

10.5 Surface Water

The potential surface water impacts associated with the Mandalong Southern Extension Project, specifically subsidence and construction of the access road (including the crossing over Morans Creek) to the proposed Mandalong South Surface Site in the Southern Extension Area, have been assessed by Umwelt (2013). Key areas of assessment were:

- Catchment area boundaries;
- Watercourse stability;
- Remnant ponding; and
- Flooding regimes.

The Study Area adopted by Umwelt (2013) for this assessment comprises the Southern Extension Area and an additional area external to the Southern Extension Area covering the 26.5 degree of draw from the edge of proposed mine plan. The remainder of the Project Application Area (to the north of the Study Area) was not assessed given that it comprises existing approved workings and infrastructure and there are no additional activities or disturbance proposed.

The assessment has been undertaken in consideration of the relevant legislation and guidelines, and to address the requirements the DGRs (see **Section 1.7.2**). A copy of the *Surface Impact Assessment* (Umwelt 2013) is contained within **Appendix O**, with significant findings and recommendations summarised in the below sub-sections.

10.5.1 Existing Environment

The existing surface water environment within the Southern Extension Area, including catchment areas and watercourses, flooding and downstream water users, is outlined in **Section 2.10**. In summary:

- The Southern Extension Area lies predominantly within the catchment of Lake Macquarie, with the southern portion within the Wyong River catchment. The Southern Extension Area intersects five sub-catchment areas, these being Morans Creek, Wyee Creek and Mannering Creek flowing to Lake Macquarie, and Buttonderry Creek and Jilliby Creek flowing to the Wyong River (see **Figure 9**). Each of these creeks are characterised, according to the Strahler ordering system, as third order (Schedule 2) watercourses.
- Anecdotal evidence, in addition to historical flood reports (Hughes Trueman 2004, cited in Umwelt 2013), indicates that the Mandalong area has a history of flooding.
- Umwelt (2013) advises that the watercourses within the Southern Extension Area are ephemeral, with periods of limited or no flow during periods of low rainfall. The ephemeral nature suggests that dependence of downstream agricultural users on flows within these watercourses is likely to be limited.

Several sections of the watercourses within the Southern Extension Area, including Wyee Creek, Mannering Creek (see **Plate 17**) and Buttonderry Creek, have been subjected to scouring, primarily in response to the construction of road culverts and bridges. In some places this has caused bank erosion and deposits of sandy sediment within the creek bed (Umwelt 2013).



Plate 17 – Evidence of Existing Scouring within Mannering Creek

Centennial Mandalong has undertaken monthly water quality monitoring for a wide range of parameters at seven locations within the Southern Extension Area, with the first samples collected in June 2011, in order to establish baseline data. The location of these monitoring points is shown on **Figure 19**. As reported by Umwelt (2013) and in summary, the water sampled is typically neutral to slight acidic and has electrical conductivity levels typical of a freshwater creek. The concentrations of total dissolved solids and total suspended solids are generally within the Australian and New Zealand Environment Conservation Council (ANZECC) default trigger values, while turbidity values regularly exceed the default trigger value for a freshwater creek.

10.5.2 Impact Assessment

The key features of the Project that have the potential to impact on surface water resources within the Southern Extension Area are subsidence and the construction of the access road (including the crossing over Morans Creek) to the proposed Mandalong South Surface Site. Importantly, the potential subsidence impacts that will impact on surface water resources is primarily limited to vertical subsidence displacement, given that no connective cracking is predicted (DGS 2013) (see **Section 9.5**).

The assessment methodology used by Umwelt (2013) comprised review of available information, including surface water monitoring data and subsidence predictions from DGS (2013), development of a digital terrain model (DTM) using airborne laser survey data, and one-dimensional (1D) and two-dimensional (2D) hydrodynamic modelling.

Catchment Areas

Based on the maximum vertical subsidence predictions for the Project (see **Section 9.5**), Umwelt (2013) identified no significant adverse impacts on the existing catchment boundaries and watercourse alignments within the Southern Extension Area.

Watercourse Stability

The existing characteristics of the watercourses within the Southern Extension Area have the potential to be impacted as a result of changes to the profiles of the watercourses caused by subsidence. This includes changes to the longitudinal grades of the watercourses, and associated changes to flow velocities and tractive stresses. Changes to the stability of a watercourse can result in increased scouring, changed channel geometry or rerouting of the watercourse. The existing environment has already undergone scouring as a result of constructed features, including culverts and bridges, however increases to scouring may degrade the existing water quality within and downstream of the Southern Extension Area.

The existing landform and predicted subsided landform long-sections and hydraulic conditions were compared by Umwelt (2013) for Morans Creek, Wyee Creek (three branches), Mannering Creek, and Buttonderry Creek in the Southern Extension Area. The predicted impacts are illustrated on **Figure 37**, and summarised below:

- Wyee Creek (Watercourse 1) – potential for sections of scouring above longwalls 56 and 57. There is minimal difference in velocities predicted between the existing landform and predicted subsided landform, with the exception of two locations in the vicinity of longwalls 57 and 55 where a decrease in velocity is predicted.
- Wyee Creek (Watercourse 2) – no significant changes to the existing scouring expected. There is little difference in the modelled bank full velocities and tractive stresses for Watercourse 2 when comparing the existing landform and predicted subsided landform.
- Wyee Creek (Watercourse 3) - potential for increased scouring in the vicinity of longwalls 40, 41 and 43. There is little difference in the modelled bank full velocities and tractive stresses for Watercourse 3 when comparing the existing landform and predicted subsided landform.
- Mannering Creek (Watercourse 4) – potential for increased scouring between longwalls 48 and 49. There is little difference in the modelled bank full velocities and tractive stresses for Mannering Creek.
- Buttonderry Creek (Watercourse 5) – only very minor changes are predicted to the watercourse long-sections as a result of the predicted subsidence. There is almost no difference in the modelled bank-full velocities and tractive stresses for Buttonderry Creek when comparing the existing landform to the predicted subsided landform.
- Morans Creek (Watercourse 6) - potential for increased scouring to occur in the vicinity of longwall 25. There is little difference in the modelled bank full velocities and tractive stresses for Morans Creek, with these parameters typically consistent between the existing landform and predicted subsided landform.

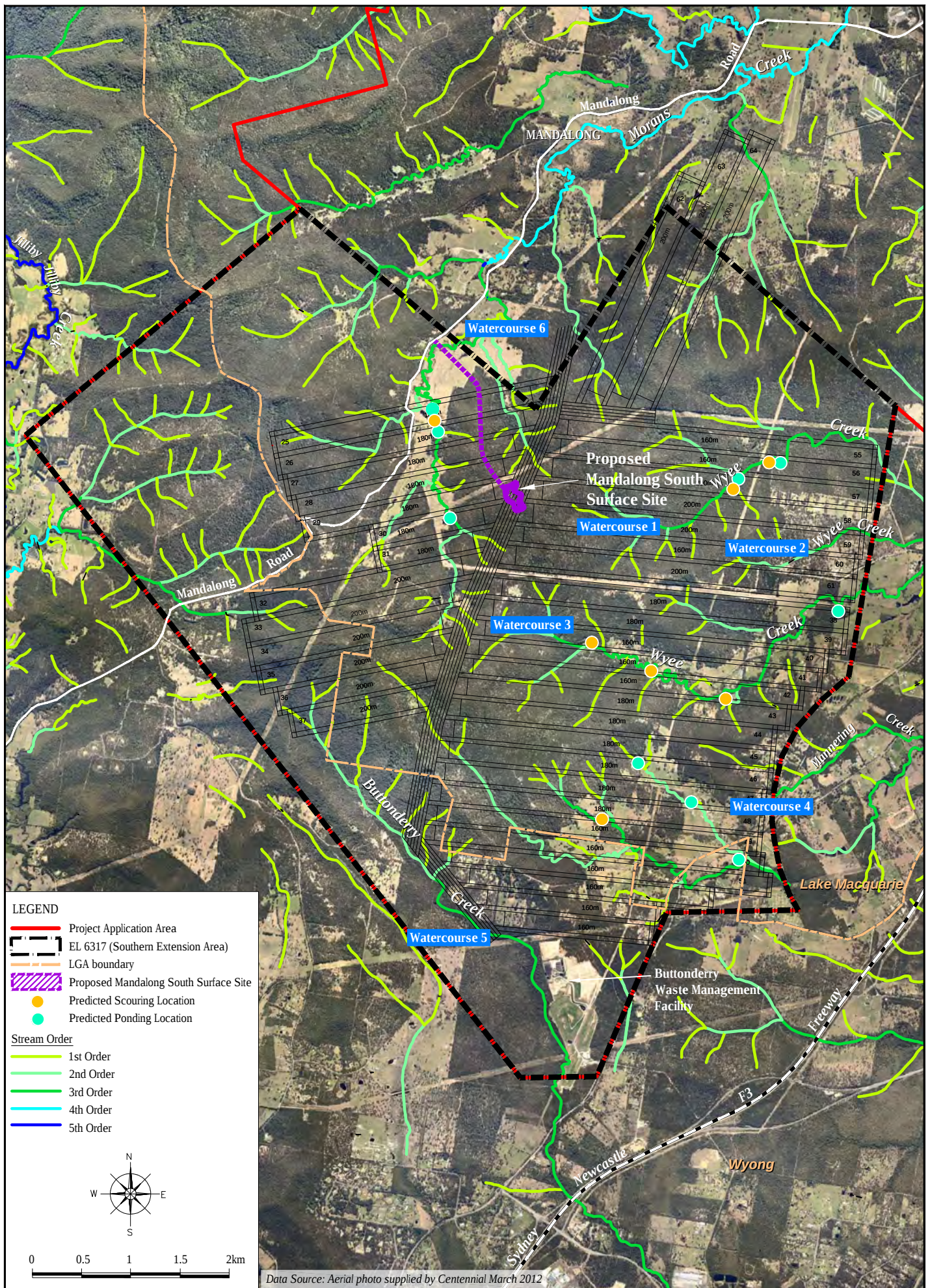
In summary, it is concluded that the potential impacts on the stability of watercourses within the Southern Extension Area are relatively minor (Umwelt 2013) and, as such, the potential for the Project to degrade the existing water quality within and downstream of the Southern Extension Area is also considered relatively minor.

Remnant Ponding

Ponding refers to pre- and post-mining depressions on the surface. Pre-mining ponding usually occurs in-channel along watercourses and may be altered in size and location as a result of subsidence. Changes to ponding can impact drainage patterns, flora and fauna and GDEs. Flat, low lying land may be susceptible to out-of-channel ponding or depressions forming after subsidence.

Predicted subsidence has the potential to affect remnant ponding in Morans Creek, Wyee Creek, Buttonderry Creek, Mannering Creek and Jilliby Jilliby Creek catchments. Analysis of remnant ponding for the current conditions in the Southern Extension Area (i.e. pre-mining) indicates that it is currently confined predominantly to existing flow paths (see **Figure 38**) and covers an area of approximately 182 hectares. Umwelt's (2013) assessment of the predicted subsided landform indicates negligible changes to remnant ponding, with a total increase in area of approximately 3.6 hectares (i.e. an increase of less than 2 percent). As shown on **Figure 38**, the increased remnant ponding is predicted in the following areas:

- Morans Creek – in the vicinity of longwalls 25 and 26;
- Wyee Creek – in the vicinity of longwalls 56 and 57 (Watercourse 1) and longwall 38 (Watercourse 3); and
- Mannering Creek – in the vicinity of longwall 50.



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Pre-mining ponding depths are assessed to range from 0 to 3.3 metres, with post-mining ponding depths predicted to range from 0.15 to 2.8 metres (DGS 2013). It is estimated that there will be ponding depth increases of up to 0.6 metres and ponding depth decreases of up to 0.55 metres after the proposed longwall panels are completed (DGS 2013).

The analysis indicates that the small areas of increased remnant ponding are largely confined to the existing flow paths/watercourses, with no predicted impact on access routes to (or within) properties and residences within the Southern Extension Area (Umwelt 2013).

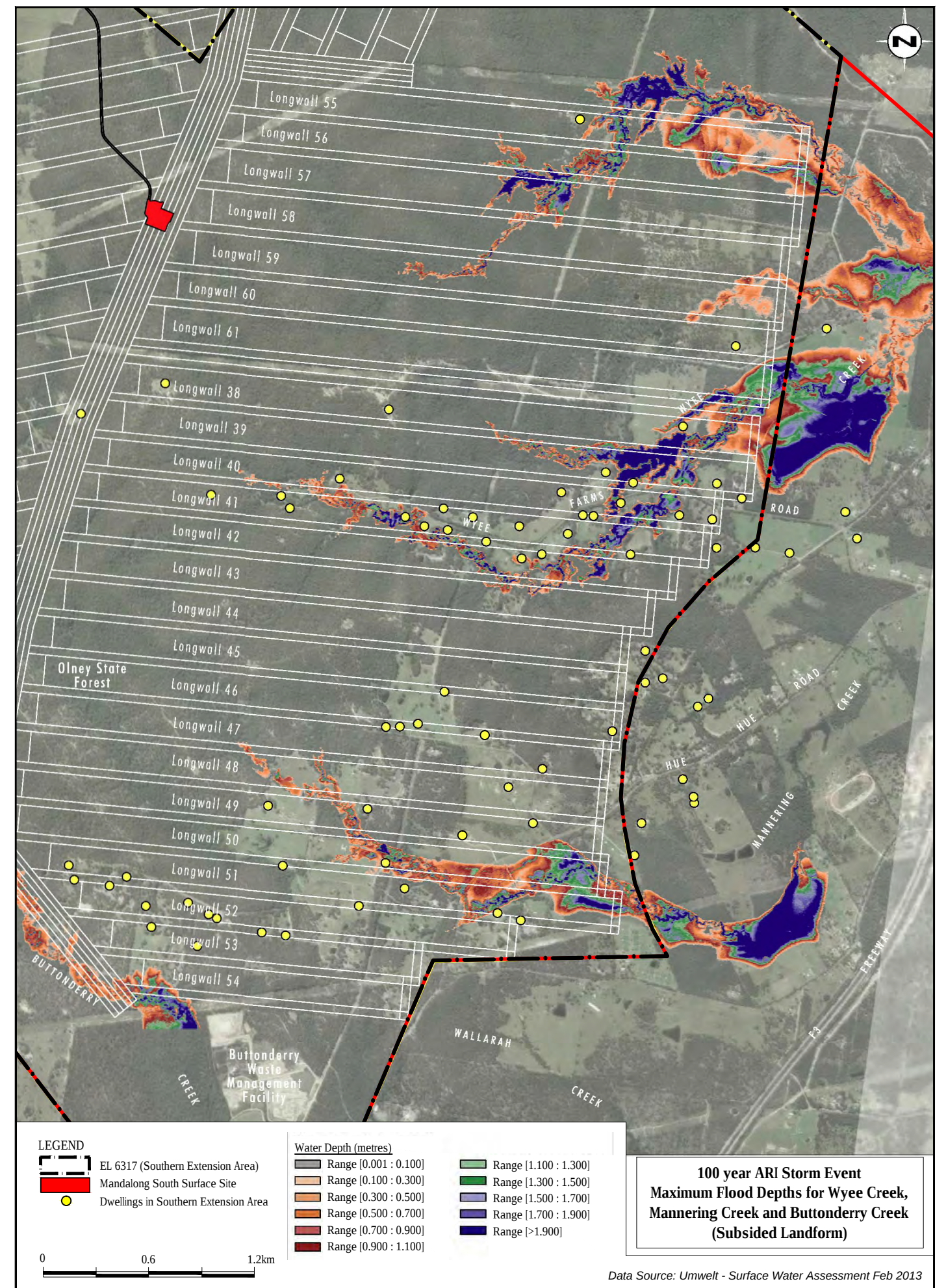
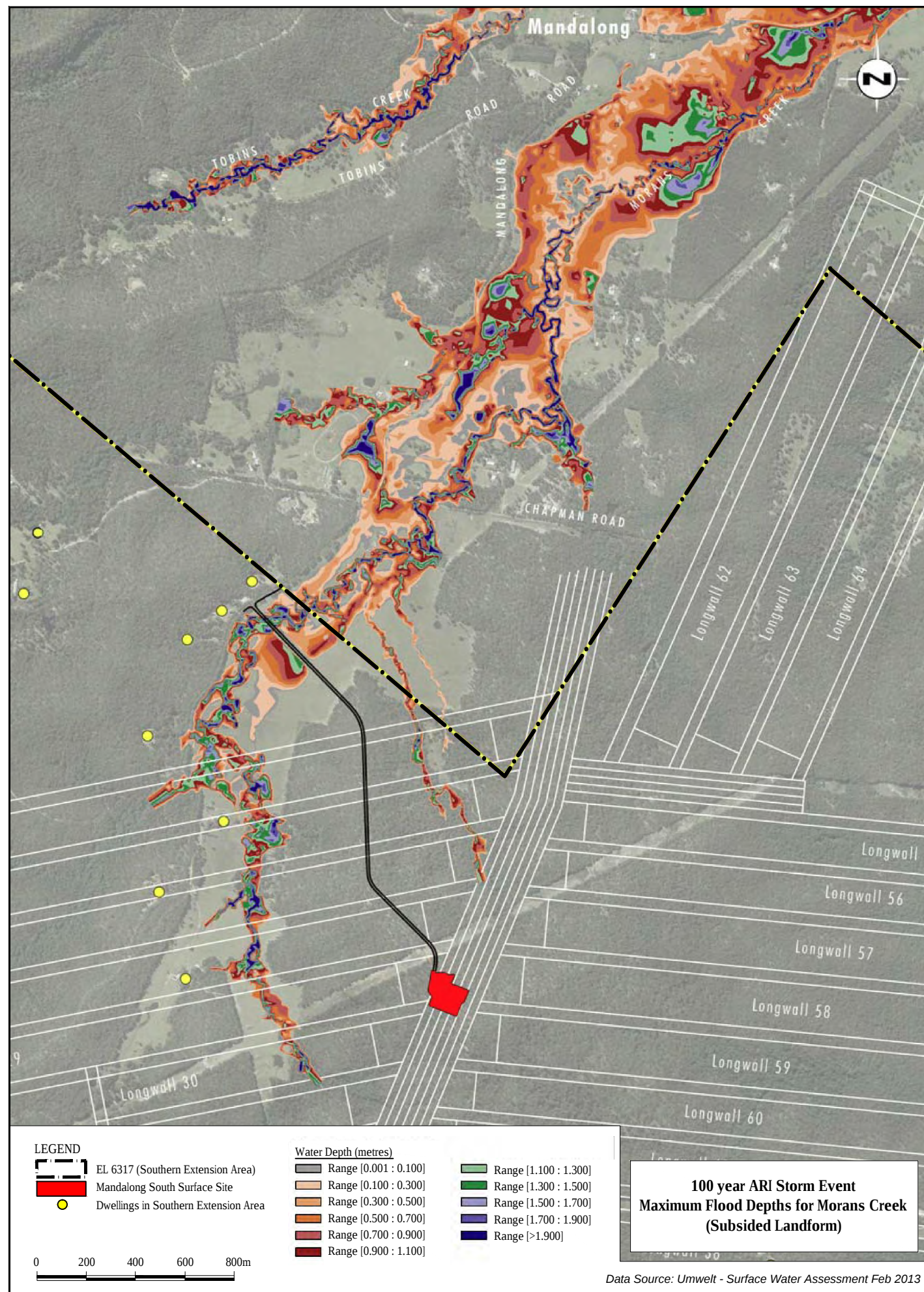
Flood Regimes

Changes to the flood regimes (flood response) within and surrounding the Southern Extension Area are a potential consequence of the predicted subsidence and proposed surface infrastructure. **Figure 39** shows the maximum modelled flood depths for the 100 year ARI design storm event for the predicted subsided conditions in Morans Creek, Wyee Creek (three branches), Mannering Creek and Buttonderry Creek.

The analysis of flood regimes within the Southern Extension Area indicated that increases to the maximum modelled flood depth for the 100 year ARI design storm event as a consequence of predicted subsidence of between 0.1 and 0.4 metres within the main channels of the watercourses are possible (Umwelt 2013). These increases are generally limited to the immediate vicinity of the proposed longwall panels, as well as upstream of the proposed access road to the Mandalong South Surface Site where flood flows are constricted by the conceptual crossing over Morans Creek. The modelled impacts on flood depths were typically limited to approximately 100 metres downstream of the conceptual road crossing over Morans Creek (Umwelt 2013). The final design of the creek crossing will include drainage structures sufficient to minimise the local impacts on flooding.

The analysis indicated that the predicted subsidence had no significant impact on the duration of flooding at the boundary of the Southern Extension Area, with minor flood events remaining in-channel and no discernible increase to the time out of bank for larger flood events (Umwelt 2013). This indicates that the potential for flooding impacts on the agricultural value of the surrounding properties are negligible.

Umwelt (2013) advises that the flooding regimes are unlikely to have a significant impact on the habitability or access to dwellings, with all of the identified dwellings within the Southern Extension Area outside of the modelled flood extent for the 100 year ARI design storm event, and no identified dwellings that are currently outside of the modelled flood extent for the 100 year ARI design storm event becoming inundated as a result of the predicted subsidence. However, three of the 114 residences (2.6 percent) are close to the 100 year ARI design storm event level and may have their floor levels subsided below the minimum free board of 0.5 metres (Umwelt 2013 and DGS 2013). However, the subsiding of a property does not necessarily increase the flood potential if the upstream and downstream areas have also be subsided allowing water to flow laterally resulting in an overall reduction in flood hazard (DGS 2013).



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Conclusion

The potential impacts of the Project on surface water resources has been minimised by the iterative process Centennial Mandalong has undertaken to develop and refine the mine design to minimise subsidence and associated impacts on the natural and built environment (Umwelt 2013). As a result:

- No significant adverse impacts on the existing catchment boundaries and watercourse alignments within the Southern Extension Area are predicted.
- Impacts on the stability of watercourses within the Southern Extension Area are predicted to be relatively minor and, as such, the potential for the Project to degrade the existing water quality within and downstream of the Southern Extension Area is also considered relatively minor. The predicted subsided landform indicates negligible changes to remnant ponding, with a total increase in area of approximately 3.6 hectares (i.e. an increase of less than 2 percent).
- The maximum modelled flood depth for the 100 year ARI design storm event as a consequence of predicted subsidence is predicted to increase between 0.1 and 0.4 metres within the main channels of the watercourses.
- The flooding regimes are unlikely to have a significant impact on the habitability or access to dwellings, with all of the identified dwellings within the Southern Extension Area outside of the modelled flood extent for the 100 year ARI design storm event, and no identified dwellings that are currently outside of the modelled flood extent for the 100 year ARI design storm event becoming inundated as a result of the predicted subsidence.
- There is limited potential for changes to water quantities, including annual flow volumes, baseflows and environmental flows. On this basis, downstream users are unlikely to experience significant changes to water availability as a consequence of the Project.

It is concluded that the Project will not result in adverse cumulative impacts on water use, flows or qualities within or surrounding the Southern Extension Area (Umwelt 2013).

10.5.3 Mitigation and Management

As detailed in **Section 5.0**, the proposed mine plan has been designed with varying longwall widths of between 160 metres and 200 metres to achieve manageable subsidence impacts to watercourses within the Southern Extension Area. To further mitigate and manage predicted impacts, the following key commitments are made:

Surface Water Monitoring and Reporting

Centennial Mandalong will expand the existing surface water monitoring program within the Southern Extension Area to include the following:

- Watercourse stability monitoring - monitoring of the watercourses within the area to be undermined, in particular locations identified as potential scouring points (see **Figure 37**). Monitoring will be undertaken before and after undermining of the areas, with additional inspection of these locations following significant rainfall events. Monitoring procedures will include:
 - Any bed control points;
 - Areas where subsidence may increase the erosive potential above the determined threshold limits potentially causing channel erosion/instability; and
 - Long-section and cross-section surveys, photographic records and/or methods outlined in the Australian Rivers Assessment System (AUSRIVAS).
- Surface water quality monitoring – surface water quality monitoring will be undertaken throughout the Project at the monitoring locations within the Southern Extension Area used to gather baseline information (see **Figure 19**).

- Flow monitoring - flow monitoring on the various creeks potentially impacted on by the Project will be undertaken by visual inspections during water quality sampling (see above). The observations will note any changes to the conditions of the watercourse bed and banks, including scouring. The visual inspections will be used to inform the assessment of water quality data.

Centennial Mandalong will continue to report surface water monitoring results in accordance with the requirements of the POEO Act on Centennial's website and on an annual basis in the Annual Review.

Annual watercourse stability reports will be prepared with the key findings reported in the Annual Review.

Erosion and Sediment Controls

Any necessary subsidence remediation work, including drainage and watercourse stabilisation works, will be accompanied by suitable erosion and sediment controls in accordance with:

- *Managing Urban Stormwater Soils and Construction* (the Blue Book) *Volume 1* (Landcom 2004) and *Volume 2C Unsealed Roads* (DECC 2008); and
- Where relevant, the *Draft Guidelines for the Design of Stable Drainage Lines on Rehabilitated Mine Sites in the Hunter Coalfields* (DIPNR, undated)

Erosion and sediment controls will be regularly inspected, including after rainfall events, and maintained.

Ponding

A suitable monitoring program and TARP will be developed to address remnant ponding as a component of the Extraction Plan in consultation with relevant government agencies. This will include reviewing and assessing any changes to drainage paths and surface vegetation in areas of ponding development (if they occur) after each longwall panel is extracted by a suitably qualified and experienced consultant.

Triggers for undertaking drainage works will be where new remnant ponding areas are created as a result of mine induced subsidence and there is a net detrimental impact on habitat, and it is practical to do so. Any mitigation works will be determined in consultation with the landowner and relevant government agencies. A suitably qualified ecologist will be engaged to assess the impact of identified significant ponding changes and recommend remedial actions.

Water Management Plan

Mandalong Mine's currently approved and implemented EMS, including the *Water Management Plan*, will be reviewed and updated for the Mandalong Southern Extension Project. The review will take into consideration the findings and conclusions of the surface water assessment (Umwelt 2013), the commitments made in this EIS and all relevant consent conditions. Specifically the *Water Management Plan* will include:

- A summary of existing watercourse conditions;
- A summary of predicted impacts to watercourses as a result of underground mining operations, including impacts to watercourse stability, remnant ponding and flood regimes;
- Monitoring requirements;
- TARPS and mitigation strategies for watercourse impact, which will include infilling of surface cracks (where appropriate to do so), drainage works (such as the installation of surface or sub-surface drains) around properties (where required) to reduce ponding effects, and watercourse stability works (where required) to provide reinforcement of creek banks in high instability risk areas; and
- Consultation processes to be implemented with relevant landholders and government agencies.

The *Water Management Plan* will be developed in consultation with the NOW, EPA and DP&I.