16 June 2020

Edithvale Wetland Monitoring and Mitigation Plan

Edithvale and Bonbeach Level Crossing Removal Projects

Authorised and published by
the Victorian Government,
1 Treasury Place, Melbourne

Document control

Version 2

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Date: 17 June 2020				

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1 Introduction

The Victorian Government is removing 75 dangerous and congested level crossings across Melbourne by 2025. At Edithvale and Bonbeach, the level crossings will be removed by lowering the rail line into a trench. An Environment Effects Statement (EES) was undertaken to assess potential impacts from the project to groundwater levels, groundwater quality and the Edithvale-Seaford Wetlands Ramsar Site. Due to the proximity of the projects to the Edithvale Wetland, which is one of two wetlands that form the Edithvale Seaford Wetlands Ramsar Site, the projects also required approval under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

An Environmental Management Framework (EMF) has been prepared for the Edithvale and Bonbeach Projects in accordance with the project's planning approval under Victorian *Planning and Environment Act 1987* (P&E Act). The EMF contains Environmental Performance Requirements (EPRs) developed through the EES process, which have been approved by the Victorian Minister for Planning. Importantly, the EES identified that groundwater levels and quality could be managed within acceptable thresholds through engineering controls (refer to Section 2.2) and implementation of the project in accordance with the EMF. As such, the EES concluded that the risk of the Edithvale-Seaford Wetlands Ramsar Site being impacted by the project was negligible.

The EMF contains Environmental Performance Requirements (EPRs) which have been approved by the Victorian Minister for Planning. These EPRs include preparation of the following:

- Groundwater Monitoring and Management Plan (EPR_GW2)
- Edithvale Wetland Monitoring and Mitigation Plan (EPR_FF7); this Plan.

These Plans are also required by specific conditions of the approval decision for the Edithvale and Bonbeach level crossing removal project granted under Sections 130(1) and 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The *Groundwater Monitoring and Management Plan* requires the monitoring of groundwater level and quality at the trench against criteria in order to identify whether the engineering controls incorporated into the design are effective and whether operational maintenance is required. The *Groundwater Monitoring and Management Plan* also defines criteria that trigger the need to implement monitoring at the Edithvale Wetland if the design and maintenance measures do not work as expected and groundwater levels rise to the extent that Edithvale Wetland may be affected. Groundwater levels rising in response to flows being obstructed is known as 'groundwater mounding'.

This *Edithvale Wetland Monitoring and Mitigation Plan* requires the monitoring of groundwater and surface water levels at Edithvale Wetland to identify whether groundwater mounding (as a result of the project) reaches Edithvale Wetland and whether this groundwater level increase affects the suitability of the habitat and therefore use of the wetland by birds. The Plan also identifies mitigation measures to be implemented if an impact is detected at Edithvale Wetland that is attributable to the level crossing removal project.

This Plan has been prepared to address the requirements of EPR FF7 and Conditions 4-6 of the EPBC Approval 2017/7906 (Appendix A). The Australian Government Department of Agriculture, Water and the Environment (DAWE), the Victorian Government Department of Environment, Land, Water and Planning (DELWP) and Melbourne Water (MW) were consulted during the preparation of this Plan.

The Level Crossing Removal Project (LXRP) will set aside funds to facilitate the implementation of this Plan.

2 Background

2.1 Edithvale-Seaford Wetlands Ramsar Site

The Edithvale-Seaford Wetlands are an internationally important wetland site listed under the Ramsar Convention and are therefore also a Matter of National Environmental Significance (MNES) protected by the EPBC Act.

The values of (and threats to) the Edithvale Seaford Wetlands Ramsar Site are well documented in the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016), the *Addendum to Ecological Character Description for the Edithvale-Seaford Wetlands Ramsar Site* (Hale and Butcher 2017) and *EES Technical Report B: Ecology: Wetlands and Groundwater Dependent Ecosystems* (AECOM-GHD JV 2018a).

In summary, components, processes and systems (CPS) that have been identified as critical to the ecological character of the Ramsar Site by Hale and Butcher (2017) are:

- Threatened wetland species
- Physical habitat for waterbirds
- Waterbird breeding
- Waterbird diversity and abundance.

Utilisation of the site by birds forms the basis for three of the four critical CPS of the site and is therefore the primary measure of change in the ecological character of the wetland. Bird utilisation is related primarily to the availability of suitable habitat. Ensuring that the wetland continues to provide suitable habitat is therefore key to maintaining the critical CPS and therefore the ecological character of the Ramsar site.

The Edithvale Wetland component of the Edithvale-Seaford Wetland Ramsar Site was the focus of the EES. Seaford Wetland is physically, hydrologically and hydrogeologically separate from Edithvale Wetland (*EES Technical Report A Groundwater*- AECOM-GHD JV 2018b) and was therefore considered unlikely to be impacted by the project. As such, this Plan relates to Edithvale Wetland only.

Edithvale Wetland supports remnant vegetation and a diversity of habitats for a range of flora and fauna species including shorebirds listed under international migratory agreements and/or wetland-dependent birds listed under the EPBC Act. Key species that regularly visit the site include Australasian Bittern *Botaurus poiciloptilus*, Curlew Sandpiper *Calidris ferruginea*, Sharp-tailed Sandpiper *Calidris acuminata* and Latham's Snipe *Gallinago hardwickii* (Ecology Australia 2016; Hale and Butcher 2017).

Habitat at Edithvale Wetland is divided into two broad zones (Quin et al. 2016 cited in Hale and Butcher 2017):

- Edithvale Wetland North which provides deeper water for ducks
- Edithvale Wetland South which is a large, mostly shallow wetland with three small pools. The large shallow pool provides foraging habitat for shorebirds and grades to tall marsh at the fringes which provides cover for species such as Australasian Bittern and Latham's Snipe.

Historically, Edithvale Wetland was divided into a series of cells to facilitate ongoing management. For consistency with this approach, the wetland cells are referred to in this Plan where relevant. The wetland cells are shown in Figure 1.

Figure 1 Edithvale Wetland management cells

The characteristics of Edithvale North and Edithvale South are shown in Figure 2 and Figure 3 (extracts from AECOM-GHD JV 2018a). These characteristics influence the degree of risk that groundwater mounding poses to the provision of the required habitat.

Edithvale North interacts with groundwater and hence may be at greater risk from changes to groundwater levels (and project induced groundwater mounding). The cells within Edithvale North are generally deep, therefore an increase in water level is unlikely to present a risk to their suitability for the types of birds which already utilise this habitat. The primary risk would be a loss of the narrow mudflats which are exposed on the margins when water levels draw down.

Edithvale South is shallow and provides extensive mudflats for shorebirds as it draws down over summer. It also provides some small, deeper areas which provide resources for other birds including breeding habitat for Black Swans and ducks. This habitat is at risk should groundwater levels increase, as it would result in the increase of the water depth within the cell and encourage the persistence of deeper water into the summer months.

More permanent inundation encourages an overabundance of reeds. Reed overabundance is recognised as an ongoing threat to wetland (Ecology Australia 2016).

Figure 2 Characteristics of Edithvale Wetland North

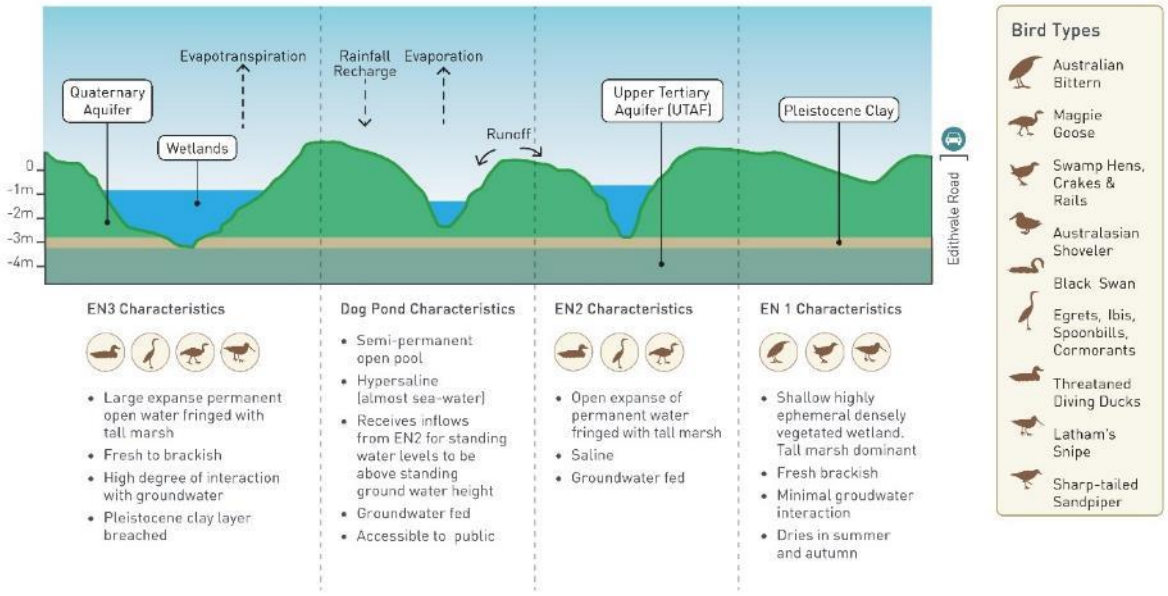
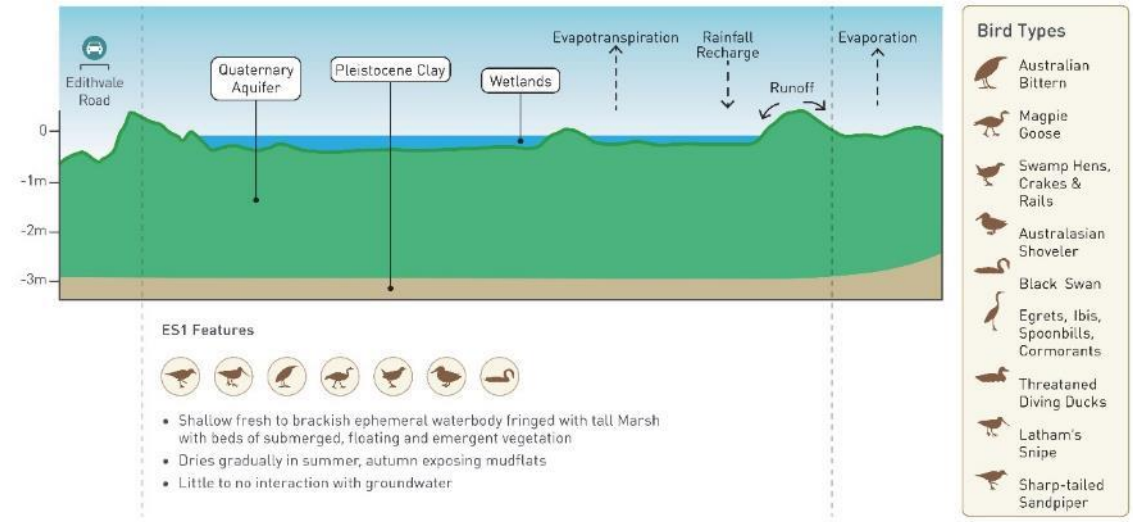


Figure 3 Characteristics of Edithvale Wetland South

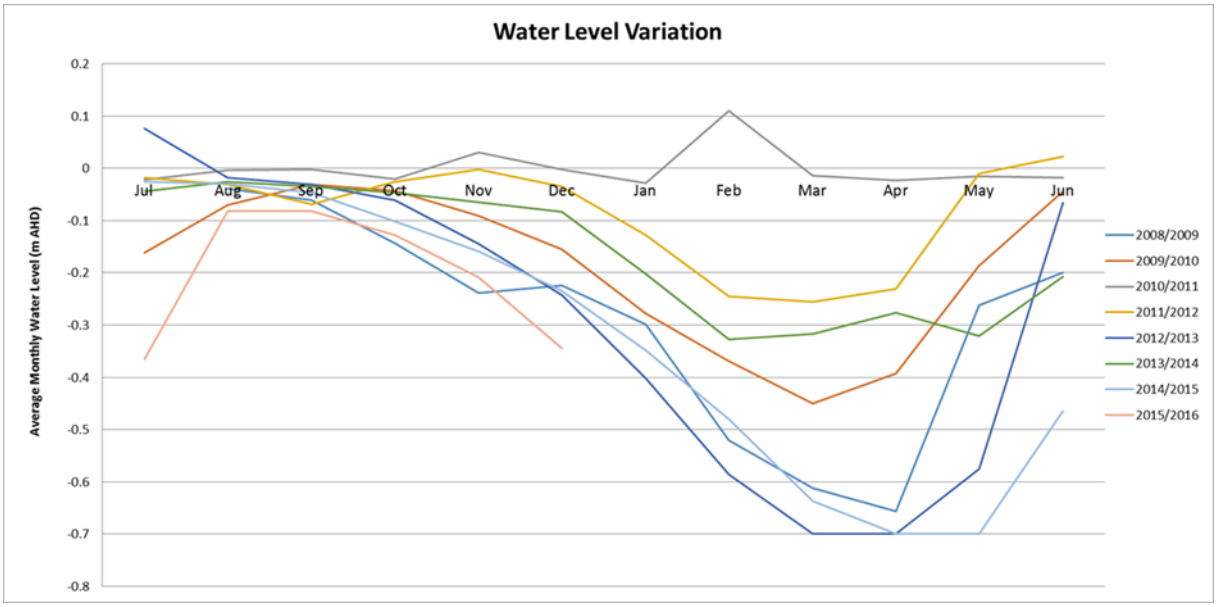


The ideal hydrology for Edithvale Wetland is that which continues to maintain the existing mosaic of wetland habitats (Ecology Australia 2016). Maintaining this regime requires:

- Inundation over winter and early-spring to drown tall reeds
- Slow drawdown from spring through to autumn to expose mudflat habitat for migratory birds primarily in Edithvale Wetland South
- Maintenance of deeper pools as permanent water for waterfowl, primarily in Edithvale Wetland North but also the few small, deeper pools in Edithvale Wetland South.

Surface water level data from monitoring locations at Edithvale Wetland has been analysed to establish seasonal baseline data (see Appendix B). The data shows a consistent trend of reduced water levels in the later summer months which then increase over winter. Edithvale Wetland South (in particular), generally experiences drawdown over spring and summer (Figure 4).

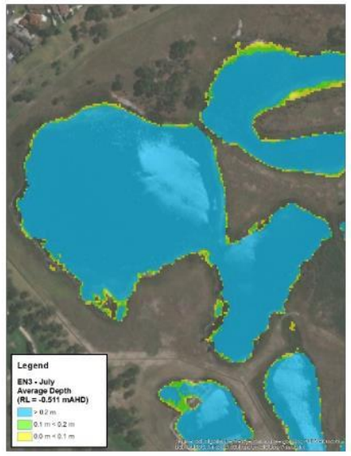
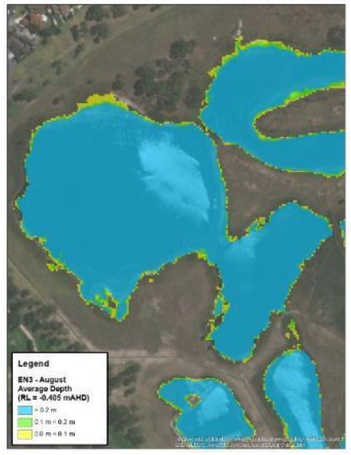
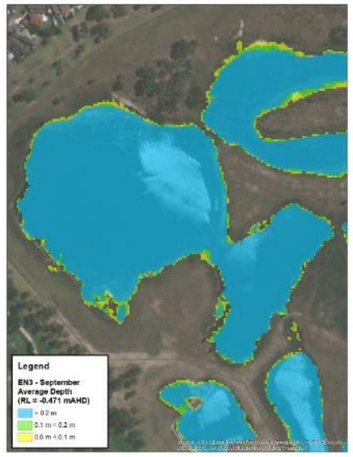
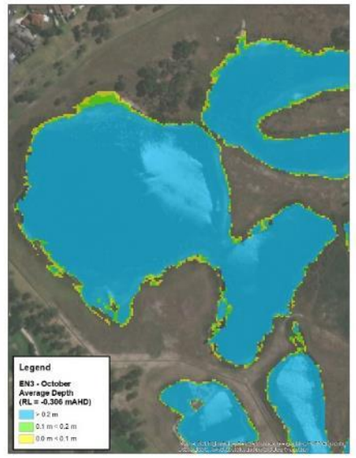
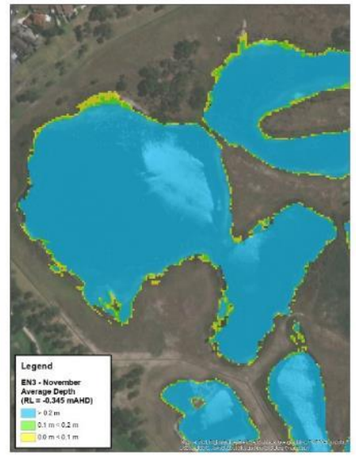
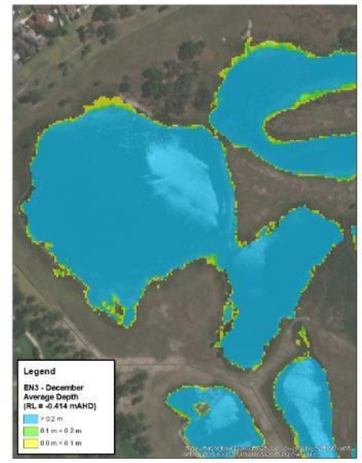
Figure 4 Average monthly water level at Edithvale Wetland South per year



Surface water levels have been combined with the bathymetry (depth profile) of the wetland cells to provide a representation of extent of mudflat available at different times of the year and to demonstrate the variability in habitat availability within and between years (see Appendix B). Surface water areas were modelled using water level categories defined on broad interspecific wading habits of the birds known to occur at Edithvale Wetland. The categories adopted were <100 mm (optimal for shorebirds; Smith et al. 2018), 100-200 mm (larger wading birds with longer necks) and >200 mm (dabbling ducks; Isola et al. 200). This information is important because shorebirds have specific, preferred water depths which determine availability and choice of foraging areas (Rogers et al. 2015).

The extent of varying water depths throughout a year (defined as July to June over the season when migratory shorebirds are present) is shown in **Figure 5** (Edithvale Wetland North represented by cell EN3) and **Figure 6** (Edithvale Wetland South).

Figure 5 Average extent of habitat per month at Edithvale Wetland North (EN3)

July	August	September	October	November	December
					
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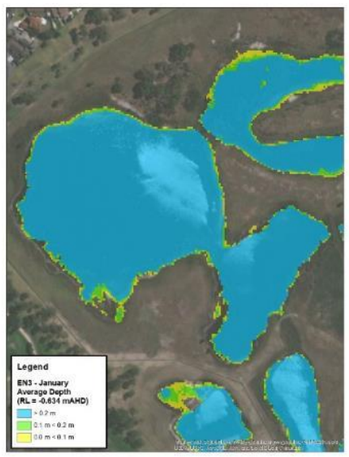
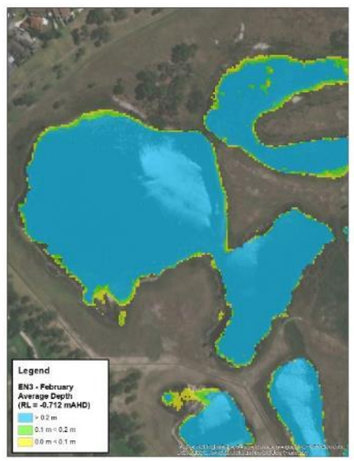
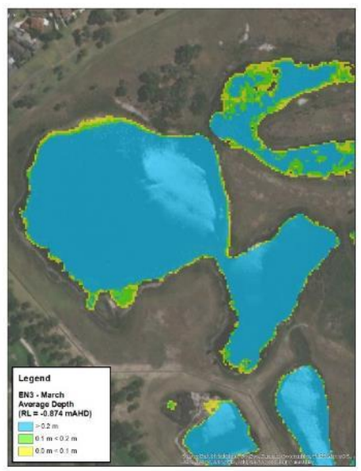
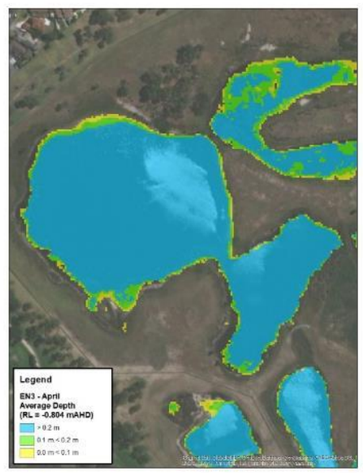
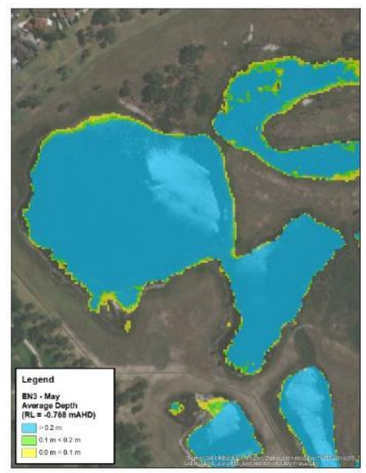
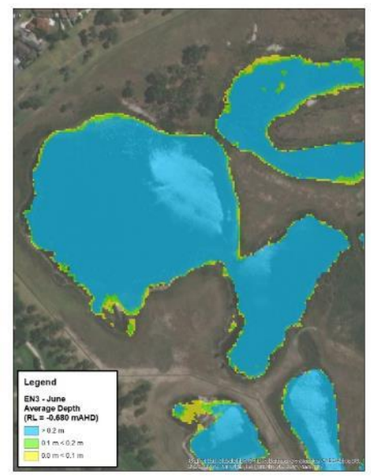
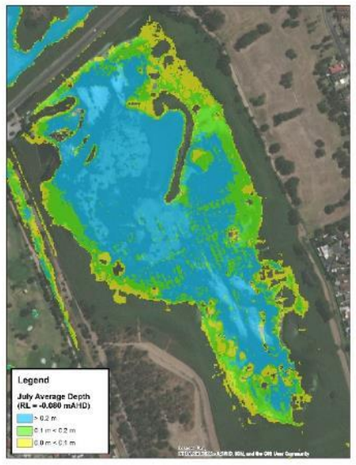
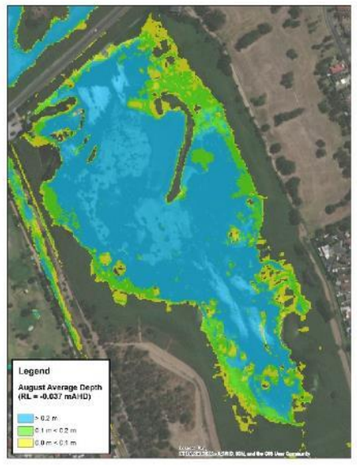
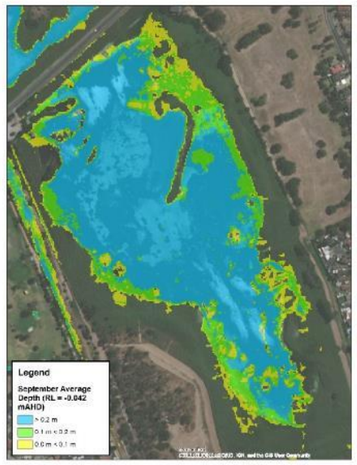
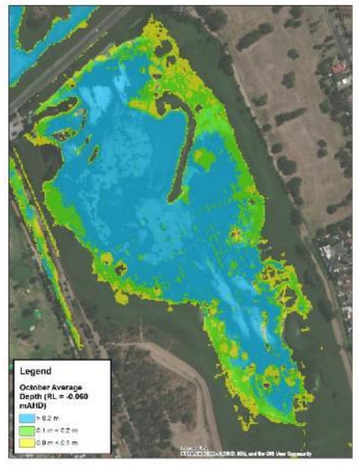
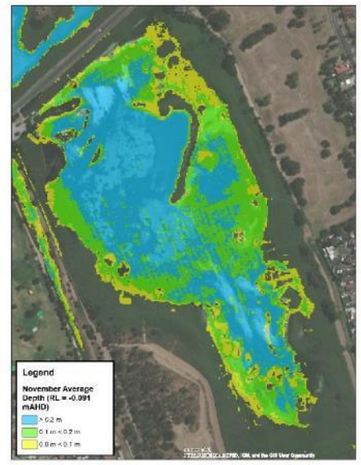
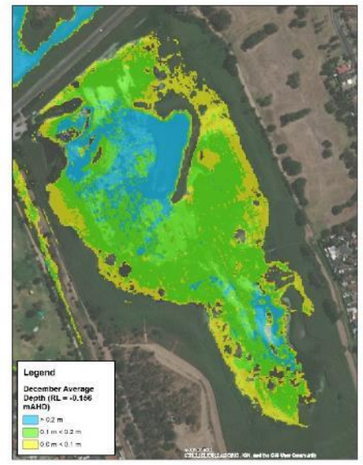
					

Legend: Blue = >200 mm depth, Green = 100-200 mm depth, Yellow = <100 mm depth (optimal shorebird habitat)

Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels.

Figure 6 Average extent of habitat per month at Edithvale Wetland South

July	August	September	October	November	December
					
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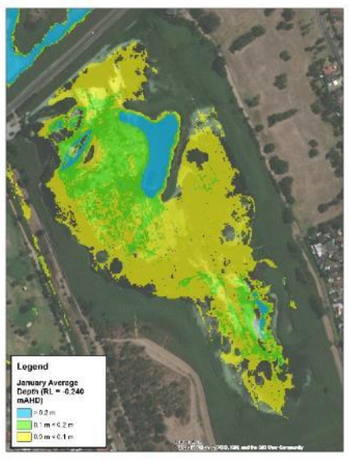
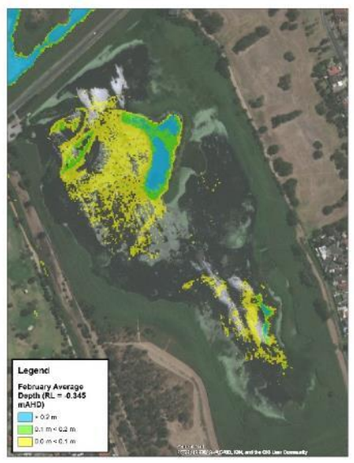
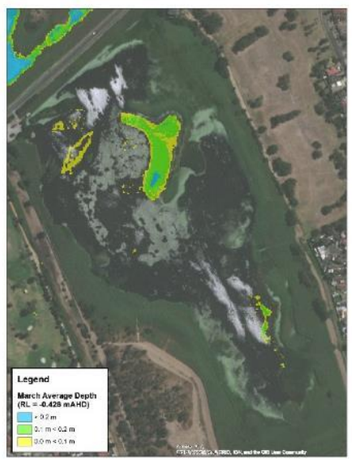
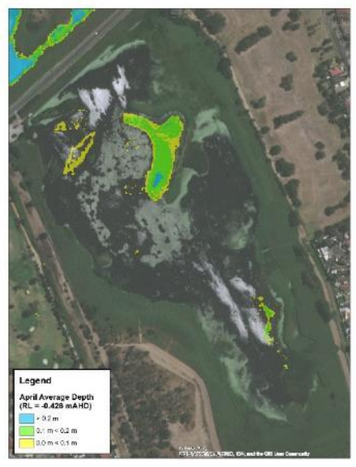
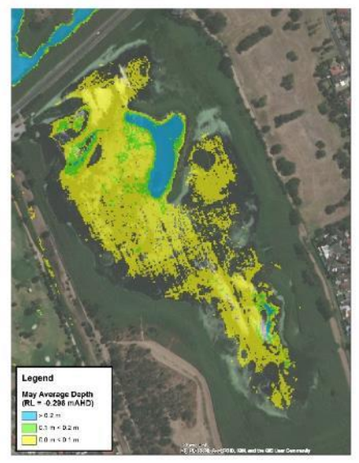
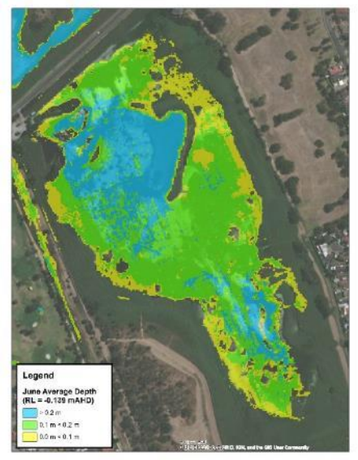
					

Legend: Blue = >200 mm depth, Green = 100-200 mm depth, Yellow = <100 mm depth (optimal shorebird habitat)

Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels.

2.2 Risk to Edithvale Wetland

Impact assessments and groundwater modelling were undertaken as part of the EES and through subsequent studies to assess numerous risks relating to groundwater. Edithvale Wetland was not predicted to be impacted by the project through any modelling or assessment scenario.

The area of predicted groundwater impact modelled initially during the EES indicated the distance between the extent of groundwater mounding for the Edithvale Project (denoted by the - 0.1 metre contour) and the Edithvale Wetland was approximately 560 metres at its closest point (refer to the left pane in **Figure 7**), but indicated risk of waterlogging in the area of predicted groundwater mounding influence.

To minimise the risk of waterlogging in the area of predicted groundwater mounding influence, the project design was refined through a mitigated assessment as part of the EES to reduce disruption to groundwater movement and reduce the risk of waterlogging in the area of predicted groundwater mounding influence (refer to the middle pane in **Figure 7**).

Subsequent to the EES, further project design refinements have been made, resulting in reduced project footprints and similarly reduced area of predicted groundwater impact (refer to the right pane in **Figure 7**). A technical summary of the project design refinements made is provided in the *Groundwater Monitoring and Management Plan*.

Figure 7 Reduction in predicted groundwater impacts at Edithvale and Bonbeach as the project designs developed

The current design substantially reduces the potential for the project to impact Edithvale Wetland. Nevertheless, there remains a comprehensive monitoring program that will alert the operators should an issue occur and contingency measures need to be enacted.

The impact pathways considered during the EES that are the focus of this Plan are those related to the ecological character of the Ramsar site. In particular, this Plan focuses on Risk ID-G73 which is 'groundwater mounding leading to altered hydrological regime resulting in a change in habitat (wet grassland / mudflats) at Edithvale Wetland to the extent that the site no longer regularly supports listed migratory and/or threatened bird species' (AECOM-GHD JV 2018a). Increased surface water levels at Edithvale Wetland could lead to prolonged or permanent inundation that results in reduced extent or loss of mudflat habitat at a time when migratory shorebirds are reliant on the resource.

Groundwater mounding is more likely to adversely impact Edithvale Wetland South as the wetland is shallow and currently not influenced by groundwater. At Edithvale Wetland North, an increase in groundwater levels is unlikely to affect the deeper water habitat but it may result in mudflat margins being permanently inundated if drawdown of surface water does not occur.

3 Objectives

This Plan has been developed to safeguard the habitat values of the Edithvale Wetland from changes to groundwater that are attributable to the project and to satisfy approval requirements. Relevant EPBC Act approval and EPR condition requirements are provided in Appendix A.

The primary objectives of this Plan are outlined in Table 1, along with commitments made by the proponent to ensure the objectives can be met.

Table 1 Objectives of the Edithvale Wetland Monitoring and Mitigation Plan

Objective	Commitments to achieve objectives	Relevant section of Plan
Establish a process to assess if groundwater mounding at the trench extends to the Edithvale Wetland	Undertake continuous groundwater monitoring between trench and Edithvale Wetland. Undertake groundwater monitoring at Edithvale Wetland.	Section 5.1
Define an approach to review and analyse existing monitoring data to determine if the habitat suitability of Edithvale Wetland is at risk and determine thresholds (triggers) for mitigation	Undertake surface water level monitoring at Edithvale Wetland.	Section 5.2-5.4
Identify mitigation measures to be implemented if monitoring determines habitat suitability of Edithvale Wetland is at risk	Design and implement mitigation measures	Section 6

This Plan considers the existing obligations on Melbourne Water as managers of the Ramsar site under the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016).

4 Implementation of this Plan

This Plan is to be implemented if groundwater monitoring indicates that a trigger (as defined in the *Groundwater Monitoring and Management Plan*), is met (see **Figure 8**). The trigger criteria in the *Groundwater Monitoring and Management Plan* have been designed to allow the implementation of this Plan before there is potential for impact to the Edithvale Wetland.

Figure 8 Trigger for implementation of Edithvale Wetland Monitoring and Mitigation Plan

- Implementation of this Plan will follow a monitoring and mitigation approach described below and shown in **Figure 9**: **Monitoring:** Monitoring is based on two main components:
    - **Monitoring for groundwater level change at Edithvale Wetland:**
        - Groundwater level data being measured by automatic dataloggers in groundwater monitoring bores within and around Edithvale Wetland will be reviewed to assess whether groundwater level changes are occurring at Edithvale Wetland.
        - Surface water level data being measured at Edithvale Wetland will also be reviewed to allow the interaction between ground and surface water to be considered in the analysis.
    - **Habitat monitoring using surface water levels as a measure of habitat suitability:** Habitat monitoring will be undertaken if groundwater level changes occur at Edithvale Wetland and are inferred to be project induced. Surface water levels will be utilised as a proxy for extent of habitat, as the levels determine surface water area and therefore the extent of mudflat habitat. The relationship between surface water levels and habitat is outlined in Appendix B. Surface water level data will be compared against baseline data to determine whether surface water levels exceed the historic range. If project-induced changes to surface water levels at the Wetland are found to have affected the extent of mudflat (habitat suitability), mitigation measures will be implemented. If there is no inferred change to habitat suitability resulting from the project, then mitigation will not be implemented.
- **Mitigation:** Mitigation measures will be implemented at Edithvale Wetland if habitat suitability is compromised. Funds will be released to Melbourne Water to implement mitigation measures to address the increased water depth and/or duration of inundation. Surface water levels will continue to be monitored post-mitigation to inform whether mitigation has been effective.

A summary of scenarios, associated risks to Edithvale Wetland and the relevant section of this Plan (where the monitoring and mitigation measures are described) is provided in Table 2. Details on monitoring are provided in

Section 5 and mitigation measures are outlined in Section 6. To facilitate implementation of this Plan, a summary of monitoring and mitigation actions is provided in Section 7; this includes timing and duration of actions and responsibilities.

Figure 9 Approach to implementation of the Edithvale Wetland Monitoring and Mitigation Plan

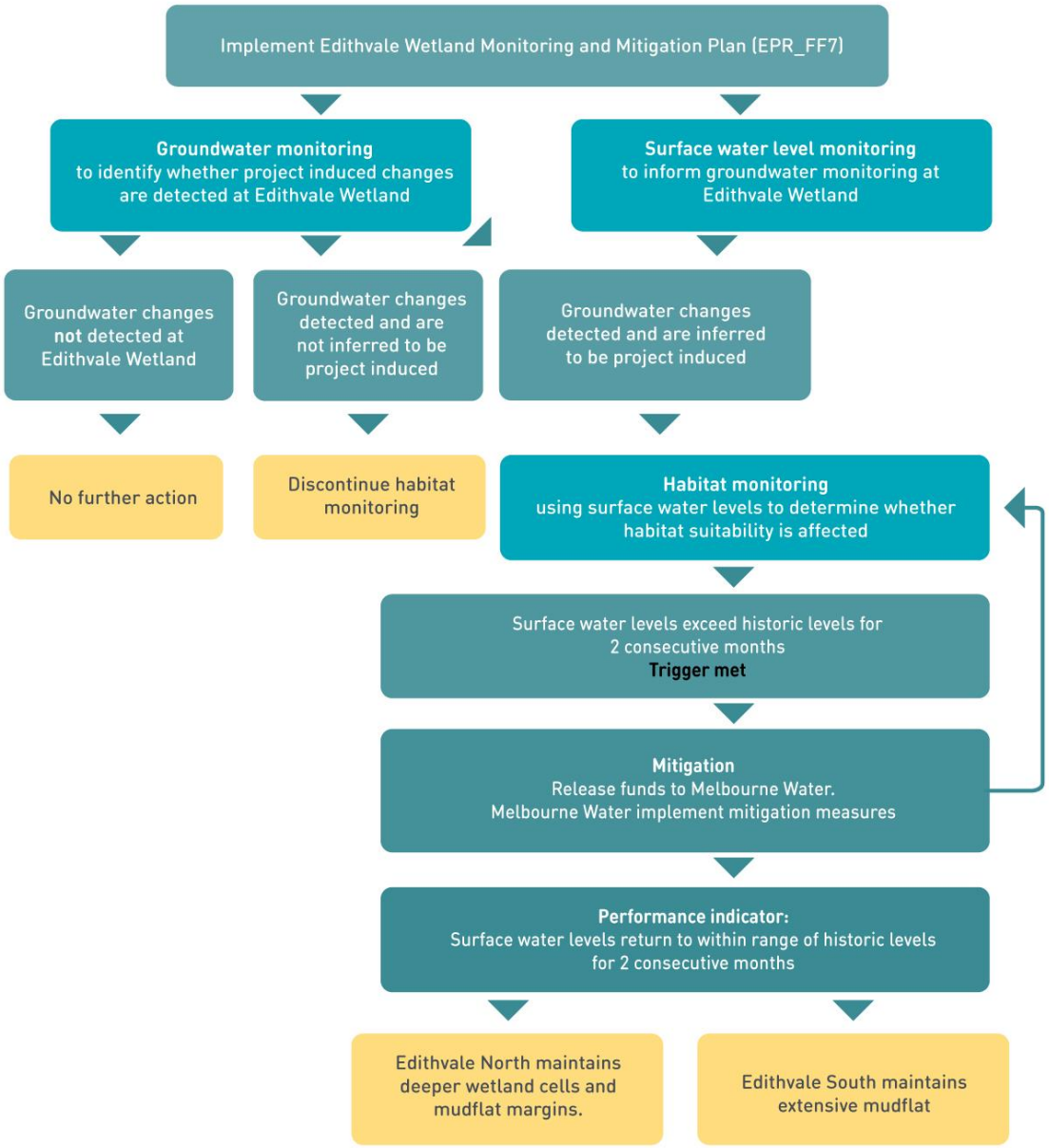


Table 2 Summary of scenarios and risks to Edithvale Wetland from the project and cross references to sections of this Plan.

Scenario	Risk to Edithvale Wetland	Relevant section of this Plan
Project design and maintenance measures work as expected	None	n/a
Project design and maintenance measures do not work as expected	Groundwater mounding occurs to the extent that Edithvale Wetland may be affected.	Section 5.1: Groundwater monitoring within and around Edithvale Wetland to determine whether groundwater level changes are project induced.
Groundwater level changes do not occur at Edithvale Wetland	None	n/a
Groundwater level changes do occur at Edithvale Wetland but are not inferred to be project induced.	None	n/a
Groundwater level changes occur at Edithvale Wetland *and* are inferred to be project induced	Groundwater level change affects the timing, duration or extent of inundation of Edithvale Wetland. Shallow wetland habitat that provides mudflats for migratory shorebirds in Edithvale Wetland South is most at risk from groundwater mounding.	Section 5.3-5.4: Habitat suitability monitoring at Edithvale Wetland using surface water level monitoring to determine whether habitat suitability is impacted.
Project induced changes to groundwater levels at Edithvale Wetland are not found to affect habitat suitability (measured by surface water levels)	None	n/a
Project-induced changes to groundwater levels at the Edithvale Wetland are found to have affected habitat suitability (measured by surface water levels).	Bird utilisation of Edithvale Wetland may be compromised due to a reduction or loss of habitat. A reduction or loss of suitable habitat and change in bird utilisation may affect the critical CPS to the extent that the ecological character of the wetland is compromised.	Section 6: Mitigation measures to be implemented to decrease surface water to maintain water levels within historic range and therefore maintain habitat.

5 Monitoring

If groundwater level change occurs at the trench and operational maintenance is ineffective (i.e. implementation of this Plan is triggered), groundwater level and surface water level monitoring at Edithvale Wetland will commence. Surface water level monitoring will be undertaken concurrently with groundwater level monitoring to enable the interaction between rainfall, surface water levels and groundwater levels to be assessed and inform whether the change in groundwater is project induced.

If project-induced groundwater level change occurs at Edithvale Wetland, habitat monitoring will be undertaken to determine whether the groundwater level change is detrimentally impacting habitat suitability.

5.1 Groundwater

Groundwater monitoring at Edithvale Wetland will commence if the trigger outlined in the *Groundwater Monitoring and Maintenance Plan* (EPR_GW2) relating to potential impacts on Edithvale Wetland is met.

Groundwater level monitoring will be undertaken:

- between the trench and Edithvale Wetland to determine whether and how far groundwater mounding extends towards Edithvale Wetland, and
- at Edithvale Wetland to determine whether groundwater levels have changed in response to groundwater mounding at the Edithvale trench.

It is not proposed to use a control site for monitoring groundwater levels at Edithvale Wetland. However, a control site (nested bores ID18-BH01 and ID18-BH01A; Figure 8) which is subject to similar groundwater recharge, discharge and flow characteristics to the Edithvale project area will be used for comparison at the trench. This bore site consist of one shallow and one deep bore and will inform whether a change in groundwater level detected at the trench is project induced or whether the change is related to something affecting the broader catchment. It is not considered necessary to repeat this exercise at Edithvale Wetland.

5.1.1 Monitoring for groundwater change between trench and Edithvale Wetland

Groundwater level data will be obtained from monitoring bores ID18-GWBH04 / ID18-GWBH05, which are located between the trench and Edithvale Wetland (see **Figure 10**). This data will be analysed to determine whether groundwater level changes correlate between the Edithvale trench and Edithvale Wetland.

Additionally, groundwater bores will be installed between the rail corridor and Edithvale Wetland to provide greater clarity on any changes in groundwater between the Edithvale trench and Edithvale Wetland. Indicatively, additional bores would be located along Edithvale Road, between the existing nested monitoring bores ID18-GWBH04 / ID18-GWBH05 and Edithvale Wetland. Groundwater levels at these bores would be monitored through automatic dataloggers.

Figure 10 Location of groundwater monitoring bores at Edithvale trench and control bore (extract from Groundwater Monitoring and Management Plan)

5.1.2 Monitoring for groundwater change at Edithvale Wetland

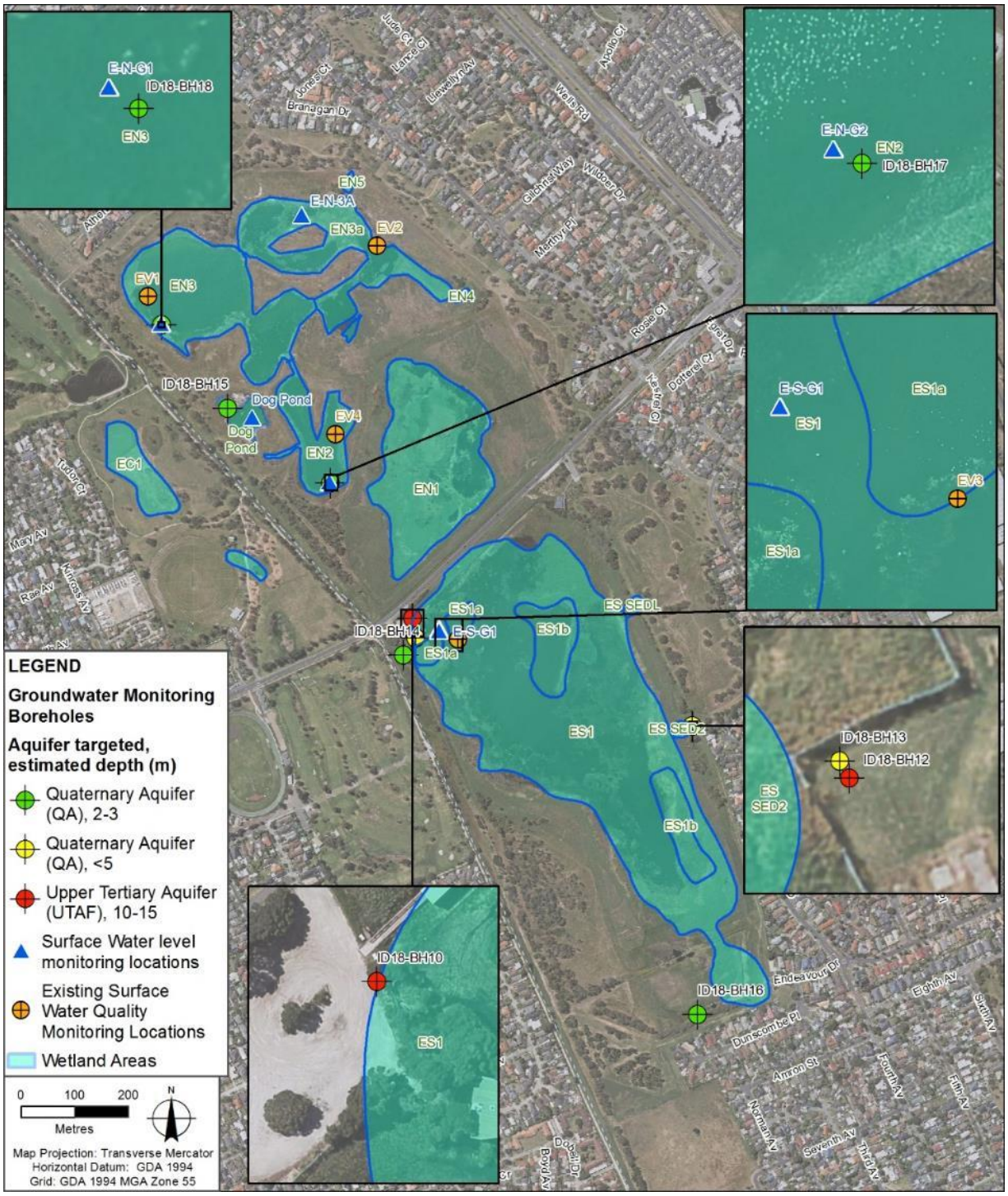
Groundwater level data will be obtained from nine monitoring bores (ID18-BH10 to ID18-BH18) that were installed at Edithvale Wetland as part of the EES for the Edithvale and Bonbeach level crossing removal project. Automatic downhole groundwater level monitoring equipment (In Situ Rugged TROLL 100 downhole dataloggers) is deployed in the bores and has been collecting data since 2017 at hourly intervals. These monitoring bores are now Melbourne Water assets which can be used to complete quarterly groundwater monitoring under Melbourne Water's obligations for implementing the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016).

The groundwater monitoring locations at Edithvale Wetland are shown in **Figure 11**.

Analysis of the groundwater level data at Edithvale Wetland will commence if triggers at the trench (i.e. in the *Groundwater Monitoring and Management Plan*) are met. Analysis will be undertaken monthly for a minimum of 2 months after triggers at the trench are met and will continue for at least 2 months after groundwater mounding is rectified at the trench (and triggers for monitoring at Edithvale Wetland are no longer met).

This is a conservative approach; groundwater modelling undertaken during the EES indicated that if significant project induced changes to groundwater occurred at the pile walls (trench), resultant groundwater mounding east of the project area and towards Edithvale Wetland would likely occur almost instantaneously (AECOM-GHD JV, 2018b).

Figure 11 Groundwater and surface water monitoring points at Edithvale Wetland



5.2 Surface water

Surface water level data will be analysed to inform the groundwater monitoring at Edithvale Wetland. Surface water level data is collected monthly by Melbourne Water as an ongoing requirement of the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016). Prior to 2017, surface water level measurements were manually collected from surface water level staff gauges. Since 2017, Surface Water Stilling Wells installed as part of the EES technical investigations have been recording surface water level data every 6 hours at five locations within Edithvale Wetland (Figure 11). These surface water level monitoring locations are:

- E-S-G1 – Edithvale South (ES1)
- E-N-G2 – Edithvale North (cell EN2)
- E-N-G1 – Edithvale North (cell EN3)
- E-N-3A – Edithvale North (cell EN3a)
- Dog pond – Edithvale North (Dog Pond).

Analysis of surface water level data as part of groundwater monitoring is important so that the interaction between rainfall, surface water levels and groundwater levels can be assessed, and it can be definitively identified whether the changes in surface water levels are driven by groundwater level changes. Where high surface water levels are identified, recent preceding rainfall events will be considered to determine if the higher water levels are the result of recent storm events. An assessment of the local contributing catchment could be undertaken to determine the likely runoff volume, and this could be compared with the additional volume of water in the wetlands.

5.3 Habitat suitability

Habitat suitability monitoring at Edithvale Wetland will use surface water levels as a measure of whether groundwater change is increasing surface water levels and reducing the area of mudflat habitat available. Alternative surrogates to habitat suitability were considered in the development of this monitoring approach. These are discussed in Appendix C.

Surface water level is used as a surrogate for habitat suitability as it:

- can be related to extent of habitat (levels determine surface water area and therefore extent of mudflat)
- is measurable
- utilises monitoring data that is already being collected at the wetlands
- is a factor which can be mitigated.

Average surface water levels form the basis of monitoring habitat suitability for this Plan. If monitoring identifies that surface water levels exceed those expected based on historic levels (baseline data), then the wetland may not experience sufficient drawdown to allow mudflat habitat to be exposed.

Analysis of surface water level data will be undertaken between August and April to align with the existing hydrological regime that is maintaining the mosaic of habitat at Edithvale Wetland (refer to Section 2.1). Analysis of surface water levels will be completed at monthly intervals.

Analysis of surface water levels will consider other factors such as rainfall and stormwater inflows and broader climatic conditions (e.g. drought or unseasonably high rainfall events). These factors may influence surface water levels, and therefore drawdown at Edithvale Wetland, in a manner which could lead to a change in surface water levels (and therefore habitat extent) being falsely attributed to the project.

Bathymetric data for calculating levels and establishing targets for surface water levels will need to be updated periodically to adjust for sedimentation of the wetland. The frequency with which bathymetry may need to be measured will depend on sedimentation rates in each of the wetland cells.

Calculation of sedimentation rates would allow a more accurate estimation of intervals for bathymetric survey but in the absence of such calculations, bathymetry updates should be undertaken at 5-year intervals (i.e. 2022, 2027) and/or following:

- a major storm event (1:100 year flood)
- any direct management works by MW which may change bathymetry
- any major changes to the stormwater network e.g. new stormwater outfall.

If cell bathymetry changes significantly then the surface water level modelling will need to be run again and triggers for mitigation will need to be adjusted accordingly.

5.4 Trigger to implement mitigation

Surface water level data has been analysed to define the range of surface water levels experienced at monitoring locations in each month of the year (see Appendix B). From this, average surface water levels have been defined for each month (**Table 3**) which form the trigger levels for mitigation implementation.

If surface water levels exceed the average levels previously experienced in the analysed data for more than two consecutive months (thus indicating drawdown may not be occurring), it could be considered that the existing hydrological regime is not being maintained and that mitigation may be require. Mitigation would not be required if the analysis determines that climatic conditions are not influencing conditions at a broader scale.

Table 3 Average surface water levels for Edithvale Wetland

Season	Month	Average surface water level (metres)		
		Edithvale Wetland South	Edithvale Wetland North	
Wetland cell		**ES1**	**EN2**	**EN3**
Surface water level monitoring point		**E-S-G1**	**E-N-G2**	**E-N-G1**
Winter	**July**	-0.080	-0.574	-0.511
Winter	**August**	-0.037	-0.524	-0.405
Spring	**September**	-0.042	-0.666	-0.471
Spring	**October**	-0.060	-0.413	-0.306
Spring	**November**	-0.091	-0.352	-0.345
Summer	**December**	-0.156	-0.407	-0.414
Summer	**January**	-0.240	-0.697	-0.634
Summer	**February**	-0.345	-0.781	-0.712
Autumn	**March**	-0.426	-0.874	-0.874
Autumn	**April**	-0.426	-0.890	-0.804
Autumn	**May**	-0.296	-0.841	-0.768
Winter	**June**	-0.139	-0.762	-0.680

6 Mitigation

Measures are to be implemented to mitigate potential impacts on Edithvale Wetland from a groundwater level rise that is attributable to the construction of the Edithvale trench. These corrective actions are consistent with the management action in the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016) which is to 'where possible, maintain current hydrological regime in wetlands to maintain ecological character'.

The mitigation measures relate to correcting the hydrology of the wetland to restore an appropriate hydrological regime (although it is acknowledged that Melbourne Water has indicated that its capacity to manipulate water in the system is limited). As changes to the hydrological regime are likely to be related to a significant increase in surface water levels, mitigation measures to decrease surface water levels will be required. These measures could include:

- Upgrade to the existing manual pump in Centre Swamp Drain adjacent to Edithvale Wetland South, if deemed to be an appropriate location and fit for purpose
- Installation of additional pump/s if required
- Pumping out water as required to discharge point/s to be determined in consultation with Melbourne Water
- Redesign or reshaping of the affected cells to ensure the provision of mudflat habitat regardless of an increase in water depth. The feasibility and risks associated with this mitigation option will be considered further in consultation with Melbourne Water, if management of water levels through pumping is ineffective. Optimal habitat for water and shorebirds should be considered when planning any reshaping works.

Surface water monitoring will continue to be undertaken to determine whether mitigation is effective and inform any adjustment that may be necessary to the approach. Performance indicators to determine whether mitigation is effective have been defined based on historic surface water levels.

Mitigation measures will be implemented by Melbourne Water using funds set aside by LXRP.

7 Summary of monitoring and mitigation actions

Table 4 is a summary of the monitoring actions and mitigation measures outlined in Section 5 and Section 6.

Table 4 Summary of monitoring and mitigation measures including timing, duration, responsibilities

Scenario	#	Action	Method	Timing and frequency	Duration	Responsibility	Trigger for habitat monitoring or mitigation	Performance indicator
Project design and maintenance measures do not work as expected and groundwater levels increase to the extent that Edithvale Wetland may be affected.	1	Release funds to implement groundwater monitoring	Release funds.	Immediately upon identifying that mitigation is required.	Once	**Asset manager** to release funds to Melbourne Water.	n/a	Funds released. Groundwater monitoring commences.
	2	Review groundwater level data at existing monitoring bores	Data from monitoring bores located between the trench and Edithvale Wetland: ID18-GWBH04 ID18-GWBH05	Immediately if groundwater triggers are met at the project area.	Until it is determined whether groundwater mounding has occurred at Edithvale Wetland and whether the change is inferred to be project-induced. Continue for 2 months after groundwater triggers at the project area are no longer met.	**Asset manager** to engage a suitably qualified and experienced environmental consultant to analyse data. **Consultant** (suitably qualified and experienced) to analyse groundwater data.	n/a	n/a
	3	Install two additional groundwater bores	Install 'transect bore 1' and 'transect bore 2' fitted with automatic dataloggers at indicative locations shown in Figure 10.	If data from monitoring bores ID18-GWBH04 / ID18-GWBH05 indicate project induced impacts.	Once	**Asset manager** to engage a suitably qualified contractor to install bores. **Contractor** (suitably qualified and experienced) to install bores.	n/a	Groundwater monitoring bores installed.
	4	Review groundwater level data between trench and Edithvale Wetland	Assess data from monitoring bores: ID18-GWBH04 ID18-GWBH05 Transect bore 1 Transect bore 2 To inform assessment of whether groundwater mounding has occurred at Edithvale Wetland.	Immediately following installation of additional transect bores.	Until it is determined whether groundwater mounding has occurred at Edithvale Wetland and whether the change is inferred to be project-induced.	**Asset manager** to engage a suitably qualified and experienced environmental consultant to analyse data. **Consultant** (suitably qualified and experienced) to analyse groundwater data.	n/a	n/a
	5	Monitor groundwater at Edithvale Wetland	Review groundwater data at Edithvale Wetland from monitoring bores: ID18-BH10 to ID18-BH18 Data loggers automatically record data at 6 hourly intervals. Refer to Section 5.1.	If trigger that relates to potential for impact to occur at Edithvale Wetland in the *Groundwater Monitoring and Management Plan* EPR_GW2) is met for project area.	Until it is determined whether groundwater mounding has occurred at Edithvale Wetland and whether the change is inferred to be project-induced.	**Melbourne Water** to: • Collect data as an ongoing requirement of *Edithvale-Seaford Wetland Ramsar Site Management Plan* • Provide data to asset manager and/or consultant for analysis **Asset manager** to engage a suitably qualified consultant to analyse data. **Consultant** (suitably qualified and experienced) to analyse groundwater data and surface water inputs and identify whether groundwater mounding is affecting Edithvale Wetland.	If groundwater level mounding (rise in groundwater levels) at Edithvale Wetland correlates with groundwater level mounding identified through triggers met in the *Groundwater Monitoring and Maintenance Plan* (EPR_GW2), within a time lag period of 2 months, then this change will be inferred to be related to the project. If project induced groundwater level mounding is inferred at Edithvale Wetland, then implement monitoring outlined in Section 3 of this Plan.	n/a
	6	Monitor surface water levels at Edithvale Wetland	Review surface water level data at Edithvale Wetland from monitoring points EV1 – EV4 to inform assessment of groundwater impacts.	If groundwater monitoring at Edithvale Wetland commences.	Until it is determined whether groundwater mounding has occurred at Edithvale Wetland and whether the change is inferred to be project-induced. Or Until habitat monitoring ceases (refer to Action 8 below)			
If groundwater level changes occur at Edithvale Wetland *and* are inferred to be project induced	7	Release funds for monitoring of habitat suitability	Release funds	Immediately upon identifying that mitigation is required.	Once	**Asset manager** to release funds to Melbourne Water.	n/a	Funds released. Habitat monitoring (surface water level monitoring) commences.
	8	Monitor surface water levels at Edithvale Wetland as a measure of habitat suitability	Review surface water level data at Edithvale Wetland from monitoring points EV1 – EV4.	If project induced groundwater level mounding is inferred at Edithvale Wetland.	5 years after (and if) project induced groundwater change is detected at Edithvale	**Asset manager** to commission the works. **Melbourne Water** to • Collect data as an ongoing requirement of the *Edithvale-*	Surface water levels exceed historic levels for more than two consecutive months and analysis indicates drawdown many not be occurring.	n/a

Scenario	#	Action	Method	Timing and frequency	Duration	Responsibility	Trigger for habitat monitoring or mitigation	Performance indicator
			Compare surface water levels with baseline data. Refer to Section 5.3 and 5.4.	Monthly intervals.	Wetland or until implementation of mitigation measures are deemed satisfactory by the appropriate authority; whichever is later.	*Seaford Wetland Ramsar Site Management Plan.* • Provide surface water level data to the asset manager and/or consultant for analysis. **Consultant** (suitably qualified and experienced) to complete surface water level monitoring.		
	9	Update bathymetric data for Edithvale Wetland	Bathymetric survey Revise water level modelling output and baseline data report (Appendix B).	5 year intervals (i.e. 2022, 2027) and/or following an event that may change the bathymetry (refer to Section 5.1.2 above)	As long as surface water level monitoring is required.	**Asset manager** to commission the works. **Specialist** to complete bathymetric survey. Suitably qualified and experienced environmental consultant to update water level modelling.	n/a	Bathymetric data collected. Surface water level modelling revised and targeted reset.
	10	Release funds to implement mitigation	Release funds	Immediately upon identifying that mitigation is required.	Once	**Asset manager** to release funds to Melbourne Water.	n/a	Funds released
If project-induced changes to groundwater levels are found to have affected habitat suitability at the Edithvale Wetland	11	Implement measures to decrease water levels	Upgrade existing manual pump in Centre Swamp Drain adjacent to Edithvale Wetland South if deemed to be an appropriate location and fit for purpose.	If triggers to implement mitigation are met.	Once	**Asset manager** to release funds to Melbourne Water. Melbourne Water to install pump/s.	n/a	Pumping system established.
	12		Install additional pump/s to allow water to be pumped out where required.					
	13		Pump out water as required to discharge point to be determined in consultation with Melbourne Water.	If triggers to implement mitigation are met.	Ongoing	**Melbourne Water**	If management of water levels through pumping is ineffective than implement action 13.	Surface water levels in Edithvale Wetland cells remain below the maximum identified in Table 3 (Section 5.4). Hydrological regime is maintained.
	14	Implement measures to alter bathymetry if water levels cannot be decreased	Redesign or reshape bathymetry of affected cells to ensure the provision of mudflat regardless of an increase in water depth.	If surface water level increase is prolonged or permanent and management of levels through pumping is ineffective.	As required.	**Asset manager** **Melbourne Water**	n/a	Bathymetry of wetland cell achieves surface water levels below the maximum identified in Table 3 (Section 5.4). Hydrological regime is restored.
	15	Monitor surface water levels post-mitigation to inform whether mitigation measures are effective.	Refer to Section 5.3.	Immediately after mitigation triggered.	5 years after habitat restored or water management strategy established for ongoing mitigation.	**Asset manager**	Surface water levels exceed historic levels for more than two consecutive months and analysis indicates drawdown many not be occurring.	n/a

8 Reporting, notification and audit

8.1 Reporting

This Plan will be made publicly available online.

If this plan is implemented, actions and confirmation of compliance must be documented within an annual compliance report to be prepared in accordance with Section 13 of EPBC Approval 2017/7906. The compliance report is to be prepared by the agency responsible for implementing this plan who must maintain accurate and complete compliance records.

8.2 Notifications and non-compliances

Any incident (i.e. an event which has the potential to, or does, impact on EPBC Act protected matters), non-compliance with the EPBC Act approval conditions or non-compliance with the commitments made in this Plan must be reported to the DAWE within two business days of becoming aware of the incident or non-compliance (Condition 14-15 of EPBC Act Approval 2017/7906).

If there is a change or likely change in the ecological character of the Ramsar site (measured by habitat suitability for this Plan), the following action must be taken:

1. Implement applicable mitigation actions within this Plan in consultation with Melbourne Water.
2. Notify DAWE in accordance with Conditions 14-15 of EPBC Act Approval 2017/7906.

8.3 Audits

The agency responsible for implementing this Plan shall ensure independent audits of compliance with the EPBC Act approval conditions are undertaken in accordance with Conditions 16-18 of EPBC Act Approval 2017/7906.

9 Roles and responsibilities

Roles and responsibilities associated with this Plan are set out in Table 5.

Table 5 Roles and responsibilities – Edithvale Wetland Monitoring and Mitigation Plan

Role	Responsibility
Implementation of *Edithvale Wetland Monitoring and Mitigation Plan* (if required)	Asset manager in conjunction with Melbourne Water. Other parties as applicable to specific sections of this plan, particularly monitoring
Funding implementation of the Plan	LXRP to set aside funds
Groundwater monitoring	A suitably qualified and experienced environmental consultant on behalf of the asset manager.
Surface water monitoring as a measure of habitat suitability	A suitably qualified and experienced environmental consultant on behalf of the asset manager.
Mitigation	Melbourne Water utilising LXRP funds
Data storage and sharing	Melbourne Water to continue to collect groundwater and surface water data in accordance with the Ramsar site management plan. Melbourne Water to provide data within 1 week of a request from asset manager to ensure potential impacts can be promptly investigated. Data collected as part of this Plan's implementation should be stored in the database maintained as part of the Groundwater Monitoring and Maintenance Plan. Data transfer, database input and quality control should be undertaken by a suitably qualified and experienced environmental consultant on behalf of the asset manager.
Review of *Edithvale Wetland Monitoring and Mitigation Plan*	Suitability qualified expert/s on behalf of the asset manager in consultation with Melbourne Water and DELWP.
Reporting	Suitability qualified expert/s on behalf of the asset manager.

10 Implementation of the Plan

10.1 Funding

LXRP will reserve funds for implementing this Plan.

Funds will be released in stages as required. This relates to implementation of the broad stages of this Plan:

- Monitoring groundwater levels at Edithvale Wetland to assess whether groundwater change at the trench extends to the wetland (refer to Section 5.1).
- Monitoring habitat suitability using surface water levels as a measure of habitat extent (refer to Section 5.2)
- Mitigation measures to be implemented if habitat suitability is compromised (refer to Section 6).

10.2 Commencement and duration

Implementation of this Plan will commence immediately on the identification of groundwater triggers being met through the *Groundwater Monitoring and Management Plan*.

Implementation of this Plan will cease when implementation of the *Groundwater Monitoring and Management Plan* (EPR_GW2) is completed or whenever implementation of mitigation measures is deemed satisfactory by the appropriate authority; whichever is later.

10.3 Review of the Plan

The Plan will be reviewed annually or sooner if implementation of the Plan identifies updates that need to be made or if new information becomes available that relates to the Plan.

Any revisions to this Plan must be made in accordance with Conditions 19 to 24 of EPBC Act Approval 2017/7906.

10.4 Risks to implementation of the Plan

An assessment of risks to achieving the environmental objectives of this Plan has been undertaken to meet Condition 6d of the EPBC Act approval. This assessment is provided in Appendix D.

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Appendix A: EPBC Act and EPR condition requirements

Monitoring of impacts at Edithvale Wetland is a requirement of EPR_FF7 and is also a condition of approval for the projects under the EPBC Act. The requirements of these respective documents are listed below and cross-referenced to the location of the supporting information.

EPR_FF7 requirements

EPR_FF7 states:

Prior to the completion of the Projects, prepare and fund the implementation of the Edithvale Wetlands Monitoring and Mitigation Plan in consultation with the Commonwealth Department of Environment and Energy, DELWP and Melbourne Water.

The Plan shall be implemented following the completion of the projects if the relevant trigger level within the Groundwater Monitoring and Mitigation Plan (refer EPR_GW2) is met.

The plan must meet the requirements outlined in **Table 6**.

Table 6 EPR_FF7 requirements and location (document/section) where this requirement is addressed

	EPR_FF7 requirements	Location
a	identify a relevant entity or entities and the roles and responsibilities for monitoring and mitigation.	Section 9 – Roles and Responsibilities
b	the plan must be made publicly available on a clearly identifiable website.	Section 8 – Reporting, notification and audit
c	include a process to review monitoring data for groundwater levels at the Wetlands to determine if there is a change in water levels corresponding to the relevant trigger level (EPR_GW2)	Section 5.1 – Groundwater
d	include a process to review the existing ecology and hydrology monitoring data (if groundwater levels at the Wetlands are elevated corresponding with the trigger level) to determine whether a change at the Wetlands is attributable to the project(s) and requires mitigation	Section 5– Monitoring
e	include a requirement to continue and/or modify existing monitoring programs, if necessary, to determine whether impacts are attributable to the projects	Section 10.3 – Reviewing the plan
f	include monitoring criteria such as hydrology and ecology indicators, consistent with the *Edithvale-Seaford Wetland Ramsar Management Plan* to determine if impacts are due to the projects.	Section 5.4 – Triggers to implement mitigation
g	include contingency measures consistent with the Edithvale-Seaford Wetland Ramsar Management Plan to mitigate potential impacts attributable to the projects. Measures may include:	Section 6 – Mitigation

	EPR_FF7 requirements	Location
	• ecological restoration measures developed by a suitably qualified ecologist that would be implemented to mitigate the effect of impacts attributable to the project(s) • engineering measures to reinstate the Wetlands to pre-impact conditions to the extent practicable.	

EPBC referral conditions

The projects were approved to proceed under the EPBC Act subject to meeting a number of conditions. Those conditions relevant to this Plan and the sections of this Plan which address the requirements of the conditions are provided in **Table 7**

Table 7 EPBC Act approval conditions and location (document/section) where addressed

	EPBC Act approval condition	Location
1	The approval holder must submit a Groundwater Monitoring and Management Plan for the Minister's approval that ensures predicted and potential impacts to groundwater as a result of the action are monitored, and corrective actions implemented if applicable trigger values are reached.	Groundwater Monitoring and Management Plan
2	The approval holder must not commence the action unless the Minister has approved the Groundwater Monitoring and Management Plan in writing. The approval holder must implement the Groundwater Monitoring and Management Plan approved by the Minister.	Groundwater Monitoring and Management Plan
3	The Groundwater Monitoring and Management Plan must be consistent with the relevant Environmental Performance Requirement approved by the Victorian Minister	Groundwater Monitoring and Management Plan
4	The approval holder must submit an Edithvale Wetlands Monitoring and Mitigation Plan for the Minister's approval that ensures impacts to wetlands as a result of the action are monitored, and corrective actions implemented if applicable trigger values are reached.	Edithvale Wetland Monitoring and Mitigation Plan
5	The approval holder must not commence the action unless the Minister has approved the Edithvale Wetlands Monitoring and Mitigation Plan in writing. The Edithvale Wetlands Monitoring and Mitigation Plan approved by the Minister must be implemented.	Edithvale Wetland Monitoring and Mitigation Plan
6	The Edithvale Wetlands Monitoring and Mitigation Plan must be consistent with the relevant Environmental Performance Requirement as approved the Victorian Minister, and must include:	EPR_FF7
6a	The Edithvale Wetlands Monitoring and Mitigation Plan environmental objectives, relevant EPBC Act protected matter/s and a table setting out where it addresses the EPBC Act approval conditions applicable to the Edithvale Wetlands Monitoring and Mitigation Plan;	This table
6b	A table of commitments made in the Edithvale Wetlands Monitoring and Mitigation Plan to achieve the objectives, and reference to where each	Section 3- Objectives

	EPBC Act approval condition	Location
	commitment is detailed in the Edithvale Wetlands Monitoring and Mitigation Plan;	
6c	Reporting and review mechanisms, and documentation standards to demonstrate compliance with the Edithvale Wetlands Monitoring and Mitigation Plan;	Section 8 – Reporting, notification and audit Section 10 – Implementation of the Plan
6d	An assessment of risks to achieving Edithvale Wetlands Monitoring and Mitigation Plan environmental objectives and risk management strategies that will be applied;	Section 10.4 / Appendix D – Risks to implementation of Plan
6e	Impact avoidance, mitigation and/or repair measures, and their timing; and	Section 6 – Mitigation
6f	A monitoring program, which must include: i. measurable performance indicators;	Section 7– Summary of monitoring and mitigation actions
	ii. the timing and frequency of monitoring to detect changes in the performance indicators;	Section 7 – Summary of monitoring and mitigation actions
	iii. trigger values for corrective actions; and	Section 5.4 – Triggers to implement mitigation
	iv. corrective actions, and commitments to implement these actions if trigger values are reached.	Section 6 – Mitigation

Appendix B: Baseline surface water report

Appendix B: Baseline surface water report

AECOM GHD JOINT VENTURE

LEVEL CROSSING REMOVAL AUTHORITY

SOUTHERN PROGRAM

00 -

Wetland Water Modelling Baseline Data - Edithvale and Bonbeach

LXRA-LX31-00-PA-RPT-0074

Revision: A

October 2019

LEVEL CROSSING REMOVAL PROJECT

VICTORIA State Government

Document Control

Release

Revision	Date Released	Release Status	Comment
A		**Draft**	For Review

LXRP Distribution List

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AECOM-GHD JV Authorisation

Name	Originator	Checker	Verifier	Package Lead	Project Manager
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	☐	☐	☐	☒	☐
	☐	☐	☐	☐	☐

Issue

Draft	☒	Final	☐

QA Sign Off

ON FILE	NOT REQUIRED
Package Lead	**Project Manager**

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1. Introduction

The Victorian Government is removing 75 dangerous and congested level crossings across Melbourne by 2025. At Edithvale and Bonbeach, the level crossings will be removed by lowering the rail line into a trench. An Environment Effects Statement (EES) was undertaken to assess potential impacts from the project to groundwater levels, groundwater quality and the Edithvale-Seaford Wetlands Ramsar Site.

The EES concluded that the risk of the Edithvale-Seaford Wetlands Ramsar Site being impacted was negligible. Despite this, the Environmental Management Framework (EMF) and associated Environmental Performance Requirements (EPRs) for the project require the preparation of two monitoring and mitigation plans. These are:

Groundwater Monitoring and Management Plan (EPR_GW2)

Edithvale Wetland Monitoring and Mitigation Plan (EPR-FF7).

The *Groundwater Monitoring and Management Plan* requires the monitoring of groundwater at the trench. Monitoring undertaken in accordance with the Groundwater Monitoring and Management Plan includes identifying whether groundwater level rise occurs to the extent that Edithvale Wetland may be affected. If this occurs then the *Edithvale Wetland Monitoring and Mitigation Plan* will be implemented.

This *Edithvale Wetland Monitoring and Mitigation Plan* requires the monitoring of groundwater and surface water levels at Edithvale Wetland to identify whether groundwater mounding (as a result of the project) reaches Edithvale Wetland and whether this groundwater increase affects the suitability of the habitat and therefore use of the wetland by birds.

In order to understand whether a change in water level affects the suitability of the habitat, an understanding of the hydrology of Edithvale Wetland that has been maintaining the existing mosaic wetland habitat is required.

A baseline assessment of historical water levels has therefore been undertaken to develop an understanding of historical seasonal fluctuations experienced at the wetland. Average water levels experienced at the wetland have been identified. Water levels have been combined with bathymetry (depth profile) of the wetland to model the extent of inundation and infer the extent of mudflat habitat for migratory shorebirds. This habitat modelling tells the story that when the water levels look like ‘X’ then the habitat looks like ‘Y’. It also aims to demonstrate that the habitat is naturally variable.

This baseline report documents historical water levels in the Edithvale Wetlands which can be used to inform water level management strategies discussed in the “Edithvale Wetlands Monitoring and Mitigation Plan.” The data contained in this report can be used to compare against future water levels in the wetlands should monitoring described in the *Edithvale Wetland Monitoring and Mitigation Plan* be required

2. Data

2.1 Water levels

Surface water level data is collected monthly by Melbourne Water from 5 locations as an ongoing requirement of the *Edithvale-Seaford Wetland Ramsar Site Management Plan* (Ecology Australia 2016). These surface water level monitoring locations and their corresponding wetland cells are shown in Figure 1 and comprise:

- E-S-G1 – Edithvale South (ES1)
- E-N-G2 – Edithvale North (cell EN2)
- E-N-G1 – Edithvale North (cell EN3)

Water level data manually collected from surface water level gauges by Melbourne Water was used to calibrate a hydrological model that predicted historical water levels based on local rainfall, runoff, evaporation, infiltration and overflow from the wetlands. The data was prepared as an input to the hydrogeological assessment that was undertaken as part of the EES.

The water levels generated by the hydrological model for an 8 year period (from 2008/09 to 2015/16) have been used in this baseline data report. This baseline data collected has been assessed to gain an understanding of how the wetland functions over time and demonstrate existing variability and fluctuations in water levels in the system.

In 2017, Surface Water Stilling Wells were installed as part of the EES technical investigations. Continuous water level monitors (data loggers) have been recording water levels at 6 hourly intervals since 2017. Data from these data loggers has not be used for defining water levels and completing habitat modelling in this report, as there is not sufficient data (<2 years) to analyse. As the period of this new data increases, it can be used to supplement or supersede the generated data used to define average water levels at Edithvale Wetland.

2.2 Bathymetry

A bathymetric survey was undertaken in July 2017 as part of the EES technical investigations to establish a detailed depth profile of each of the cells of the wetland and allow a water volume of each cell to be determined. Despite some limitations, a good coverage of the bathymetry of the wetland cells was achieved.

Bathymetric data allows the contours to be defined for each of the cells which can then be used in conjunction with surface water level data to model extent of inundation (maximum water line) of each cell over time.

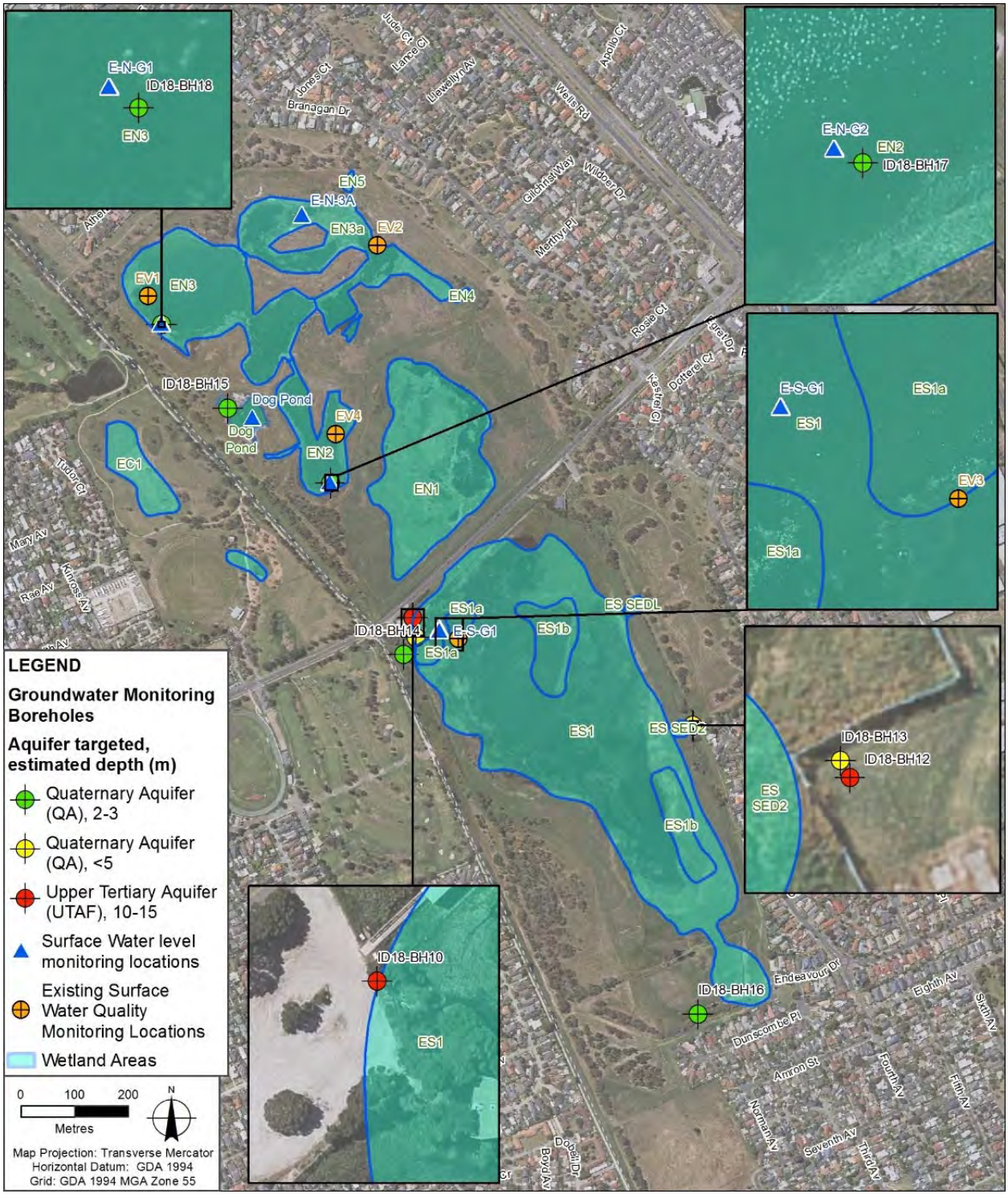


Figure 1 Groundwater and surface water monitoring points at Edithvale Wetland

3. Water levels

Surface water level data shows a consistent trend of reduced water levels in the later summer months which then increase over winter. Edithvale South (in particular), generally experiences drawdown over spring and summer.

3.1 Long-term fluctuations

Long term fluctuations in water levels within the wetlands have been determined by hydrological and water balance modelling and calibrated to historical records are indicated in the following figures:

- Edithvale South (ES1) - Figure 2
- Edithvale North (cell EN2) - Figure 3
- Edithvale North (cell EN3) - Figure 4

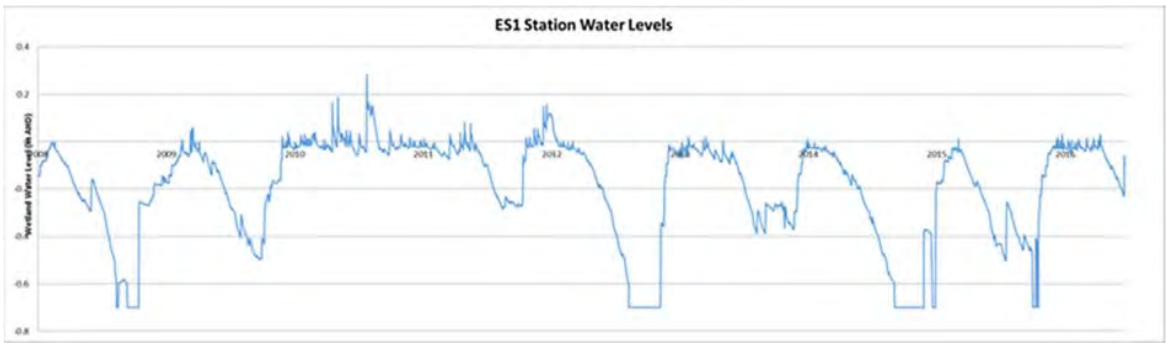


Figure 2 Long-term surface water levels in Edithvale South

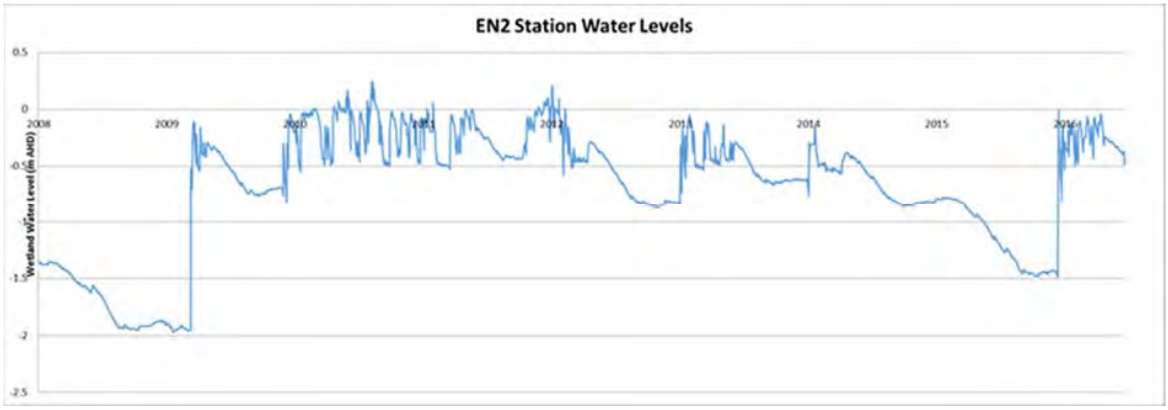


Figure 3 Long-term surface water levels in Edithvale North – cell EN2

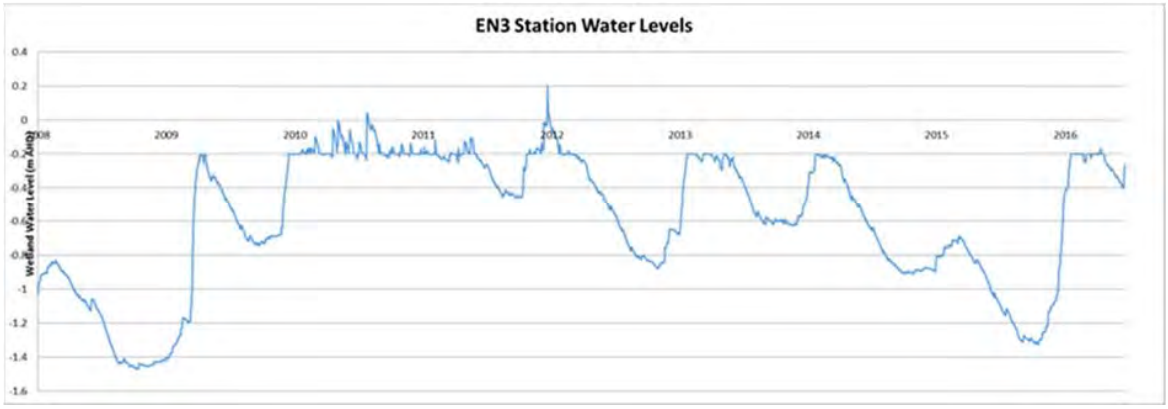


Figure 4 Long-term surface water levels in Edithvale North – cell EN3

3.2 Average water levels

Average water levels have been calculated for each of the surface water level monitoring points and associated wetland cell. These levels are provided in a sequence to align with the period when migratory shorebirds are present in Australia (as the migratory shorebirds are the primary reason the Edithvale-Seaford Wetlands Ramsar Site is recognised as an internationally important wetland). Migratory shorebirds spend their non-breeding season in Australia generally arriving in September and departing in April. The sequence applied to the water data is therefore July to June depicted either in months or as a season spanning from July to one year to June the following year (e.g. 2015/16).

Average monthly water levels experienced at Edithvale Wetland over preceding years are provided in Table 1 and shown in Figure 5 (Edithvale South), Figure 6 (Edithvale North – EN2) and 7 (Edithvale North – EN3).

Table 1 Average surface water levels for Edithvale Wetland

Season	Month	Average surface water level (metres AHD)		
		Edithvale South	Edithvale North	
Wetland cell		**ES1**	**EN2**	**EN3**
Surface water level monitoring point		**E-S-G1**	**E-N-G2**	**E-N-G1**
Winter	**July**	-0.080	-0.574	-0.511
Winter	**August**	-0.037	-0.524	-0.405
Spring	**September**	-0.042	-0.666	-0.471
Spring	**October**	-0.060	-0.413	-0.306

Season	Month	Average surface water level (metres AHD)		
		Edithvale South	Edithvale North	
Spring	**November**	-0.091	-0.352	-0.345
Summer	**December**	-0.156	-0.407	-0.414
Summer	**January**	-0.240	-0.697	-0.634
Summer	**February**	-0.345	-0.781	-0.712
Autumn	**March**	-0.426	-0.874	-0.874
Autumn	**April**	-0.426	-0.890	-0.804
Autumn	**May**	-0.296	-0.841	-0.768
Winter	**June**	-0.139	-0.762	-0.680

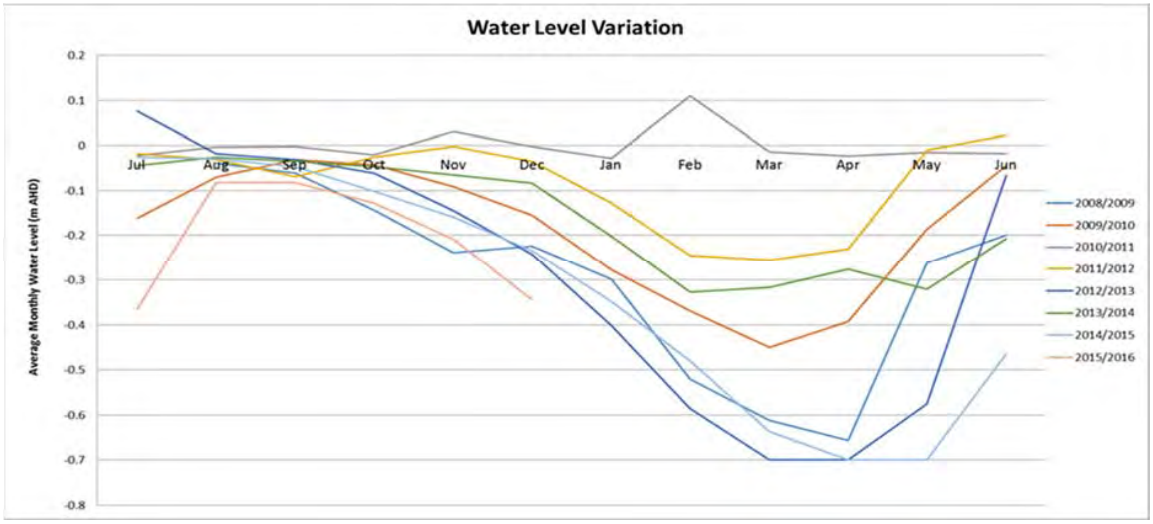


Figure 5 Average monthly water level at Edithvale South (ES1) per year

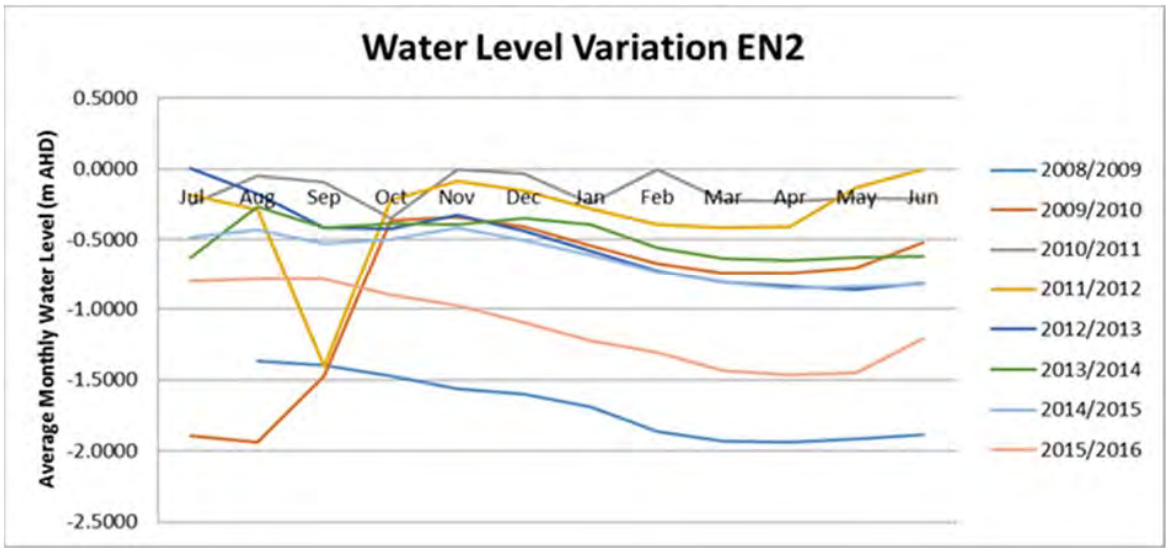


Figure 6 Average monthly water level at Edithvale North (EN2) per year

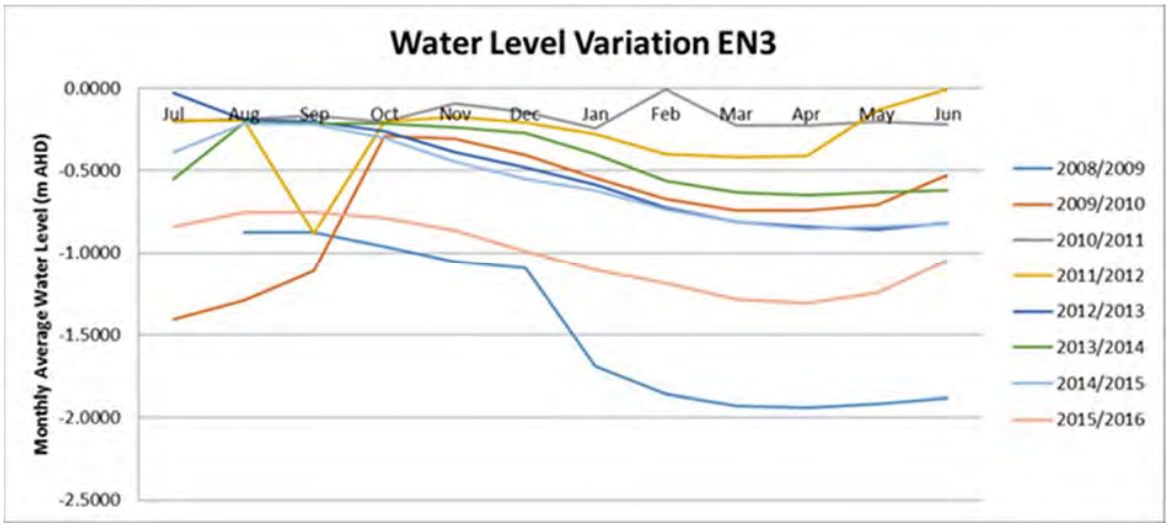


Figure 7 Average monthly water level at Edithvale North (EN3) per year

4. Habitat modelling

Bathymetric and surface water level data has been used to model the extent of inundation (maximum water line) and therefore infer the extent of mudflat habitat. Surface water areas were modelled using water level categories defined on broad interspecific wading habits of the birds known to occur at Edithvale Wetland. The categories adopted were <100mm (optimal for shorebirds; Smith et al. 2018), 100-200mm (larger wading birds with longer necks) and >200mm (dabbling ducks; Isola et al. 200).

To do this, modelling has been completed for each month of the 8 years of data analysed (2008/09-2015/16). An average water level in a given month has been determined and used to generate historical average extents which provide an indication of what each cell could be expected to be like at a given point in time. Changes in inundation over a season and variability in inundation extent between years is shown in the modelling outputs.

The water extents were determined in GIS by intersecting the average monthly water levels with the terrain model. The water extents depict changes in seasonal inundation as well as identifying variation between years.

Extent of inundation based on average water levels experienced at Edithvale Wetland are provided in the tables below. Extent is expressed as area and as a percentage of the wetland cell total area. The sequence applied to the water data is July to June to align with the period of shorebird migration to Australia.

The modelling outputs showing the extent of inundation experienced on average are shown in Figure 8 for Edithvale South and Figure 9 for Edithvale North using cell EN3 as a representative example of the hydrology of the deeper cells in that part of the wetland.

As Edithvale South experiences the most prominent drawdown over spring and summer and is recognised as being the portion of Edithvale Wetland which provides the most habitat for migratory shorebirds, further modelling has been completed to show the inundation extents from July to June across each season between 2009/10 and 2015/16 (Appendix A) and inundation extents at the same time each year (Appendix B). This modelling shows that the rate and extent of drawdown and mudflat extent can vary each season.

Overall, the modelling shows the hydrological regime that is maintaining the mosaic of wetland habitats at Editvhale Wetland. This hydrology aligns with the ideal hydrology broadly described in the *Edithvale-Seaford Wetlands Ramsar Site Management Plan* (Ecology Australia 2016). This is:

- Inundation over winter and early-spring to drown tall reeds
- Slow drawdown from spring through to autumn to expose mudflat habitat for migratory birds primarily in Edithvale South
- Maintenance of deeper pools as permanent water for waterfowl, primarily in Edithvale North but also the few small, deeper pools in Edithvale South.

4.1 Inundation extent data (inferred habitat extent)

4.1.1 Edithvale South (cell ES1)

Table 2 Average surface water area for Edithvale Wetland by month – Edithvale South (cell ES1)

Wetland Number		Edithvale South (cell ES1)							
Monitoring point		E-S-G1							
Depth of water		0mm		<100mm		100-200mm		>200mm	
Season	Month	(dry)							
Winter	July	8272	(5%)	25212	(14%)	42940	(24%)	101404	(57%)
Winter	August	0	(0%)	20312	(11%)	33556	(19%)	123960	(70%)
Spring	September	1288	(1%)	20788	(12%)	31792	(18%)	123960	(70%)
Spring	October	4156	(2%)	22776	(13%)	38676	(22%)	112220	(63%)
Spring	November	9780	(5%)	26060	(15%)	56772	(32%)	85216	(48%)
Summer	December	24092	(14%)	37176	(21%)	84884	(48%)	31676	(18%)
Summer	January	53868	(30%)	80292	(45%)	34376	(19%)	9292	(5%)
Summer	February	141224	(79%)	27312	(15%)	5244	(3%)	4048	(2%)
Autumn	March	167636	(94%)	4700	(3%)	5212	(3%)	280	(0%)
Autumn	April	167636	(94%)	4700	(3%)	5212	(3%)	280	(0%)
Autumn	May	92612	(52%)	70360	(40%)	7948	(4%)	6908	(4%)
Winter	June	20312	(11%)	33556	(19%)	80292	(45%)	43668	(25%)

4.1.2 Edithvale North (cell EN2)

Table 3 Average surface water area for Edithvale Wetland by month – Edithvale North (cell EN2)

Wetland Number		Edithvale North (cell EN2)							
Monitoring point		E-N-G2							
Depth of water		0mm		<100mm		100-200mm		>200mm	
Season	Month	(dry)							
Winter	July	1568	(10%)	544	(3%)	504	(3%)	13808	(84%)
Winter	August	1312	(8%)	532	(3%)	464	(3%)	14116	(86%)
Spring	September	2072	(13%)	484	(3%)	516	(3%)	13352	(81%)
Spring	October	508	(3%)	728	(4%)	576	(4%)	14612	(89%)
Spring	November	0	(0%)	804	(5%)	616	(4%)	15004	(91%)
Summer	December	508	(3%)	688	(4%)	560	(3%)	14668	(89%)
Summer	January	2196	(13%)	576	(4%)	424	(3%)	13228	(81%)
Summer	February	2616	(16%)	508	(3%)	580	(4%)	12720	(77%)
Autumn	March	3088	(19%)	572	(3%)	484	(3%)	12280	(75%)
Autumn	April	3168	(19%)	568	(3%)	508	(3%)	12180	(74%)
Autumn	May	2964	(18%)	472	(3%)	544	(3%)	12444	(76%)
Winter	June	2532	(15%)	540	(3%)	512	(3%)	12840	(78%)

4.1.3 Edithvale North (cell EN3)

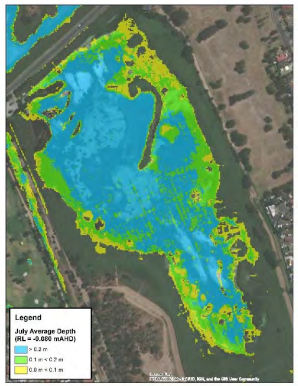
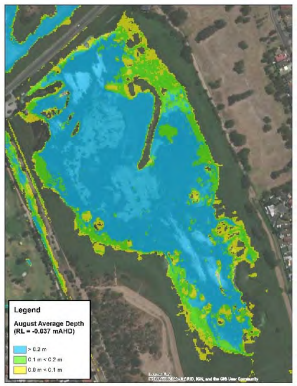
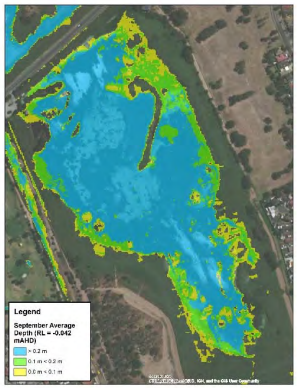
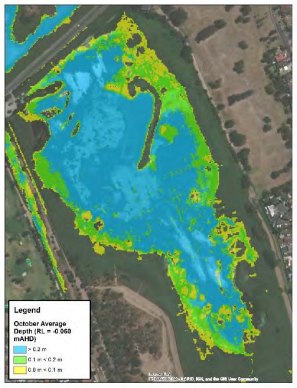
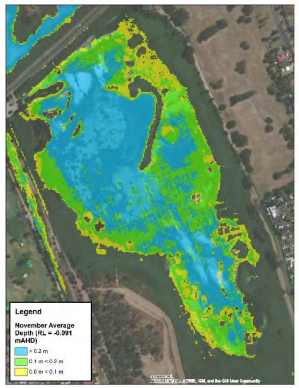
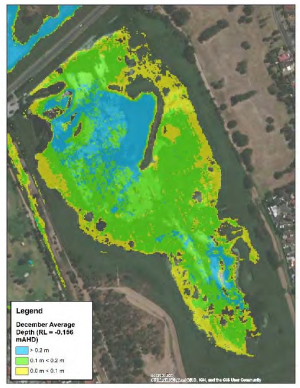
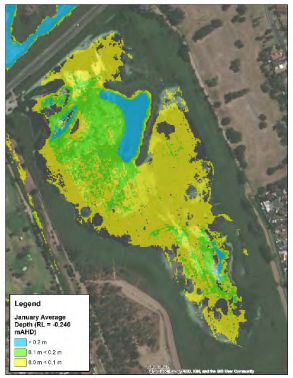
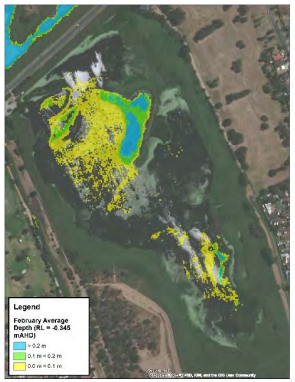
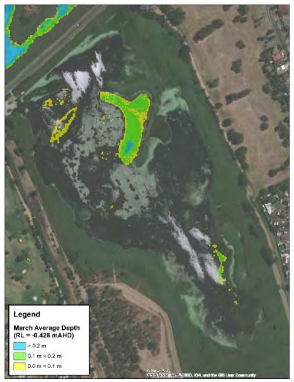
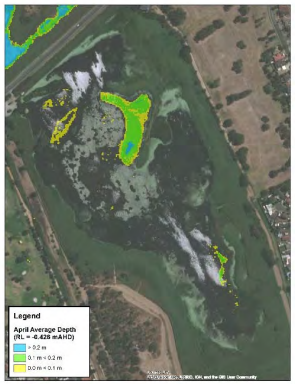
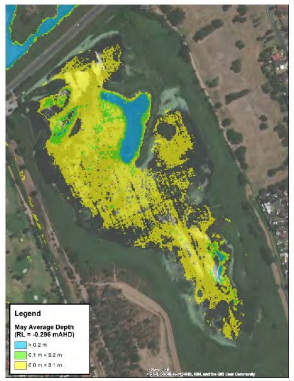
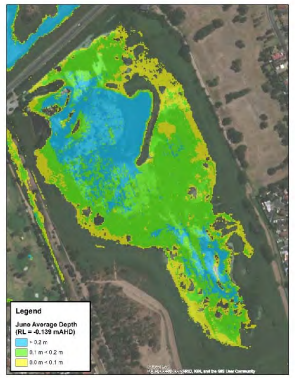
Table 4 Average surface water area for Edithvale Wetland by month – Edithvale North (cell EN3)

Wetland Number		Edithvale North (cell EN3)							
Monitoring point		E-N-G1							
Depth of water		0mm		<100mm		100-200mm		>200mm	
Season	Month	(dry)							
Winter	July	3704	(7%)	1268	(3%)	1260	(3%)	43496	(87%)
Winter	August	1768	(4%)	1836	(4%)	1256	(3%)	44868	(90%)
Spring	September	3176	(6%)	1284	(3%)	1240	(2%)	44028	(89%)
Spring	October	0	(0%)	1768	(4%)	1836	(4%)	46124	(93%)

Wetland Number		Edithvale North (cell EN3)							
Monitoring point		E-N-G1							
Depth of water		0mm		<100mm		100-200mm		>200mm	
Season	Month	(dry)							
Spring	**November**	780	(2%)	1844	(4%)	1468	(3%)	45636	(92%)
Summer	**December**	1964	(4%)	1740	(3%)	1268	(3%)	44756	(90%)
Summer	**January**	5236	(11%)	1272	(3%)	1416	(3%)	41804	(84%)
Summer	**February**	6232	(13%)	1324	(3%)	1536	(3%)	40636	(82%)
Autumn	**March**	8492	(17%)	1608	(3%)	1728	(3%)	37900	(76%)
Autumn	**April**	7440	(15%)	1508	(3%)	2384	(5%)	38396	(77%)
Autumn	**May**	6972	(14%)	1520	(3%)	1452	(3%)	39784	(80%)
Winter	**June**	5852	(12%)	1216	(2%)	1552	(3%)	41108	(83%)

4.2 Modelled habitat extent

4.2.1 Edithvale South

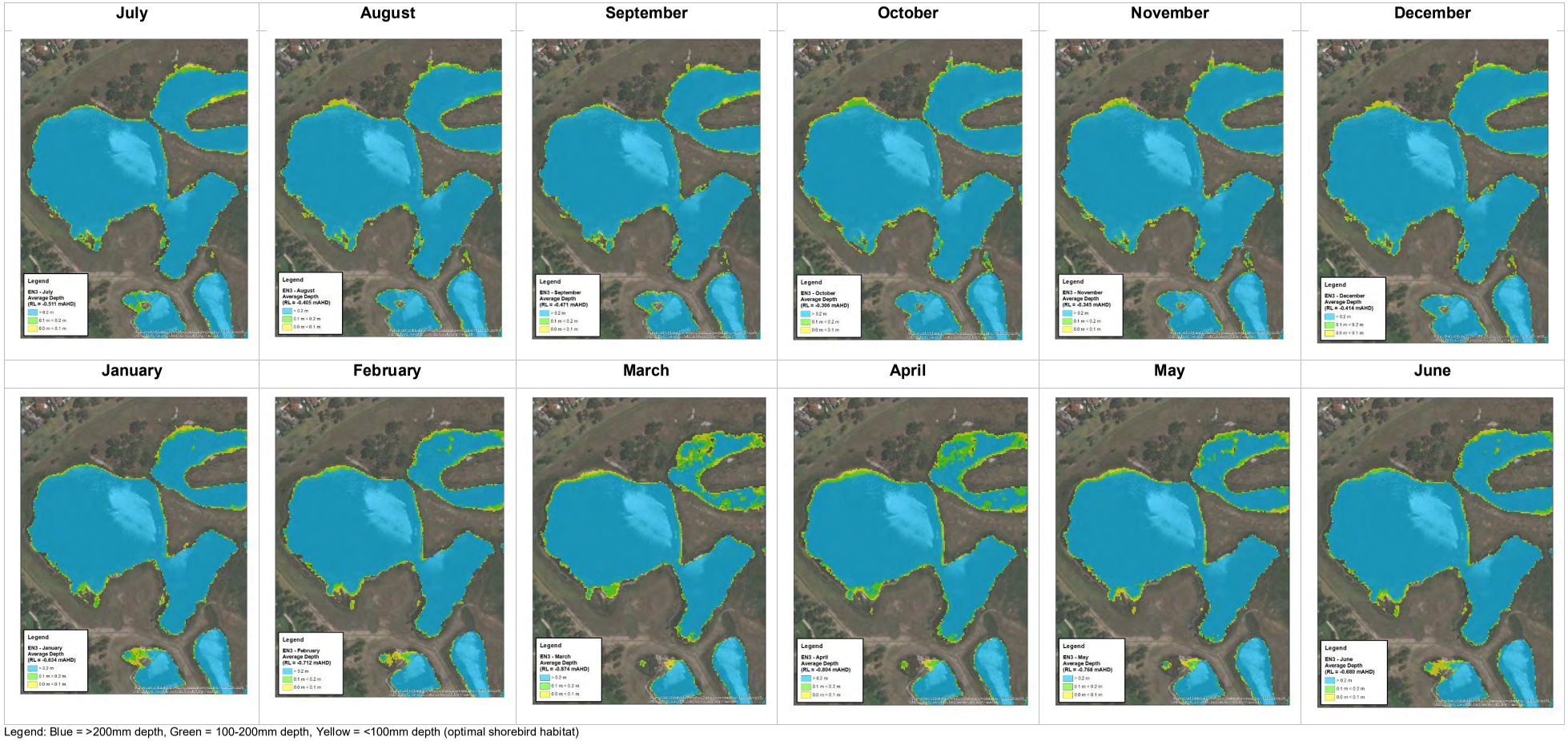
July	August	September	October	November	December
					
January	**February**	**March**	**April**	**May**	**June**
					

Legend: Blue = >200mm depth, Green = 100-200mm depth, Yellow = <100mm depth (optimal shorebird habitat)

Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels/inundation extent.

Figure 8 Average extent of habitat per month at Edithvale South

4.2.2 Edithvale North (cell EN3)



Legend: Blue = >200mm depth, Green = 100-200mm depth, Yellow = <100mm depth (optimal shorebird habitat)

Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels / inundation extent.

Figure 9 Average extent of habitat per month at Edithvale North (EN3)

5. References

AECOM-GHD JV 2018a. Edithvale and Bonbeach Level Crossing Removal Projects Environment Effects Statement Technical Report B Ecology: Wetlands and Groundwater Dependent Ecosystems. Level Crossing Removal Authority, Melbourne. Available at: https://levelcrossings.vic.gov.au/media/publications/ees/read-the-ees

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Appendices

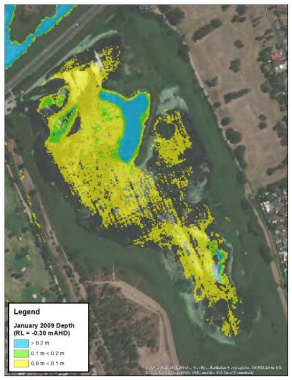
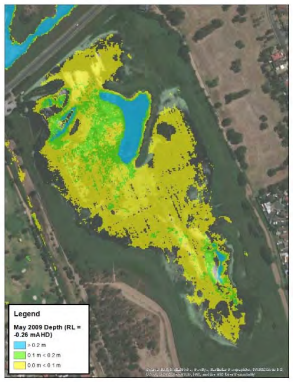
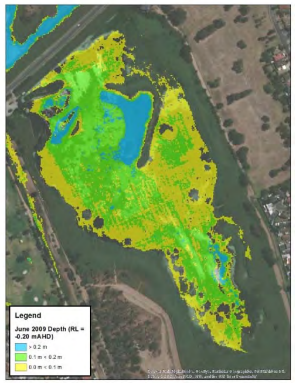
Appendix A - Water levels across each July to June (spring-summer) season

Water levels depicting habitat extent per year over migratory shorebird season July to June

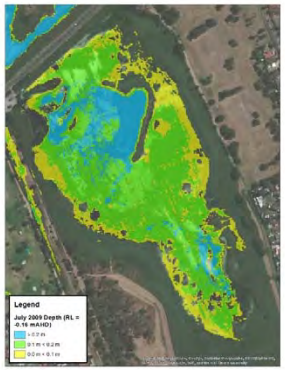
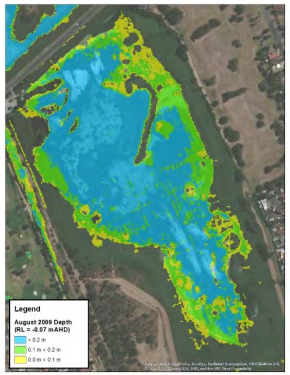
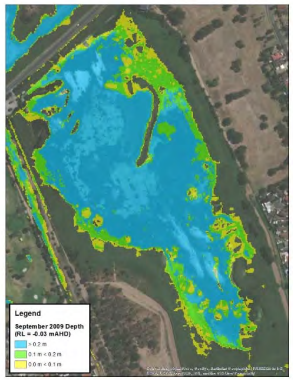
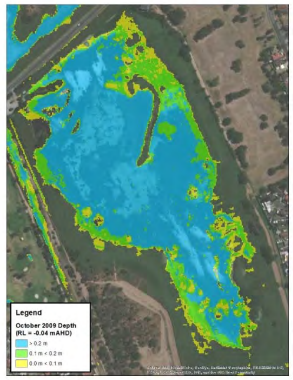
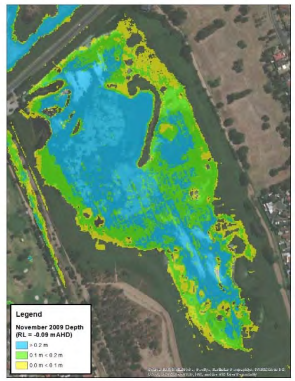
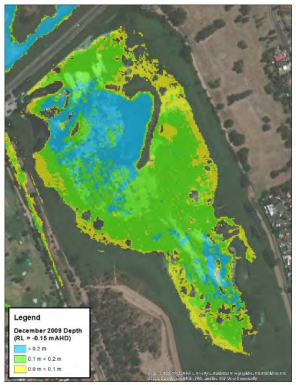
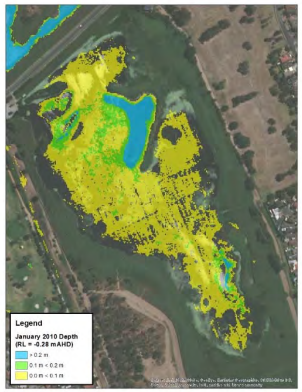
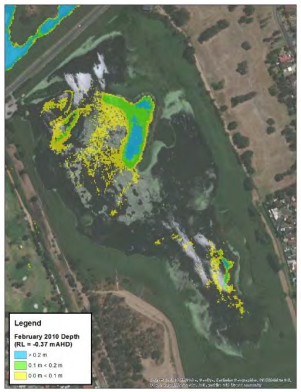
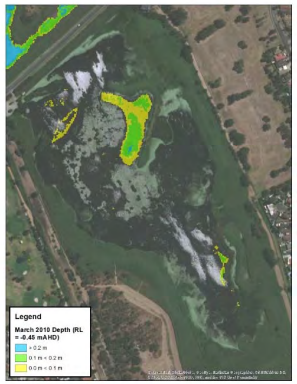
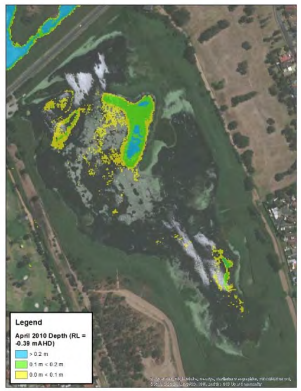
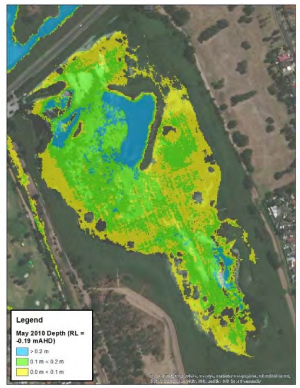
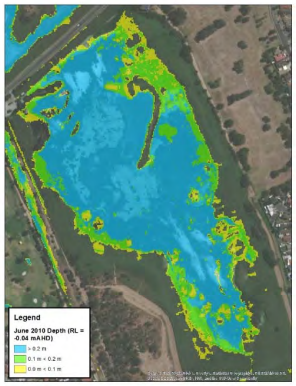
Legend: Blue = >200mm depth, Green = 100-200mm depth, Yellow = <100mm depth (optimal shorebird habitat)

Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels / inundation extent.

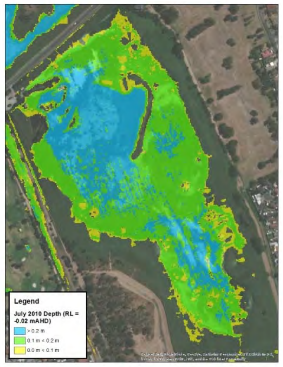
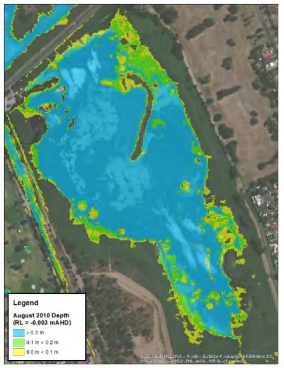
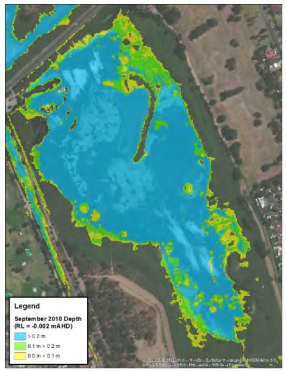
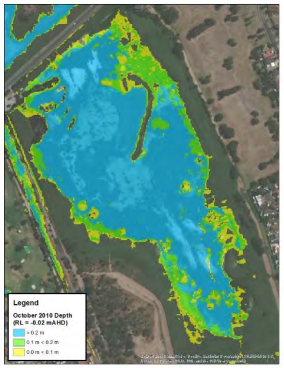
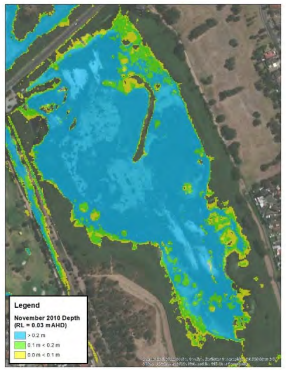
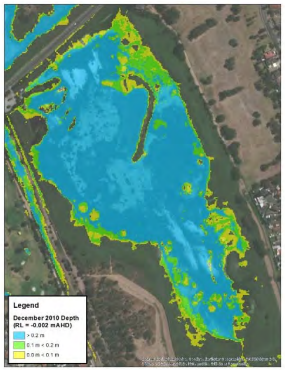
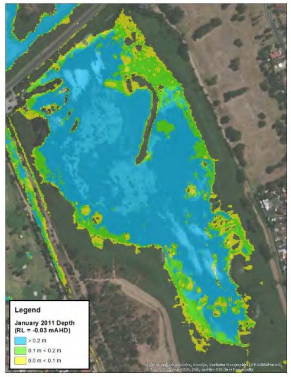
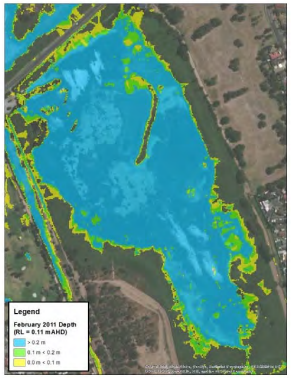
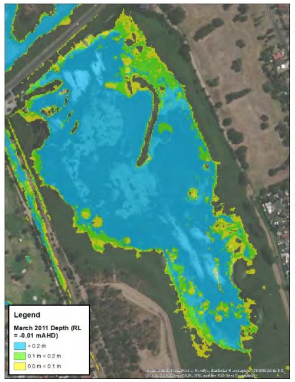
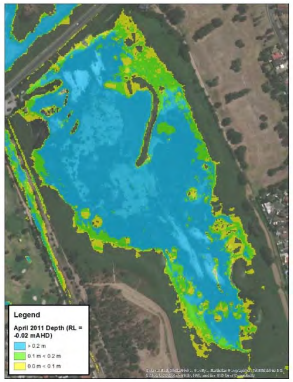
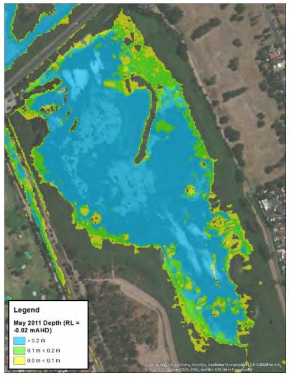
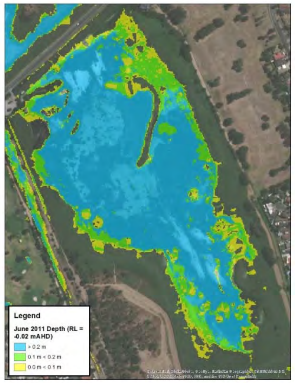
2008-2009 season

January 2009	February 2009	March 2009	April 2009	May 2009	June 2009
					

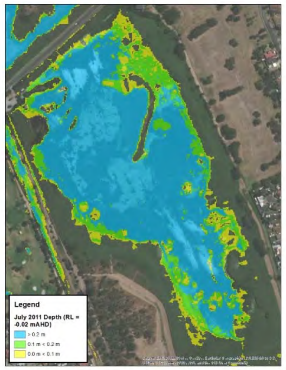
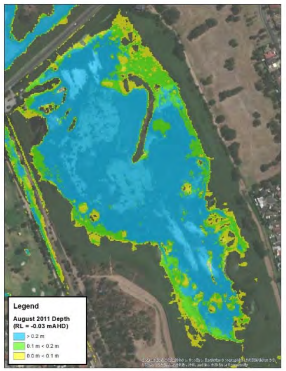
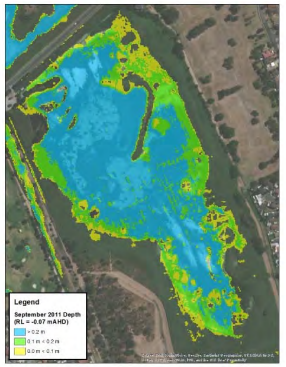
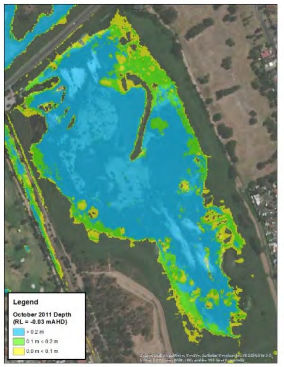
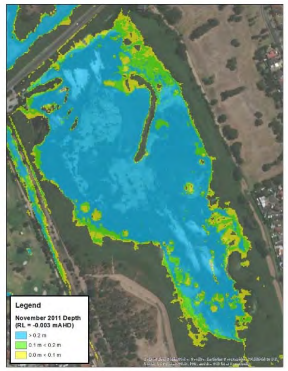
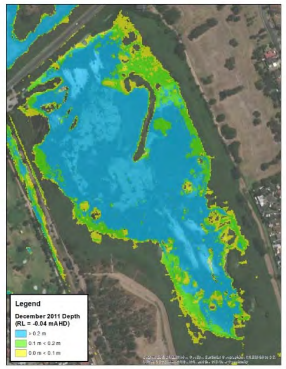
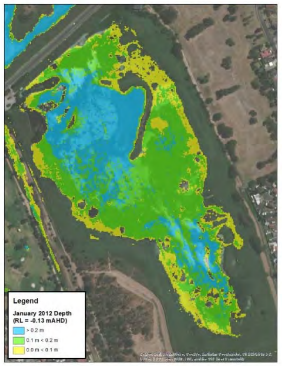
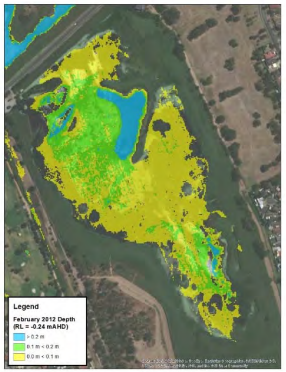
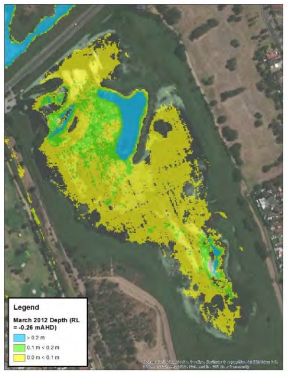
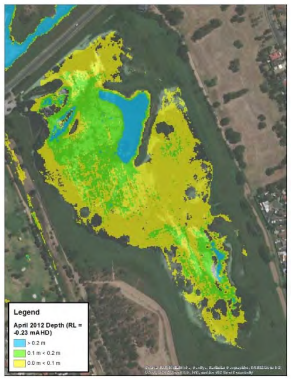
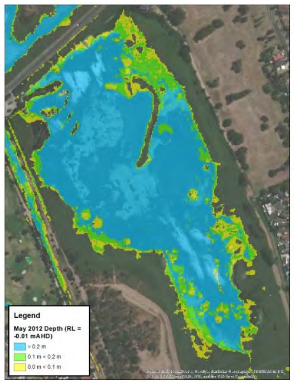
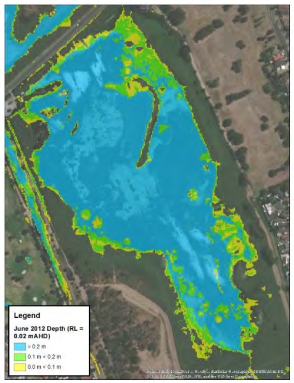
2009 – 2010 season

July 2009	August 2009	September 2009	October 2009	November 2009	December 2009
					
January 2010	**February 2010**	**March 2010**	**April 2010**	**May 2010**	**June 2010**
					

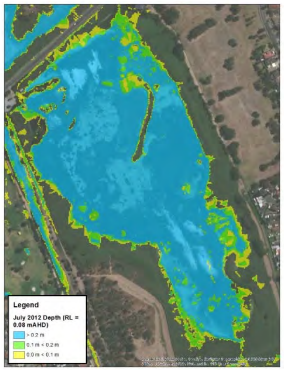
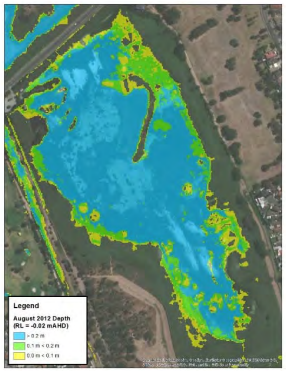
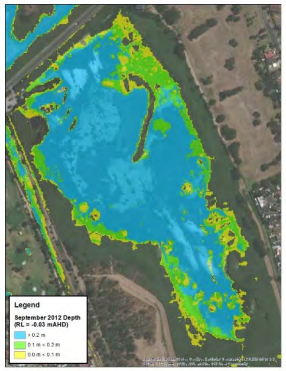
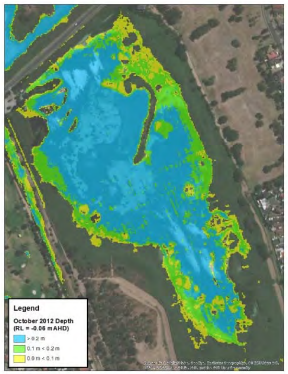
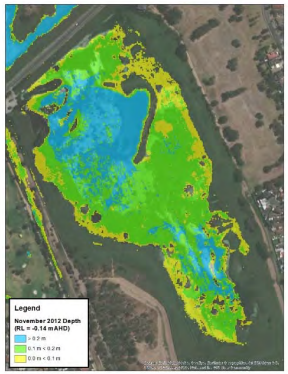
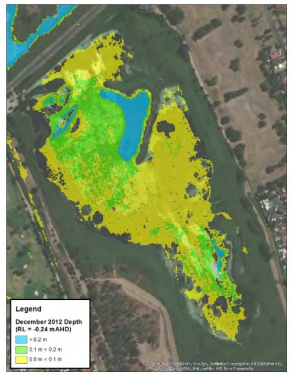
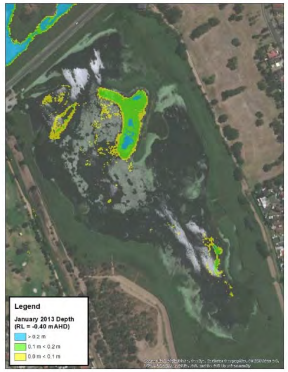
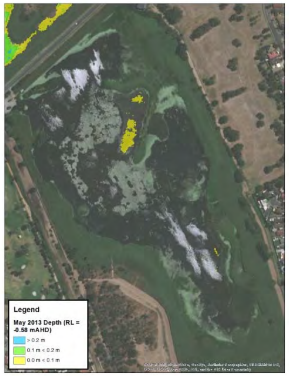
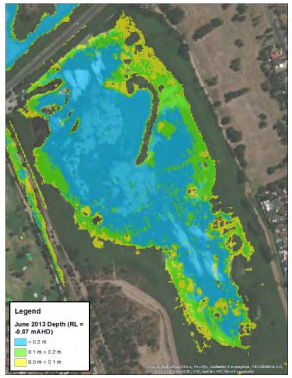
2010-2011 season (the year the millennial drought broke)

July 2010	August 2010	September 2010	October 2010	November 2010	December 2010
					
January 2011	**February 2011**	**March 2011**	**April 2011**	**May 2011**	**June 2011**
					

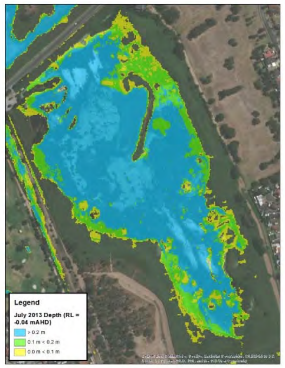
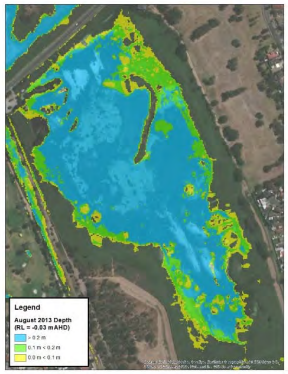
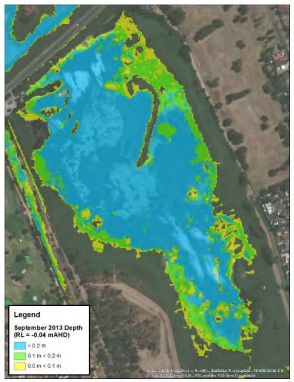
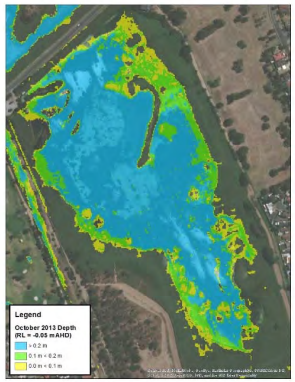
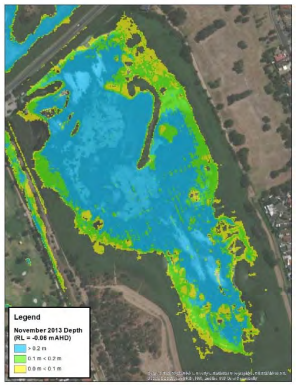
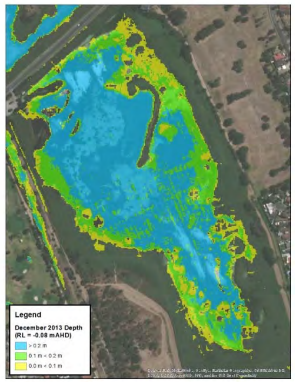
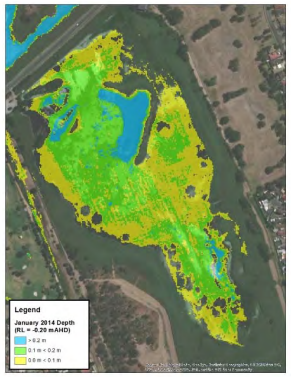
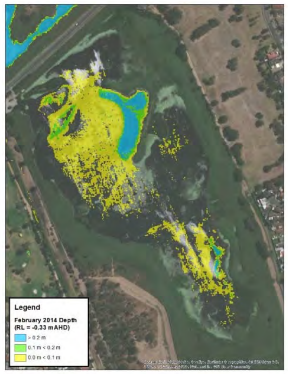
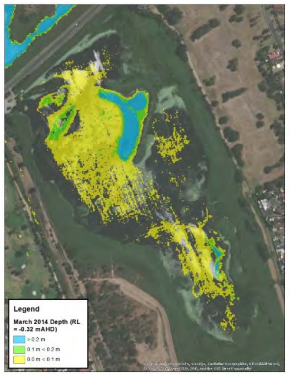
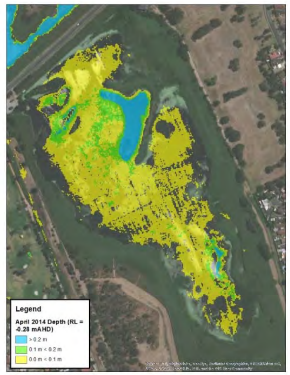
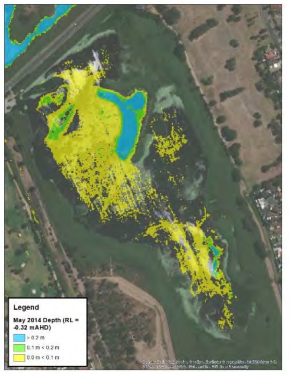
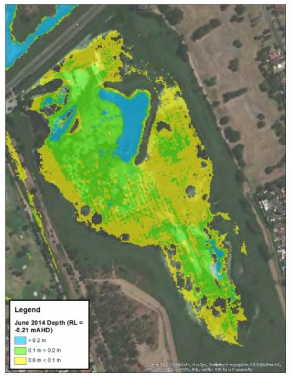
2011 – 2012 season

July 2011	August 2011	September 2011	October 2011	November 2011	December 2011
					
January 2012	**February 2012**	**March 2012**	**April 2012**	**May 2012**	**June 2012**
					

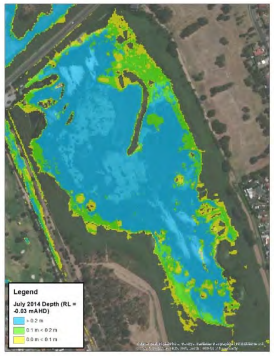
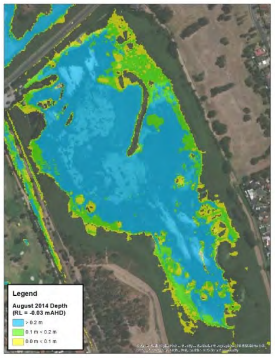
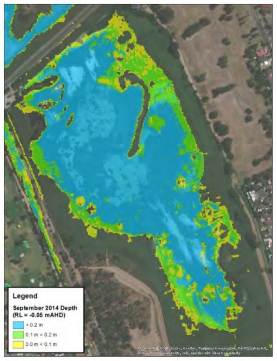
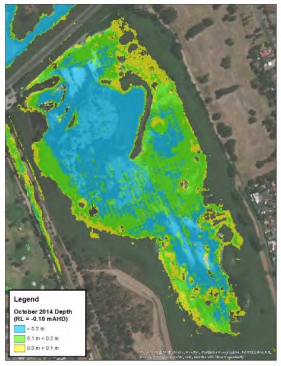
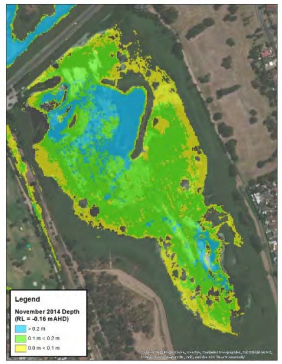
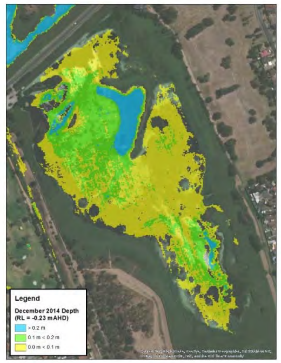
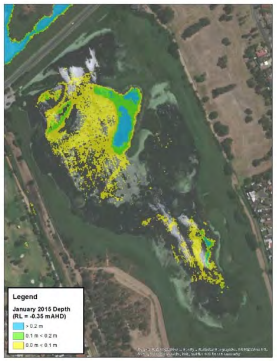
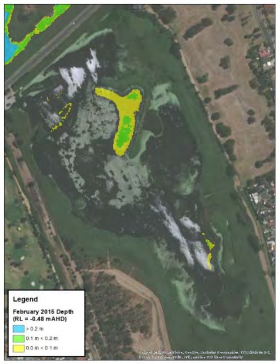
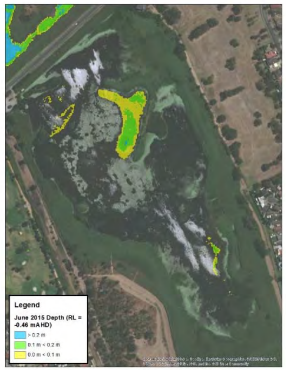
2012 – 2013 season

July 2012	August 2012	September 2012	October 2012	November 2012	December 2012
					
January 2013	**February 2013**	**March 2013**	**April 2013**	**May 2013**	**June 2013**
					

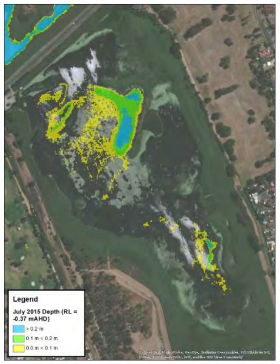
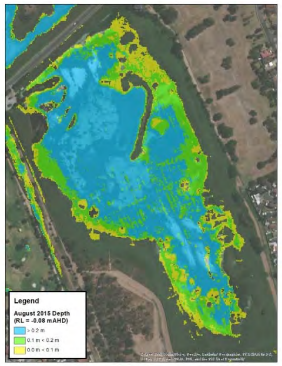
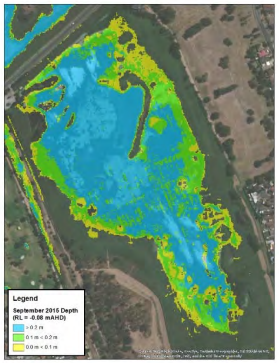
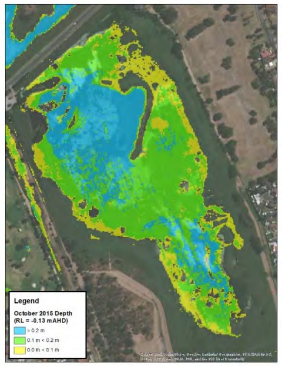
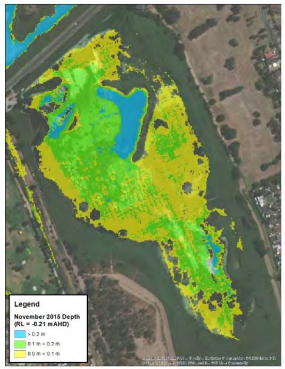
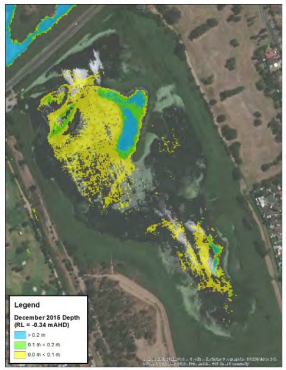
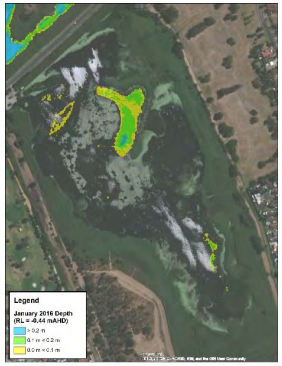
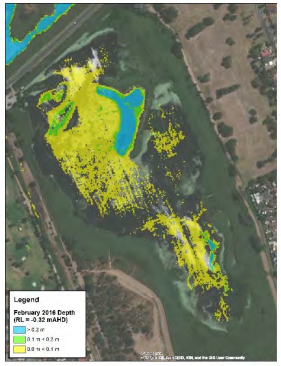
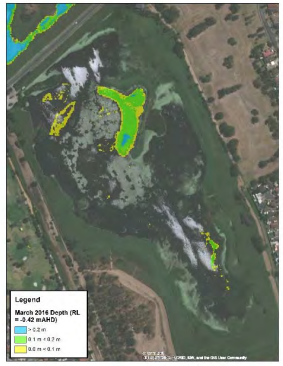
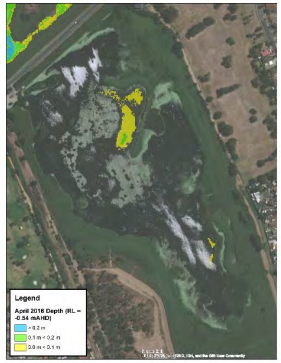
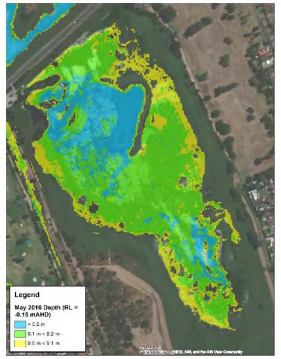
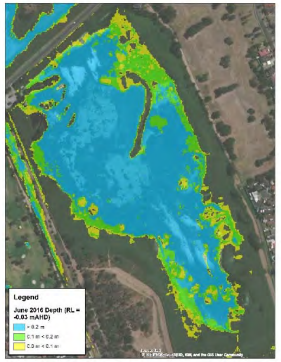
2013 – 2014 season

July 2013	August 2013	September 2013	October 2013	November 2013	December 2013
					
January 2014	**February 2014**	**March 2014**	**April 2014**	**May 2014**	**June 2014**
					

2014 – 2015 season

July 2014	August 2014	September 2014	October 2014	November 2014	December 2014
					
January 2015	**February 2015**	**March 2015**	**April 2015**	**May 2015**	**June 2015**
					

2015 – 2016 season

July 2015	August 2015	September 2015	October 2015	November 2015	December 2015
					
January 2016	**February 2016**	**March 2016**	**April 2016**	**May 2016**	**June 2016**
					

Appendix B - Water levels in a given month each year

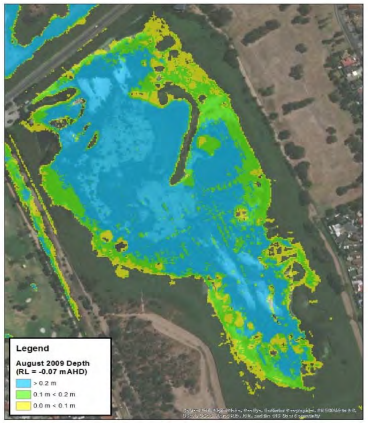
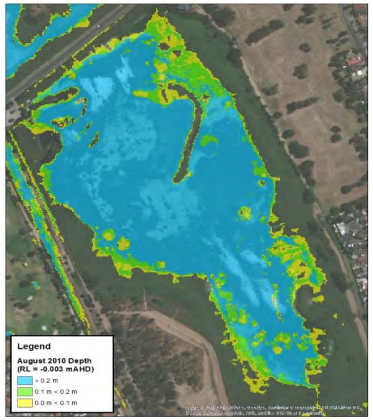
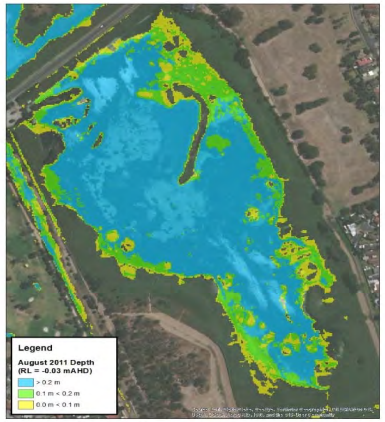
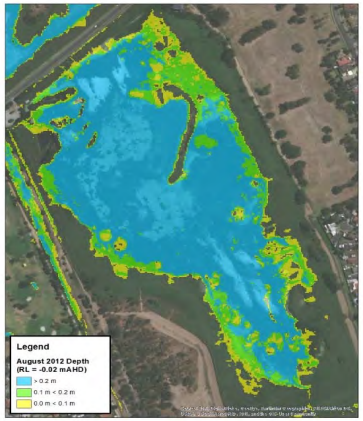
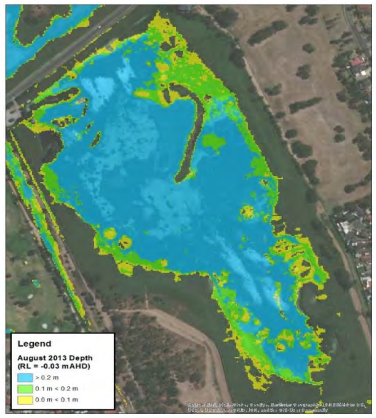
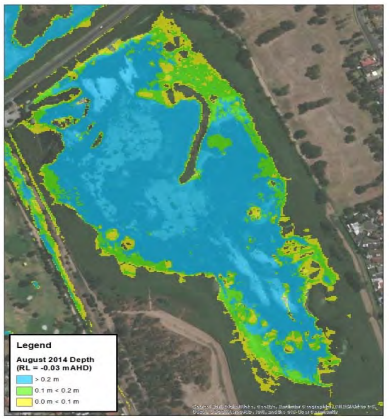
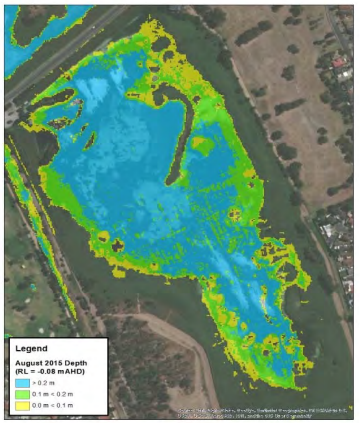
Photos same month each year since 2009

Legend: Blue = >200mm depth, Green = 100-200mm depth, Yellow = <100mm depth (optimal shorebird habitat)

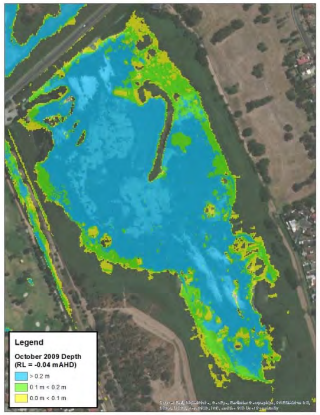
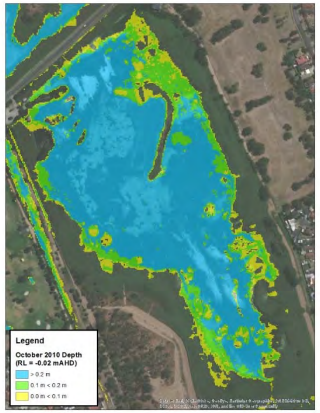
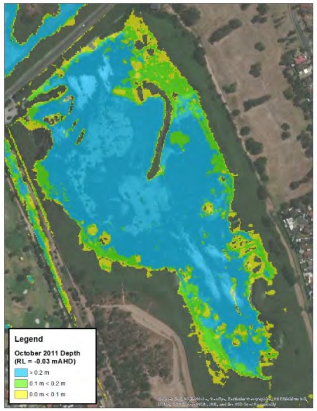
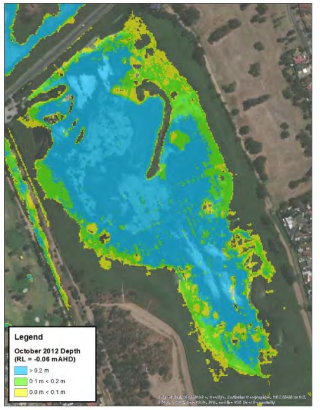
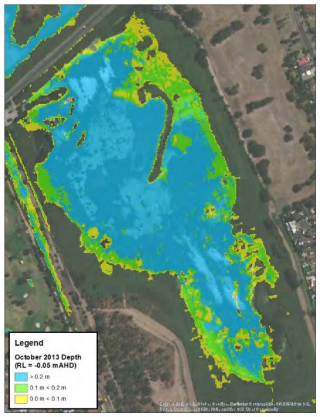
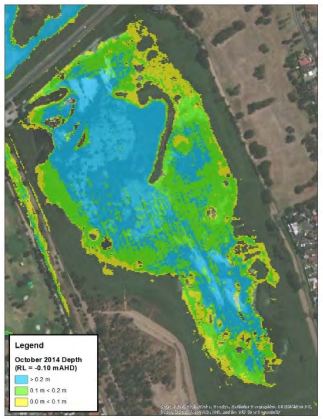
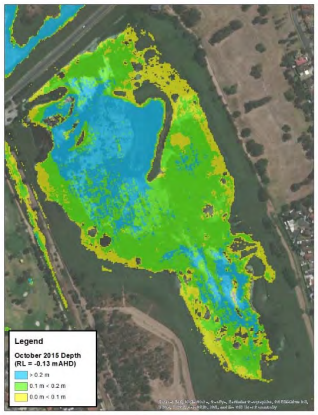
Note: aerial base is consistent for all images as a reference only. It does not reflect the water levels / inundation extent.

Months to represent the season - August, October, December, February, April

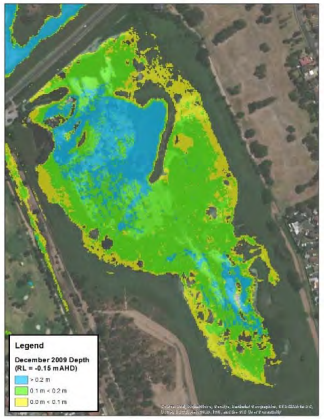
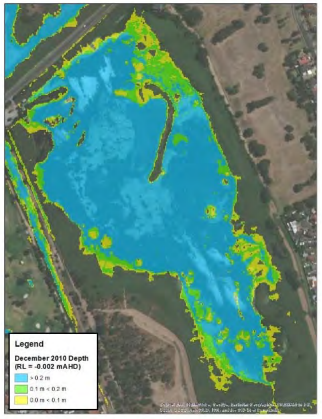
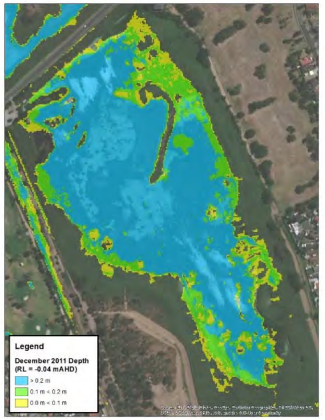
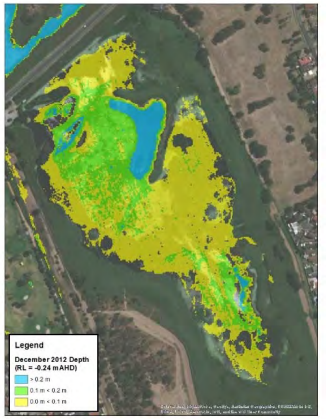
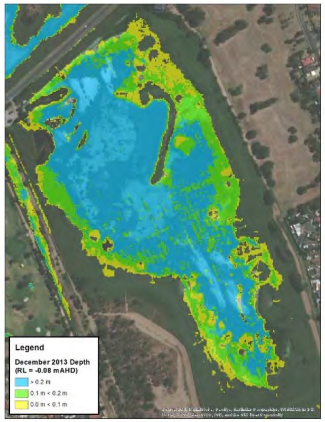
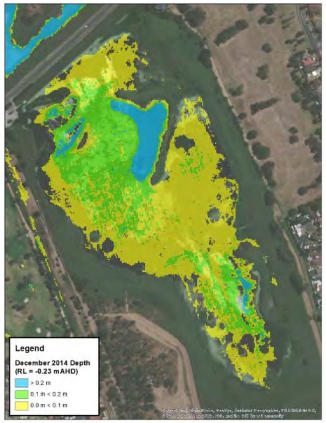
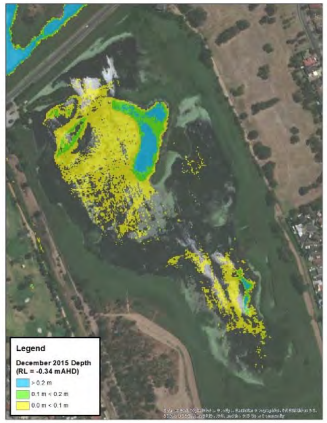
August 2009 – 2015

August 2009	August 2010	August 2011	August 2012
			
August 2013	**August 2014**	**August 2015**	
			

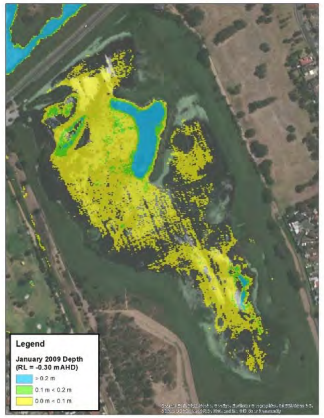
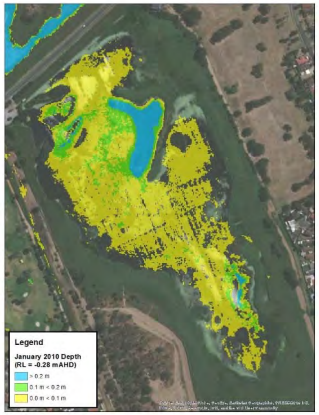
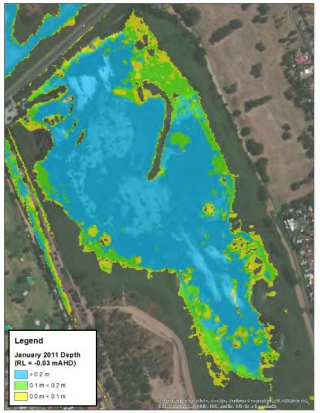
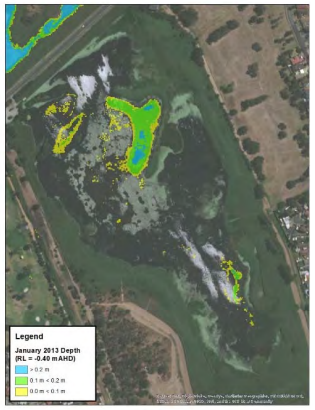
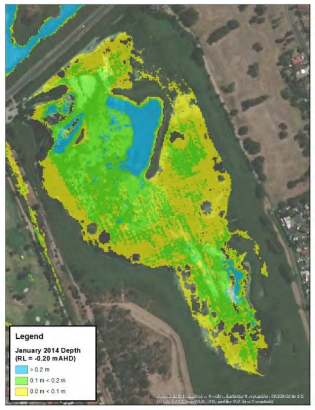
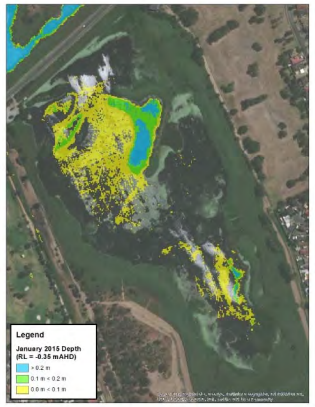
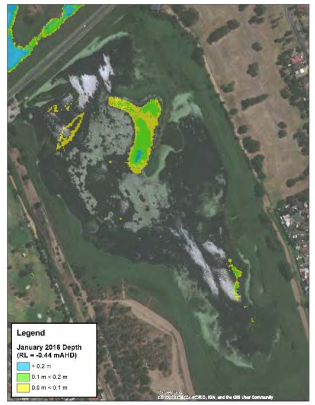
October 2009 – 2015

October 2009	October 2010	October 2011	October 2012
			
October 2013	**October 2014**	**October 2015**	
			

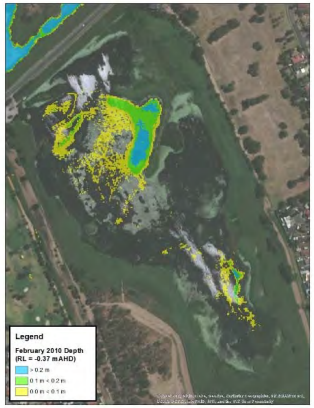
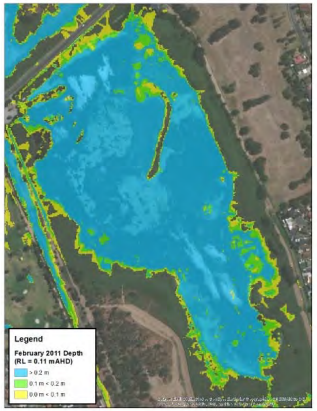
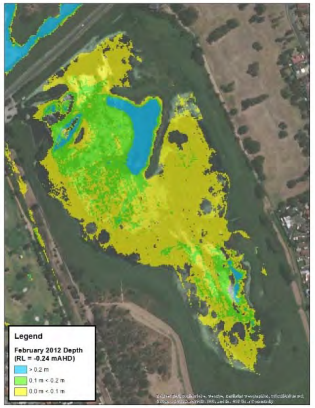
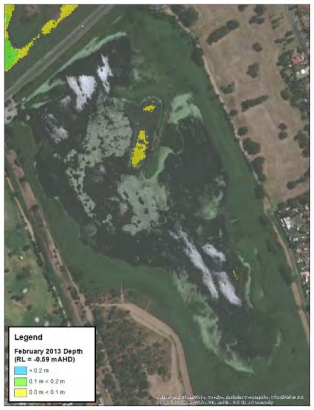
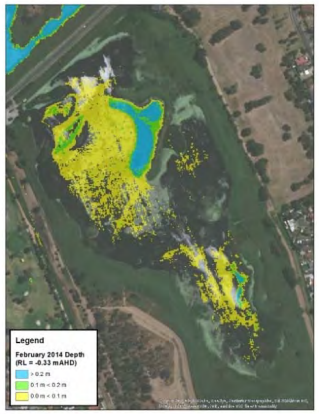
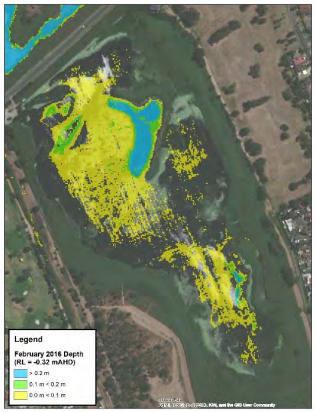
December 2009 - 2015

December 2009	December 2010	December 2011	December 2012
			
December 2013	**December 2014**	**December 2015**	
			

January 2009 – 2016

January 2009	January 2010	January 2011	January 2012
			
January 2013	**January 2014**	**January 2015**	**January 2016**
			

February 2009 - 2016

February 2009	February 2010	February 2011	February 2012
			
February 2013	**February 2014**	**February 2015**	**February 2016**
			

April 2009 - 2016

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	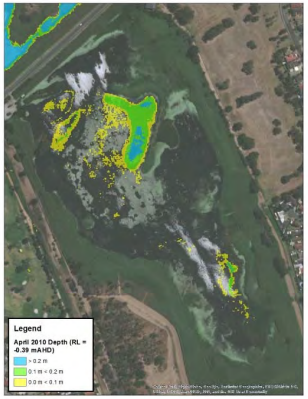	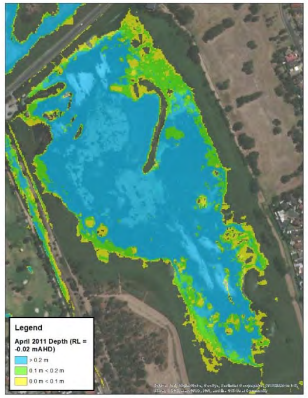	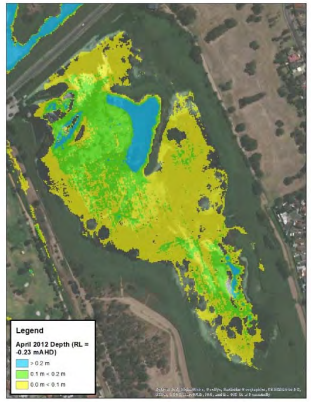
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	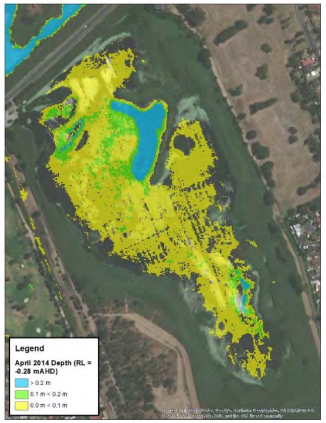		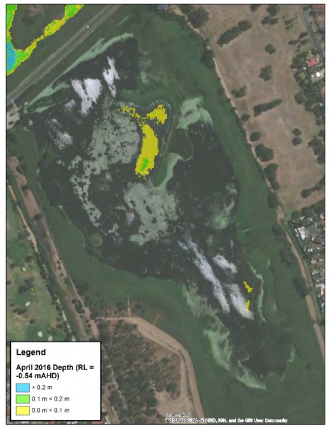

Appendix C: Other monitoring parameters considered

Table 8 Parameters that are not considered appropriate for measuring changes at Edithvale Wetland

Factor	Availability of existing information	Method considered	Rationale for exclusion
Bird utilisation	BirdLife Australia have been surveying birds at Edithvale Wetland since October 1987 for Melbourne Water. Melbourne Water has an obligation to conduct these monthly bird surveys in accordance with the Edithvale-Seaford Wetlands Ramsar Site Management Plan (Ecology Australia 2016).	An evaluation of bird utilisation could occur concurrently with contingency measures being implemented to address habitat change or bird utilisation could be considered if contingency measures were unsuccessful to evaluate whether the change in habitat suitability actually affects bird utilisation of the site.	Plan needs to focus on not only what can be measured but what could be influenced by the Project and what can be mitigated. A change in bird utilisation may not be directly attributed to changes in habitat suitability, particularly if bird utilisation is found to change despite mitigation measures being successfully implemented to address project related habitat change. Other factors such as global population change or natural variation in site selection may influence bird utilisation in a given year. Annual reporting will identify a trend in bird utilisation which will be drawn upon in the event habitat change is detected. Global population estimates are likely to continue to be revised. If groundwater changes and habitat changes the impacts may still be due to other factors such as surface water inputs rather than groundwater change caused by the project.
Salinity (surface water quality)	Melbourne Water monthly monitoring of surface water quality (hand sampling) as an ongoing requirement of the Edithvale-Seaford Wetland Ramsar Site Management Plan (Ecology Australia 2016). Surface water quality has been recorded since September 2009 at 4 locations (Figure 11).	Analysis of existing surface water quality (salinity) data to define salinity ranges pre-project. Compare surface water quality (salinity) data with salinity (EC) data obtained prior to implementation of this Plan, to determine whether salinity remains within range. Use salinity tolerances of macroinvertebrates to define thresholds for water quality. Relate surface water quality data to rainfall, groundwater quality data and stormwater inputs into the system as a means of understanding factors which have led to a change in water quality and therefore enable an evaluation to be made on whether the change can be attributed to the project.	Known tolerances of macroinvertbrates are wide (refer to Section 5.3 of the *EES Technical Report B Ecology: Wetlands and Groundwater Dependent Ecosystems*). A detailed review MW commissioned for the WTP found little published data from sites comparable to south-eastern Australian coastal wetlands (Rogers et al. 2015). There is limited information on how long macroinvertebrates can survive under increased salinity and therefore defining triggers around salinity levels and duration of increased salinity is problematic. Macroinvertebrates have a wide tolerance of salinity therefore mitigation may not be necessary. Mitigation options for addressing an increase in salinity relate to dilution. Diluting the water in Edithvale Wetland would involve introducing water from an alternate source. There are risks associated with introduction of water depending on the source. These include introduction of pathogens and inappropriate water quality. Introducing water to dilute salinity also poses a risk to the availability of habitat associated with an increase in water level. It was considered that the risk posed to Edithvale Wetland by introducing water (e.g. water levels, pathogens) outweighed the

Factor	Availability of existing information	Method considered	Rationale for exclusion
			potential risk of increased salinity if groundwater mounding did affect the wetland. This view was supported by Melbourne Water and DELWP.
Macroinvertebrates	Currently the only information on macroinvertebrates at Edithvale Wetland is based on a single sample collected in 2017 for the EES technical investigations. One year of sampling in Autumn and Spring (as per Rapid Bio Assessment method) is required to establish baseline data for the macroinvertebrate population diversity and abundance at Edithvale Wetland for comparison with monitoring data if the requirement for monitoring is triggered.	Macroinvertebrate monitoring would commence IF change in habitat suitability (water quality) is detected. Sampling would aim to identify diversity (number of families) and abundance (quantity) of macroinvertebrates as a measure of available food. Monitoring of abundance would focus on chironomid larvae as these were the most abundant invertebrate and therefore represent the greatest biomass	Macroinvertebrate monitoring is not included in this Plan for similar reasons for salinity monitoring not being undertaken. Macroinvertebrate monitoring would also be subject to the following assumptions and limitations: • Decline in macroinvertebrates could occur due to surface water quality changes that are not related to the project even if groundwater change is detected at the wetland that is attributed to the project. • Macroinvertebrate species recorded at Edithvale Wetland are generally tolerant of a wide range of water quality conditions. A change in macroinvertebrate population may therefore occur as a result of water quality parameters not usually sampled e.g. heavy metals. • Other mechanisms beyond those being monitored could cause a decline therefore monitoring may enable the project to identify a decline but not the mechanism by which it declined. • Habitats and therefore the diversity and abundance of invertebrates were found to be locally patchy, even within the same wetland cell, during the EES technical investigations. • Changes in macroinvertebrate assemblages in changes in systems already impacted to some degree by anthropogenic stressors and dominated by opportunistic taxa may be difficult to observe (Horrigan et al. 2005). It is unknown how long the macroinvertebrate population takes to recover from a sample to obtain dry weight measurements therefore the interval for sampling cannot be defined and a reduction in abundance may be a result of population depletion from sampling rather than represent a change due to habitat change.

Factor	Availability of existing information	Method considered	Rationale for exclusion
Groundwater quality	Groundwater quality monitoring is not currently a requirement of the Ramsar management plan.	Groundwater quality data loggers could be installed to replace existing level only loggers.	Groundwater quality monitoring is not included in this Plan for similar reasons to why salinity monitoring is not included.
Vegetation	Vegetation surveys have been undertaken on behalf of Melbourne Water (Ecology Australia 2016). Vegetation surveys were completed as part of the EES Technical Report investigations.	Vegetation survey to assess condition and map extent of native vegetation.	Vegetation surveys are not included in this Plan as the primary manner in which vegetation could be affected is through a change in hydrology which results in an overabundance of reeds. Reed bed extent is already monitored by Melbourne Water and is actively managed through grooming (Ecology Australia 2016).

Appendix D: Risks to the Plan

This section has been prepared to meet EPBC requirement 6d - *An assessment of risks to achieving Edithvale Wetlands Monitoring and Mitigation Plan environmental objectives and risk management strategies that will be applied.*

Table 9 Risks to implementation of this Plan

Risk	Risk description	Risk management strategy
Dynamic system	Edithvale Wetland is a dynamic and complex system which already experiences fluctuations in water level and quality due to stormwater inputs from the surrounding urbanised environment. The wetland is also exposed to a range of other pressures including anthropogenic factors, climate change and pest plants and animals. It may not be possible to definitively associate any changes in habitat suitability (water level and/or quality) from the project to a change in the diversity and/or abundance of birds or macroinvertebrates.	The approach to implementation of this Plan is maintenance of the existing hydrological regime which allows for variability in the system.
Mordialloc Bypass influencing hydrology of Edithvale Wetland	Mordialloc Bypass is due to be built in the next 2 years and is within 700 m of the Edithvale Wetlands at its closest point and may influence the local hydrological environment. The Mordialloc Bypass Groundwater Impact Assessment did not identify any potential for a cumulative impact with the Edithvale-Bonbeach level crossing removal project because the predicted changes in groundwater levels caused by the presence of the Mordialloc Bypass embankments were negligible (around 11 cm or less) and are predicted to be locally confined to the locations of the embankments, several hundred metres to the east of the Edithvale Wetlands. The Mordialloc Bypass assessment identified that the combined effects of surface and groundwater from the project would have an insignificant hydrology and hydraulic effect on Edithvale Wetland. Through the implementation EPRs, the project 'would have minimal impact on surface water and floodplain environments and would minimise effects on water quality and beneficial uses, including the ecological character of the Ramsar-listed Edithvale-Seaford Wetlands' (MRPA 2018; Chapter 16 p16-1).	No risk management required.
Catchment-related influences	The Edithvale Wetland is currently utilised by Melbourne Water for flood mitigation. As such, it receives water from the surrounding catchment. This catchment is heavily urbanised and is therefore likely to influence the sediment and pollutants which enter the wetland which could influence the ecological character of the wetland.	Surface water quality data will need to be related to rainfall, groundwater quality data and stormwater inputs into the system as a means of understanding factors which have led to a change in water quality and therefore enable an evaluation to be made on whether the change can be attributed to the project.

Risk	Risk description	Risk management strategy
Co-operation of management authority/s	Monitoring may need to be undertaken by a consultant and not Melbourne Water. Access to Edithvale Wetland will therefore be required otherwise monitoring will not be possible.	Agreement to provide access for monitoring in a timely manner if monitoring needs to be undertaken by a consultant and not Melbourne Water.
Management practices affecting habitat or monitoring program	Melbourne Water management activities such as artificial watering, stormwater system upgrades or maintenance activities, dredging or other earthworks or fire management that may influence habitat and/or water quality.	Collaborate with Melbourne Water. Melbourne Water to document and provide details on management activities each year.
Availability of existing data	Implementation of this Plan assumes that Melbourne Water will continue to download groundwater and surface water level data at Edithvale Wetland.	An agreement needs to be in place with Melbourne Water for the project to receive data and/or reports within a nominated timeframe if data is required by the project.
Discontinuation of existing monitoring/surveys due to change in management plan priority actions	Ramsar site management is plan due for review in 2023. Monitoring requirements within the management plan may change and this may affect the availability of data required to implement the Edithvale Wetland Monitoring and Management Plan.	Consult with DELWP and Melbourne Water in relation to the implications of a change in Ramsar site management plan in relation to implementation of the Edithvale Wetland Monitoring and Management Plan. Update the *Edithvale Wetland Monitoring and Management Plan* to reflect updated Ramsar site management plan if relevant.