstream receiving wetland include:

- Contributing to high inundation depths within the downstream wetlands.
- Contributing to longer periods of inundation (with and without impacts to the downstream intermittently closed and open estuary).
- Increased freshwater flows into a historically saltwater system.
- Changes to the natural wetting and drying regime of the saltmarsh wetlands.

These impacts are leading to increased stress on the downstream system including vegetation dieback and encroachment of freshwater vegetation and weeds.

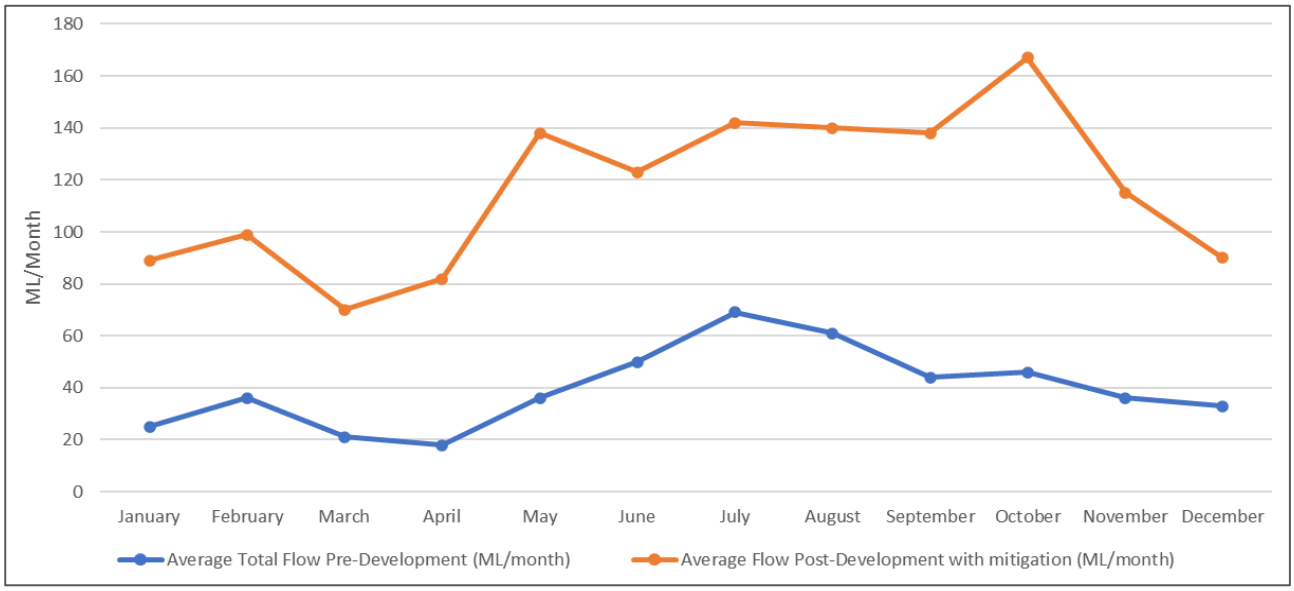

FIGURE 6-1 DEVELOPED CATCHMENT VOLUME DIFFERENCES

The downstream saltmarsh areas of the Karaaf Wetlands are considered particularly sensitive to the receiving waters of the upstream catchment flows. This is more recently recognised in the June 2021 release of the EPA Urban Stormwater Management Guidance (EPA, 2021). The new guidance now recognises volume management as a performance measure of effective stormwater control, and one of the performance measures which must be considered in mitigating harm to receiving waters. The guidance note provides specific Melbourne priority areas and recommended performance objectives in relation to reduction % for mean annual impervious runoff. Whilst this is not directly applicable to Surf Coast Shire Council at this time, the guidance note does acknowledge the requirements of assessment of volume risk and states that 'A transparent process is required to identify priority areas for enhanced stormwater management outside the greater Melbourne area'.

Based on the information presented above and the identified risks to the sensitive Karaaf Wetlands and Thompson Creek Estuary, progressing with efforts to reduce volumes discharging from the developed catchment is increasingly important.

Whilst the other parts of the Stretton and Dunes development are still undergoing construction, in order to mitigate the ongoing stress of these significant freshwater inflows to the Karaaf Wetlands, an integrated water plan and mitigation strategy is required.

The strategy should consider where storage and reuse within the existing catchment could be achieved, with the construction and expansion of existing stormwater assets. This might include:

- Expansion of the Esplanade wetlands to create a larger retention system (allowing storage and evaporation)
- Creation of an open water storage body or chain of ponds within the Horseshoe Bend development area linear park.
- Construction of a large storage retention system within the remainder of the undeveloped Stretton estate or neighbouring rural land holdings with connection through to other wetlands.
- Where storage and reuse within the catchment cannot be feasibly achieved diversion of catchment stormwater to Deep Creek or alternative direct ocean outfall should also be considered (Esplanade Catchment).

- Investigate opportunities for mixing of reclaimed wastewater (Barwon Water) with stormwater to service existing commercial and agricultural demand within the catchment, a service previously offered by the Pintail Dam.
- Investigation of diversion systems

Any reuse scheme must consider the seasonal requirements of the wetlands including the annual wetting and drying regimes of the saltmarsh areas. Furthermore, flexibility within the system should be enabled such that the system is not starved of flow during drought or low rainfall periods should vegetation stress be identified. The watering plan should consider a whole of system, integrated water plan which can closely examine a holistic water balance.

Making the most of existing partnerships with local industry and Barwon Water, who currently operate a wastewater reuse system which services many of the estates and local agricultural land, is encouraged.

6.3 Maintenance and Remediation of Existing Constructed Wetlands

The assessment provided in Section 4 indicates a number of issues associated with the sediment basins and wetlands within this catchment are attributed to maintenance deficiencies, undersized assets and likely significant construction sediment loading. The assessment used MUSIC which is an industry standard tool to test and confirm treatment performance within the catchment based on an assessment of assumptions around fraction impervious and constructed assets within the catchment.

Key to this assessment was available information regarding the developed outcomes of areas within Torquay North and The Sands alongside visual condition assessment of the existing stormwater treatment assets.

Constructed stormwater assets within the Torquay North precinct plan utilised a fraction impervious percentage of 45% for the purposes of sizing required stormwater treatment. Melbourne Water MUSIC guidelines suggest a FI of 70% would be more appropriate for the type and density of development in the catchment.

An assessment of developed lot sizes using VicMap datasets within the respective catchment indicates that in general, lot sizes range between 300-600 m^2, trending towards the smaller end of this range. Current Melbourne Water MUSIC guidelines, which outline the accepted industry standard, indicate that for residential developments where lot sizes range between 300-600 m^2 that a fraction impervious ranging between 0.7 - 0.8 is considered appropriate (Melbourne Water, 2018). In consideration of other associated land uses within the catchments, fraction impervious values of between 67% and 73% were adopted for this assessment, which is considered conservative. The difference in the fraction impervious values resulted in changes to both stormwater quality and quantity results for the catchment. The results at a site level are presented in Table 4-1 of this report and suggest a number of the constructed wetlands do not meet current TSS and TN load reduction targets (BPEM, 1999). This is due to these wetlands being sized to accommodate less intense development (and hence less impervious surface area) than has actually occured. This results in more stormwater runoff than anticipated in the design process and subsequently higher pollutant loads.

Sediment basins are generally designed such that their sediment storage capacity is sufficient to require cleaning out once every 3-5 years. This does not consider the high sediment loading that can result from construction. The higher than anticipated development intensity is also expected to fill the sediment ponds more quickly than estimated at the original investigation stage. These aspects are consistent with the observed condition of the sediment basins, which suggests current maintenance frequency is not adequate to ensure adequate treatment performance..

TABLE 6-2 SEDIMENT LOADING AND DESIGN EFFICACY

Location	Pollutant	Total Catchment Runoff Load (kg/year)	WSUD Catchment Load[1] (kg/year)	Passing Load (kg/year)	Load Removed (kg/year)	Load Reduction as % of Total Catchment Load	BPEM Standard
Downstream of Stretton	TSS	21,300	21,300	7,120	14,180	67%	67%
Downstream of the Dunes Development	TSS	32,200	32,200	7,160	25,040	78%	78%
Downstream of Zeally Sands Development	TSS	111,000	111,000	40,100	70,900	64%	80%
Downstream of Quay Development	TSS	43,900	43,900	29,100	14,800	34%	80%
Downstream of Esplanade (Quay) Wetland	TSS	101,000	101,000	36,400	64,600	64%	80%
Downstream of Sand Development and Golf Course	TSS	292,000	252,607	74,200	217,800	75%	80%

Whilst MUSIC modelling suggests the overall water quality treatment load reduction targets are being achieved at the Karaaf Wetlands inlet, this is dependent on the additional treatment occurring within the amenity and irrigation lakes of the Sands site. This is due to the large surface area and storage volume which contribute to extended detention within the Sands system. This is expected to have a negative impact on the Sands lakes due to excessive sediment loads being retained.

Under sized sediment basins and wetlands places increasing stress on the stormwater treatment assets. This means that the sediment basins fill more frequently which has a flow on impact with excess sediment then also accumulating in the downstream wetland areas, diminishing the capacity of deep-water zones. This consequently impacts on design detention depths, effectiveness of outlet controls and overall shallowing of wetland profiles, leading to encroachment of vegetation. These issues have been observed within this system with inspection of the existing constructed wetlands within this catchment indicating shallowing of sediment basins and wetlands areas and encroachment of vegetation.

Sediment basins are typically sized in consideration of a 3 to 5 year maintenance cycle; however, smaller assets will likely require cleanout frequencies of less than 3 years and should be monitored and works undertaken as necessary. This cleanout frequency may need to be further reduced if assets are undersized due to likely load thresholds being met more quickly. During the construction phase it is possible that inspection and clean out frequency could reduce to as little at 3 months, with construction within larger development area often extending beyond 5 years.

Poor construction sediment management within this catchment has also contributed to high construction sediment loads to a number of these wetlands and the downstream Sands amenity lakes. As a result, it is likely that many of the existing sediment basins and wetlands within the catchment will now require major works to bring them back to full functionality. Typically, the basins and wetlands are constructed as part of the

initial subdivision infrastructure. When these are allowed to come online prior to works being complete and without appropriate protection within the catchment they are severely impacted by construction sediment which impacts the geometry of the wetlands along with the vegetation health and performance of water quality treatment mechanisms. Construction within the catchment can continue for some time (5-10 years) after infrastructure works are complete. During this time, with the wetlands connected to the drainage network, construction at a lot level creates a steady sediment load within the system. The design on which wetlands are based does not consider this loading which means that sediment management becomes one of the most important mitigation measures in preserving these wetlands in the early stages of any development. Because these wetlands function as a system, failure within the upper parts of the network will cascade through the system resulting in a cumulative impact over the time the construction continues.

Whilst the wetlands, basins and lakes carry the burden of high sediment loads, this also impacts the performance of the pipe drainage network, leading to blockages and reduced system capacity. These blockages are also likely to be observed within the wetlands themselves (inlet pipes, balance pipes and outlets).

Poor turbidity and high sediment load within The Sands wetlands and amenity lakes was identified in the 2017 GHD report, regarding the impact on the environment of the offsite water entering The Sands system. This report investigated available water quality monitoring which identified continually increasing turbidity and nutrient levels above acceptable thresholds. It is likely that the cumulative impact of both the construction sediment load and wetland performance has resulted in a significant volume of sediment being deposited within the wetlands as has been reported.

The MUSIC water quality modelling completed as part of this assessment indicated the existing wetlands in series alongside the amenity lakes and irrigation wetlands assists to maintain water quality discharging to the Karaaf Wetlands. The efficacy of this system if the waterbodies within The Sands estate are unable to be properly restored is uncertain. Further to this, it should be noted these current comparisons are made to BPEM standards (CSIRO, 1999) and do not recognise the higher water quality standards/thresholds which are likely required to ensure protection of the sensitive downstream natural environment.

The modelling and anecdotal evidence indicates that these private assets have contributed to the protection of the Karaaf Wetlands from higher sediment and nutrient loads from the developing catchment and as such the cost associated with remediating these waterbodies should be shared amongst the beneficiaries. To understand the necessary works required within both the Sands and upstream wetlands a detailed survey of the extent and depth of sedimentation is required.

With a number of outstanding development stages still to be constructed within the upper catchment, tightening of sediment management compliance should be a focus. Appropriate sediment management during construction of future stages within this development will ensure that maintenance and remediation works to downstream wetlands can be controlled. Sediment management control and compliance should also be extended to any dewatering activities which are likely to be required within the catchment to facilitate maintenance and remediation works.

In line with the current guidelines, minimum standards of sediment management within the estate and domestic development sites should include:

- Sediment fencing
- Coir logs
- Temporary sediment basins
- Appropriate remediation of wetlands and basins prior to asset handover
- Controlled dewatering of wetlands prior to works

- Regular street sweeping
- Environmental Management Plan compliance and auditing
- Domestic builder site management spot checks

High gross pollutant loads within the Dunes and Zeally Sands wetlands were observed. The Dunes Wetlands receive surface runoff drainage from the Neighbourhood Activity Centre. High gross pollutant loads (general rubbish) are typically associated within retail and hospitality areas as was evident by the type of litter visible within the wetlands, dominated by drink bottles, snack food and take away containers. Based on this high load and the evident exceeded capacity of the gross pollutant traps, the clean out frequency on these assets needs to be increased. Whilst there are a number of further wetlands in series from the point to the Karaaf Wetlands, even small quantities within the Karaaf Wetlands could cause significant hardship and or death of valuable and threatened mammal and bird species. Plastic within this system is of increasing concern with microplastics pollution having been recently reported in the Thompson Creek.

Careful consideration should be given by council to the development and endorsement of specific municipal guidelines for development, which outline the accepted assumptions and industry standards around design of water sensitive urban design assets within with catchment, alongside management and maintenance obligations. This would enable council to have greater proactive involvement in mitigating poor construction management practices which impact catchment health and ensure future wetlands are designed in line with current accepted industry standards. With industry standards around water management rapidly evolving frequent review and update is critical.

6.4 Ongoing Monitoring

As part of this assessment, it was recognised that limited available data on which to base modelling assumptions and environmental trends analysis was available. No detailed level or flow information within the Karaaf Wetlands was available on which to understand existing and or pre-development hydrological regimes. An active ‘estuary watch’ program does exist within the highly engaged local community of Breamlea who have recorded and observed changes to the downstream system over the period of record. This citizen science contributes significantly to the broader understanding of catchment response to increasing urbanisation, however a formal permanent monitoring system within other parts of the catchment is required and would complement this ongoing monitoring.

Whilst it is noted that some infrequent water quality testing takes place by Surf Coast Shire and within the Sands, there is a lack of long-term records regarding flows, water levels and quality within the Karaaf Wetlands. The frequency and timing of monitoring, especially if this is only occurring monthly, can limit meaningful information being collected about effectiveness of treatment and flow managment within the catchment, as is currently occurring. A permanent telemetry system would be beneficial, so that changing flow and quality trends can be recorded and inform appropriate management response activities. Instantaneous data would also enable more comprehensive and ongoing monitoring of the system and changes to hydrologic flow conditions as part of longitudinal studies, such as is occurring in similar settings (Lower Barwon Wetlands and Sparrovale Wetlands). Significant increases in freshwater flows will and have impacted the natural wetting and drying regime of the salt marsh putting ecological stress on existing vulnerable vegetation species.

In light of the above, a monitoring plan in partnership with Surf Coast Shire, CCMA and Parks Victoria should be established with suggested emphasis on monitoring:

- Water level, quality and flow entering and within Karaaf Wetlands
- Ecological monitoring of Karaaf Wetlands– regular flora condition assessment and fauna survey.
- Frequent and ongoing monitoring of constructed wetlands water quality, vegetation health and performance

Consideration should be given to permanent telemetered gauges which could form part the Victorian Water Quality Monitoring Network.

6.5 Formal Protection and Recognition of the Karaaf Wetlands

The Karaaf Wetlands are part of a sensitive wetlands complex which makes up the Thompson Creek Estuary. A number of key environmental studies have identified important flora and fauna within this area, including species of state and national significance. The wetlands themselves and the adjoining catchment share similarities to the Lake Connewarre wetlands complex and require management interventions. The modelled changes to the hydrologic regime of the wetlands are continuing to impact on the health of this natural system. The wetlands and the management of the upstream catchment require urgent attention from responsible agencies to ensure appropriate management actions are taken to mitigate the impacts of intensifying development which has significantly changed the watering regime of the saltmarsh areas.

The Convention of Wetlands of International Importance holds an important recognition in conserving natural resources. The Ramsar convention seeks to protect against the loss of unique wetlands. The Karaaf Wetlands and the greater estuary of Thompson Creek does not currently fall within the already identified Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site, although it shares many similarities to the wetlands identified within these areas. The Index of Estuary Condition (DELWP 2021) indicated that the overall condition score for the Thompson Creek estuary equalled that of the adjacent Barwon River estuary.

Formal recognition of this wetland's importance would help to ensure that key ongoing management and maintenance activities within the catchment are given appropriate importance and status.

Preservation of the wetlands falls to a number of key agencies within this area including the following:

- Parks Victoria (as the committee of management)
- Corangamite Catchment Management Authority
- Surf Coast Shire Council
- City of Greater Geelong
- Department of Environment Land Water and Planning

6.6 Recommendations

The following key priorities are recommended in order to address identified water management risks within the catchment:

1. Undertake an Integrated Water Management (IWM) plan for the Karaaf Wetlands catchment, focusing on volume management, water quality and environmental protection. The development of the plan should be led by Surf Coast Shire in conjunction with City of Greater Geelong, Corangamite CMA, Barwon Water, Parks Victoria, Southern Rural Water, EPA and DELWP. This plan may be complementary to an estuary management plan for the catchment which must also consider how increased volume and flow within this system impacts on estuary entrance management.
2. Improved maintenance, operation and enforcement of water quality treatment assets including;
    A. Install sediment protection measures within the Stretton Estate and developing land within other sites of the contributing catchment. This should include compliance auditing of developers and private builders within these estates. Regular street sweeping of these areas should also be implemented to ensure longevity of the installed measures.

B. Immediately service existing GPTs within the Dunes Wetlands, initiate inspection program of these assets at frequency intervals of no less than 3 months, until such time as the wetlands and developing catchment is considered stable. This inspection program should also include as required maintenance and cleaning of these structures. Undertake immediate works to reinstate catchment wetlands to as design condition including verification of operational levels, sediment basin remediation, control structure inspections and vegetation planting (pipe connections, outlets weirs etc.). Consideration should also be given to the need for installation of litter traps as pre-treatment for existing and future wetlands which otherwise rely on the wetlands solely managing gross pollutant loads from the system.

C. Develop clear and specific council standards and guideline for developers in relation to design, maintenance and operation of water quality assets and construction sediment management. Asset management plans should be completed with clear guidelines on maintenance frequency, monitoring and triggers for major works.

3. Develop a monitoring program to survey sediment levels and vegetation within all catchment wetlands including the Sands amenity lakes. The surveys should be used to inform a works program to reinstate design levels and function of sediment basins, wetlands and the amenity lakes of the Sands.

4. Develop and commence monitoring program within the Karaaf wetlands. Consideration should be given to the installation of a telemetered system which is able to monitor:

   - Water Level
   - Depth
   - Electrical Conductivity
   - PH
   - Temperature
   - Turbidity
   - Pollutant Loads (TN and TP)

   Further to this, ecological monitoring should also be implemented with regular vegetation surveys to best understand seasonal plant die off, structure and species cover/abundance change, including freshwater species invasion, and to record images from repeatable photo points.

5. Develop and implement a monitoring program for the constructed wetlands within the catchment. It is understood that some monitoring does occur, although the breadth and frequency of this monitoring should be increased to understand the performance of the system in terms of flow and pollutant generation and treatment.

6. Initiate procedure to formally extend the boundaries of the Ramsar listing of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar area to encompass the Thompson Creek Estuary inclusive of the Breamlea Flora and Fauna reserve and the Karaaf wetlands.