

Boundary Creek, Big Swamp and Surrounding Environment – Remediation and Environmental Protection Plan

QUARTERLY UPDATE

1 October to 31 December 2021

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Introduction

In June 2017, Barwon Water acknowledged that historic management of groundwater pumping had an environmentally significant impact in the Boundary Creek catchment. Reductions in flows caused by groundwater extraction coupled with a drier climate and supplementary flows not reaching the intended area, all contributed to the drying out of Big Swamp. This resulted in the activation of acid sulfate soils and ongoing release of acidic water to the lower reach of Boundary Creek.

In May 2018, Barwon Water established a community and stakeholder working group to participate in the design of a remediation plan for Boundary Creek and Big Swamp. As part of this process, Barwon Water invited the working group to nominate their own technical experts to help support them in their discussions to shape the remediation plan.

In September 2018 Barwon Water's commitment to undertake remedial works was legally strengthened through the issuing of a Ministerial Notice under section 78 of the Water Act, 1989. This notice mandated the development and implementation of the Boundary Creek, Big Swamp and surrounding environment – Remediation and Environmental Protection Plan (REPP) by 1 March 2020.

The section 78 notice defined remediation to be the controls and actions that could be practicably carried out to achieve improved environmental outcomes. In order to align this with an accepted scientific definition for remediation, the REPP further expanded the definition to be "the controls and actions that could be practicably carried out to improve the ecological condition and function of areas confirmed to have been impacted by historical management of groundwater pumping at Barwon Downs, noting that this is likely to be different to the original condition due to the extent of change since European settlement."

In February 2020, Southern Rural Water (SRW) accepted Barwon Water's REPP, which will be delivered under two parallel work packages:

- The Boundary Creek and Big Swamp Remediation Plan to address remediation of confirmed impact in the Boundary Creek catchment resulting from historical management of groundwater extraction.
- The Surrounding Environment Investigation to investigate whether other areas within the regional groundwater system have been impacted by historical management of groundwater extraction.

A key requirement of the section 78 notice and the REPP is the provision of quarterly updates to Southern Rural Water to report on progress with implementation of the plan, as well as an Annual Report. The section 78 notice also stipulates that the Annual Report is required to be submitted to Southern Rural Water and made publicly available by 30 September each year.

This quarterly update is the seventh since the REPP was implemented on 1 March, 2020 and provides a high-level update on progress against the high level plan and timeframes outlined in the REPP.

In addition to the information contained in the quarterly updates, the Annual Report, released on the 30th September each year, provides more detail on technical investigations, monitoring, data collected, and tracking against the REPP success targets.

Implementation of the REPP

In accordance with the REPP, the remedial strategy focussed on implementing an adaptive management approach to ensure the remediation option(s) meet the vision and priorities of the project as informed by the community and stakeholder Remediation Working Group and their nominated experts.

To help address the section 78 notice and ensure momentum was maintained, a number of key milestones were established. These were then used to develop an initial REPP implementation timeline, as shown in Figure 1. However, in accordance with the adaptive management approach, the implementation roadmap has since been updated to account for the current state of knowledge and capture the additional actions relating to the upstream treatment trial, as shown in Figure 2,

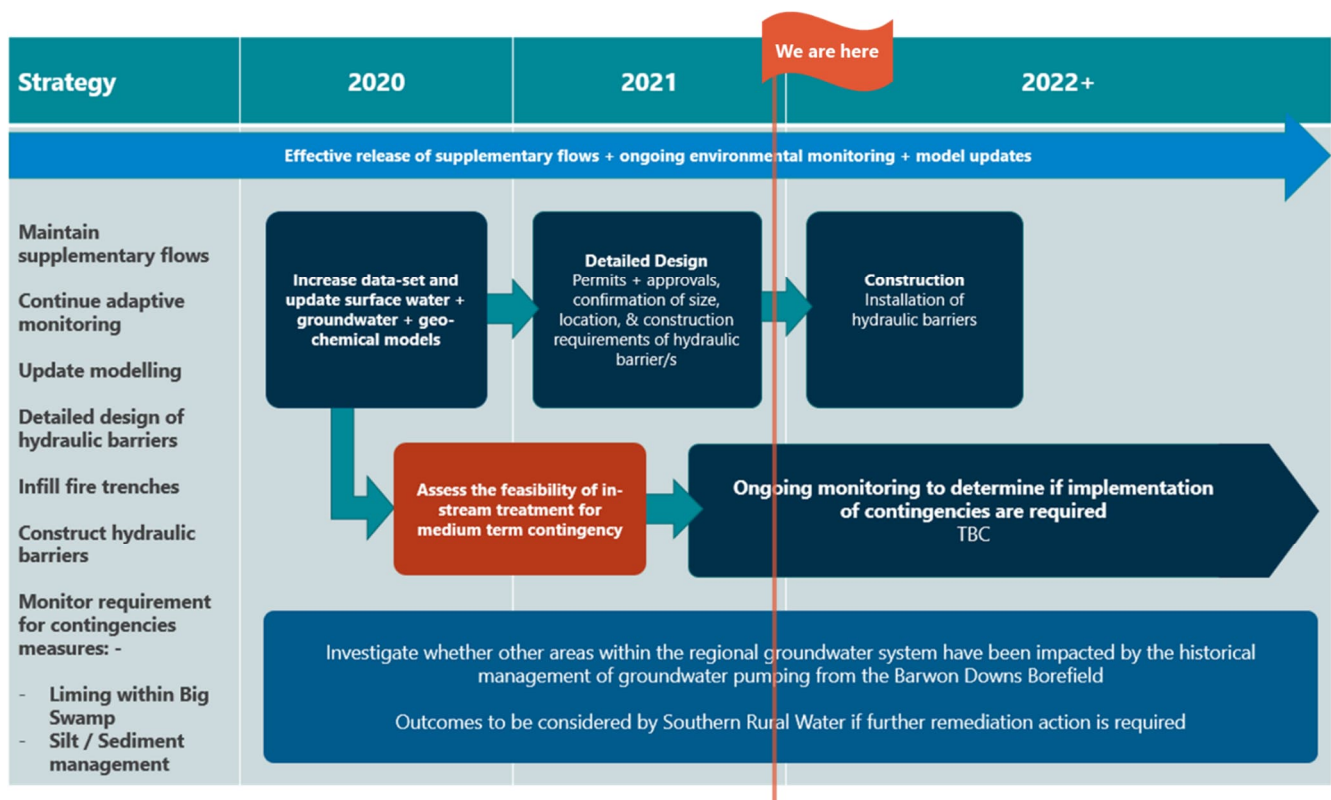


Figure 1 Timelines for Implementation of the REPP



Figure 2 Revised Timelines for Implementation of the REPP

Remediation of Boundary Creek and Big Swamp

Boundary Creek & Big Swamp Status Update

Following cessation of pumping activities at the Barwon Downs borefield in 2016 and expiry of the groundwater water licence in 2019, conditions at the swamp have improved due to recent climatic conditions involving high rainfall, the release of supplementary flows, where required, and the recovery and re-pressurisation of the Lower Tertiary Aquifer (LTA).

This is evidenced by both the groundwater levels from groundwater monitoring bores installed within the swamp (refer Figure 3) and the reduced occurrence of no-flow events and subsequent increase in pH levels within Boundary Creek downstream of the swamp (refer Figure 4 and Figure 5). However, while this is a step in the right direction, it is currently unclear if this water level recovery is sufficient to prevent drying out of the swamp and subsequent oxidation of Acid Sulfate Soils (ASS) during the dryer months.

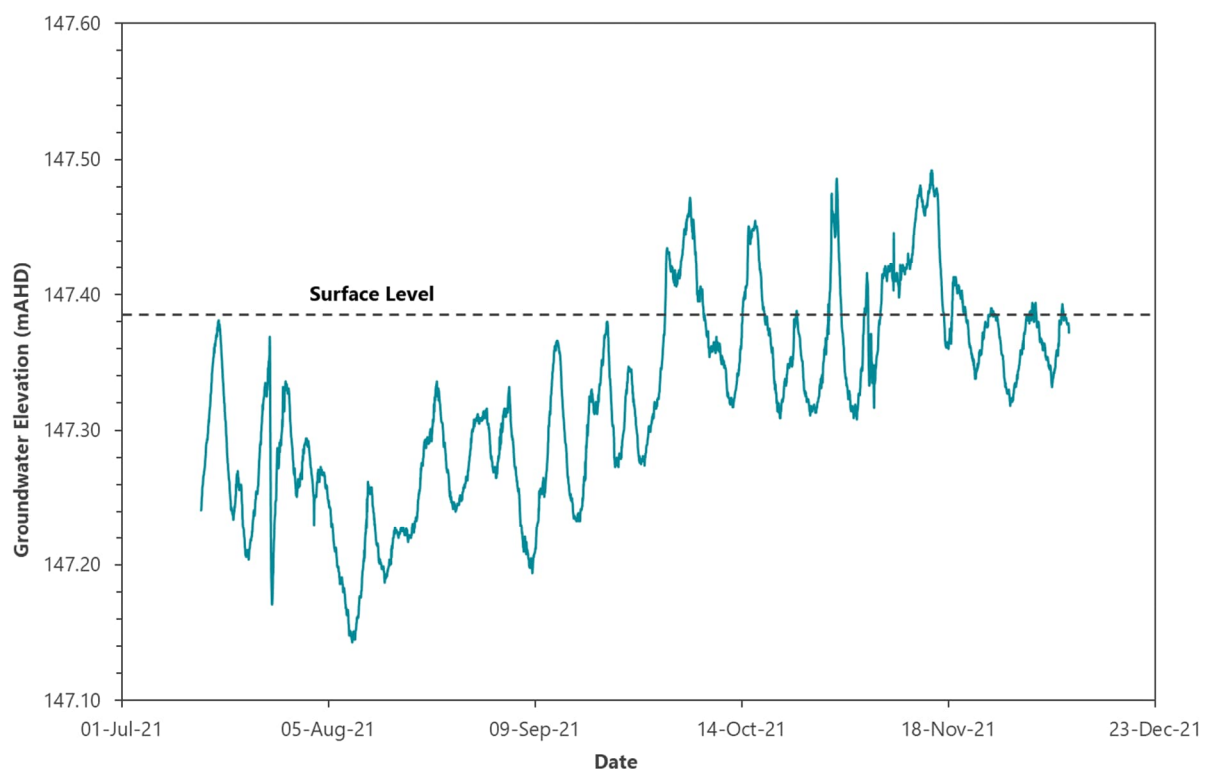


Figure 3 Groundwater elevations within the LTA at monitoring bore BSBH13LTA – located within the western portion of the swamp

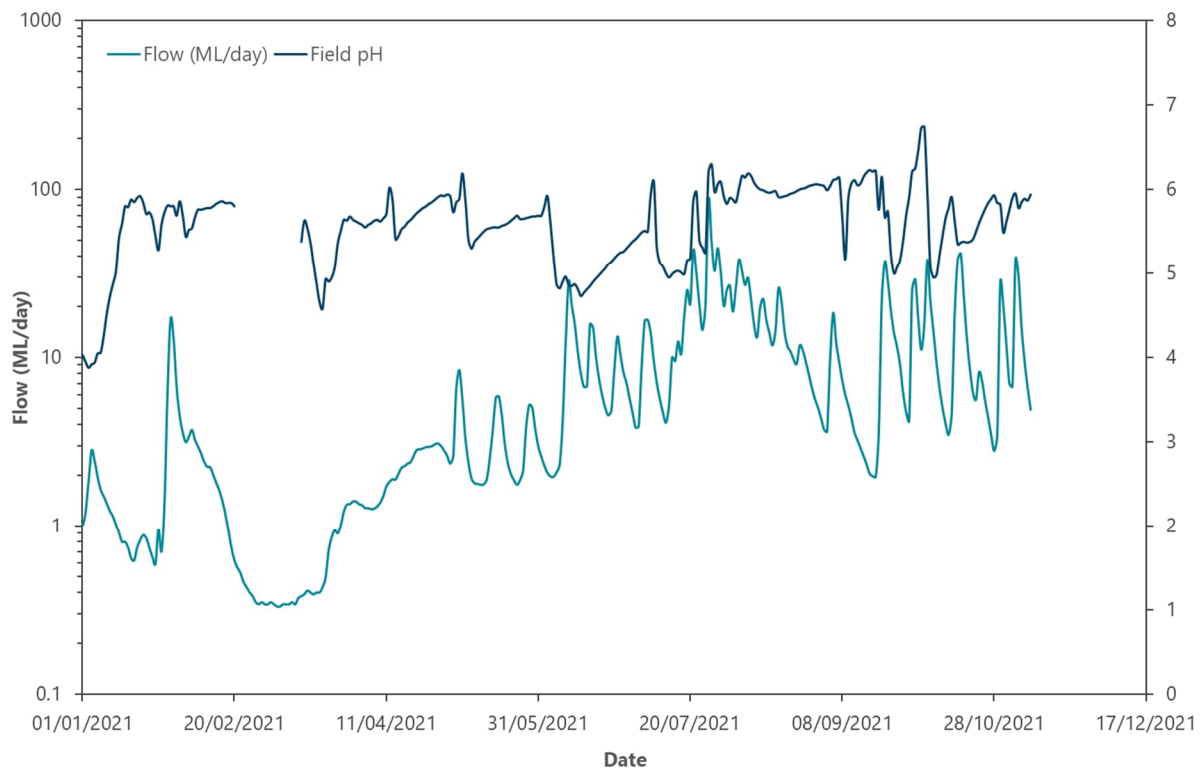


Figure 4 Streamflow and pH readings in Boundary Creek – downstream of Big Swamp as recorded at stream gauge 233276

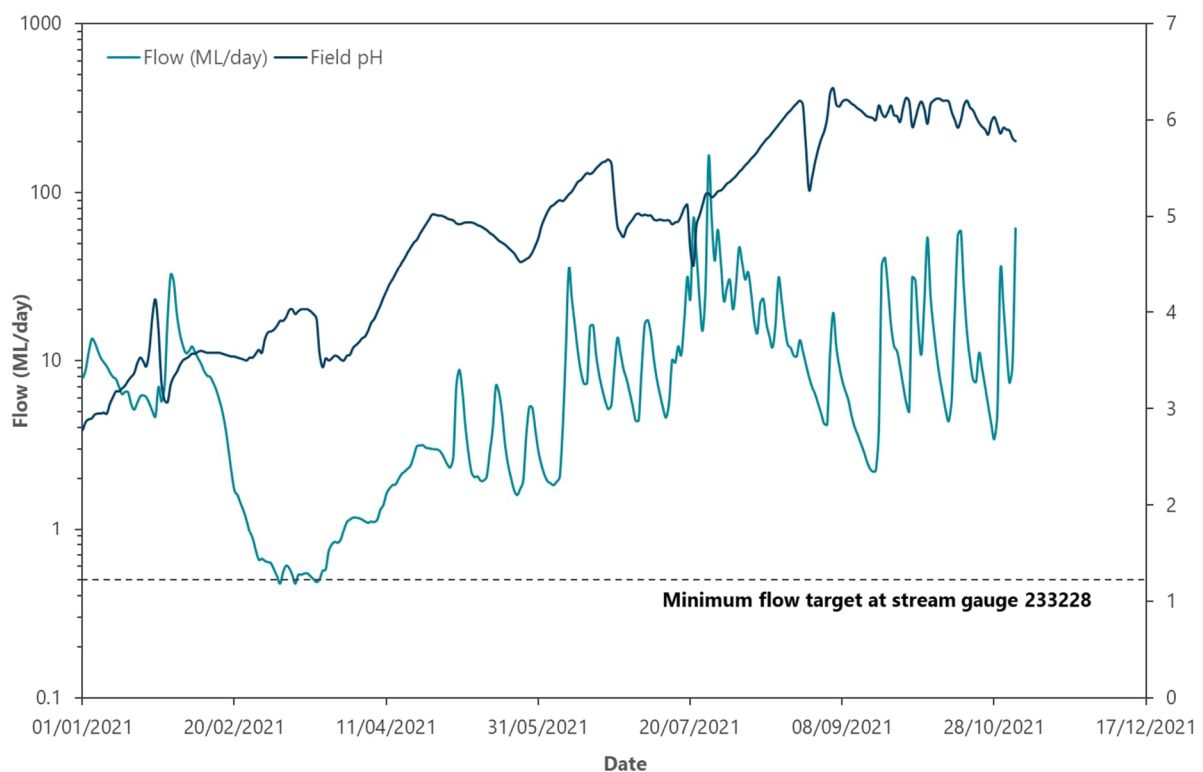


Figure 5 Streamflow and pH readings in Boundary Creek as recorded at stream gauge 233228 – Boundary Creek @ Yeodene

Despite this improvement, the acidity loads within Big Swamp and the lower reaches of Boundary Creek continue to present a risk to the receiving environment and remain a key focus for Q3 2021/22 (1 January – 31 March 2022) through the upstream treatment investigation involving the novel use of caustic magnesia as requested by Southern Rural Water and the Independent Technical Review Panel.

It is noted that the construction of hydraulic barriers and infilling of fire trenches is currently on hold due to the upstream treatment investigation and recent improvement in conditions both within and downstream of the swamp. These works will need to be reassessed and possibly adapted, where required following completion of the upstream treatment investigation to account for the current state of knowledge. This is to ensure that any active interventions are in line with the remedial goals and do not lead to undue impacts on the swamp or the surrounding environment.

Actions Completed – Boundary Creek & Big Swamp Remediation Plan

Table 1 outlines the actions completed for the Boundary Creek and Big Swamp Remediation Plan between 1 October and 31 December 2021. In response to feedback from SRW and the ITRP, a key focus of this work has been the commencement of upstream treatment investigation as an interim measure to manage acidity loads leaving Big Swamp and the potential risks to downstream reaches of Boundary Creek and the Barwon River.

Table 1 Boundary Creek and Big Swamp - Actions completed in Q2 2021/22 (1 October – 31 December 2021)

Action Items	Comment / Link
Continue to collect data from new and existing monitoring assets	Complete and ongoing
Continue to release supplementary flows, where required, to maintain a flow of at least 0.5 ML/day at the Yeodene stream gauge #233228	Complete and ongoing
Undertake desktop investigation of upstream treatment method for reducing acidity loads within Big Swamp and develop laboratory and field testing plan Feedback will be sought from Southern Rural Water and the ITRP	<p>In progress – Trial Plan including initial ecological risk assessment to be submitted to SRW by 14 January 2021.</p> <p>In addition to this the following actions have also been completed:</p> <ul style="list-style-type: none"> • Completion of a 2-day site visit with Earth Systems to obtain a greater understanding of site conditions, and • Completion of a workshop with Barwon Water, the appointed consultants and

Action Items	Comment / Link
	the Remediation Reference Groups nominated experts on 24 November 2021 to determine a treatment trial and risk assessment approach
Finalise remaining REPP amendments to address Southern Rural Water feedback.	Barwon Water are currently working through addressing SRW and ITRP feedback on the proposed REPP amendments
Undertake spring macro-invertebrate and water quality sampling in the Barwon River and Boundary Creek	Sampling undertaken in November 2021
Q2 Remediation Reference Group meeting	Completed on 9 December 2021
Submit quarterly update for the period 1 October to 31 December 2021 to Southern Rural Water and publish to web page	Complete – this report

Upcoming Actions - Boundary Creek & Big Swamp Remediation Plan

Error! Reference source not found. outlines the upcoming actions associated with the Boundary Creek and Big Swamp Remediation Plan between 1 January and 31 March 2022.

Table 2 Boundary Creek and Big Swamp - Upcoming actions / milestones for the Q3 2021/2022 (1 January – 31 March 2022)

Action Items	Due
Continue to collect data from new and existing monitoring assets	Ongoing
Continue to release supplementary flows, where required, to maintain a flow of at least 0.5 ML/day at the Yeodene stream gauge #233228	Ongoing
Complete the laboratory trials associated with the upstream treatment investigation and conduct a feasibility assessment to determine if this remains a viable treatment option	February 2022
Complete detailed design of the proposed novel upstream treatment system. It is noted that this will be subject to approval by Southern Rural Water	March 2022
Complete small-scale field trial of the proposed novel upstream treatment system and assess feasibility of implementing a full-scale system	March/April 2022 pending the above actions
Q3 Remediation Reference Group meeting	March 2022
Submit quarterly update to Southern Rural Water for the period 1 January to 30 March 2022 and publish to web page	31 March 2022

Surrounding Environment Investigation

Surrounding Environment Investigation Update

As reported in the Annual Report, Barwon Water is also progressing the surrounding environment investigation in line with the process outlined in Figure 6. The focus to date has been the design, planning and installation of new site-specific monitoring assets, comprising 5 stream gauges and 23 groundwater monitoring bores.

While the installation of these assets has commenced, elevated streamflows and wet ground conditions continue to prevent the installation of the remaining 3 stream gauges and 4 groundwater monitoring bores. Completion of these installations will be a key focus for Q3 2021/22 (1 January – 31 March 2022).

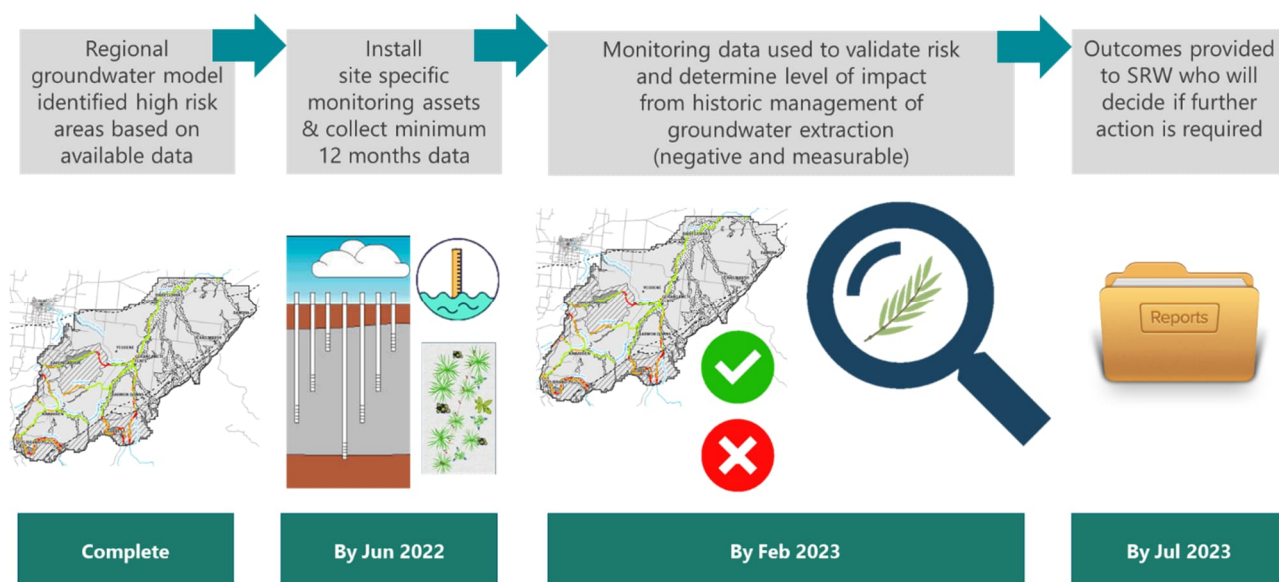


Figure 6 Process overview for the surrounding environment investigation

Actions Completed – Surrounding Environment Investigation

Table 3 outlines the actions completed for the Surrounding Environment Investigation between 1 October and 31 December 2021.

Table 3 Surrounding Environment Investigation - Actions completed in Q2 2021/22 (1 October – 31 December 2021)

Action Items	Comment / Link
Continue collection of data from new monitoring assets for the surrounding environment investigation	Ongoing

Action Items	Comment / Link
Subject to streamflows and site conditions, complete stream gauge installations for the Gellibrand River, Barongarook Creek and Barwon River downstream of the confluence with Boundary Creek	Conditions have not allowed for any further work to be conducted during this quarter. Works remain on hold until streamflows reduce sufficiently to facilitate installation. Works to be a key focus for Q3 2021/22 as conditions improve
Subject to safe site conditions install 4 remaining surrounding environment monitoring bores	Conditions have not allowed for any further work to be conducted during this quarter. Works to be a key focus for Q3 2021/22 as conditions improve.
Continue collation of community information regarding sites/issues of concern to inform the surrounding environment investigation	Ongoing
Q2 Remediation Reference Group meeting	Completed on 9 December 2021
Submit quarterly update for the period 1 October to 31 December 2021 to Southern Rural Water and publish to web page*	Complete – this report

Upcoming Actions – Surrounding Environment Investigation

Table 4 outlines the upcoming actions associated with the Surrounding Environment Investigation between 1 January and 31 March 2022.

Table 4 Surrounding Environment Investigation - Upcoming actions / milestones for the Q3 2021/2022 (1 January – 31 March 2022)

Action Items	Due
Continue collection of data from new monitoring assets for the surrounding environment investigation	Ongoing
Subject to streamflows and site conditions, complete stream gauge installations for the Gellibrand River, Barongarook Creek and Barwon River downstream of the confluence with Boundary Creek	TBC – subject to safe river levels
Subject to safe site conditions install 4 remaining surrounding environment monitoring bores	TBC – subject to safe conditions
Q3 Remediation Reference Group Meeting	March 2022
Submit quarterly update to Southern Rural Water for the period 1 January to 31 March 2022 and publish to web page*	31 March 2022

Issues Register

Table 5 below outlines any issues that have been identified during implementation of the REPP that may impact future implementation activities.

Table 5 Issues register

Issue	Likelihood	Consequence	Comments
Coronavirus (COVID-19) pandemic limits/delays engagement with stakeholders and the community	Medium	Low	<p>Coronavirus (COVID-19) continues to impact face-to-face stakeholder and community engagement activities.</p> <p>The December Remediation Working Group meeting was again held online, with e-mail updates provided in lieu of a face-to-face meeting.</p> <p>In general, these meetings have been well attended with most members being able to attend online.</p>
Coronavirus (COVID-19) pandemic impacts availability of appropriate consultants or contractors to undertake required work for implementation of the REPP	Low	Low	<p>To date Barwon Water has experienced little impact on availability of consultants and contractors to complete work for this project during the coronavirus (COVID-19) pandemic.</p> <p>With consultants continuing to be close to capacity this remains an ongoing risk and may lead to unexpected delays.</p>
Continued Wet conditions	Medium	Medium	<p>Wet conditions have continued to delayed installation of some of the new stream gauges and monitoring bores required as part of the surrounding environment investigation.</p> <p>It is envisaged that these works will recommence during Q1 2022 with the aim to complete prior to the wet season.</p> <p>If wet conditions persist into summer 2021/22 and again prevents installation of the new monitoring sites this could impact milestone timeframes for the surrounding environment investigation.</p> <p>Additionally, wet conditions during summer 2021/22 could also impact on any remedial works being carried out in Big Swamp and Boundary Creek.</p>

Issue	Likelihood	Consequence	Comments
Extended remediation timeframes	Medium	Low	The hydro-geochemical modelling indicated that even with active intervention, the timeframe for removal of existing acidity loads in the swamp could still be in the order of 35 years. In line with the feedback received from the ITRP and community representatives Barwon Water is currently investigating upstream contingency measures as an interim solution to manage the acidity loads until the system can sufficiently recover. This investigation will extend the timeframes for implementation of further remediation actions.

Community Engagement

The fifth Remediation Reference Group (RRG) meeting was held via Zoom on 9 December 2021. This meeting was attended by both Barwon Water's RRG members and Southern Rural Water's Community Leaders Group (CLG).

Topics discussed included:

- A Remediation and Environmental Protection Plan (REPP) progress update
- An overview of the current remedial strategy and swamp conditions following implementation of remedial actions
- An update on the design of contingency measures
- An overview of the proposed upstream treatment roadmap and treatment trial approach/methodology
- The proposed ecological risk assessment approach to assess the risks associated with the upstream treatment trial
- Next steps
- Discussion on continuing to meet together as two groups – RRG and CLG

An open forum was also held for group members to raise any topics that were not discussed above. The feedback from these discussions is captured in Table 6.

Table 6 Community feedback

Community Feedback Received	Response
The Remediation Reference Group would like to ensure that there is adequate consultation with stakeholders during each phase of the upstream treatment investigation.	Given we are still in the early stages of this investigation, Barwon Water will outline the specific consultation process during each phase of the project. SRW, the ITRP and RRG members will be provided a copy of the Trial Plan following submission to SRW on 31 December 2021. Feedback received will be used to inform subsequent phases of the project.
The Remediation Reference Group would like the opportunity to undertake a site visit to see the current condition of Big Swamp.	Barwon Water and SRW indicated that they would both be happy to facilitate a site visit. While dates are to be confirmed, this will likely be undertaken in March 2022.
In relation to contingency measures, the Remediation Reference Group would like to know if there is a plan to neutralise the Acid Sulfate Soils (ASS) rather than just treating the water.	Given the acid is generated from the oxidation of naturally occurring Acid Sulfate Soils (ASS), the primary remedial strategy is to prevent further oxidation by inundating the area and preventing the wet-dry cycling. The implementation of an upstream treatment system would be to reduce the acidity loads in the water within Big Swamp, thus reducing downstream impacts.
In relation to installation of the hydraulic barriers, the Remediation Reference Group indicated that this is an area of concern due to the recent improvement in conditions within Big Swamp, the intrusive nature and size of these barriers and the potential ecological impacts. In addition to this, the Remediation Reference Group would also like to explore the use of alternative barriers, such as hay bales etc.	Barwon Water has put the installation of hydraulic barriers on hold due to the upstream treatment investigation and improvement in conditions. The hydraulic barrier design would need to be revisited and modified to suit the current conditions, should these still be required to prevent the swamp drying out. This could include consideration of hybrid models in conjunction with contingency treatment measures, if deemed appropriate.
The Remediation Reference Group highlighted the importance of learning as we go and that we should not implement drastic measures unnecessarily. They also reiterated that there are positive signs of recovery and that we may not need to implement intrusive remedial actions such as the hydraulic barriers. Consideration should also be given to potential bioremediation options.	Despite water level and quality improvements within Big Swamp and Boundary Creek, the acidity loads remain a concern to the downstream reaches of Boundary Creek and the Barwon River. The current focus is on filling the current data gaps and assessing how the system responds during the dryer months. This will then be used alongside the outcomes of the upstream treatment trial to inform whether any additional remedial actions are warranted to continue to facilitate improvement in swamp conditions.
The Remediation Reference Group expressed an interest in the lessons learnt from Barwon Downs in informing future water management strategies.	Despite having its own complexities, the lessons learnt from Barwon Downs are currently informing planning decisions at the Anglesea borefield. A review of the Anglesea borefield has recently commenced, with the findings expected to be released in 2024. Further information regarding the Anglesea borefield can be accessed at:

Community Feedback Received	Response
	https://www.yoursay.barwonwater.vic.gov.au/anglesea-borefield In addition to this, the issues experienced at Barwon Downs have also informed the recent Draft Water for our Future Strategy. Further information regarding this strategy can be accessed at: https://www.waterfuture.barwonwater.vic.gov.au/draftuws

Success Targets

Following completion of the REPP, the success targets presented in the REPP underwent a review in 2021 to account for any additional data obtained since development of the REPP. The revised success targets have not yet been accepted by SRW and are likely to be finalized in the front half of 2022. As such, these will need to be accepted by SRW before they can be adopted.

An update on progress against the relevant success targets will be provided in the Annual Report along with the supporting monitoring data.

Technical Reports and Investigation

Relevant technical and investigation reports that have been completed for Boundary Creek, Big Swamp and as part of the Surrounding Environment Investigation can be accessed from the dedicated Boundary Creek Remediation webpage via the following link:

<https://www.yoursay.barwonwater.vic.gov.au/boundary-creek>

Contingency Measures

Table 7 outlines the contingency measures identified during the design and implementation of the REPP. It is noted that no contingency measures have been implemented to date.

Table 7 Contingency Measures Identified

Contingency Measure	Status
Downstream treatment – preferred method being a sodium hydroxide (NaOH) dosing plant	Design complete, implementation on hold pending outcomes of the below upstream treatment investigation
Upstream treatment – using caustic magnesia (MgO)	Trial plan development in progress – due for submission to SRW by 31 December 2021

REPP Amendments

Table 8 outlines any recent and upcoming REPP amendments current as of the time of this report.

Table 8 Required Amendments to the REPP

No.	REPP Amendments	Status
1	Feedback received from SRW and the ITRP on the proposed amendments	Barwon Water and SRW are in ongoing discussions regarding the proposed amendments. Once these are confirmed the REPP will be amended accordingly
2	Implementation of revised success targets	ITRP feedback has been received on the revised success targets. Barwon Water will consider this feedback in finalising the updated success targets

Progress Report

Table 9 outlines the actions that have been completed, are currently in progress, or are yet to commence as part of implementation of the REPP. It is important to note that additional tasks may be added as they are identified during implementation of the REPP.

Table 9 Action Register

#	Activity	Due Date	Status	Health Indicator	Comments
1.0	Meeting with SRW to be held at the Barwon Water office to develop work plan towards confirming priority actions relating to feedback provided.	30-Apr-20	Complete	Complete	Complete
2.0	Complete autumn macro-invertebrates survey:	30-Jun-20	Complete	Complete	Report now complete and is now uploaded on website
3.0	Complete soil incubation testing	31-May-20	Complete	Complete	Report has been finalised and is now uploaded on website
4.0	Submit Quarterly Update to SRW and publish to website	30-Jun-20	Complete	Complete	SRW review of template complete. Quarterly Update uploaded to website on 30th June.
5.0	Scoping of SW-GW technical work packages required to inform detailed design and address feedback register	30-Nov-20	Complete	Complete	Complete
6.0	Complete installation of additional monitoring assets for the following sites identified as 'high risk' in the Surrounding Environment Investigation	31-May-22	In progress	On track	19 of 23 bores are installed - remaining 4 to be completed once conditions permit and appropriate drill rig is available. 2 of 5 Stream Gauges installed, the wet weather and high flows over summer prevented installation of 2 gauges. 1 stream gauge is still awaiting permit approval.

#	Activity	Due Date	Status	Health Indicator	Comments
7.0	Conclusion of monitoring period enabling the capture of a full seasonal cycle of data to inform updates to the groundwater-surface water model and geochemical model.	31-Jul-20	Complete	Complete	1 year of monitoring completed. Monitoring of GW levels, stream flows and water quality continues in Big Swamp and Boundary Creek.
8.0	REPP Feedback Work plan - Submission and Acceptance	31-Jul-20	Complete	Complete	Completed
9.0	Governance Framework - Submission and Acceptance	31-Jul-20	Complete	Complete	Completed
10.0	Barwon Water Communications and Engagement Plan	Ongoing	In progress	On track	Remediation Reference Group meetings continue to be held quarterly.
11.0	Submit updated REPP to capture the work plan for addressing the feedback register. SRW to accept the updated REPP.	TBA	In progress	On track	Barwon Water submitted changes to SRW on 30th September. SRW has provided feedback, and discussed on 10th March. BW has submitted proposed updates including any which were contingent on detailed design on the 31st July. Barwon Water and SRW are in ongoing discussions to verify the proposed amendments prior to making any formal updates
12.0	Submit annual report to SRW and publish to website	30-Sep-20	Complete	Complete	Completed
13.0	Remediation Reference Group Meeting	2-Dec-20	Complete	Complete	Completed
14.0	Establish vegetation baseline monitoring for Boundary Creek and Big Swamp Remediation Plan:	31-Dec-20	Complete	Complete	Baseline Monitoring undertaken 25th of November - Further monitoring to be completed in 2022
15.0	Update groundwater-surface water model	31-Dec-20	Complete	Complete	Final report uploaded to website

#	Activity	Due Date	Status	Health Indicator	Comments
16.0	Submit quarterly report to SRW and publish to website	31-Dec-20	Complete	Complete	Completed
17.0	Remediation Reference Group Meeting	17-Mar-21	Complete	Complete	Completed
18.0	Submit quarterly report to SRW and publish to website	31-Mar-21	Complete	Complete	Completed
19.0	Remediation Reference Group Meeting	23-Jun-21	Complete	Complete	Completed
20.0	Submit quarterly report to SRW and publish to website	30-Jun-21	Complete	Complete	Completed and uploaded to website
21.0	Submission of detailed design of the hydraulic barriers outlining proposed controls or actions and any revisions to success measures/targets.	1-Jul-21	Complete	Complete	Complete. Submitted to SRW on 1 July 2021
22.0	Update Hydrogeochemical model	31-Jul-21	Complete	Complete	Completed and uploaded to website
23.0	Complete detailed design of contingency measure and feasibility assessment for up-stream for new upstream treatment method	31-Jul-21	Complete	Complete	Detailed design of downstream treatment system submitted to SRW 30 July 2021. Further work required to assess applicability and feasibility of upstream treatment system - refer item 27
24.0	Remediation Reference Group Meeting	8-Sep-21	Complete	Complete	Barwon Water presented on the key aspects of the hydraulic barrier and contingency measure submissions, including the proposed further investigation of upstream treatment.
25.0	Submit annual report to SRW and publish to website	30-Sep-21	Complete	Complete	Report currently being drafted
26.0	Remediation Reference Group Meeting	9-Dec-21	Complete	Complete	Meeting notes to be circulated by 23 December 2021

#	Activity	Due Date	Status	Health Indicator	Comments
27.0	Completion of upstream treatment investigation and development of Trial Plan	14-Jan-22	In progress	On track	In progress – Trial Plan to be submitted to SRW by 14 January 2021. It is noted that this has been delayed by 2 weeks due to expert availability
28.0	Submit quarterly report to SRW and publish to website	31-Dec-21	In progress	On track	
29.0	If trial plan is approved undertake upstream treatment trial	31-Mar-22	Not yet commenced		Timelines for completion of the treatment trial will likely need to be revised following receipt of feedback on the Trial Plan
30.0	Submit quarterly report to SRW and publish to website	31-Mar-22	Not yet commenced		
31.0	Decision on full scale upstream treatment, hydraulic barriers and downstream treatment	30-Apr-22	Not yet commenced		
32.0	Submit quarterly report to SRW and publish to website	30-Jun-22	Not yet commenced		