# LAKE WELLS SULPHATE OF POTASH PROJECT

# ENVIRONMENTAL REVIEW DOCUMENT

PREPARED FOR:

## AUSTRALIAN POTASH LIMITED

AUSTRALIAN POTASH
The Australian SOP Company

JUNE 2020


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# SCOPING CHECKLIST

| Task No. | Required Work | Section | Page No. |
|---|---|---|---|
| EPA Factor 1 – Flora and Vegetation | | | |
| 1. | Identify and characterise flora and vegetation within the proposed Development Envelopes through detailed Flora and Vegetation Surveys in accordance with the standards of Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). Surveys will include searches for populations of plants of significance within or in close proximity to the Development Envelopes. Submission of specimens of potentially new species to the WA Herbarium for verification by taxonomic experts. Specimens of all significant flora will be vouchered at the WA Herbarium. | 5.1.3 | 35 |
| 2. | Complete a detailed sampling regime within the salt lake playas in accordance with pages 13-14 of the Technical Guidance. Undertake targeted surveys for Tecticornia dominated vegetation units within the salt lake playas based on the establishment of a series of 3 x 3 m quadrats. Two sampling events to occur to target the flowering periods, one between August and October and one in December or January. All Tecticornia specimens will be submitted to the WA Herbarium for identification and vouchering. Targeted surveys for significant flora will quantify and map the size and extent of populations. | 5.1.3<br>Appendix 3 | 35 |
| 3. | Identify and provide detailed mapping of the vegetation communities within the Development Envelopes, including the recorded locations of significant species and communities. Figures to show the likely spatial extent of loss of vegetation units from both direct and indirect impacts. | 5.1.3 | 35 |
| 4. | Assess the extent of direct and indirect impacts associated with the proposal on the flora and vegetation within the Development Envelopes, including percentages of vegetation communities to be disturbed or otherwise impacted in a local and regional context, to assist in determining significance of impacts. Provide tables quantifying the direct and indirect impacts of the proposal on vegetation and significant flora in terms of number of plants, area of vegetation, number of populations/occurrences and proportions of the total. | 5.1.5 | 44 |
| 5. | Undertake a review of areas outside the Development Envelopes to determine the likelihood of indirect impacts to significant flora or vegetation. | 5.1.5 | 44 |
| 6. | Demonstrate that all practicable measures have been taken to reduce the area of the proposed disturbance footprint based on project design. | 2.5 | 25 |
| 7. | Demonstrate application of the mitigation hierarchy to avoid and minimise impacts to flora and vegetation. | 5.1.6 | 59 |
| 8. | Provide a discussion of the proposed management, monitoring and mitigation methods to be implemented in order to demonstrating that residual impacts will not be greater than predicted. | 5.1.6 | 59 |
| 9. | Determine and quantify any significant residual impacts for the proposal by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offset Guidelines (2014), with reference to the Commonwealth Assessment Guide. | 5.1.6 | 59 |
| 10. | Where significant residual impacts remain propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. Spatial data defining the area of each significant residual impact should also be provided. | 6 | 162 |

| Task No. | Required Work | Section | Page No. |
|---|---|---|---|
| 11. | Provide a discussion which demonstrated an assessment of any proposed offset against the six offset principles in the WA Environmental Offsets Policy. | 6 | 162 |
| 12. | Prepare a Mine Closure Plan consistent with DMIRS/EPA Guidelines for Preparing Mine Closure Plans (2015) which details the proposed rehabilitation methodologies to achieve successful progressive rehabilitation of all areas disturbed by mining with vegetation composed of native species of local provenance where possible. Where local provenance seed cannot be sourced seed will be collected from an appropriate reference ecosystem as close as possible to the rehabilitation site. | Appendix 2 | NA |
| 13. | Demonstrate and document in the ERD how the EPA's objectives for this factor can be met. | 5.1.6 | 59 |
| EPA Factor 2 – Terrestrial Fauna | | | |
| 14. | Undertake a terrestrial fauna desktop study to provide context for the proposed field surveys and impact assessment in accordance with EPA Guidance in order to gather sufficient information to allow evaluation of the field survey results and assessment of the potential impacts of the proposal in a regional context. | Appendix 3 | NA |
| 15. | Conduct Level 2 terrestrial fauna, Short Range Endemic (SRE) and Lake Ecology surveys, in areas that are likely to be directly or indirectly impacted as a result of the proposal in order to identify and characterise the fauna communities and fauna habitats present. Surveys are to be undertaken in accordance with relevant EPA policies and technical guidance and where available, species-specific survey guidelines for relevant species. | Appendix 3 | NA |
| 16. | Conduct targeted surveys for the Night Parrot in order to determine presence/absence of the species and/or critical habitat. | Appendix 3 | NA |
| 17. | Provide a review of Night Parrot records and map potentially suitable habitat in the local and regional area. | Appendix 3 | NA |
| 18. | Detail the extent to which clearing will remove critical habitat and be expected to impact the Night Parrot. | 5.2.5.1 | 89 |
| 19. | Undertake targeted surveys for significant species as/if required. | Appendix 3 | NA |
| 20. | Identify and provided detailed mapping and tables of the fauna habitats within the Development Envelope, including the known recorded locations of significant species and communities in relation to the proposed footprint areas. Figures and tables should show the likely spatial extent of loss of habitats from both direct and indirect impacts. For each significant species provide quantification of the area of habitat, broken down by habitat type (i.e. breeding, foraging etc.) that is likely to be directly or indirectly impacted by the proposal. | 5.2.3<br>5.2.5.1 | 64<br>89 |
| 21. | Assess the occurrence of SRE invertebrate's species and provide figures to show the extent of potential impacts to SRE's. | 5.2.3<br>5.2.5.1 | 64<br>89 |
| 22. | Demonstrate that no SRE's or other significant terrestrial invertebrates are restricted to the area of impact, if this cannot be demonstrated, that such species have been adequately surveyed for outside the area of impact. | 5.2.3.5<br>Appendix 3 | 83 |
| 23. | Assess the extent of direct and indirect impacts to fauna species (including migratory birds) and fauna habitats in a local and regional context. | 5.2.5 | 89 |
| 24. | Demonstrate application of the mitigation hierarchy to avoid, minimise and rehabilitate impacts to fauna and fauna habitat. | 5.2.6 | 103 |

| Task No. | Required Work | Section | Page No. |
|---|---|---|---|
| 25. | Provide a discussion of the proposed management, monitoring and mitigation methods to be implemented in order to demonstrate that residual impacts will not be greater than predicted. | 5.2.6 | 103 |
| 26. | Determine and quantify any significant residual impacts for the proposal by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offset Guidelines (2014) and include reference to the Commonwealth Assessment guide. | 5.2.6 | 103 |
| 27. | Where significant residual impacts remain propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. Spatial data defining the area of each significant residual impact should also be provided. | 6 | 162 |
| 28. | Provide a discussion which demonstrated an assessment of any proposed offset against the six offset principles in the WA Environmental Offsets Policy. | 6 | 162 |
| 29. | Prepare a Mine Closure Plan consistent with DMIRS/EPA Guidelines for Preparing Mine Closure Plans (2015) which considers rehabilitation and decommissioning for areas of habitat for significant fauna. | Appendix 2 | NA |
| 30. | Demonstrate and document in the ERD how the EPA's objectives for this factor can be met. | 5.2.6 | 103 |
| EPA Factor 3 – Subterranean Fauna | | | |
| 31. | Conduct stygofauna surveys within areas to be impacted (Off Playa) and in surrounding areas in accordance with the EPA guidance. | 5.4.3.3<br>Appendix 2 | 132 |
| 32. | Assess likelihood of troglofauna habitat being present and if likely undertake surveys as appropriate and in accordance with EPA guidance. | 5.4.3.3<br>Appendix 3 | 132 |
| 33. | Present figures and tables to summarise the results and illustrate the areas of impact in relation to subterranean fauna species and habitat. | 5.4.5 | 140 |
| 34. | Assess the extent of direct and indirect impacts to subterranean fauna. For species which are likely to be impacted provide information, including figures, to demonstrate any habitat connectivity beyond the impact area. | 5.4.5.2 | 142 |
| 35. | Demonstrate that no subterranean fauna species are restricted to the potential direct and indirect area of impact or, if this cannot be demonstrated, that such species have been adequately surveyed for outside of these areas and/or that habitat connectivity exists for these species. | 5.4.5.2 | 142 |
| 36. | Provide a discussion of the proposed management, monitoring and mitigation methods to be implemented in relation to subterranean fauna. | 5.4.6<br>Appendix 4 | 151 |
| 37. | Determine and quantify any significant residual impacts for the proposal by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offset Guidelines (2014) and include reference to the Commonwealth Assessment guide. | 6 | 162 |
| 38. | Where significant residual impacts remain propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. | 6 | 162 |
| 39. | Provide a discussion which demonstrated an assessment of any proposed offset against the six offset principles in the WA Environmental Offsets Policy. | 6 | 162 |

| Task No. | Required Work | Section | Page No. |
|---|---|---|---|
| 40. | Demonstrate and document in the ERD how the EPA's objectives for this factor can be met. | 5.4.6 | 151 |
| EPA Factor 4 – Inland Waters | | | |
| 41. | Conduct a H3 detailed hydrological assessment, including drilling, test pumping and groundwater model in accordance with DWER's Operational Policy No. 5.12 – Hydrological reporting associated with groundwater well licence (DWER 2009). | Appendix 3 | NA |
| 42. | Identify key environmental values in the project area that may be supported by ground or surface water regimes. | 5.3.3.5 | 116 |
| 43. | Characterise the baseline surface and groundwater hydrology in a local and regional context and describe any connection between the surface water and groundwater system. | 5.3.3 | 110 |
| 44. | Assess groundwater drawdown associated with the proposal and analyse and discuss any impacts to key environmental values, surface water flows and surface and groundwater quantity expected as a result of the proposal. | 5.3.5 | 117 |
| 45. | Identify borefield locations and design requirements to meet project needs (water supply and extraction of brine). | 2.4 | 16 |
| 46. | Determine expected abstraction over the life of the project and assess the sustainability of borefields. | 2.4<br>Appendix 3 | 16 |
| 47. | Provide a water balance for the mining operations demonstrating that there is sufficient water for the duration of the mining operations. | Appendix 3 | NA |
| 48. | Determine the change and impact to hydrological regimes as a result of abstraction. | 5.3.5 | 117 |
| 49. | Assess, analyse and discuss changes to surface water regimes as a result of the proposal and analyses and discuss impacts to any key environmental values supported by surface water flows. | 5.3.5.2 | 118 |
| 50. | Characterise and describe the baseline surface and groundwater quality in a local and regional context. | 5.3.3 | 110 |
| 51. | Identify key environmental values that could be impacted by adverse changes to surface and groundwater quality. | 5.3.3.5 | 116 |
| 52. | Characterise sediments to be disturbed by On Playa infrastructure in terms of presence of acid sulfate soils, metals and metalloid concentrations in addition to salt concentrations. | 5.3.3.1 | 111 |
| 53. | Evaluate the potential for mobilisation of metals from sediment porewater due to disturbance and evapo-concentration of metals within ponds and detail mitigation measures if required. | 5.3.3.1 | 111 |
| 54. | Assess the likelihood for change in pH, salinity and metal concentrations of surface waters within the ponds and potential toxicity for waterbirds and aquatic invertebrate fauna. Detail mitigation methods if required. | 5.3.3.1 | 111 |
| 55. | Describe the potential direct and indirect impacts from the proposal on surface and groundwater quality. | 5.3.5 | 117 |
| 56. | Discuss the proposed management, monitoring and mitigation measures to be implemented to prevent significant adverse impacts to ground and surface water hydrology and quality as a result of the construction and operation of the proposal, including the development of water quality trigger levels. | 5.3.6 | 126 |

| Task No. | Required Work | Section | Page No. |
|---|---|---|---|
| 57. | Determine and quantify any significant residual impacts for the proposal by applying the Residual Impact Significance Model (page 11) and WA Offset Template in the WA Environmental Offset Guidelines (Appendix 1). | 5.1.6 | 59 |
| 58. | Where significant residual impacts remain propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. | 6 | 162 |
| 59. | Provide a discussion which demonstrated an assessment of any proposed offset against the six offset principles in the WA Environmental Offsets Policy. | 6 | 162 |
| 60. | Prepare a Mine Closure Plan consistent with DMIRS/EPA Guidelines for Preparing Mine Closure Plans (2015) which addresses the development of completion criteria to maintain surface and groundwater regimes and the quality of surface and groundwater so that environmental values are maintained post closure. | Appendix 2 | NA |
| 61. | Demonstrate and document in the ERD how the EPA's objectives for this factor can be met. | 5.3.6 | 126 |
| EPA Factor 5 – Social Surroundings | | | |
| 62. | Conduct consultation with Traditional Owner groups. | 3 | 30 |
| 63. | Provide details on consultation undertaken with Traditional Owner Groups and future plans for consultation. Detail any changes made to the proposal as a result from this consultation. | 3 | 30 |
| 64. | Characterise and map the heritage sites and cultural values of proposed disturbance areas and any other areas that may be indirectly impacted to identify sites of significance and their relevance and value within a wider regional context. Assess the impacts on heritage sites and cultural values in accordance with the Environmental Factor Guideline – Social Surroundings (EPA 2016) and predict the residual impacts after considering the mitigation hierarchy. | 5.5.3<br>5.5.5 | 153<br>159 |
| 65. | Detail and assess the product transport corridors including the proposed trucking route, rail siding loading area and port access route. Describe management measures and monitoring arrangements proposed to mitigate impacts to amenity from product transport. | 2.4.8 | 23 |
| 66. | Assess the impacts on amenity and predict the residual impacts after considering the mitigation hierarchy. | 2.4.8[1] | 23 |

[1] It is noted that potential impacts to amenity are not identified under the 'potential impacts and risks'. Section 2.4.8 discusses the transport route and existing mitigation measures such as use of sealed roads, use of sealed side-tipping trailers and avoidance of population centres. Section 5.1.5.9 discusses potential environmental impacts associated with dust emissions adjacent to the transport route and proposed mitigation measures.

# EXECUTIVE SUMMARY

## INTRODUCTION

The Lake Wells Sulphate of Potash Project (the Proposal) is a proposed greenfields Sulphate of Potash (SOP) development, owned by Australian Potash Limited (APC). The site is located approximately 160 km north northeast of Laverton, in the north eastern Goldfields region of Western Australia. APC proposes to abstract brine resources found in a palaeochannel at Lake Wells to produce a SOP product which will be transported to Geraldton Port.

APC referred the Proposal to the Western Australian Environmental Protection Authority (EPA) on 21 December 2017 under Section 38 of the *Environmental Protection Act 1986* (EP Act). On 5 February 2018, the level of assessment was set as Environmental Review - no public review. In April 2018 APC submitted a Change to Proposal request under Section 43A of the EP Act, to formalise a significant reduction in the size of the Development Envelopes. This Change to Proposal was approved on 16 May 2018.

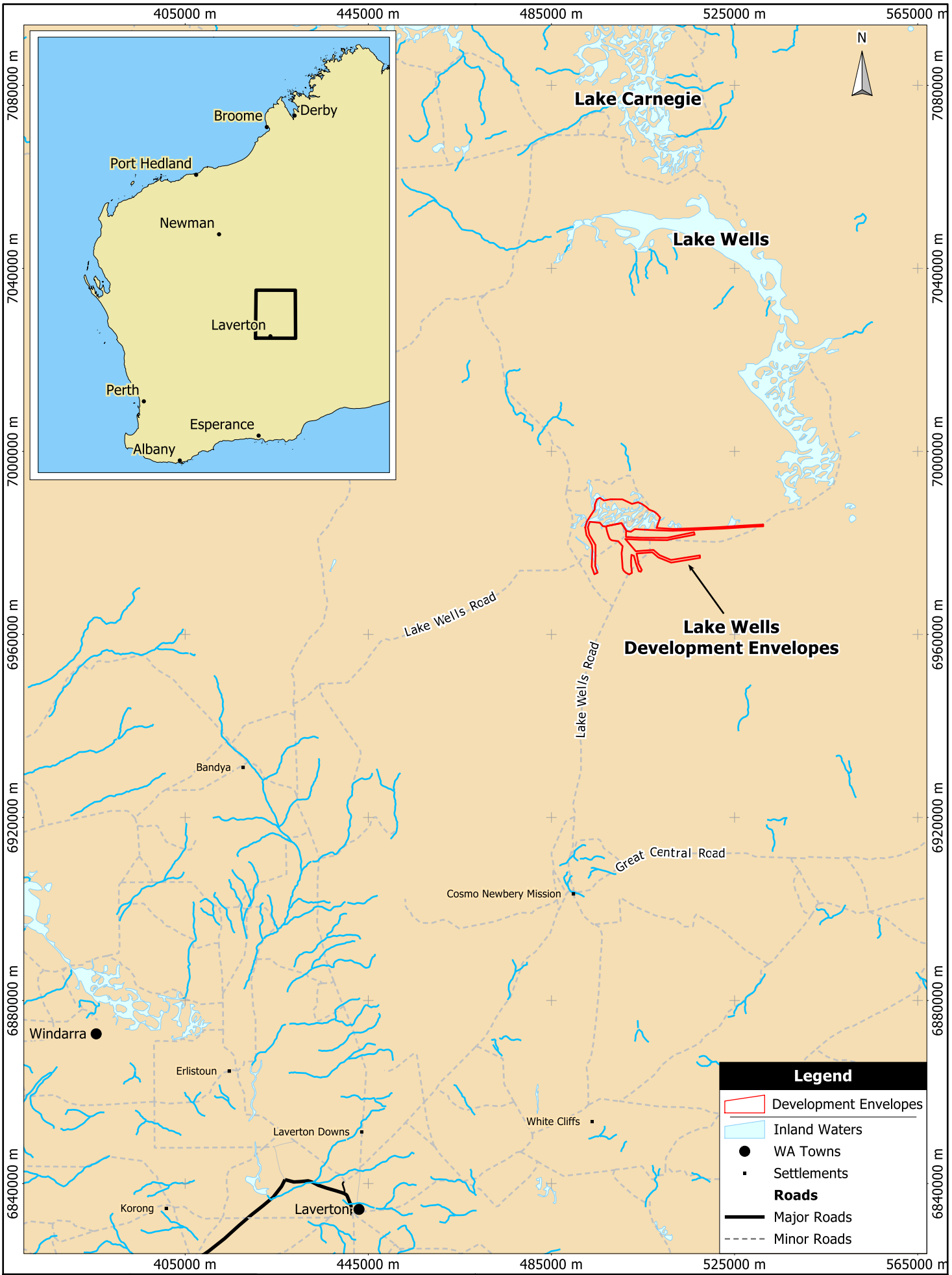
An Environmental Scoping Document (ESD) was prepared by APC (2018) to define the form, content, timing and procedure of the Environmental Review Document (ERD) (this document). The ESD was approved on 21 September 2018 (Appendix 1). The ESD outlines the preliminary key environmental factors, other environmental factors or matters and work requirements for completion of the ERD.

This ERD addresses potential impacts from the Proposal and was prepared by APC in accordance with the approved Environmental Scoping Document (ESD) (Appendix 1), guidance within the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2018a)*, the *EIA Procedures Manual (EPA 2018a)* and Part IV of the *Environmental Protection Act 1986* (WA) (*EP Act*). The form of this ERD is consistent with the *Environmental Review Document Template (EPA 2018b)*.

## BACKGROUND AND CONTEXT

The Proposal occupies an area of palaeovalley and salt lake terrain in the north northeast part of the Yilgarn Craton of Western Australia, at Lake Wells, located approximately 160 km north east of Laverton (ES Figure 1). The Proposal aims to extract and treat potassium-rich brine from the Lake Wells palaeochannel, producing SOP for domestic and international markets. Potash is used as an agricultural fertiliser, playing an important role in crop production. Within Australia, 140,000 tonnes of potash was applied to 1,872,000 ha of agricultural land in the year ending 30 June 2017 (ABS 2017). At present, Australia imports 100% of potash products with no current domestic sources (although several other SOP projects are currently proposed). The Proposal includes development of a 150,000 tonnes per annum (tpa) SOP project.

APC commenced exploration into potential potash resources in 2014. Results from previous gold and base metal exploration work in the area dating back to the 1990's has been considered during project evaluation, including water table and water inflow data and lithological information. Pit sampling, auger and air-core (AC) drilling has demonstrated the presence of consistent high-grade potash brine concentrations to significant depths on, and adjacent to, the salt lake (or 'playa').

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Original Size: A4
Grid: MGA94(51)

0 40 km

Australian Potash
Lake Wells
Environmental Review Document

**Executive Summary**
**Figure 1**

**Proposal Location**

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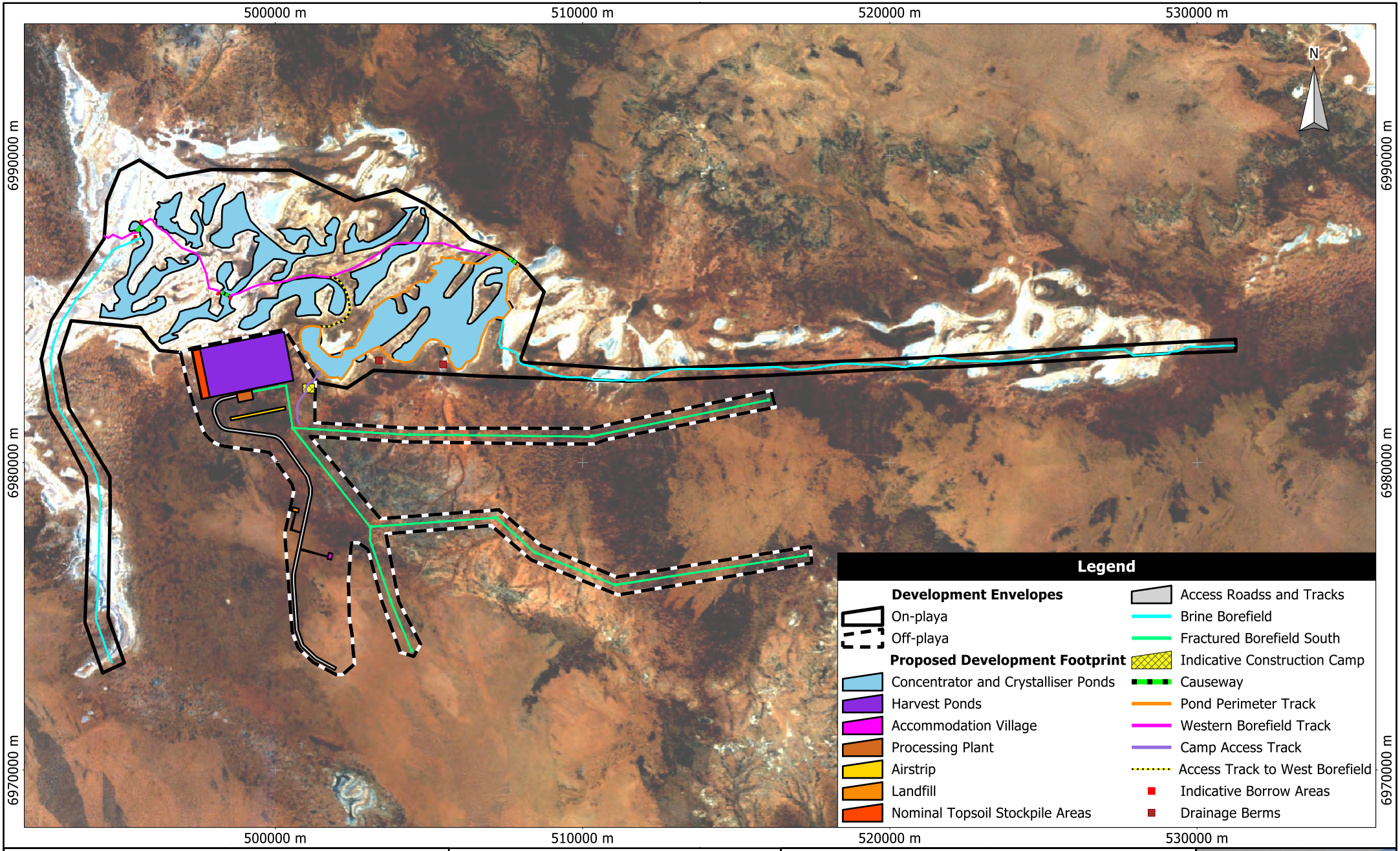
W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\Location Plan.map 1/11/2019 ES F1 Proposal Location Layout

# OVERVIEW OF THE PROPOSAL

The Proposal, with a life of over 30 years, will consist of (refer ES Figure 2):

- Development of a brine production borefield within the palaeochannel and development of solar evaporation ponds within the Lake Wells playa lake system (On Playa).
- Development of harvest ponds of approximately 2 $km^2$ (Off Playa).
- Construction and operation of a SOP processing plant to process salts harvested from the solar evaporation ponds (Off Playa).
- Development of a Process/Potable water supply borefield to provide water for use during construction and operations (Off Playa).
- Associated infrastructure (stormwater management infrastructure (bunds and drains), internal roads, site access road, power station, accommodation village (150 beds), wastewater treatment plant, airstrip, landfill) (predominantly Off Playa).

The SOP product will be transported to Geraldton via existing roads.




Scale: 1:160000
Original Size: A4
Aerial Photo Date: March 2016
Grid: MGA94(51)

0 5 km

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**Executive Summary Figure 2**

**Development Envelopes, Indicative Development Footprint and Key Infrastructure**

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W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\Location Plan.map 24/03/2020 ES F2 Development Envelope, Indicitive Development Footprint

A summary of the key physical and operational characteristics of the Proposal is presented in ES Table 1.

ES Table 1: Key Characteristics of the Proposal

| Summary | | |
|---|---|---|
| Proposal Title | Lake Wells Sulphate of Potash Project | |
| Proponent Name | Australian Potash Ltd (APC) | |
| Short Description | APC aims to develop a Sulphate of Potash (SOP) operation by evaporation and processing of the potassium and sulphate rich brines found at Lake Wells.<br>The project involves the development of a 150,000 tonne per annum (tpa) SOP processing plant, brine abstraction bores and associated brine transfer network, evaporation ponds, accommodation village, Process/Potable water borefield and associated site infrastructure. | |
| **Physical Elements** | | |
| **Element** | **Location** | **Proposed Extent Authorised** |
| **On Playa Development Envelope** | | |
| Bitterns Pond | ES Figure 2 | Clearing no more than 30 ha within the 9,322 ha On Playa Development Envelope. |
| Concentrator and Crystalliser Ponds and Brine Borefield/On Playa Infrastructure | ES Figure 2 | Clearing no more than 2,440 ha within the 9,322 ha On Playa Development Envelope. |
| **Off Playa Development Envelope** | | |
| Project Infrastructure | ES Figure 2 | Clearing no more than 150 ha within the 4,629 ha Off Playa Development Envelope. |
| Process/Potable water borefield (i.e. Fractured Rock Borefield) | ES Figure 2 | Clearing no more than 90 ha within the 4,629 ha Off Playa Development Envelope. |
| Harvest Ponds and Processing Plant | ES Figure 2 | Clearing no more than 510 ha within the 4,629 ha Off Playa Development Envelope. |
| **Operational Elements** | | |
| **Element** | **Location** | **Proposed Extent Authorised** |
| **On Playa Development Envelope** | | |
| Waste Salt Residue Stockpiles | ES Figure 2 | Production of up to 3.0 Mtpa of waste salt |
| Bitterns (magnesium chloride) | ES Figure 2 | Production of up to 1.0 Mtpa of bitterns |
| Brine Abstraction | ES Figure 2 | Abstraction of up 17 Gigalitres per annum (GLpa) |
| **Off Playa Development Envelope** | | |
| Process/Potable Water Abstraction | ES Figure 2 | Abstraction of up 0.8 GLpa |
| Processing Plant | ES Figure 2 | 150,000 tpa |
| Power Plant | ES Figure 2 | 10 MW |

# SUMMARY OF POTENTIAL IMPACTS, PROPOSED MITIGATION AND OUTCOMES

ES Table 2 provides a summary of potential impacts, proposed mitigation measures, and predicted outcomes relevant to each environmental factor.

## ES Table 2: Summary of Potential Impacts, Proposed Mitigation, and Outcomes

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| **Flora and Vegetation** | | |
| Localised loss of vegetation from clearing<br>Loss of biological diversity and reduced regional representation of flora and vegetation communities | Measures to avoid:<br>• Concentrator/Crystalliser Ponds have been located on predominantly bare salt flat areas within the On Playa environment.<br>Measures to minimise:<br>• Disturbance of Off Playa vegetation has been minimised through careful design of the site layout.<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>Measures to rehabilitate:<br>• A conceptual Mine Closure Plan has been developed, including objectives for rehabilitation of disturbed areas (Appendix 2). | The proposed clearing is of vegetation communities that are well represented outside of the Development Envelopes. APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation across the Lake Wells Playa system and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br>Limited removal of Priority species will occur as a result of implementation of the Proposal. All Priority species likely to be impacted are known to occur beyond the Development Envelopes and Proposal footprint.<br><br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of flora and vegetation will be maintained.<br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope.<br>Monthly assessment, following Proposal implementation, of the mapped populations of *Tecticornia* sp. Sterile 1.<br>Any decline in the extent of the population attributable or potentially attributable to the Proposal will be reported to the EPA and the potential causes investigated and appropriate management measures implemented, in consultation with the EPA. |
| Loss of significant flora and vegetation | Measures to avoid:<br>• Specimen of 'Tecticornia sp. sterile 1' to be retained, with a 50 m clearance buffer put in place to prevent impacts.<br>• Alignment of brine borefield disturbance to minimise impact on Melaleuca apostiba (P3 locations). Four of 35 recorded individuals (11%) are located within the Off Playa Proposal footprint. These individuals will be retained where practicable.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>Measures to rehabilitate:<br>• NA | |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Fragmentation of vegetation communities (On Playa) | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>• Concentrator and Crystalliser Ponds will predominantly be bound by existing dunes, thereby minimising any additional fragmentation of vegetation.<br>Measures to rehabilitate:<br>• Surface water flow paths between ponds will be re-established, if altered, on closure. | Fragmentation may affect flora and vegetation within and immediately adjacent to the On Playa Development Footprint, though it is noted that the playa is currently divided by numerous internal dunes. The On Playa *Tecticornia* spp. vegetation communities are widespread throughout the region.<br><br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation across the Lake Wells playa system and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Alteration of vegetation communities resulting from changed drainage patterns | Measures to avoid:<br>• Suitable floodways, drains and culverts will be installed Off Playa to maintain, as much as possible, natural flow patterns adjacent to infrastructure.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines and flood levels in Off Playa areas with the aim of minimising changes to drainage patterns.<br>Measures to rehabilitate:<br>• Upon closure, reinstatement of the natural flow paths will occur after removal of the project infrastructure. | Modification to surface water flows are considered to be minor at a local scale and as such are unlikely to affect the survival of, or reduce the condition of, vegetation within or adjacent to the Development Envelopes.<br>Vegetation communities within the Development Envelopes are well represented locally and regionally, and are resilient to both drought and short term inundation associated with seasonal rainfall events.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br><br><u>Monitoring</u><br><br>Monthly assessment, following Proposal implementation, of the mapped populations of *Tecticornia* sp. Sterile 1, *Tecticornia* aff. u*ndulata* and *Tecticornia willisii* including:<br>• Population extent, density (plant density), health (plant health).<br>• Observations for signs of surface water impacts within or adjacent to population (scour, surface water ponding).<br>• Observations for signs of other actual or potential impacts (grazing, fire, land clearing). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | Any decline in the extent, density or health in any monitored population, if outside of the baseline variation and attributable or potentially attributable to the Proposal, will be reported to the EPA, the potential causes investigated and appropriate management measures implemented, in consultation with the EPA. |
| Introduction of new, and spread of existing, weed species | Measures to avoid:<br>• Earth moving machinery will be required to be clean of soil and vegetation prior to entering the Development Envelopes.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelopes.<br>• During operations, vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• Vehicle and equipment hygiene procedures will be implemented to minimise entry of weed and soil borne diseases.<br>Measures to rehabilitate:<br>• Weed inspection and control to be implemented during operations and closure stages as required. | Increased presence of weeds (species and abundance) may affect the health and quality of vegetation. The vegetation types are all well represented regionally, and several weed species already occur. The saline nature of the majority of the operational area of the Proposal will minimise the risk of weed introduction and spread as a result of the Proposal.<br><br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Vegetation damage due to increased fire risk | Measures to avoid:<br>• Project infrastructure located in cleared Off Playa areas to be surrounded by appropriate fire break.<br>• All works to be carried out under hot works permit system.<br>Measures to minimise:<br>• Fire breaks will be installed in Off Playa areas to protect key infrastructure (where required).<br>• Firefighting equipment will be located in vehicles and buildings, and personnel will be trained in fire response.<br>Measures to rehabilitate:<br>• NA | Increased incidence of fire has the potential to affect the survival or condition of vegetation.<br><br>APC considers that the risk can be managed such that significant residual impacts to flora and vegetation are unlikely, and the biological diversity and ecological integrity of flora and vegetation will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Death of vegetation due to saline water spills or leaks (Off Playa) | Measures to avoid:<br>• Concentrator/Crystalliser Ponds located On Playa within saline environment.<br>Measures to minimise:<br>• Pipelines will be fitted with leak detection systems.<br>• Water flows will be automatically shut off if leaks are detected.<br>• Pipelines will be inspected regularly, especially during extreme heat or fire events.<br>• Investigations will be conducted into the cause of any spills, and remedial actions will be taken to minimise the chance of reoccurrence.<br>Measures to rehabilitate:<br>• NA | Leaks or spills of saline water have the potential to cause adverse impacts to flora and vegetation. Impacts could result in localised effects on the health, abundance and structure of vegetation communities.<br><br>The majority of the Proposal area is located in the On Playa Development Envelope which is saline in nature and as such supports limited vegetation, with this primarily being fringing samphire vegetation types adapted to varying salinity ranges.<br>All vegetation types are well represented in the region and loss would not result in loss of a community or significant species.<br><br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Reduction in vegetation condition due to dust emissions | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Dust control measures will be implemented during construction and operations.<br>• Speed limits will be implemented in project areas to minimise dust emissions.<br>Measures to rehabilitate:<br>• NA | Dust emissions during construction will be short-term and unlikely to result in permanent impacts to vegetation.<br><br>Dust emissions during operations will be localised and limited primarily to the site access road (<50 m from source). Vegetation in areas adjacent to land clearing activities and the proposed access road is well represented locally and regionally. Impacts may result in reduced vegetation condition, but are considered unlikely to result in vegetation death.<br><br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Terrestrial Fauna | | |
| Removal and fragmentation of fauna habitat (On and Off Playa) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• Vehicle crossing points established at regular intervals along borefield pipelines which will facilitate fauna movement.<br>Measures to rehabilitate:<br>• Rehabilitation of temporary cleared areas as soon as practicable.<br>• Topsoil will be appropriately stored and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be appropriately stored and respread over rehabilitated areas to protect the soil from erosion and provide habitat for fauna. | The dominant On Playa fauna habitat, Salt Lake, is well represented beyond the Development Footprint with 21% of the mapped area potentially impacted. It is expected that this fauna habitat is well represented at a regional scale within adjacent playa systems as it was mapped extending to the east and west beyond the survey area. Most of the aquatic invertebrates collected in March 2017 belong to widespread species, with the ranges of three species potentially known only from Lake Wells known to extend beyond the Proposal area (Bennelongia 2017, 2020). Given the retention of large areas of the playa to the east and west of the Development Envelope, and the maintenance of connectivity of wetland habitat, no significant impacts to wetland fauna habitat are expected as a result of the Proposal.<br><br>The Off Playa fauna habitats are well represented beyond the Proposal footprint, with the majority of clearing to occur in Sand dunes (7% of the mapped habitat) and Mulga woodland (1.6% of mapped habitat).<br><br>The proposed clearing will result in a total cumulative loss of no more than 21% of the local mapped extent of a fauna habitat, with all impacted communities expected to be regionally widespread.<br><br>The potential for habitat fragmentation is most likely to occur where there is limited extent of a fauna habitat supporting a population of breeding fauna species or where a particular species is limited to that specific habitat. Fauna habitats in the Development Envelopes are well represented locally and regionally and do not support species that are restricted.<br><br>The extent of the mapped Short Range Endemic (SRE) habitats and species life histories suggests that all species are likely to have ranges extending beyond the Proposal area, making it unlikely that the conservation status of any of the species will be adversely impacted by the Proposal.<br><br>Based on the above, it is considered the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Impacts to conservation significant fauna species | Measures to avoid:<br>• Alignment of proposed access road within Development Envelope as far from Great Desert Skink and Mulgara burrows as possible.<br>• Daylight-only vehicle movements along access road.<br>• Borefield pipelines laid on surface to avoid trenches and potential fauna entrapment.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Ground disturbance procedures and a permitting system will be implemented.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• Vehicle crossing points established at regular intervals along borefield pipelines which will facilitate fauna movement.<br><br>Measures to rehabilitate:<br>• Rehabilitation of temporary cleared areas as soon as practicable.<br>• Topsoil will be appropriately stored and respread over rehabilitated areas to act as a seed source.<br>• Cleared vegetation will be appropriately stored and respread over rehabilitated areas to protect the soil from erosion and provide habitat for fauna.<br>• Vertebrate fauna injuries and/or deaths will be reported, and a register maintained. | Known Great Desert Skink burrows are located outside of the infrastructure footprint and will not be directly impacted through clearing or mining activities. Clearing of 97.6 ha of Sandplain habitat, within which the species was recorded, represents only 0.5% of the mapped Sandplain habitat. Risks to the Great Desert Skink from vehicle strike are considered low given the crepuscular to nocturnal nature of the Great Desert Skink and restriction of truck movements along the access road to daylight hours, and given the low number of truck movements (8 per day) along the access road.<br><br>Surveys failed to detect the Night Parrot although potential habitat was recorded. It is concluded that the likelihood of the species being present is low given the poor condition of the potential habitat.<br><br>No known Mulgara burrows will be directly impacted by the Proposal. Impacts to habitat (Sandplain and Mulga Woodlands), will be minor in relation to the mapped extents (0.5% and 1.6% respectively). Several burrows/tracks/scats were recorded in proximity to the proposed access road. Significant impacts from vehicle strike are not expected given the nocturnal nature of the species means it forages at night when vehicle movements along the access road will not occur, and given the low number of daily truck movements (8 per day).<br><br>The Long-tailed Dunnart was recorded on Rocky Hills within the Off Playa Development Envelope. The species potentially also occurs on Stony Plains habitat within the Proposal area and may disperse through adjacent habitats. Impacts to Rocky Hills habitat will be minor (0.2% of the total mapped area). The Long-tailed Dunnart is known to occur throughout the Gibson Desert, southern areas of the Carnarvon Basin, the Pilbara and areas of the Northern Territory.<br><br>The On Playa Development Envelope is not a significant habitat area for migratory birds. The majority of other migratory bird species potentially occurring within the area have not been recorded within 100 km of the Development Envelope.<br><br>Based on the above, it is considered the biological diversity and ecological integrity of terrestrial fauna will be able to be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | Monitoring<br>Six-monthly assessment, following Proposal implementation, of the mapped populations of the Great Desert Skink (Liopholis kintorei), including:<br>• Count and inspection of known burrows.<br>• Opportunistic searches of surrounding suitable habitat for additional, unmapped, burrows.<br>• Observations for signs of any Proposal-related impacts to known burrows.<br>• Observations for signs of other actual or potential impacts (grazing, fire, land clearing, vehicle strike).<br>Any decline in any monitored population, if outside of the baseline variation and attributable or potentially attributable to the Proposal, will be reported to the EPA, the potential causes investigated and appropriate management measures implemented, in consultation with the EPA. |
| Loss and reduction in connectivity of wetland fauna habitat due to construction of ponds in playa depressions (On Playa) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Suitable floodways drains and culverts will be installed to maintain, as much as possible, natural flow patterns outside of the ponds.<br>• Project design has considered the local surface water flow paths and location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• NA | There is currently poor connectivity between many of the depressions within the playa, with dunes separating each pond. Given the limited flows between the playa depressions, except during or following larger flood events, and the limited interference with surface water flows as a result of the Proposal, significant impacts to aquatic fauna habitats beyond the Evaporation Pond footprint are not expected.<br><br>The Playa within the Development Envelope, including within the Proposal footprint, has not been found to provide important habitat for a significant fauna species, or support a species or assemblage not occurring elsewhere. Most of the aquatic invertebrates collected during baseline studies belong to widespread species, with the three species initially considered to potentially be range restricted recorded outside of the Development Envelopes and/or regionally. The 55 diatom species collected in the Lake Wells system also appear to represent a relatively rich assemblage for an inland saline Playa system, but all species are likely to be widespread (Bennelongia 2017).<br><br>Given the retention of large areas of the playa to the east and west of the Development Envelope, and the maintenance of connectivity of wetland habitat outside of the Proposal footprint, no significant impacts to wetland fauna habitat are expected as a result of the Proposal. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | No significant loss or reduction in connectivity of wetland fauna habitat is expected as a result of the Proposal and the biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Loss and degradation of fauna habitats as a result of interference with On Playa surface water flows (On Playa) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns outside of the ponds.<br>• Project design has considered the local surface water flow paths and location of drainage lines with the aim of minimising changes to natural flows.<br>Measures to rehabilitate:<br>• NA | There is currently poor connectivity between many of the depressions within the playa, with dunes separating each pond. Given the limited flows between the playa depressions, except during or following larger flood events, and the limited interference with surface water flows as a result of the Proposal, significant impacts to aquatic fauna habitats beyond the Evaporation Pond footprint are not expected.<br><br>The invertebrate faunal assemblage within the On Playa Development Envelope was neither species rich nor abundant when compared to the assemblage recorded at locations outside of the Development Envelope.<br><br>Surface water flows throughout the playa will not be significantly affected as a result of the Proposal. Flood flows will continue to cross the playa system, moving west to east, adjacent to the Evaporation Ponds and Harvest Ponds, thus maintaining fauna habitat.<br><br>The biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Death of fauna within the On Playa ponds due to bogging (On Playa) | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | The hypersaline On Playa environment provides limited habitat for both vertebrate and invertebrate fauna. The water within the ponds will be hypersaline and therefore will unlikely to be utilised by fauna as a water source. Lake Wells is not known to support significant numbers of shorebirds or other vertebrates.<br><br>Based on the above, the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Degradation of fauna habitat through indirect impacts (i.e. weeds and fire) (On and Off Playa) | Measures to avoid:<br>• Evaporation Ponds located On Playa to reduce risk of direct and indirect impacts to fauna habitat.<br>Measures to minimise:<br>• Suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns.<br>• Project design has considered the local surface water flow paths and location of drainage lines with the aim of minimising changes to natural flows.<br>• Vehicle movement restricted to daylight hours only.<br>• Water will be applied for dust suppression during construction.<br>• Earth moving machinery will be clean of soil and vegetation prior to entering the Development Envelope.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelope.<br>• A weed hygiene system will be developed and implemented during the construction phase to avoid the establishment of new populations within the Development Envelope.<br>• Treatment of access roads with MgCl solution during operations, as required, to control dust emissions.<br>• Firefighting equipment will be located on site and in project vehicles.<br>• Project personnel will be trained in fire response.<br>• A Hot Work Permit system will be developed and implemented.<br>Measures to rehabilitate:<br>• NA | Given the monitoring and controls in place to prevent seepage or leaks of brine from the ponds or borefield pipelines, a significant impact to fauna habitat is not expected.<br><br>Management of dust and the introduction and spread of weeds is likely to prevent impacts to fauna habitat.<br><br>The provision of firefighting equipment and implementation of a hot work permit system will reduce the risk of impacts from accidental fires.<br><br>Implementation of the management measures will ensure that the biological diversity and ecological integrity of terrestrial fauna will be maintained. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Potential increase in feral animals resulting in increased predation and competition (Off Playa) | Measures to avoid:<br>• Containment or fencing of freshwater storages and potential food sources.<br>Measures to minimise:<br>• Fencing of landfill site and regular covering of waste.<br>• Targeted feral animal control programs.<br>Measures to rehabilitate:<br>• NA | Containment or fencing of freshwater storages and potential food sources will limit the potential for an increase in feral animals within the area. Targeted feral animals control programs will be implemented if feral animal numbers within the Development Envelope increase as a result of the Proposal.<br><br>The biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Fauna mortality from vehicle strikes (Off Playa) | Measures to avoid:<br>• Access Road alignment chosen to maximise distance from Great Desert Skink and Mulgara burrows.<br>Measures to minimise:<br>• Land disturbance will be kept to the minimum necessary for development of the Proposal.<br>• Where practicable, land clearing will be undertaken progressively with the amount of active disturbance minimised.<br>• Vehicles undertaking land clearing will be slow moving and operate during daylight hours only.<br>• Vehicle traffic will be confined to defined roads and tracks (except during active clearing).<br>• Speed limits will be implemented and enforced to minimise fauna mortality due to vehicle strike.<br>• The site induction program will provide information on fauna of conservation significance, including their appearance and habitats.<br>Measures to rehabilitate:<br>• NA | Given the measures proposed for the construction phase, and relatively small number of operational vehicle movements, to occur during daylight hours only, a significant impact on the biological diversity and ecological integrity of terrestrial fauna is not expected. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Light and noise impacts on fauna due to 24 hour operations (Off Playa) | Measures to avoid:<br>• Vehicles movements along the access road will occur during daylight hours only.<br>Measures to minimise:<br>• Directional/timed lighting.<br>• Minimal lighting needed for safe operations.<br>• Processing Plant enclosed to reduce noise emissions.<br>• Regular maintenance of fixed and mobile plant.<br>Measures to rehabilitate:<br>• NA | Light spill will be limited to the immediate proximity of the accommodation village and processing plant. Noise will predominantly be limited to that from the processing plant (enclosed), pumps and vehicles. Vehicle movements at night will be infrequent or rare.<br><br>Significant impacts to fauna within the local area are not expected. The biological diversity and ecological integrity of terrestrial fauna will be maintained. |
| Subterranean Fauna | | |
| Loss of Stygofauna Habitat or Species due to Groundwater Abstraction | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Minimise water abstraction through storage and re-use where possible.<br>• Monitoring of groundwater levels and management of abstraction between bores to minimise localised drawdown.<br>Measures to rehabilitate:<br>• NA. | The moderately large linear ranges of a number of recorded stygofauna species and geologic interpretation provide evidence of habitat connectivity throughout basement fractured rock aquifer within and around the Off Playa Development Envelope.<br><br>The distribution of surrogates for the potentially restricted species suggests that brine and/or Process/Potable water abstraction would be unlikely to result in loss of a species.<br><br>A significant impact on stygofauna, leading to a total loss of habitat for a species, is not expected. The EPA objective for Subterranean Fauna will be met.<br><br><u>Monitoring</u><br>Regular monitoring of groundwater levels and quality in accordance with the groundwater monitoring strategy (Appendix 4). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Contamination of Groundwater Resulting in loss of Habitat | Measures to avoid:<br>• Hazardous materials will be stored, in or adjacent to the fabrication shed, in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures to prevent leaks or spills.<br>Measures to minimise:<br>• Refuelling to occur on concrete or HDPE lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Employees and contractors will be trained in use of spill kits.<br>• Spills will be cleaned up and contaminated soils will be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Remediation and rehabilitation of any contaminated areas. | Considering the application of standard industry practices for chemical storage and handling, the risk of impacts to subterranean fauna is considered low.<br>The quality of groundwater will be maintained and the EPA objective for Subterranean Fauna will be met. |
| Inland Waters | | |
| Potential direct and indirect impacts to Groundwater Dependent Ecosystems and riparian vegetation | Addressed under Flora and Vegetation. | |
| Changes to Local Surface Water Drainage Patterns and Water Quality | Measures to avoid:<br>• Suitable floodways, drains and culverts will be installed to maintain, as much as possible, natural flow patterns across the playa around the evaporation ponds and in the Off Playa area.<br>• Pipelines in the Off Playa area will be buried when crossing watercourses to prevent impediment of flow.<br>• Sufficient freeboard will be maintained in Harvest Ponds and water storages to allow capture of rainfall from a 0.01 AEP (72 hour) event.<br>• The WWTP has been designed and located consistent with regulatory requirements relevant to the protection of water quality. | *On Playa*<br>After installation of surface water drainage measures, surface water flow patterns to the east and west of the evaporation ponds are expected to remain similar to baseline flow patterns, and changes to flow velocities are not expected to alter the natural scour or sedimentation characteristics of the catchment.<br>Significant impacts to surface water quality are not expected as no ASS will be disturbed, and brine will remain within the evaporation ponds.<br>Off Playa<br>After installation of surface water drainage measures, surface water flow patterns are expected to remain similar to baseline flow patterns, and changes to flow |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | • Treatment of greywater will be provided by an advanced system (such as a Wise Water system) to ensure a high recovery of nutrients.<br>• Location of WWTP sprayfield chosen to avoid defined drainage channels.<br>• Hazardous materials will be stored in accordance with relevant Australian Standards and Dangerous Goods Storage regulations.<br>• Chemical storage and handling procedures will be used to prevent leaks or spills.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines with the aim of minimising changes to natural flows.<br>• Evaporation ponds to be appropriately constructed to prevent lateral movement of brine through pond walls.<br>• Evaporation ponds to be appropriately designed to contain rainfall without overflow.<br>• All blackwater will be tankered offsite.<br>• WWTP spray field appropriately sized to promote nutrient update by vegetation and soil.<br>• Refuelling of light vehicles to occur on concrete or HDPE lined pads to contain any drips and spills. The pads will drain to a sump to allow removal of collected material.<br>• Spill kits will be located at strategic locations throughout the project area and employees trained in their use.<br>• Spills will be cleaned up and contaminated soils will either be treated in situ or be removed from site by a licensed third party.<br>Measures to rehabilitate:<br>• Upon closure the reinstatement of the natural flow paths after removal of Proposal infrastructure.<br>• Final post-closure landform of evaporation ponds will adopt a water holding design to promote infiltration of rainwater through the pond to the host aquifer.<br>• Remediation and rehabilitation of any contaminated areas. | velocities are not expected to alter the natural scour or sedimentation characteristics of the catchment.<br>No significant impact to surface water quality is expected as a result of the discharge of treated wastewater.<br>Considering the ephemeral nature of watercourses, infrequency of flows, application of standard industry practices for chemical storage and handling and the low volumes required given the nature of the proposed operations, the risk of contamination of surface water by hydrocarbons and chemicals is considered low.<br>The hydrological regimes in both On and Off Playa environments will be maintained after implementation of the Proposal so that environmental values are protected consistent with the EPA objective for Inland Waters. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Changes to Groundwater Volumes and Quality Due to Brine Abstraction and Process/Potable Water Abstraction | Measures to avoid:<br>• No disturbance of ASS as low risk of occurrence.<br>Measures to minimise:<br>• Minimise Process/Potable water abstraction through the storage and re-use of water (where possible).<br>• Monitoring bores will be established to assess groundwater drawdown within the basement fractured rock aquifer.<br>• In the event of a significant increase in salinity of the groundwater within the Process/Potable water bores, abstraction from affected bore(s) will be ceased (monitoring and thresholds as presented within the groundwater monitoring strategy (Appendix 4).<br><br>Measures to rehabilitate:<br>• In the event of impact to the quantity or quality of groundwater available for pastoral use, APC will ensure that an alternative supply for pastoral uses is provided to the Lake Wells Station. | <u>On Playa</u><br>The hydrological regimes will be maintained after implementation of the Proposal so that environmental values are protected consistent with the EPA objective for Inland Waters.<br><br>Considering the absence of chemical storage and handling within the On Playa area, the risk of contamination of groundwater is considered low. No significant changes in groundwater quality are expected.<br><br><u>Off Playa</u><br>Abstraction of Process/Potable water from the basement fractured rock aquifer has the potential to lead to localised drawdown. Given the expected connectivity within the aquifer over significant distances, extending outside of the region of groundwater abstraction, significant impacts at any single bore are not expected. Groundwater levels and quality will be monitored and any changes in quality (for example an increase in salinity in the event of a direct connection to the palaeovalley aquifer) will result in the implementation of a management response, as outlined in the groundwater monitoring strategy (Appendix 4).<br><br>A predicted drawdown of 1 m, associated with brine abstraction, occurs at the Golden, Lake Wells and Gibsons pastoral bores after approximately 15, 21 and 27 years of brine abstraction (respectively), with maximum drawdowns of 3.2 m, 1.9 m and 1.2 m predicted after 30 years, but no changes in water quality are anticipated. The predicted drawdown at the Far East bore is predicted to reach 1 m after approximately 4 years and approximately 16 m after 30 years, and the salinity is likely to be affected.<br><br>Although groundwater abstraction in the Off Playa (fractured rock aquifer) has the potential to result in changes in water levels as well as changes in chemistry associated with brine ingress from the adjacent palaeovalley, any changes will be mitigated as outlined in the groundwater monitoring strategy (Appendix 4).<br>No significant changes in water quality are expected within the basement fractured rock aquifer.<br><br><u>Monitoring</u><br>Regular monitoring of groundwater levels and quality in accordance with the groundwater monitoring strategy (Appendix 4). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Social Surrounds | | |
| Clearing of or alterations to sites of cultural significance | Measures to avoid:<br>• Project has been designed to avoid Aboriginal sites of cultural significance.<br>Measures to minimise:<br>• The site induction program will provide written and verbal information on cultural and heritage awareness.<br>• If artefacts are located, all work will be stopped until appropriate assessment has been completed and approval to remove/disturb is obtained.<br>• Providing Culture Awareness training to workforce.<br>Measures to rehabilitate:<br>• NA | Given that no sites or cultural places of significance were identified within the Development Envelopes, significant impacts to Aboriginal Heritage are not expected.<br><br>The proposed management measures will ensure the EPA Objective for Social Surrounds will be met. |
| Prevention or change to access to a site of cultural significance | Measures to avoid:<br>• Project has been designed to avoid Aboriginal sites of cultural significance.<br>Measures to minimise:<br>• NA<br>Measures to rehabilitate:<br>• NA | Given that the Development Envelope does not contain any culturally significant sites, and that access to sites to the north will be maintained, impacts will be minimal. The EPA objective for Social Surrounds will be met. |

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# APPENDICES

# 1. INTRODUCTION

## 1.1 PURPOSE AND SCOPE OF THIS ERD

This Environmental Review Document (ERD) has been prepared for the Lake Wells Sulphate of Potash Project (the Proposal), owned by Australian Potash Limited (APC). The Proposal is for a greenfields Sulphate of Potash (SOP) development located approximately 180 km north northeast of Laverton in the north eastern Goldfields Region of Western Australia (
Figure 1).

The Proposal consists of development of a brine production borefield within the Lake Wells palaeochannel, solar evaporation ponds, harvest ponds, bitterns ponds, SOP processing plant and Process/Potable water borefield. The Proposal was referred to the Western Australian Environmental Protection Authority (EPA) on 21 December 2017. On 5 February 2018, the level of assessment was set as Environmental Review - no public review.

An environmental scoping document (ESD) was prepared by APC to define the form, content, timing and procedure of the Environmental Review Document (this document). This was approved by the EPA on 21 September 2018 (Appendix 1). The ESD outlines the preliminary key environmental factors, potential impacts and risks and required studies for the completion of this ERD.

This ERD has been prepared to fulfil the requirements for assessment of the project at a level of Environmental Review - no public review pursuant to Part IV of the Western Australian *EP Act.* It has been prepared in accordance with the *EP Act Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016*, the Guidelines for Preparing an Environmental Review Document (EPA 2017) and to the requirements of the ESD.

## 1.2 PROPONENT DETAILS

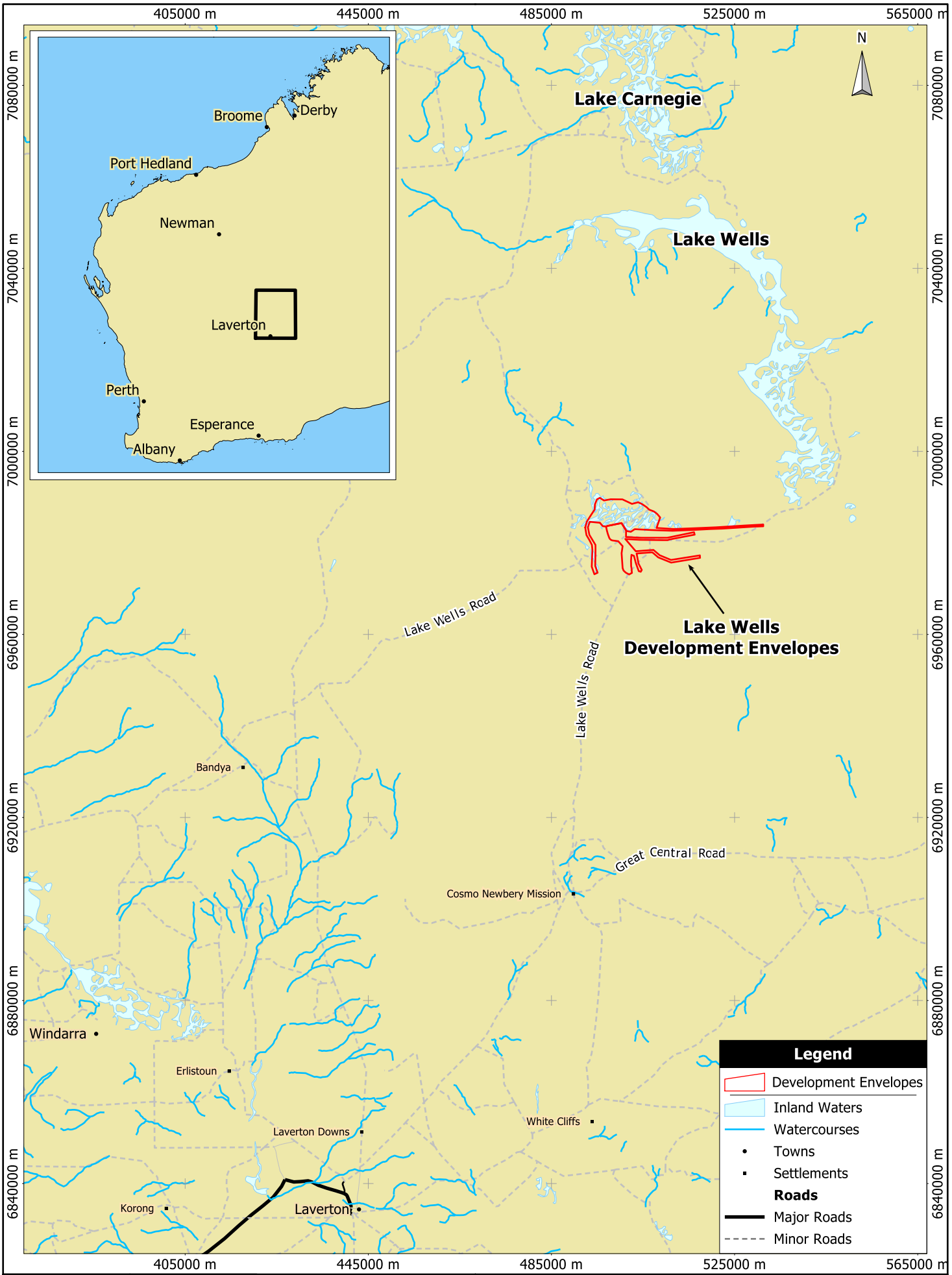
The manager and proponent is APC. APC is a company incorporated in Australia (ABN 58 149 390 394) with shares listed on the ASX (APC).

All compliance and regulatory requirements regarding this assessment document should be forwarded by email, fax, post or courier to the following address:

Name: Stewart McCallion
Company: Australian Potash Ltd
Title: Project Manager

Address: Suite 31, 22 Railway Road
Subiaco, WA 6008

Postal Address: PO Box 180
Subiaco, WA 6904
Phone: (08) 9322 1003
Email: s.mccallion@australianpotash.com.au




Scale: 1:1100000
Original Size: A4
Grid: MGA94(51)

0 40 km

Australian Potash
Lake Wells
Environmental Review Document

**Figure 1**

**Location Plan**

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West Perth WA 6005
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info@mbsenvironmental.com.au
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MBS ENVIRONMENTAL

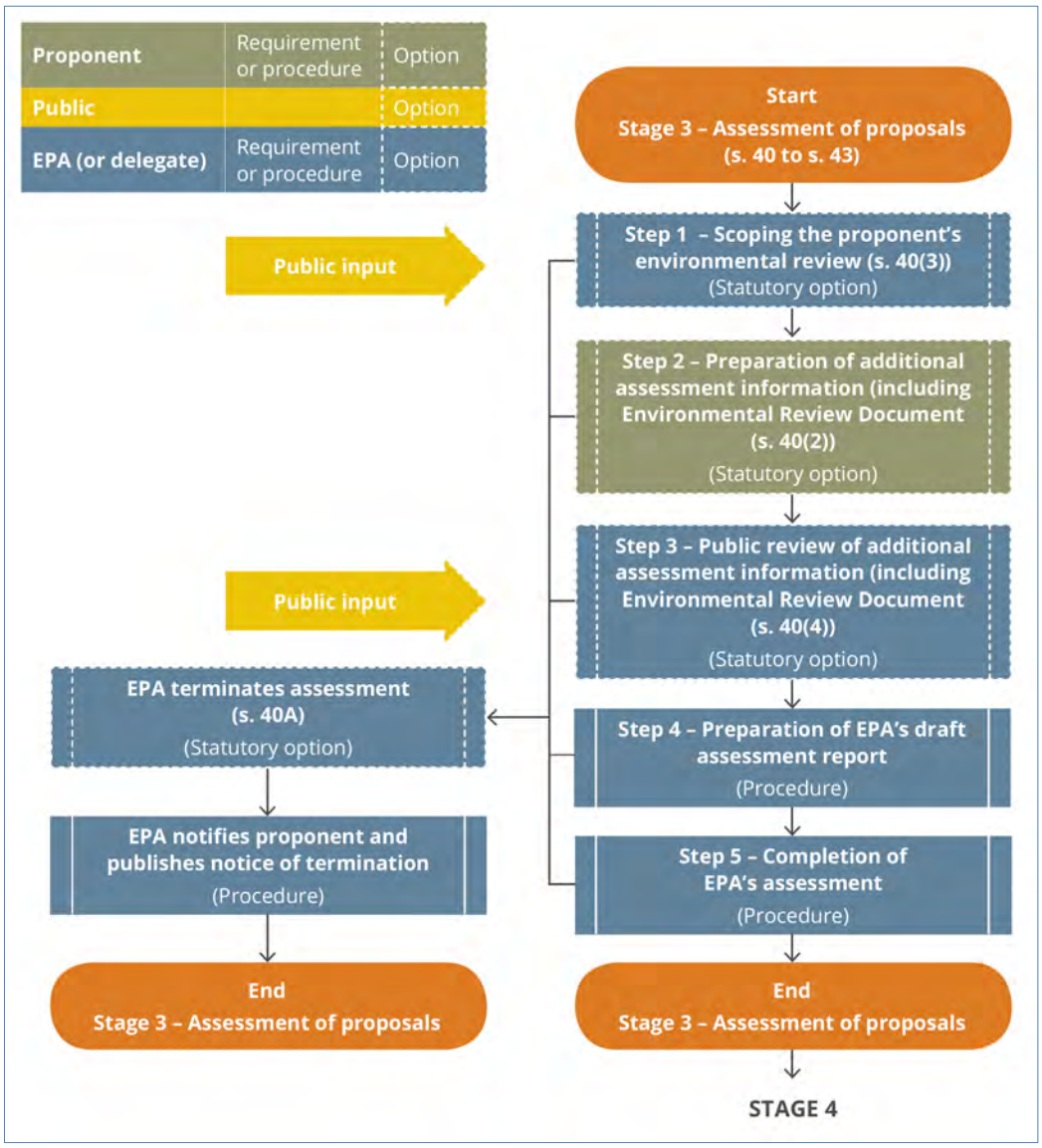
## 1.3 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The *EP Act* is the primary legislation governing environmental protection and impact assessment in the State. Approvals can be required under two parts of the Act: Part IV and Part V. Projects with potential to significantly impact on the environment, or of sufficient public interest, are assessed under Part IV. Facilities that may constitute a 'Prescribed Premises' (as listed under Schedule 1 of the *Environmental Protection Regulations 1987*) require approval under Part V.

Procedural requirements for environmental assessment prescribed under the *EP Act* are set out in the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a).

Following the EPA determination that the Proposal required formal assessment, the formal assessment process needs to be completed (refer Figure 2). Following preparation of the ERD (this document) (Step 2 in Figure 2), the EPA will complete the assessment of the Proposal (Step 4 in Figure 2), consider advice obtained from any other persons it considers appropriate, and then submit an assessment report (EPA Report) to the WA Minister for Environment.

Figure 2: Flowchart of EPA Assessment Process (EPA 2016a)



APC referred the Proposal to the Western Australian Environmental Protection Authority (EPA) on 21 December 2017 under Section 38 of the *Environmental Protection Act 1986* (EP Act). On 5 February 2018, the level of assessment was set as Environmental Review - no public review. In April 2018 APC submitted a Change to Proposal request under Section 43A of the EP Act, to formalise a significant reduction in the size of the Development Envelopes. This Change to Proposal was approved on 16 May 2018. An Environmental Scoping Document (ESD) was prepared by APC (2018) to define the form, content, timing and procedure of the Environmental Review Document (ERD) (this document). The ESD was approved on 21 September 2018 (Appendix 1).

The key piece of legislation for environmental protection at the Federal level is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act is a legislative tool used by the Federal Department of the Environment and Energy (DoEE) to protect Matters of National Environment Significance (MNES). Under the Act, actions that are likely to have a significant impact on a matter of national environment significance (MNES) require approval from the Australian Government Minister for the Environment, where it will then be decided whether assessment and approval is required.

MNES include:

- Listed threatened ecological communities (TECs) and species.
- Listed migratory species.
- Ramsar wetlands of international importance.
- Commonwealth marine environment.
- World heritage properties.
- National heritage places.
- The Great Barrier Reef Marine Park (GBRMP).
- Nuclear actions.
- A water resource; in relation to coal seam gas development and large coal mining development.

No TECs, Ramsar sites, world heritage properties, national heritage places or relevant water resources occur in proximity to the Development Envelopes and no impacts to the commonwealth marine environment or the GBRMP will occur. The Proposal does not involve a nuclear action. Listed threatened species and listed migratory species recorded within or adjacent to the Development Envelope are limited to the Great Desert Skink (*Liopholis kintorei*) (Vulnerable) and the Marsh Sandpiper (*Tringa stagnatilis*) (Migratory). A significant impact on these species is not expected and therefore the Proposal has not been referred to the DoEE under the EPBC Act.

## 1.4 OTHER APPROVALS

In addition to the assessment of the Proposal under Part IV of the *EP Act*, a range of other environmental assessments and authorisations will be required before the Proposal can be implemented. The main additional consents/approvals that will be required are summarised in Table 1 and are described in the following subsections.

Table 1: Other Environmental Approvals for the Proposal

| Proposed Activity | Land tenure/access | Approval Required | Legislation (Regulatory Body) |
|---|---|---|---|
| Ground disturbance for mining, processing and related support infrastructure | Mining Tenure | Grant of tenure | *Mining Act 1978 (*DMIRS) |
| Mining, processing and ancillary activities | Mining Tenure | Environmental approval via Mining Proposal and Mine Closure Plan | |
| Mining and processing | Mining Tenure | Approval to operate via project management plan | *Mines Safety and Inspection Act 1994 (*DMIRS) |
| Mine rehabilitation | Mining Tenure | Annual payment of Mining Rehabilitation Fund levy | *Mining Rehabilitation Fund Act 2012* (DMIRS) |
| Construction of water production bores | Mining Lease<br>Miscellaneous Licence | 26D licence | *Rights in Water & Irrigation (RIWI) Act 1914 (*DWER) |
| Process/Potable water and brine abstraction | Mining Lease<br>Miscellaneous Licence | 5C licence | |
| Potash production by solar evaporation; non-metallic mineral processing | Mining Tenure | Works Approval and Environmental Licence | *Environmental Protection Act 1986 – Part V (*DWER) |
| Support activities (septic waste treatment, power generation, operation of landfill) | Mining Tenure | Works Approval and Environmental Licence or registration | |
| Construction and use of accommodation village and associated waste treatment and management facilities | Mining Tenure | Planning consent, building approvals, | *Planning and Development Act 2005* (Shire of Laverton)<br>*Health Act 1911* (Shire of Laverton) |

### 1.4.1 EP Act Part V - Environmental Regulation

Under Part V of the *EP Act,* Works Approvals and Environmental Licences are required for a range of activities prescribed within Schedule 1 of the Act. Works Approvals and Environmental Licences are administered by the Department of Water and Environment Regulation (DWER) to allow construction and operation of key infrastructure (respectively) including brine abstraction and processing, water transfer infrastructure, water holding dams, power generation facilities, and waste treatment and disposal facilities (landfill and sewage treatment plants).

A Works Approval and an Environmental Licence and will be required for the construction and operation of the Proposal respectively. Activities expected to be regulated under Part V of the EP Act include solar salt manufacture (Category 14), electric power generation (Category 84 if >10 MW), sewage facility (Category 85 if >20 $m^3$/d), landfill (Category 89 if >20 tonnes/yr).

### 1.4.2 Mining Act

The Department of Mines, Industry Regulation and Safety (DMIRS) (formerly the DMP) is the lead government agency with regards to approvals for mining operations in Western Australia. The *Mining Act 1978* requires that, to

conduct mining activities (as defined under the Act); a Mining Proposal is to be submitted to DMIRS, who assess and assign environmental conditions to the project if it is to be approved.

Mining Proposals are also required to include a Mine Closure Plan (MCP) compliant with the joint DMP/EPA Guidelines for Preparing Mine Closure Plans (May 2015). This is assessed as part of the Mining Proposal assessment process and reviewed every three years. Mining Proposals can only be approved where Mining Lease, General Purpose Lease and or Miscellaneous Licence tenements have been granted.

A small Operations Mining Proposal, to allow an On Playa Trial Evaporation Pond, was submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) in February 2019.

## 1.5 STRUCTURE OF THIS ERD

A description of the Proposal is provided in Section 2.

Stakeholder Engagement is described in Section 3. Stakeholders are identified, the processes of engagement described, and the outcomes of the engagement documented including how the issues raised have been addressed.

Section 4 provides information on how the EP Act principles have been addressed by the Proposal.

The environmental impact assessment has been divided into sections relating to each of the preliminary key environmental factors, as follows:

- Flora and Vegetation (Section 5.1).
- Terrestrial Fauna (Section 5.2)
- Inland Waters (Section 5.3).
- Subterranean Fauna (Section 5.4).
- Social Surrounds (Section 5.5).

For each of the impact assessment sections, a standard structure has been used to describe the factor, its value, potential impacts, mitigation and predicted outcome, as follows:

- EPA Objective (statement of the EPA's objective for each factor).
- Policy and Guidance (provides an overview of relevant policy and guidance and how this has been taken into account in the design of the Proposal and/or the completion of technical studies and environmental impact assessment).
- Receiving Environment (provides an overview of studies undertaken and a description of the existing environment).
- Potential Impacts (provides an overview of the potential impacts to the factor as a result of the Proposal).
- Assessment of Impacts (discusses in detail the potential environmental impacts and their significance within the context of the knowledge provided by the studies undertaken).
- Mitigation and Predicted Outcome (provides a high-level discussion of the proposed approach to avoiding and managing its impacts and, taking into account the proposed mitigation, a summary of the predicted outcome for the environmental factor within the context of the relevant objective(s)). Monitoring to demonstrate that residual impacts are not greater than predicted will also be described.

The following overarching sections are then provided:

- Offsets (Section 6).
- Holistic Impact Assessment (Section 7).

# 2. THE PROPOSAL

## 2.1 PROPOSAL OVERVIEW

The Proposal consists of development of a brine production borefield within the Lake Wells palaeochannel, solar evaporation ponds, harvest ponds, bitterns ponds, an SOP processing plant and Process/Potable water supply borefield.

The Proposal occupies an area of palaeovalley and salt lake (or 'playa') terrain in the north east part of the Yilgarn Craton of Western Australia. APC aims to develop a SOP operation by evaporation and processing of the potassium and sulphate rich brines found at Lake Wells. The Proposal includes development of a 150,000 tonnes per annum (tpa) SOP processing plant, 78 brine abstraction bores and associated brine transfer network, evaporation ponds, Process/Potable water supply borefield, accommodation village and other associated site infrastructure. Key characteristics of the Proposal are detailed in Section 2.3.

## 2.2 PROPOSAL LOCATION AND TENURE

The site is located approximately 160 km north northeast of Laverton, in the north eastern Goldfields region of Western Australia (Figure 1). Access to the Proposal will be via Laverton along the Great Central Road (about 80 km) and then via Lake Wells Road to a new site access road (Figure 4). Minor upgrades will be required for the 85 km section of the Lake Wells Road proposed to be used. Lake Wells Road is owned, managed and maintained by the Shire of Laverton. APC has held meetings with the Shire and will enter into a road maintenance agreement with the Shire prior to commencement of construction.

APC currently holds Mining Leases M38/1274, M38/1275 and M38/1276 as summarised in Table 2. Additional Mining Leases and Miscellaneous Licences will be sought for additional areas of the Development Envelopes.

Table 2: APC Project Tenement Summary

| Tenement | Area (ha) | Grant Date | Expiry Date |
|---|---|---|---|
| M38/1274 | 13,366.4 | 11/09/2018 | 10/09/2039 |
| M38/1275 | 8,771.9 | 11/09/2018 | 10/09/2039 |
| M38/1276 | 6,188.3 | 11/09/2018 | 10/09/2039 |

Unallocated Crown Land (UCL) and the Lake Wells Pastoral Lease (PL NO50056), an operating cattle station in the Mount Margaret mineral field, underlie the Proposal.

In July 2018, the Waturta people lodged a Native Title claim (WC2018/012) over a wide area, including the Proposal area. This claim was registered on 17 August 2018 and is under assessment.

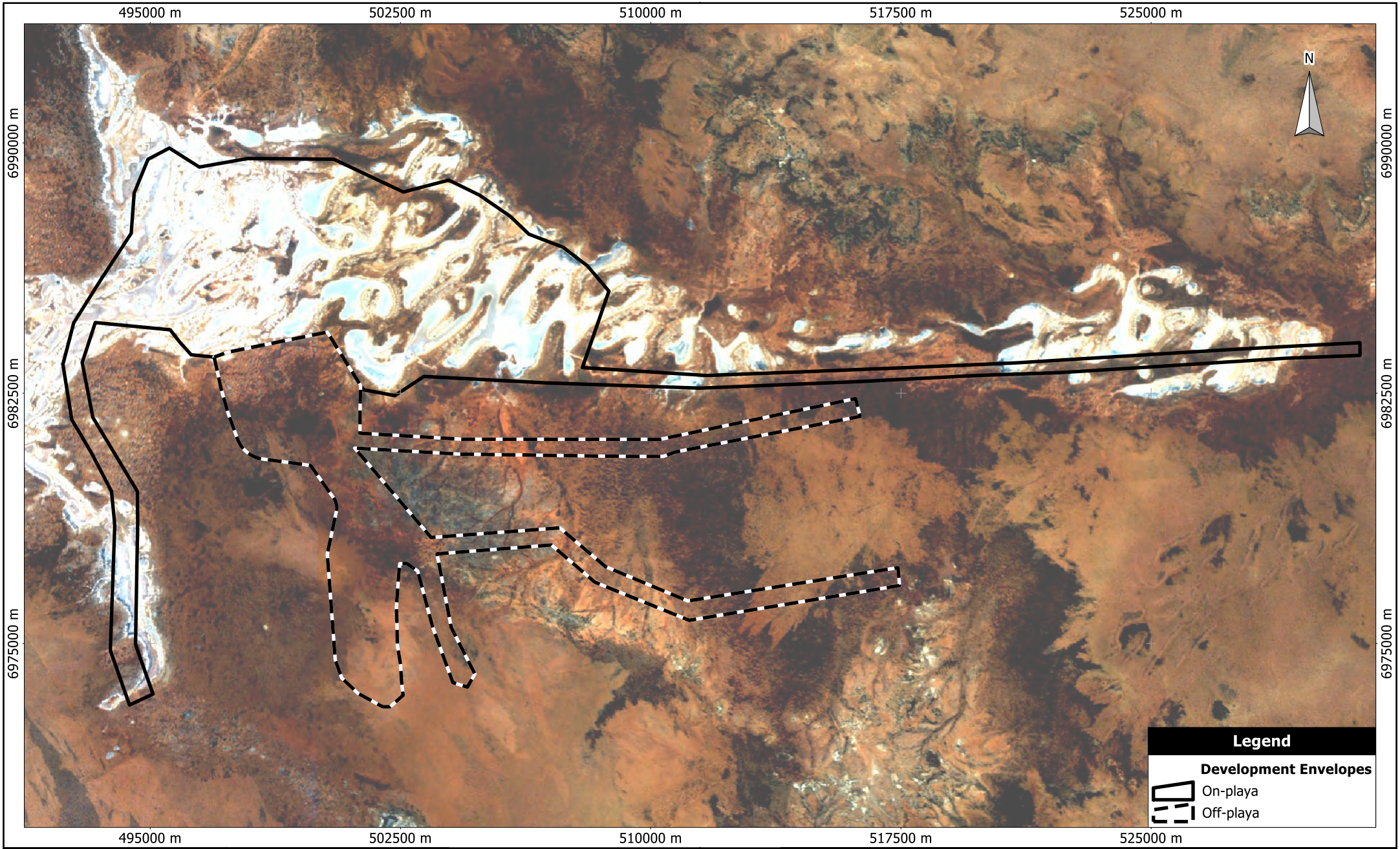
## 2.3 KEY PROPOSAL CHARACTERISTICS

Key Proposal characteristics are shown in Table 3. Two Development Envelope areas totalling 13,951 ha have been defined (Figure 3). These reflect the different environments between the On and Off Playa[2] areas associated with the Proposal. A previously nominated 'Fractured Borefield North' area has been removed from the Off Playa Development Envelope. A conceptual Proposal Footprint is presented in Figure 4.

[2] Playas are found in interior desert basins within arid to semiarid regions. They are described as flat bottomed depressions which are periodically covered by water that slowly infiltrates into the groundwater system or evaporates into the atmosphere causing the deposition of salt, sand and mud along the bottom and around the edges of the depression.

Table 3: Key Proposal Characteristics

| Summary | | |
|---|---|---|
| Proposal Title | Lake Wells Sulphate of Potash Project | |
| Proponent Name | Australian Potash Ltd (APC) | |
| Short Description | APC aims to develop a Sulphate of Potash (SOP) operation by evaporation and processing of the potassium and sulphate rich brines found at Lake Wells.<br>The project involves the development of a 150,000 tonne per annum (tpa) SOP processing plant, brine abstraction bores and associated brine transfer network, evaporation ponds, accommodation village, Process/Potable water borefield and associated site infrastructure. | |
| **Physical Elements** | | |
| **Element** | **Location** | **Proposed Extent Authorised** |
| **On Playa Development Envelope** | | |
| Bitterns Pond | Figure 4 | Clearing no more than 30 ha within the 9,322 ha On Playa Development Envelope. |
| Concentrator and Crystalliser Ponds and Brine Borefield/On Playa Infrastructure | Figure 4 | Clearing no more than 2,440 ha within the 9,322 ha On Playa Development Envelope. |
| **Off Playa Development Envelope** | | |
| Project Infrastructure | Figure 4 | Clearing no more than 150 ha within the 4,629 ha Off Playa Development Envelope. |
| Process/Potable Water Supply Borefield (i.e. Fractured Rock Borefield) | Figure 4 | Clearing no more than 90 ha within the 4,629 ha Off Playa Development Envelope. |
| Harvest Ponds and Processing Plant | Figure 4 | Clearing no more than 510 ha within the 4,629 ha Off Playa Development Envelope. |
| **Operational Elements** | | |
| **Element** | **Location** | **Proposed Extent Authorised** |
| **On Playa Development Envelope** | | |
| Waste Salt Residue Stockpiles | Figure 4 | Production of up to 3.0 Mtpa of waste salt |
| Bitterns – magnesium chloride | Figure 4 | Production of up to 1.0 Mtpa of bitterns brine |
| Brine Abstraction | Figure 4 | Abstraction of up 17 Gigalitres per annum (GLpa) |
| **Off Playa Development Envelope** | | |
| Process/Potable Water Abstraction | Figure 4 | Abstraction of up 0.8 GLpa |
| Processing Plant | Figure 4 | 150,000 tpa |
| Power Plant | Figure 4 | 10 MW |

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Aerial Photo Date: March 2016
Grid: Australia MGA94 (51)

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**Figure 3**

**Development Envelopes**

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www.mbsenvironmental.com.au

W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\Location Plan.map 20/03/2020 F3 Development Envelopes Layout

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6990000 m

6980000 m

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**Legend**

**Development Envelopes**
- On-playa
- Off-playa
- Existing Tracks
- Drainage Lines

**Proposed Development Footprint**
- Concentrator and Crystalliser Ponds (including Pond Walls and Borrow Areas)
- Harvest Ponds
- Accommodation Village
- Processing Plant
- Airstrip
- Landfill
- Nominal Topsoil Stockpile Areas
- Access Road and Tracks
- Indicative Construction Camp
- Causeway
- Fractured Borefield South
- Brine Borefield
- Pond Perimeter Track
- Western Borefield Track
- Camp Access Track
- Access Track to West Borefield
- Indicative Borrow Areas
- Drainage Berms

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Air Photo Date: 2016
Grid: MGA94(51)

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**Figure 4**

**Development Envelopes, Indicative Proposal Footprint and Nominal Key Infrastructure Locations**

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MBS ENVIRONMENTAL

# 2.4 PROPOSAL DESCRIPTION

## 2.4.1 Proposed Land Disturbance

Estimated total land disturbance is 3,214 ha of which 2,470 ha (77%) is within the On Playa Development Envelope and 750 ha (23%) is within the Off Playa Development Envelope. Indicative land disturbance for key components of the Proposal for each Development Envelope are shown in Table 4.

Table 4: Estimated Land Disturbance for Key Project Components (ha)

| Project Component | Estimated Disturbance Area |
|---|---|
| On Playa Development Envelope | |
| Bitterns Pond | 30 |
| Brine Borefield (including pipelines, bore pads and access roads) | 30 |
| Concentrator/Crystalliser Ponds (including pond walls, borrow areas & access roads) | 2,410 |
| Sub Total | 2,470 |
| Off Playa Development Envelope | |
| Access Roads and Tracks | 127 |
| Accommodation Village (including sprayfield) | 2.5 |
| Airstrip | 18 |
| Process/Potable Water Supply Borefield | 84 |
| Harvest Ponds | 495 |
| Landfill | 2.5 |
| Processing Plant | 15 |
| Infrastructure (drainage, topsoil stockpiles) | 6 |
| Sub Total | 750 |
| Total | 3,220 |

## 2.4.2 Brine Abstraction

The Lake Wells resource (brine) is contained within a palaeochannel extending the along the length of the On Playa Development Envelope. Additional details on the aquifers are presented in Section 5.3.3.3.

Potassium-rich brine will be pumped to the surface via a network of bores positioned along the centre line of the palaeochannel and transferred by pipeline to the evaporation ponds. Pipelines will consist of HDPE pipe of up to 600 mm diameter, aligned with access tracks, but separated by a safety bund to prevent damage. Based on an assumed weighted average potassium concentration of 3,700 mg/L, the brine borefield will produce approximately 540 L/s on a continuous basis.

## 2.4.3 Concentrator/Crystalliser and Harvest Ponds

Extracted brine will be continually pumped from the brine borefield to ponds where it will be evapo-concentrated to allow recovery of potassium-bearing minerals required to produce SOP. Three types of ponds will be used at Lake Wells:

- Brine pre-concentration and storage ponds (referred to as Concentrator Ponds).
- Sodium Chloride (Halite) deposition ponds (referred to as Crystalliser Ponds).

- Mixed potassium harvest salt deposition ponds (referred to as Harvest Ponds).

Concentrator and Crystalliser Ponds (also collectively termed 'Evaporation Ponds') will be constructed within the playa system within the On Playa Development Envelope and will have a total footprint of approximately 2,410 ha (Figure 5). Harvest Ponds will be constructed within the Off Playa Development Envelope and will have a total footprint of approximately 495 ha (Figure 5).

#### *2.4.3.1 On Playa Concentrator and Crystalliser Ponds*

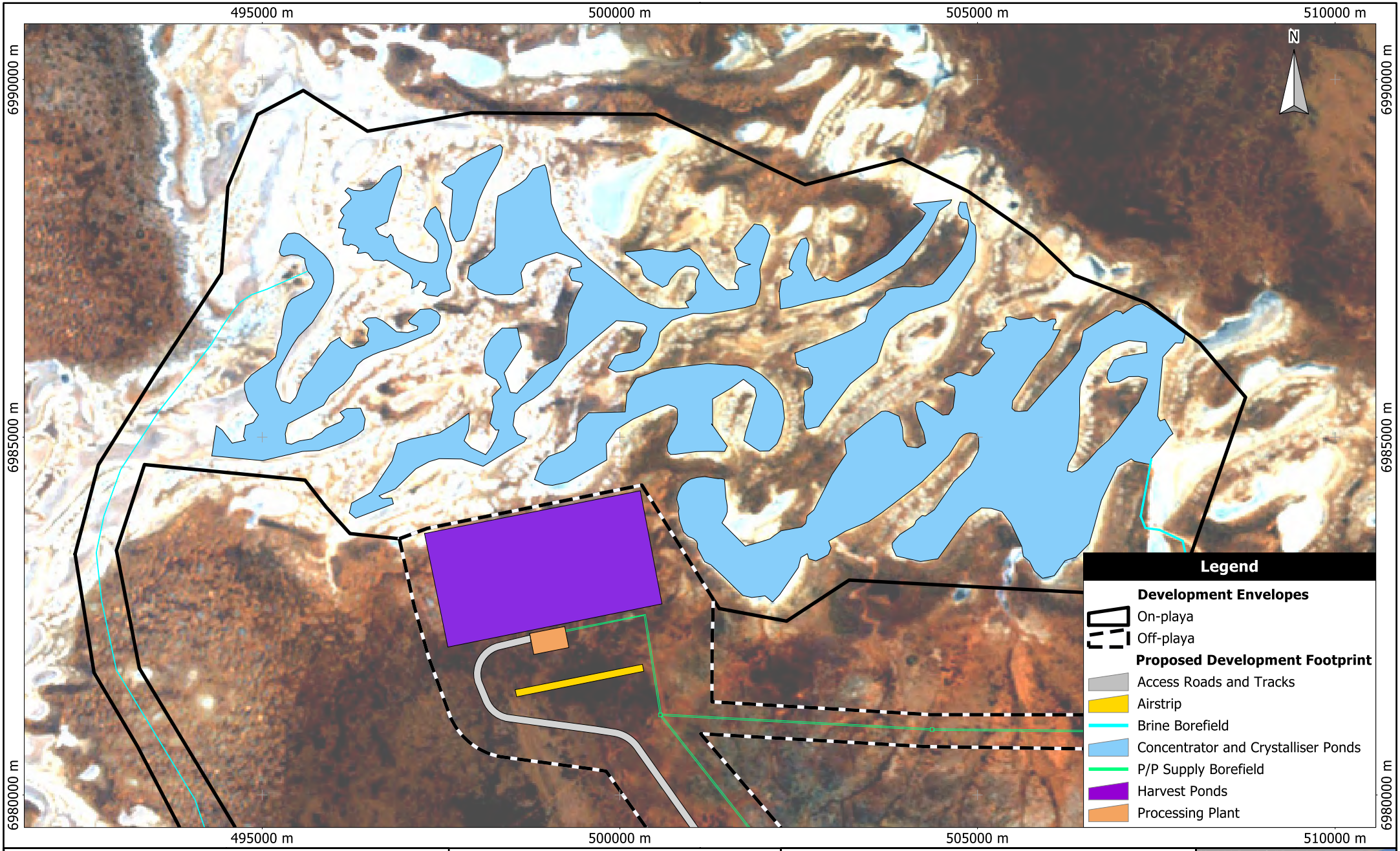
Concentrator Ponds will be used to concentrate the extracted brine up to potassium saturation and also separate the potassium bearing minerals from non-target (gangue) minerals. As water evaporates from brine within the Concentrator Ponds, potassium concentration increases and halite (NaCl) is precipitated along with minor quantities of non-potassium bearing minerals. During winter months, bore production will exceed evaporation rates and Concentrator Ponds will fill to a higher level. Storage levels will drop in summer months when evaporation exceeds bore production.

A key requirement for efficient ponds is that they have a low rate of brine seepage. Preliminary geotechnical assessments undertaken in 2016 (Galt Geotechnical 2016a) aimed to identify areas with suitably low seepage rates. Sites off the playa lake system were initially investigated and found to be unsuitable for unlined ponds due to the high permeability of the underlying soil (Galt Geotechnical 2016a). Subsequently a more comprehensive site investigation was conducted within the playa system in 2017 (Galt Geotechnical 2017). Sufficiently impermeable clays of between 1 m and 2.5 m deep were identified as suitable as a base for the construction of the Concentrator Ponds and Crystalliser Ponds on the playa system.

To prevent the linear seepage of brine beneath the pond walls (formed by natural dunes with occasional berms constructed to provide a continuous barrier), a slurry wall will be installed down to the clay layer at the perimeter of the ponds (Figure 6).

As salt (sodium chloride) will slowly precipitate out within the ponds and across the pond bases, successive pond wall 'raises' will be required to maintain the brine holding capacity of the ponds. The maximum wall height at Year 20 will be approximately 8 m, which is similar to the height of the natural kopi dunes that occur as islands on the playa surface. Raises will be completed through a combination of the construction of standalone perimeter embankments (where a berm has been constructed or the natural dune is of insufficient height) or HDPE lining of the natural sand dune.

The brine from the Concentrator Ponds will be pumped to the Crystalliser Ponds, with the proportion of NaCl decreasing as it deposits in each sequential pond. At the point where potassium salts start to deposit, the brine will be moved into the Off Playa Harvest Ponds by gravity flow.

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Grid: Australia MGA94 (51)

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**Figure 5**

**Indicative Location of Concentrator/Crystalliser Ponds and Harvest Ponds**

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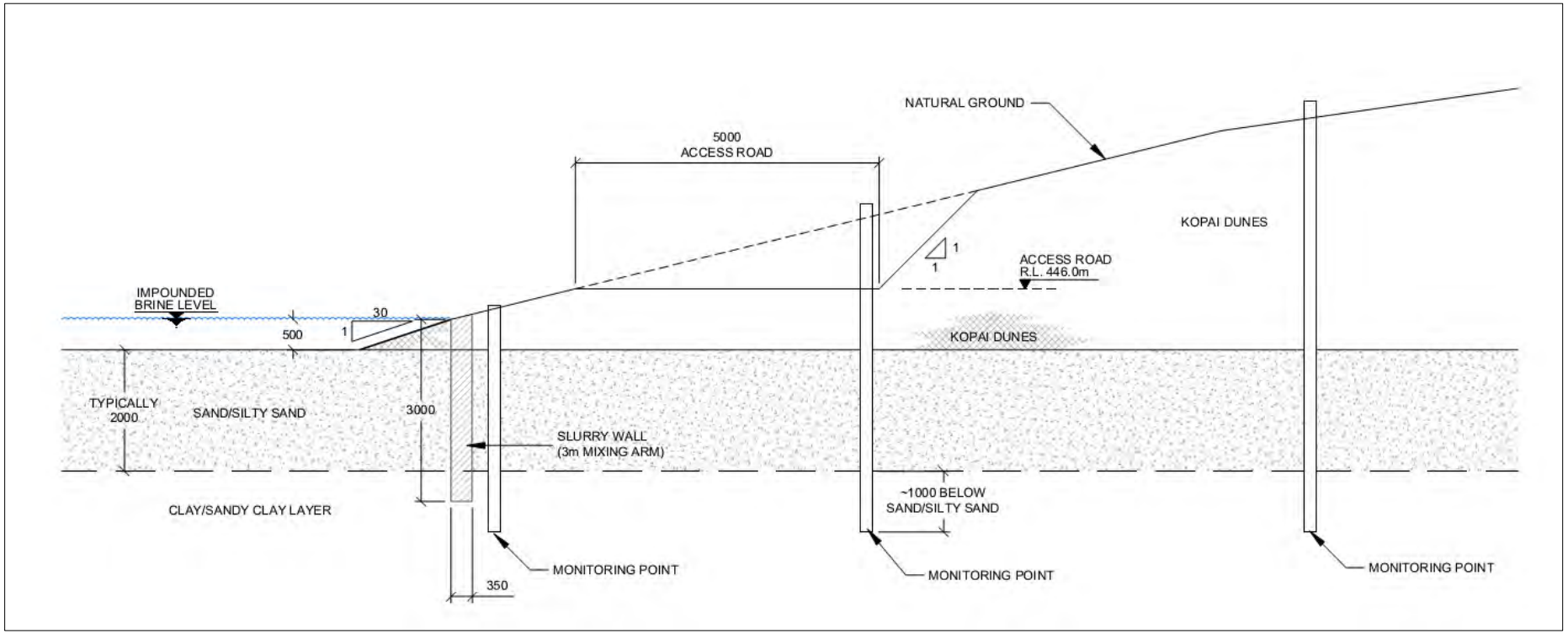
W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\Location Plan.map 24/03/2020 F5 Indicative Location of Concentrator Storage, Crystalliser and Harvest Ponds Layout




*Source: Knight Piésold 2019*

Figure 6: Conceptual Cross Section of a Concentrator Pond wall (including slurry wall, access road and groundwater monitoring bores)

#### 2.4.3.2 Off Playa Harvest Ponds

Sixteen Harvest Ponds will be constructed south of the playa, adjacent to the Processing Plant. The location and orientation of the ponds was selected to run parallel to contours in a relatively flat area of the terrain, off the playa. Brine from the Crystalliser Ponds and brine recycled from the Processing Plant will be fed into the Harvest Ponds as a solution of mixed salts, then harvested in a solid form and blended before being fed into the Processing Plant.

The internal walls and floor of the Harvest Ponds will have an engineered HDPE liner to prevent loss of brine through seepage. The floor of the ponds will include a pavement layer of salt to act as a buffer, protecting the pond floor liner from physical damage by harvesting equipment.

The final brine from the Harvest Ponds is high in magnesium chloride (MgCl) as well as gangue minerals; halite (NaCl) and epsomite ($MgSO_4$). The MgCl solution will be stored in an On Playa pond and used for dust suppression on roads within the On Playa Development Envelope, with any excess disposed of in the permeable cell of the Bitterns Pond (On Playa).

Solid waste salts from the Harvest Ponds will be returned to the Concentrator/Crystalliser Ponds for permanent disposal.

### 2.4.4 Brine Processing

The Process Plant is located within the Off Playa Development Envelope adjacent to the Harvest Ponds (Figure 5) and will be constructed to support the processing of 150,000 tpa SOP.

Figure 7 provides a flow diagram for brine processing, and is described in more detail in the following subsections.

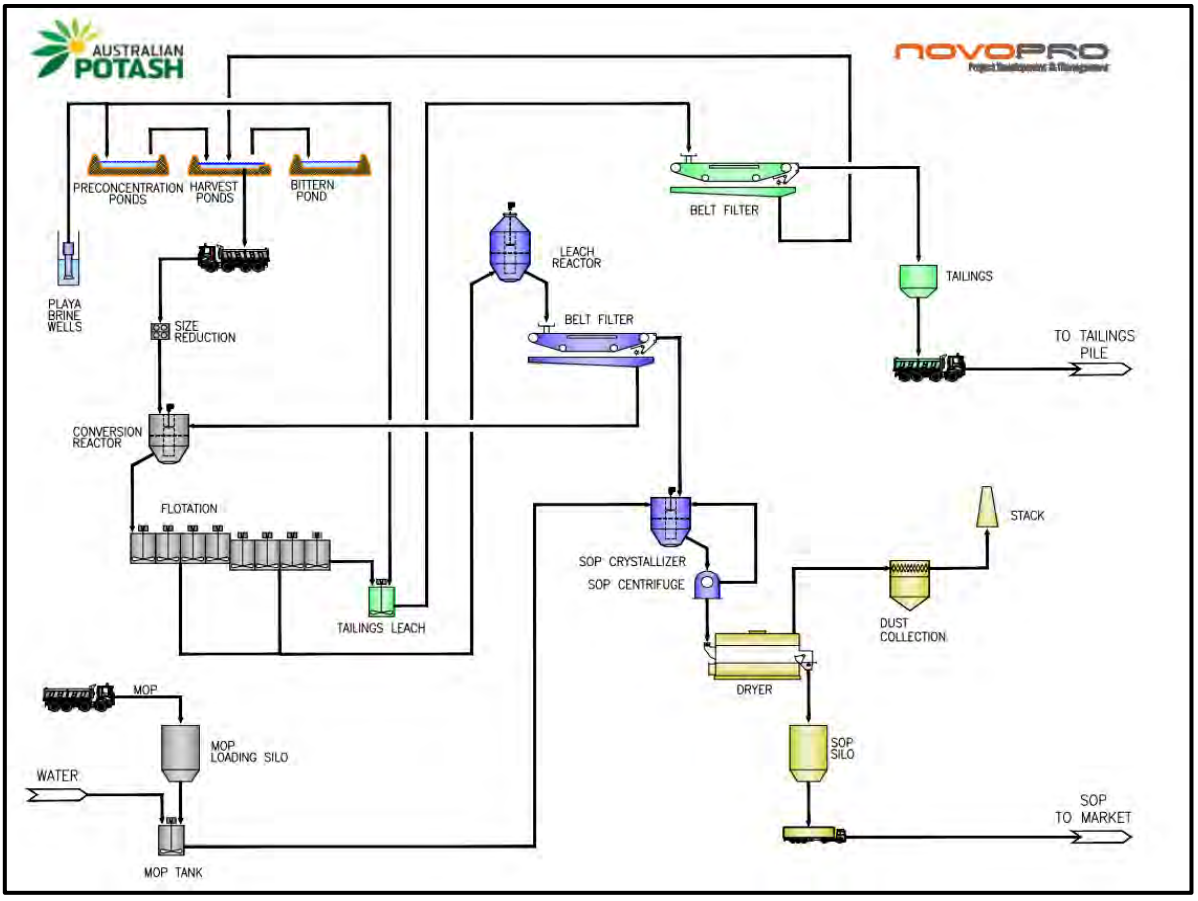



Figure 7: Potash Processing Flow Diagram

#### 2.4.4.1 Salts Crushing Circuit

The objective of the crushing circuit is to produce a crushed slurry with the correct particle size distribution for downstream unit operations. Salts from the Harvest Ponds enter the circuit via discharge onto an apron feeder. The mixed salts are then simultaneously fed with conversion brine (from the conversion reactor) into a cage mill to produce a 50% solids salt slurry. The 50% solids content will prevent caking in the crushing unit while keeping the total feed volume to the unit as small as possible. To allow for pumping once crushing has been completed, additional conversion brine is then added to reduce the solids content in the slurry to 35%.

#### 2.4.4.2 Conversion Reactor

This reactor converts all potassium minerals and magnesium sulphate ($MgSO_4$) salts to the potassium bearing mineral known as schoenite. The circuit consists of continuously stirred tank reactors where the crushed salt slurry from the crushing circuit is mixed with mother liquor from the halite leach reactor at a constant near-ambient temperature. The conversion slurry is transferred to the flotation circuit while a portion of the clear brine overflow from the conversion reactor is sent to the crushing circuit to slurry the incoming salts.

#### 2.4.4.3 Flotation

The slurry from the conversion reactor is mixed with flotation reagents in a series of two conditioning tanks where the solids are placed in close contact with a schoenite-specific flotation collector. Conditioned solids are pumped into a series of flotation cells where the schoenite is preferentially separated from the halite and epsomite. The flotation concentrate is transferred to a leach reactor, with the process residue directed to a leach circuit.

#### 2.4.4.4 Leach reactor

Flotation concentrate slurry is mixed with mother liquor from the SOP crystalliser in the leach reactor to dissolve the residual halite (NaCl) and epsomite ($MgSO_4$). The resulting slurry containing only schoenite solids is pumped to a belt filter. The mother liquor is separated from the pure schoenite on the belt filter and transferred back to the conversion circuit. Schoenite is then washed before being sent to the SOP crystalliser.

#### 2.4.4.5 Crystallisation

The washed schoenite solids are fed to the SOP crystalliser where they are mixed with dilute Muriate of Potash (MOP) brine for the precipitation of SOP. The MOP brine is produced by dissolving MOP into heated freshwater and this is then directed to the crystalliser. The resulting SOP slurry is pumped to hydrocyclones followed by centrifuge to separate the mother liquid from the solid SOP crystals. Mother liquid separated from the SOP slurry is recycled to the leach reactor, while SOP solids are dried and directed to the compaction plant and loadout point.

#### 2.4.4.6 Compaction and Loadout

After drying, SOP crystals are fed to a single roller compaction via a bucket elevator with the discharge from the compactor then fed to a crusher. The SOP crystals are then sent to a post-compaction circuit which features a glazing dryer/cooler for final treatment to harden the surface of individual granules. The granular product is then treated with de-dusting and anti-caking additives before storage in a silo (retention time of up to 20 hours) before loading onto trucks in bulk for transport.

### 2.4.5 Process Residue Management

The Proposal will produce three types of process residues, namely:

- Halite solids (NaCl): This is produced in the Concentrator Ponds.
- Magnesium Chloride brine: This is a purge brine rejected from the last Harvest Pond.
- Flotation Solids: These are the process residue from the floatation cells and consist of non-potassium bearing salts (generally halite, NaCl).

Management of these waste streams is discussed in the sections below.

### 2.4.5.1 Halite Solids

Halite solids will be generated in the Concentrator Ponds, forming deposits in the base of the ponds. The halite will naturally precipitate from the brine solution as it is evaporated and concentrates through the concentration pond circuit. The halite will collect on the floor of each pond at a rate of approximately 0.25 m per year. It is expected that 2,300,000 tonnes per year of halite will be generated in the Concentrator Ponds and a total of 69,000,000 tonnes will be generated over the life of the project.

As the depth of the halite on the floor of each of the Concentrator Ponds builds, the height of the pond walls will be raised to maintain the working capacity of the ponds. The embankment walls will be lifted about every five years to sustain pond capacity with three lifts expected over the life of project. At the end of project life, the Concentrator Ponds will contain approximately 5 m depth of solid halite. The expected final height of the Concentrator Pond walls will be approximately 12 m.

### 2.4.5.2 Magnesium Chloride Brine

Magnesium chloride brine will be purged from the final Harvest Ponds. The composition of the magnesium chloride brine is provided in Table 5.

Table 5: Magnesium Chloride Brine Composition

| Compound | Composition (%w/w) |
|---|---|
| $H_2O$ (water) | 65.4% |
| $MgCl_2$ | 30.5% |
| $MgSO_4$ (epsom salts) | 3.3% |
| NaCl (halite) | 0.6% |
| KCl | 0.2% |

Approximately 1,020,000 tpa of magnesium chloride brine is anticipated to be produced (for the ~30 year project life).

Magnesium chloride brine will be pumped to an On Playa Bitterns Pond, with the On Playa location specifically chosen due to its higher permeability (Figure 4). The Bitterns Pond will have two cells. The first, relatively impermeable cell, will be used for temporary storage of brine purged from the Harvest Ponds, and will have a continuous overflow into a second, more permeable cell from which process brine will be disposed of via infiltration into the playa lake. The higher permeability of the second cell will allow brine to seep back into the surficial aquifer.

It is recognised that magnesium chloride brine is an effective dust reducing agent. APC intends to utilise magnesium chloride brine, harvested from the first, impermeable, cell, for dust suppression on haul roads and unsealed access roads within the On Playa Development Envelope. It is anticipated that approximately 50,000 tpa of magnesium chloride brine will be used for this purpose.

### 2.4.5.3 Flotation Solids

The composition of the flotation solids is provided in Table 6. The solids will consist primarily of halite with minor traces of flotation reagents. Approximately 320,000 tpa of flotation solids will be generated each year.

Table 6: Flotation Solids Composition

| Compound | Composition (%w/w) |
|---|---|
| Halite (NaCl) | 62% |
| Epsomite ($MgSO_4$) | 18% |
| Polyhalite (mixed K, Na, Mg chlorides) | 0.8% |
| Brine (similar composition to magnesium chloride brine) | 19.2% |

The flotation solids will be loaded into trucks and delivered to a pond, adjacent to the Harvest Ponds, where they will be dry-tipped and spread with a front end loader.

### 2.4.6 Potable and Process Water

As well as brine abstracted from the Lake Wells palaeochannel system, the Proposal will require up to 0.8 GL per annum of lower salinity water for ore processing and other ancillary uses such as potable water for the accommodation village. This water will be obtained from the fractured rock basement aquifer in the southern area of the Off Playa Development Envelope.

### 2.4.7 Internal Roads

Internal project roads within the Off Playa Development Envelope will generally be 12 m wide for two way traffic and constructed with v-drains on either side to allow for drainage. On Playa roads will be approximately 5 m in width (Figure 6).

### 2.4.8 Product Transport and Export

A preliminary transport study investigated transport options for the product from site to both domestic and international destinations. Geraldton was identified as the preferred export port based on the concept of bulk-loading the product and transporting with quad road trains. The Port of Geraldton, which is closer to Lake Wells than Fremantle, is well suited to bulk exports.

Product will be transported along the access road, along Lake Wells Road and then along sealed roads in proximity to Laverton, Leonora, Sandstone and Mount Magnet to the Port of Geraldton, as follows:

- Lake Wells Road is an unsealed, gravel road that will be upgraded to accommodate quad road trains. The distance between the Development Envelope and the intersection with the Great Central Road is approximately 85 km.
- The Great Central Road (GCR) from the Lake Wells Road to Laverton, approximately 80 km. APC was advised by the Shire of Laverton and Main Roads WA that the section of the GCR that is currently unsealed, some 85 km, will be bitumen sealed by the end of 2021.
- The Laverton-Leonora Road, some 125 km of sealed road frequently traversed by heavy haul vehicles. A heavy vehicle by-pass road exists to the north of the Laverton town centre.
- Goldfields Highway, the Agnew-Sandfire Road, the Mt Magnet Sandfire Road and then through Geraldton to arrive at Geraldton Port.

SOP will be bulk loaded into sealed side-tipping trailers of super-quad road trains for haulage to Geraldton. Thus issues associated with dust emissions and loss of product will be negated. Off-site (outside of the port) storage facilities for both SOP export and MOP import were confirmed with the Mid West Ports Authority.

Four product return journeys per day (eight movements) by quad road trains, restricted to daylight hours, are proposed once the project is in full production. Goods received will be transported via the same route as required.

APC and the Mid-West Ports Authority have signed a joint cooperation agreement to investigate the port's capabilities to handle export volumes of up to 150,000 tpa of SOP.

### 2.4.9 Support Facilities

Support facilities at Lake Wells will include:

- Accommodation Village: A permanent accommodation village is proposed to support the long-term operation of Lake Wells. The accommodation village will consist of motel style rooms with associated messing and recreational facilities. It will consist of up to 100 rooms.
- Airstrip: The existing Lake Wells airstrip will be upgraded by widening, lengthening and repairing the pavement to make it suitable for 20 seater aircraft. The airstrip will be upgraded in line with CASA standards using suitable materials.
- Buildings/Offices: A warehouse/stores building, medical facility and processing and administration office buildings will be required.
- Communications: Communications will include high speed wireless internet, satellite television, site SCADA radios for pump stations and plant and UHF radio network.
- Landfill: An onsite landfill will be required for disposal of putrescible waste. The landfill is proposed to be located to the south of the project and accommodation village (Figure 4).
- Power: LNG power generating facilities will consist of a primary 'package plant' powering the processing plant and the accommodation village. The central power station will also power overhead power lines to the production bores. Individual diesel generators will power pond transfer pumps and the potable and process water pumps. Diesel storage for generators and the mobile fleet will be limited to approximately 50 kL.
- Washdown Facility: A washdown facility will be constructed consisting of light/heavy vehicle drive through areas with high pressure spray water for cleaning. Solids and dirty wash down water will drain to a primary settlement sump where the solids settle out. Oily water will overflow to an adjacent cell where oil will be separated using an oil skimmer and the oil will be pumped directly to a small waste oil tank.
- Wastewater (Sewage) Treatment: A wastewater treatment plant will be located near to the accommodation village and will process wastewater from ablution and shower facilities. Wastewater from these systems will either be recycled or disposed of via evaporation or discharge to land (sprayfield).
- Workshops/Laydowns: A heavy/light vehicle workshop and maintenance workshop are proposed on site.

### 2.4.10 Closure and Rehabilitation

The intent for the Proposal area post closure is for a return to the pre-mining land-use of cattle grazing. Initial closure strategies have been developed within a conceptual Mine Closure Plan (MCP) (Appendix 2) to ensure that the Proposal will meet the following criteria:

- Safe to both humans and wildlife.
- Non-polluting.
- Geotechnically stable.
- Self-sustaining with minimal maintenance required.
- Ecologically similar to the pre-mining environment, incorporating local native vegetation and fauna habitat to the extent practicable.
- Visually compatible with the surrounding natural landscape
- Suitable for agreed post-mining land uses.

At the end of project life, the only remaining permanent landforms will be the Concentrator and Crystalliser Ponds, which will have embankment walls up to 12 m high. All other infrastructure will be decommissioned, removed and disturbed areas rehabilitated.

The Concentrator/Crystalliser Ponds will be filled with solidified halite that has precipitated from solution and built up on the floor during the life of the project. The final shape of the mounds will essentially fill in the valleys between the existing kopai dunes, largely merging into the existing landforms. They will remain uncovered and will adopt a water holding design to facilitate dissolution of salts and return to the host aquifer. Residual halite will dissolve in rain events and gradually flow back into the hypersaline playa groundwater system. At closure, all pumps, pipework and associated infrastructure in and around the Concentrator/Crystalliser Ponds will be removed.

The Off Playa Harvest Ponds will be fully decommissioned. All remaining pavement salts will be removed and disposed within the On Playa Ponds where it will slowly dissolve and permeate back into the palaeochannel aquifer. The exposed Harvest Pond area will be covered with the original topsoil, which was stockpiled during construction, and will be revegetated.

The Process Plant and associated infrastructure will be decommissioned and removed from site. This includes the complete removal of:

- Brine and Process/Potable water bores and pipelines.
- Accommodation Village and WWTP.
- Power station and power infrastructure.
- Airstrip.

Further details on closure are presented within the conceptual Mine Closure Plan (MCP) (Appendix 2).

## 2.5 PROPOSAL JUSTIFICATION AND ALTERNATIVES

Australia currently imports 100% of its potash fertilisers, with CRU Fertiliser Week reporting 2016 import volumes of 273,000 tonnes of MOP and 2015 SOP imports at 72,000 tonnes.

The SOP form of potash is generally considered a safer form of fertiliser, as it is much lower in chloride and is less likely to give rise to harmful salinity effects on crops and soils. There are three SOP product grades, each with similar potassium levels, but differing in physical characteristics; standard grade, granular grade, and soluble grade. APC will produce standard and granular grade initially and will explore the potential for soluble grade.

Asia is the biggest growth region for SOP fertiliser demand and APC is well positioned to supply this market. The global demand for SOP, excluding China, has grown from 2.2 million tonnes per year in 2010 to 3.2 million tonnes in 2015. The Chinese market has shown similar growth in demand volumes over the same period. China is expected to continue to be a significant consumer of SOP for the foreseeable future.

The only viable alternative is to not proceed with the Proposal.

The Proposal has been designed to minimise potential environmental impacts, as follows:

- Concentrator/Crystalliser Ponds located On Playa to minimise the direct loss of native vegetation.
- Concentrator/Crystalliser Pond walls to primarily use existing dunes within the playa to minimise disturbance of On Playa sediments and morphology (to minimise changes to surface water quality and flows) and minimise the need for other construction materials.
- Development of brine bores within the On Playa Development Area to minimise impacts to native vegetation. The optimisation of the proposed borefields is ongoing, with the aim of further reducing the extent of clearing.

- LNG 'package plant' approach adopted to minimise the clearing of native vegetation and volumes of diesel required to be stored on site.
- Selection of Geraldton as the preferred export port, as an alternative to export through Esperance which would involve greater shipping distances and additional product handling.
- Use of existing roads (with the exception of the site access road) to minimise the clearing of native vegetation associated with the SOP haulage route.
- Use of covered trailers to minimise the loss of SOP, and associated dust impacts, adjacent to the SOP haulage route.

Since referral of the Proposal, the 'Fractured Borefield North' has been removed from the Off Playa Development Envelope.

## 2.6 LOCAL AND REGIONAL CONTEXT

### 2.6.1 Land Systems and Vegetation Units

The Proposal lies within the southern fringe of the Great Victoria Desert (GVD) and within the Eremaean Province in a region known as the Helms Botanical District. The GVD region is further divided into four subregions (Shield, Central, Maralinga and Kintore) based on the Interim Biogeographic Regionalisation of Australia (IBRA); Lake Wells is located within the Shield (GVD1) subregion.

Vegetation of the Helms Botanical District (as described by Beard, 1990) comprises a mosaic of tree and shrub steppe between sand dunes and on sandplains, consisting of Marble Gum, Mallee and Spinifex (*Eucalyptus gongylocarpa* (9-12 m), *E. youngiana*, *Triodia basedowii*). Beard states that dunes in the west are rather thinner, few and weak. *E. gongylocarpa* is comparatively scarce with *E. youngiana* replaced by *E. kingsmillii* and *Acacia aneura* and *A. linophylla* becoming frequent on the sandplain.

The Shield subregion contains Spinifex (*Triodia spp.*) and Mallee (*Eucalyptus kingsmillii, E. youngiana*) over hummock grassland dominated by *Triodia basedowii* on aeolian sand plains. Scattered Marble Gum (*E. gongylocarpa*) and native pine (*Callitris sp.)* occur on the deeper sands of the sand plains. Mulga and Acacia woodland occur mainly on the colluvial and residual soils. Halophytes such as Salt Bush (*Atriplex*), Bluebush (Kochia) and Samphire (*Arthrocnemum*) occur on the margins of salt lakes and in saline drainage areas (Barton and Cowan 2001).

The western end of the Shield subregion is underlain by the Yilgarn Craton. Here there is a higher proportion of sandplains in comparison to the rest of the bioregion. To the east is an arid active sand-ridge desert of deep Quaternary Aeolian sands overlying Permian and Mesozoic strata of the Officer Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. The sandplains occur with patches of seif dunes running east-west and areas of moderate relief without-cropping and silcrete-capped mesas and plateaus (breakaways). The subregion contains a major paleo channel of Ponton Creek (Barton and Cowan 2001).

Lake Wells is located within the Leemans Sandplain Zone of the Murchison Province (DPIRD 2017). The Leemans Sandplain Zone is characterised by sandplains (with some gravel plains, mesas and salt lakes) on granitic rocks of the Yilgarn Craton (Eastern Goldfields Superterrane). Soils are comprised of red sandy earths with red loamy earths and some red deep sands, red-brown hardpan shallow loams and Calcareous loamy earths. Vegetation is predominately Spinifex grasslands with Marble Gum, Mallee and Mulga shrublands (and some halophytic shrublands).

### 2.6.2 Climate

The Proposal is located within the semi-arid zone of Western Australia, with mild winters and hot summers. The annual temperature regime is characterised by marked diurnal and seasonal fluctuations. The nearest Bureau of

Meteorology (BoM) weather station to Lake Wells is located at Carnegie (Site Number 013015), approximately 120 km to the north west. Mean monthly maximum temperatures (for years 1989 to 2019) range from 38.7 to 21.2°C, while mean monthly minimum temperatures range from 24 to 6°C; average annual rainfall (for years 1942 to 2019) is 242.2 mm, with January, February and March receiving the highest monthly rainfalls (BoM 2019a). Mean monthly rainfall, maximum temperature and minimum temperature data is shown in Chart 1.

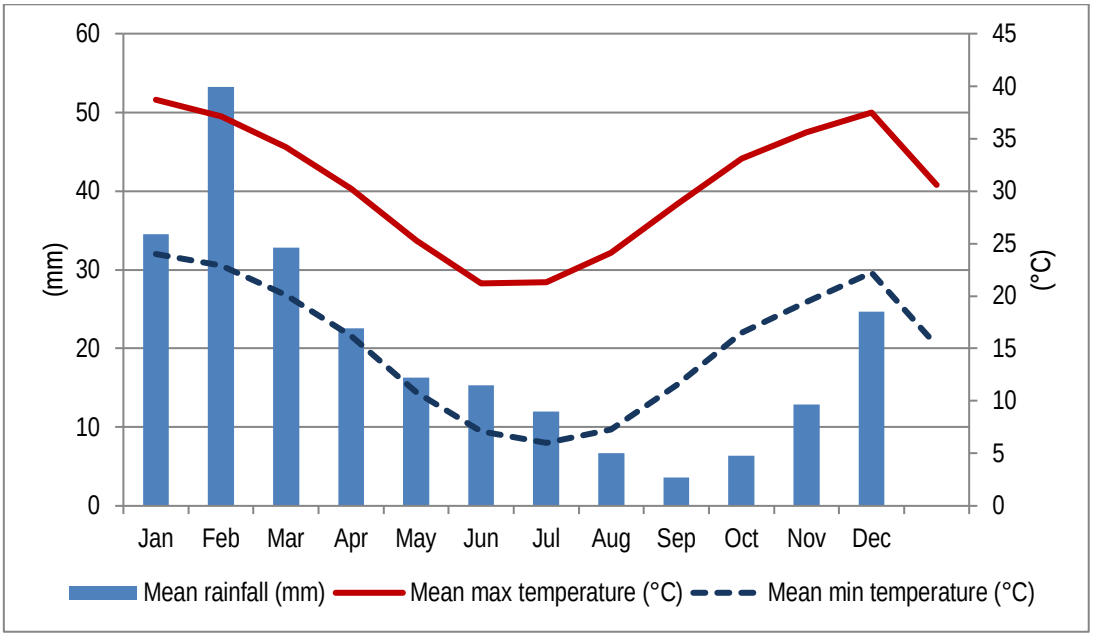



Chart 1: Climate Data for Carnegie (Station 013015; BoM 2019a)

The average annual evaporation rate for the Lake Wells area was calculated as 3,095 mm, with monthly evaporation rates increasing and decreasing in line with average monthly rainfalls (Golder Associates 2017).

Annual rainfall in the semi-arid zone is highly variable and the region is subject to drought periods. Rainfall is related both to locally generated thunderstorms and to dissipating tropical cyclones tracking southeast. Thunderstorm activity tends to be greatest between October and December when cool air flows from the south wedge beneath humid north westerly winds.

Tropical cyclone activity in the area is relatively infrequent, with five tropical cyclones having passed within 100 km of Lake Wells between 1970 and 2017 (Figure 8). Remnant cyclonic activity is greatest between January and May, reflecting the tropical wet season in the north of WA. Rainfall tends to fall predominantly over the winter months.

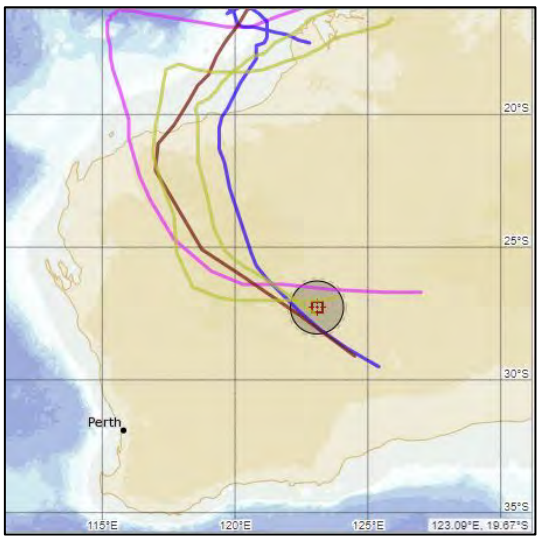



Figure 8: Lake Wells Tropical Cyclones 1970 – 2017 (BoM 2019b)

## 2.6.3 Hydrology and Hydrogeology

The Proposal is located in the south west region of Lake Wells. From a review of Shuttle Radar Topography Mission (SRTM) data for the area the southwest lake area is estimated to have a catchment area of 6,600 km$^2$, with the majority of the catchment area flowing from the west.

Dependent upon the actual rainfall distribution in any year, a portion of the water reporting to the lake will infiltrate the lake-bed sediments. Lake Wells is roughly shaped like a reverse "C" and constitutes an internally draining terminal basin (i.e. there is no surface water outflow). Surface water connection across the lake is poorly defined and smaller rainfall events would likely result in development of ponds within the overall lake bed. It is possible that the entire lake could be interconnected during high levels of inundation (AQ2 2019).

The Proposal area sits within a deep palaeovalley (ranging between 150 and 170 m in depth), infilled with predominantly lacustrine clays and sand interbeds (Figure 9), confirmed by palynological dating to be of Tertiary age. Hydrogeological units within the Proposal area are described as follows (AQ2 2019):

- An extensive surficial aquifer unit of Pliocene – Quaternary mixed alluvial/lacustrine sediments.
- A Pliocene / Pleistocene aquifer unit of predominantly sand at the base of the surficial aquifer unit, occurring at depths ranging between 35 and 70 m, with thicknesses varying between 1 and 12 m.
- A Miocene clay aquitard comprising puggy lacustrine clay with minor sandy interbeds.
- A Miocene mixed aquifer unit comprising interbedded sand and clay.
- A basal sand has been encountered in 25 drill holes located across the entire project area (the of age of which is uncertain and could range between Eocene and Miocene).
- Bedrock comprising low permeability Archean basement.

A more thorough description is provided in Section 5.3.3.3.

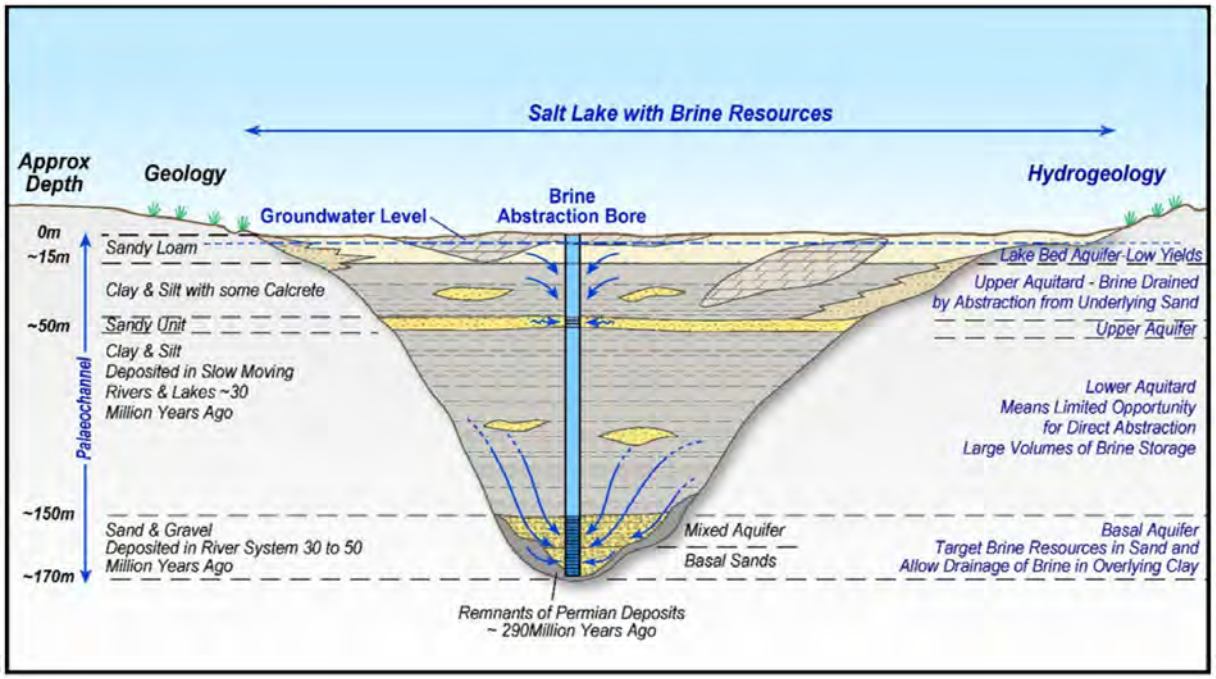



Figure 9: Conceptual Cross Section of the Lake Wells Palaeochannel (AQ2 2019)

## 2.6.4 Social Environment

The Proposal is located within the north eastern Goldfields region of Western Australia. This area contains Unallocated Crown Land and reserves, and is used for grazing, tourism, exploration and mining.

Low rainfall and high evaporation rates in the Lake Wells area mean that surface water generally does not last for prolonged periods, a factor that has affected Aboriginal occupation of the area. Lake Wells falls within the Western Desert Bloc, a culturally and socially distinct mix of Aboriginal groups. Ethnographic and archaeological surveys of the Proposal and surrounding areas, along with consultation with Traditional Owners, have confirmed that no sites of social significance occur within the Proposal area.

At the time of referral of the Proposal to the EPA, no Native Title Claims were lodged, registered or determined over the Development Envelopes. In July 2018, the Waturta people lodged a claim (WC2018/012) over a wide area, including the Proposal area. This claim was registered in July 2018 and is under assessment.

# 3. STAKEHOLDER ENGAGEMENT

## 3.1 STAKEHOLDER IDENTIFICATION

A number of meetings and briefings on the Proposal have been held with the local community, local, State and Federal government agencies, other industry participants, non-government organisations, Traditional Owner groups and the pastoralist. Key stakeholders are considered to include:

- Pastoralist Lake Wells Station).
- Shire of Laverton.
- The Waturta People and Central Desert Native Title Services (CCNT).
- Department of Water and Environmental Regulation (DWER) including the Environmental Protection Authority (EPA) Services.
- Department of Mines Industry Regulation and Safety (DMIRS).
- Main Roads WA.
- Mid-West Ports Authority.

## 3.2 STAKEHOLDER ENGAGEMENT PROCESS

A comprehensive consultation program has been implemented to ensure all relevant stakeholders have been identified and effectively consulted. Communication tools and consultation methods were designed and targeted to maximise opportunities for feedback from stakeholders, with identified key issues considered in the final design of the Proposal. APC will continue to engage with stakeholders to ensure concerns are identified and considered.

## 3.3 STAKEHOLDER CONSULTATION

Table 7 summarises the key stakeholders identified for the Proposal and identifies their interests in relation to the Proposal.

Table 7: Stakeholder Consultation for the Proposal

| Stakeholder | Date | Issues/Topics Raised | Proponent Response/Outcome |
|---|---|---|---|
| Pastoralist (Lake Wells Station) | August 2016 (meeting) | Proposed water drilling programme and heritage surveys. | No issues raised. |
| | March 2017 (meeting) | APC Activities Plan for March-April 2017 including lidar survey and potable water exploration. | No issues raised and activities understood. Pastoralist in process of engaging a lawyer to assist them with engaging with APC and other resource companies operating on the Lake Wells pastoral lease. |
| | September 2017 (meeting) | Pastoralist requested a map of the entire lake area and APC's tracks and drill holes. | APC agreed to provide a map. |
| | November 2017 (meeting) | Pastoralist has spoken to Pastoralists Land Board regarding the potential sale of the station. Pastoralist requested copies of PoWs, map of drill holes and data from samples taken from station bores. | APC agreed to provide the requested information. |
| | September 2018 (meeting) | Update on access including discussions with the Shire of Laverton. | NA |
| | April 2019 (meeting) | Notice of arrival of a sea container and removal of site office. | NA |
| Traditional Owners | June 2016 (meeting with Bruce Smith) | Discussed future heritage survey. | NA |
| | September 2018 (phone call) | Discussion regarding upcoming heritage survey. | NA |
| | April 2019 (meeting with Waturta and CCNT) | Discussed Native Title claim. | NA |
| | May 2019 (meeting with Waturta and CCNT) | Discussion regarding APC's heritage consultant and preferred pathways for future dialogue. APC invitation to Waturta to attend next heritage survey. | Heritage consultant will not be changed. Question from APC regarding the acceptability of Bruce Smith/ Bruce Hogan to speak on behalf of the Waturta. |
| | August 2019 (meeting with Waturta and CCNT) | APC discussed on protocols and mechanisms for negotiation and agreement and outlined the status of the Proposal. Commercial agreement proposed and discussed. | No commercial agreement reached. |
| | September 2019 (heritage survey including Waturta) | Reviewed areas of interest and discussed protection of areas and sites of significance. | NA |

| Stakeholder | Date | Issues/Topics Raised | Proponent Response/Outcome |
|---|---|---|---|
| Shire of Laverton | August 2018 (meeting) | Meeting with Shire of Laverton CEO and Technical Services Manager to discuss Lake Wells access road and Great Central Road. Opportunity to seal Lake Wells Road discussed. | APC to assess use of Laverton Airport. |
| | September 2019 (meeting) | Meeting with Shire of Laverton CEO and Technical Services Manager to discuss Proposal timeline, stakeholder consultation and DIDO opportunities. | NA |
| Main Roads | April 2019 | Utilisation of the road network to transport product to Geraldton Port, proposed upgrades to Great Central Road (GCR). | Overview of Proposal and Lake Wells Road upgrade. MRWA needs to assess GCR/Lake Wells Road intersection design. |
| Mid-West Ports Authority | September 2019 (meeting) | Discussions with Operations Manager regarding the Proposal and anticipated export volumes and timelines. | NA |

# 4. EPA PRINCIPLES

The EPA has identified a set of principles for environmental management. Details of how these have currently been considered in early project design are provided in Table 8.

Table 8: Lake Wells Potash Project – Principles of Environmental Management

| Principle | Application |
|---|---|
| Precautionary Principle<br><br>Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.<br><br>In the application of the precautionary principle, decisions should be guided by:<br>• Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and<br>• An assessment of the risk-weighted consequences of various options. | Environmental knowledge gaps and uncertainty has been explicitly considered during the preparation of the ERD.<br><br>APC commits to the development, implementation and monitoring of measures to prevent unacceptable environmental harm or pollution associated with implementation of the Proposal.<br><br>APC has undertaken comprehensive environmental studies on aspects of the Proposal that may impact the environment, including flora and vegetation surveys, terrestrial fauna surveys, groundwater investigations, stygofauna sampling and heritage surveys. These studies are described under the relevant preliminary key environmental factor, within the 'receiving environment' section.<br><br>The Proposal design has, as much as practicable, taken into account the outcomes of the environmental technical studies. Appropriate management measures have been adopted to minimise residual impacts. |
| Intergenerational Equity<br><br>The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. | APC commits to managing those environmental factors within its control such that future adverse impacts are minimised and that, wherever possible, the quality of the environment is maintained or enhanced.<br><br>A conceptual Mine Closure Plan has been prepared for the Proposal to demonstrate that closure can result in an appropriate environmental outcome. |
| Conservation of Biological Diversity and Ecological Integrity<br><br>Conservation of biological diversity and ecological integrity should be a fundamental consideration. | The Proposal design has taken into account the outcomes of baseline surveys. There will be no direct impacts on conservation significant flora and fauna species or ecological communities.<br><br>APC has fully assessed the effects of the Proposal, both direct and indirect, on biological diversity and ecological integrity and commits to implementing measures to minimise residual impacts.<br><br>Impacts to terrestrial flora and vegetation, terrestrial fauna and subterranean fauna are not expected to be significant, or pose a risk of loss of biological diversity and ecological integrity. |
| Improved Valuation, Pricing and Incentive Mechanisms<br><br>• Environmental factors should be included in the valuation of assets and services.<br>• The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.<br>• The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. | Where possible, APC will employ appropriately trained local personnel and source local goods and services.<br><br>APC will ensure best practice standards during construction and operations to minimise emissions and discharges as far as possible and ensure negative legacies are not created.<br><br>APC recognises the need to provide sufficient capital and operating funds to ensure environmental management measures are implemented throughout the project life. Provision has also been made for costs associated with closure and decommissioning and these costs form part of the cost of production. |

| Principle | Application |
|---|---|
| • Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems. | |
| Waste Minimisation<br><br>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment. | All reasonable and practicable measures to minimise the generation of waste and its discharge to the environment will be taken. Waste generated from the Proposal will be minimised through the implementation of the hierarchy of waste controls i.e.; avoid, re use, recycle, recover and dispose. |

# 5. KEY ENVIRONMENTAL FACTORS

## 5.1 KEY ENVIRONMENTAL FACTOR 1 – FLORA AND VEGETATION

### 5.1.1 EPA Objective

To protect flora and vegetation so that biological diversity and ecological integrity is maintained.

### 5.1.2 Policy and Guidance

The following policy and guidance documents were taken into consideration in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD:

- EPA - Statement of Environmental Principles, Factors and Objectives (EPA 2018c).
- Environmental Impact Assessment (EIA) (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a).
- EIA (Part IV Divisions 1 and 2) Procedures Manual 2016 (EPA 2018a).
- EPA Factor Guideline – Flora and Vegetation (EPA 2016b).
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c).

### 5.1.3 Receiving Environment

A number of project specific vegetation and flora surveys have been undertaken as outlined in Table 9.

Table 9: Summary of Flora and Vegetation Surveys

| Survey Date | Consultant | Description |
|---|---|---|
| December 2015 | Botanica | Level 1 Flora and Vegetation Survey |
| September 2016<br>April 2017<br>August 2017 | Botanica | Detailed Flora and Vegetation Surveys |
| September 2018<br>January 2019 | Botanica | Targeted Samphire Surveys |
| December 2017 | Hydrobiology | NDVI, NDWI and ET Calculation for determination of Groundwater Dependent Ecosystems |

#### *5.1.3.1 Vegetation Communities*

The Development Envelopes intersect five Beard (1990) vegetation associations (Botanica Consulting 2019a), all of which currently remain at close to 100% of the pre-European extent:

- Great Victoria Desert 39.
- Great Victoria Desert 125.
- Great Victoria Desert 676.
- Great Victoria Desert 1239.
- Wiluna 107.

Flora surveys identified 45 families, 128 genera and 288 taxa (including 60 annual taxa), noting that the survey area of 74,760 ha is larger than the combined Development Envelope area of 13,951 ha. These communities are described in Table 10 and shown in Figure 10. Of these 17 vegetation communities, 12 are present within the On Playa Development Envelope and 12 within the Off Playa Development Envelope.

The 'Kopai' dunes within the On playa Development Envelope comprise sparsely vegetated, gypsum-cemented sand and loose sand (Plate 1). The Kopai dunes are, in places, 8 to 10 m above the salt lake surface and are sparsely vegetated with an open woodland of *Casuarina pauper*, sometimes with Kopi Mallee (*Eucalyptus gypsophila*), over *Acacia burkittii*, *Grevillea sarrissa*, *Senna* and/or *Eremophila* shrubland and low chenopods (*Atriplex vesicaria*) (Appendix 3F).

Between the sand dunes the playa 'lake' system is widely devoid of vegetation, with the exception of *Tecticornia* spp. communities at some locations (Plate 1, Figure 10).

Plate 1: On Playa Vegetation on Kopai Sand Dune (Left) and Within Playa 'Lake' (Right)

Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen (1988) (ranging from 'pristine' to 'completely degraded'), six vegetation communities were rated as 'good' and the remaining eleven vegetation communities were rated as 'very good'.

#### *5.1.3.2 Threatened / Priority Ecological Communities*

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) as defined under the EPBC Act or BC Act were recorded within the survey area.

Table 10: Mapped Vegetation Communities

| Code | Description | Total Mapped (ha) | Area in Development Envelopes (ha) |
|---|---|---|---|
| **Chenopod Shrublands, Samphire Shrublands and Forblands** | | | |
| CD-CSSSF1 | Low samphire shrubland of *Tecticornia indica* subsp. *bidens*/ *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS522) in Playa | 6,233 | 3,061 |
| CD-CSSSF2 | Mid heathland of *Cratystylis subspinescens* over low open chenopod shrubland of *Atriplex vesicaria* and open forbland of *Frankenia* spp. on Playa edge | 4,068 | 1,039 |
| CD-CSSSF3 | Mid open shrubland of *Eremophila paisleyi*/ *Lawrencia squamata*/ *Lycium australis* over low open chenopod shrubland of *Atriplex* spp. and open forbland of *Frankenia* spp. on Playa edge | 4,124 | 582 |
| **Acacia Forests and Woodlands** | | | |
| CLP-AFW1 | Low open forest of *Acacia incurvaneura* over mid shrubland of *Eremophila margarethae* and low open tussock grassland of *Eriachne mucronata*/ *Eragrostis eriopoda* on clay loam plain | 11,345 | 1,211 |
| CLP-AFW2 | Low woodland of *Acacia caesaneura* over mid open shrubland of *A. burkittii* and mid chenopod shrubland of *Maireana pyramidata*/ low open hummock grassland of *Triodia desertorum* on clay loam plain | 2,014 | 174 |
| DD-AFW1 | Low open forest of *Acacia caesaneura* over mid open shrubland of *Senna artemisioides* subsp. *filifolia* and low open tussock grassland of *Eragrostis eriopoda* in drainage depression | 2,013 | 298 |
| QRP-AFW1 | Low open woodland of Acacia caesaneura/ A. incurvaneura over mid open shrubland of A. burkittii/ Eremophila fraseri and low open shrubland of Ptilotus obovatus/ sparse tussock grassland of Eragrostis eriopoda on quartz/rocky plain | 2,877 | 333 |
| RH-AFW1 | Low open forest of Acacia quadrimarginea over mid open shrubland of Senna artemisioides subsp. filifolia/ Senna sp. Meekatharra (E. Bailey 1-26) and low open shrubland of Ptilotus obovatus on rocky hillslope | 820 | 260 |
| RH-AFW2 | Low woodland of Acacia incurvaneura over mid open shrubland of Eremophila jucunda and tussock grassland of Eragrostis eriopoda/ Eriachne mucronata on rocky hillslope | 2,472 | 4 |
| SD-AFW1 | Low woodland of *Acacia caesaneura*/ *A. incurvaneura* over tall open shrubland of *Eremophila spp.*/ *Senna spp.*/ *Melaleuca interioris* and low open hummock grassland of *Triodia basedowii*/ low open tussock grassland of *Eragrostis eriopoda* in dunefield | 3,821 | 2,016 |
| **Casuarina Forests and Woodlands** | | | |
| D-CFW1 | Low open forest of *Casuarina pauper* over tall open shrubland of *Acacia burkittii* and low sparse chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 3,461 | 1,5734 |
| QRP-CFW1 | Low woodland of *Casuarina pauper* over mid shrubland *of Eremophila paisleyi subsp. paisleyi*/ *Senna artemisioides subsp. filifolia* and low open shrubland of *Ptilotus obovatus* on quartz/rocky plain | 1,334 | 37 |
| **Mallee Woodlands and Shrublands** | | | |
| D-MWS1 | Mid open mallee forest of *Eucalyptus gypsophila* over mid open shrubland of *Senna artemisioides*/ *Eremophila spp.* and low open chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 1,436 | 900 |

| Code | Description | Total Mapped (ha) | Area in Development Envelopes (ha) |
|---|---|---|---|
| SD-MWS1 | Mid mallee woodland of *Eucalyptus concinna* over low open shrubland of *Aluta maisonneuvei subsp. auriculata/ Dodonaea viscosa* and low closed hummock grassland of *Triodia desertorum* in dune field | 1,806 | 203 |
| SP-MWS1 | Mid mallee shrubland of *Eucalyptus spp.* over mid open shrubland of *Acacia spp.* and low closed hummock grassland of *Triodia basedowii* on sandplain | 13,205 | 1,279 |
| Acacia Forests and Woodlands/Mallee Woodlands and Shrublands | | | |
| SLP-AFW/MWS1 | Low open forest of *Acacia caesaneura*/ mid mallee woodland of *Eucalyptus lucasii* over mid open shrubland *of Eremophila latrobei subsp. glabra* and low hummock grassland of *Triodia desertorum* on sand-loam plain | 7,592 | 904 |
| Eucalypt Woodlands | | | |
| SP-EW1 | Low woodland of *Eucalyptus gongylocarpa* over mid open shrubland of *Eremophila platythamnos subsp. exotrachys* and low hummock grassland of *Triodia desertorum* on sandplain | 5,957 | 76 |

#### *5.1.3.3 Flora*

Database searches recorded 37 Priority flora taxa within the local region (Botanica 2019a). These taxa were assessed and ranked for their likelihood of occurrence within the survey area (Table 11).

Three Priority flora taxa were identified within the survey area; *Lepidium xylodes* (P1), *Melaleuca apostiba* (P3) and *Tecticornia willisii* (P1) (Botanica 2019a, 2019b). *Lepidium xylodes* (P1) and *Tecticornia willisii* (P1) were not present within the Development Envelopes, several individuals of *Melaleuca apostiba* (P3) were present within the Development Envelope.

*Lepidium xylodes* is described as an erect shrub, which grows between 0.4-1.5 m high, with stems becoming spinescent. It occurs on gravelly loam or clayey sand soils (WAH 2019c) and three locations of this taxon were recorded within the survey area, with an estimated 10,500 plants recorded. There are currently only six DBCA listed locations of this taxon recorded on the DBCA database, all of which occur within the Western Murchison subregion. The record of this taxon within the survey area is a range extension for this taxon (Botanica 2019a).

*Melaleuca apostiba* is described as a spreading shrub, which grows to 2 m high, with grey fissured bark and dull green leaves (WAH 2019c). Thirty-five locations of this taxon were recorded within the survey area, one location of which is located approximately 1 km east of a DBCA known location. An estimated 1,681 plants were recorded within the survey area (Botanica 2019a).

*Tecticornia willisii* is described as an erect subshrub to shrub with single florets in the axil of each bract; vegetative articles and bracts with a denticulate margin, apiculate apex and a distinctive rough epidermis; and 'Type 3' seed coat ornamentation. Three locations of this taxon were recorded within the survey area with an estimated 141,605 plants recorded. This taxon was previously listed as *Tecticornia* sp. Little Sandy Desert (K.A. Shepherd & C. Wilkins KS 830) and was considered endemic to the Little Sandy Desert Region. The record of this taxon within the survey area is a range extension for this taxon (Botanica 2019a).

Table 11: Likelihood of Occurrence for Flora of Conservation Significance Within the Survey Area

| Species | Conservation Code | Description | Likelihood of Occurrence[3] |
|---|---|---|---|
| *Eremophila anomala* | P1 | Shrub. Fl. white, Aug to Sep. Basalt outcrop. | Unlikely |
| *Eucalyptus semota* | P1 | (Mallee) or tree, 2-9 m high, bark rough & peeling on trunk, smooth above. Clay. Quartz outcrops. | Unlikely |
| *Hibiscus* sp. Carnarvon (S. van Leeuwen 5110) | P1 | No description available. | Possible |
| *Hibiscus* sp. Wonganoo Station (K. Boladeras 125) | P1 | No description available. | Possible |
| *Minuria* sp. Little Sandy Desert (S. van Leeuwen 4919) | P1 | No description available. | Possible |
| *Ptilotus tetrandrus* | P1 | Annual, herb, 0.15-0.3 m high. Fl. Oct. | Possible |
| *Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702) | P1 | No description available. | Possible |
| *Tecticornia bibenda* | P1 | Erect or spreading shrub, 0.5-1.2 m high. Fl. Aug to Oct. Red-brown saline sand with some clay over calcrete and gypsum. Near the edges of gypsiferous Playas and salt lakes on flat to gently undulating terrain. | Possible |
| *Tecticornia mellarium* | P1 | Erect, perennial shrub, 0.2-0.4 m high. Well-drained red gypseous sand, clay. Gypseous dunes, margins of Playa lakes, on clay pans. | Possible |
| *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) | P1 | No description available. | Possible |
| *Tecticornia* sp. Little Sandy Desert (K.A. Shepherd & C. Wilkins KS 830) | P1 | No description available. | Possible |
| *Tecticornia* sp. Sunshine Lake (K.A. Shepherd et al. KS 867) | P1 | No description available. | Possible |
| *Calytrix warburtonensis* | P2 | Shrub, 0.3-0.6 m high. Fl. white, Mar or Sep to Oct. Rocky Hills, breakaways. | Unlikely |
| *Eremophila undulata* | P2 | Small shrub, to 0.5 m high, 1 m wide. Fl. green-brown/yellow-green, Jul to Sep. Red- brown clay loam, sand. | Possible |
| *Acacia eremophila* var. Numerous-nerved variant (A.S. George 11924) | P3 | Dense, spreading shrub, 1-2 m high. Fl. yellow, Sep. Sandy soils. Flats. | Possible |

[3] Refer Botanica 2019a for description of likelihood of occurrence classifications.

| Species | Conservation Code | Description | Likelihood of Occurrence[3] |
|---|---|---|---|
| *Bossiaea eremaea* | P3 | Divaricately-branched, spreading shrub, to 1.2 m high. Fl. red-yellow-purple-brown, Jul to Sep. Deep red sand. | Possible |
| *Calytrix praecipua* | P3 | Shrub, 0.3-0.7 m high. Fl. pink-white, Jun to Jul or Sep to Nov. Skeletal sandy soils over granite or laterite. Breakaways, outcrops. | Unlikely |
| *Comesperma pallidum* | P3 | Erect shrub, 0.7-2 m high. Fl. yellow/cream & purple, May to Aug. Red sand. Sandplains & dunes. | Possible |
| *Daviesia arthropoda* | P3 | Spiny, bushy shrub, to 1 m high. Fl. yellow- brown. Dunes. | Possible |
| *Eremophila campanulata* | P3 | Low shrub, ca 0.3 m high, 0.4 m wide. Fl. purple-red, Sep. Stony red/brown clay. | Possible |
| *Eremophila gracillima* | P3 | Low flat shrub, ca 0.3 m high, 1.2 m wide. Fl. blue, Sep. Stony flats. | Possible |
| *Eremophila shonae subsp. diffusa* | P3 | Erect, open, straggly shrub, ca 0.4 m high. Fl. purple, Aug to Oct. Stony yellow or red sandy soils. | Possible |
| *Fimbristylis sieberiana* | P3 | Shortly rhizomatous, tufted perennial, grass-like or herb (sedge), 0.25-0.6 m high. Fl. brown, May to Jun. Mud, skeletal soil pockets. Pool edges, sandstone cliffs. | Unlikely |
| *Gonocarpus pycnostachyus* | P3 | Erect annual, herb, 0.1-0.15 m high. Fl. green-red. Sand or clay soils. Wet depressions, granite rocks. | Unlikely |
| *Goodenia modesta* | P3 | Herb, to 0.5 m high. Fl. yellow, probably Jan to Dec. Red loam, sand. | Possible |
| *Gunniopsis propinqua* | P3 | Prostrate annual or perennial, herb, 0.03-0.1 m high. Fl. white/pink, Aug to Sep. Stony sandy loam. Lateritic outcrops, winter-wet sites. | Unlikely |
| *Homalocalyx echinulatus* | P3 | Shrub, 0.45-1 m high. Fl. pink, Jun to Sep. Laterite. Breakaways, sandstone hills. | Known to occur |
| *Melaleuca apostiba* | P3 | Spreading shrub, to 2 m high, with grey fissured bark and dull green leaves. Fl. red, Jun. | Known to occur |
| *Phyllanthus baeckeoides* | P3 | Shrub, 0.5-1.5 m high. Fl. white- yellow/green-yellow, Jul to Sep. Red lateritic & sandy clay soils. Granite outcrops. | Unlikely |
| *Stackhousia clementii* | P3 | Dense broom-like perennial, herb, to 0.45 m high. Fl. green/yellow/brown. Skeletal soils. Sandstone hills. | Unlikely |
| *Thryptomene nealensis* | P3 | Shrub, ca 0.3 m high. Fl. pink, Oct. Lateritic breakaways | Unlikely |
| *Comesperma viscidulum* | P4 | Shrub, to ca 0.7 m high. | Possible |
| *Eremophila pungens* | P4 | Erect, viscid shrub, 0.5-1.5 m high. Fl. purple-violet, Jun to Aug. Sandy loam, clayey sand over laterite. Plains, ridges, breakaways. | Known to occur |

| Species | Conservation Code | Description | Likelihood of Occurrence[3] |
|---|---|---|---|
| *Frankenia glomerata* | P4 | Prostrate shrub. Fl. pink-white, Nov. White sand. | Unlikely |
| *Grevillea inconspicua* | P4 | Intricately branched, spreading shrub, 0.6-2 m high. Fl. white/pink-white, Jun to Aug. Loam, gravel. Along drainage lines on rocky outcrops, creeklines. | Possible |
| *Hemigenia exilis* | P4 | Erect, multi-stemmed shrub, 0.5-2 m high. Fl. blue-purple/white, Apr or Sep to Nov. Laterite. Breakaways, slopes. | Unlikely |
| *Olearia arida* | P4 | Erect shrub, to 0.4 m high. Fl. white, Jul to Sep. Red or yellow sand. Undulating low rises. | Possible |

#### *5.1.3.4 Tecticornia spp.*

In 2018, targeted surveys were commissioned to establish target transects and undertake targeted searches for Priority flora within samphire (*Tecticornia* spp.) vegetation. Surveys were designed in accordance with the EPA's Technical Guidance – Flora and Vegetation Survey (EPA 2016c). APC were advised that two sampling events were required for each quadrat; one between August and October when winter-flowering taxa are in fruit and spring-flowering taxa are in late flower, and the second in December or January when spring-flowering taxa are in fruit.

During the initial targeted survey of the On Playa Samphire community (*Tecticornia* spp.) (September 2018), six different species were identified, one Priority 1 Flora taxon was identified (*Tecticornia willisii*) (with all three records located outside of the Proposal footprint (Figure 11), one potentially distinct taxon was identified (*Tecticornia* aff. *undulata*) and six specimens out of the 60 collected were found to be sterile and could not be identified.

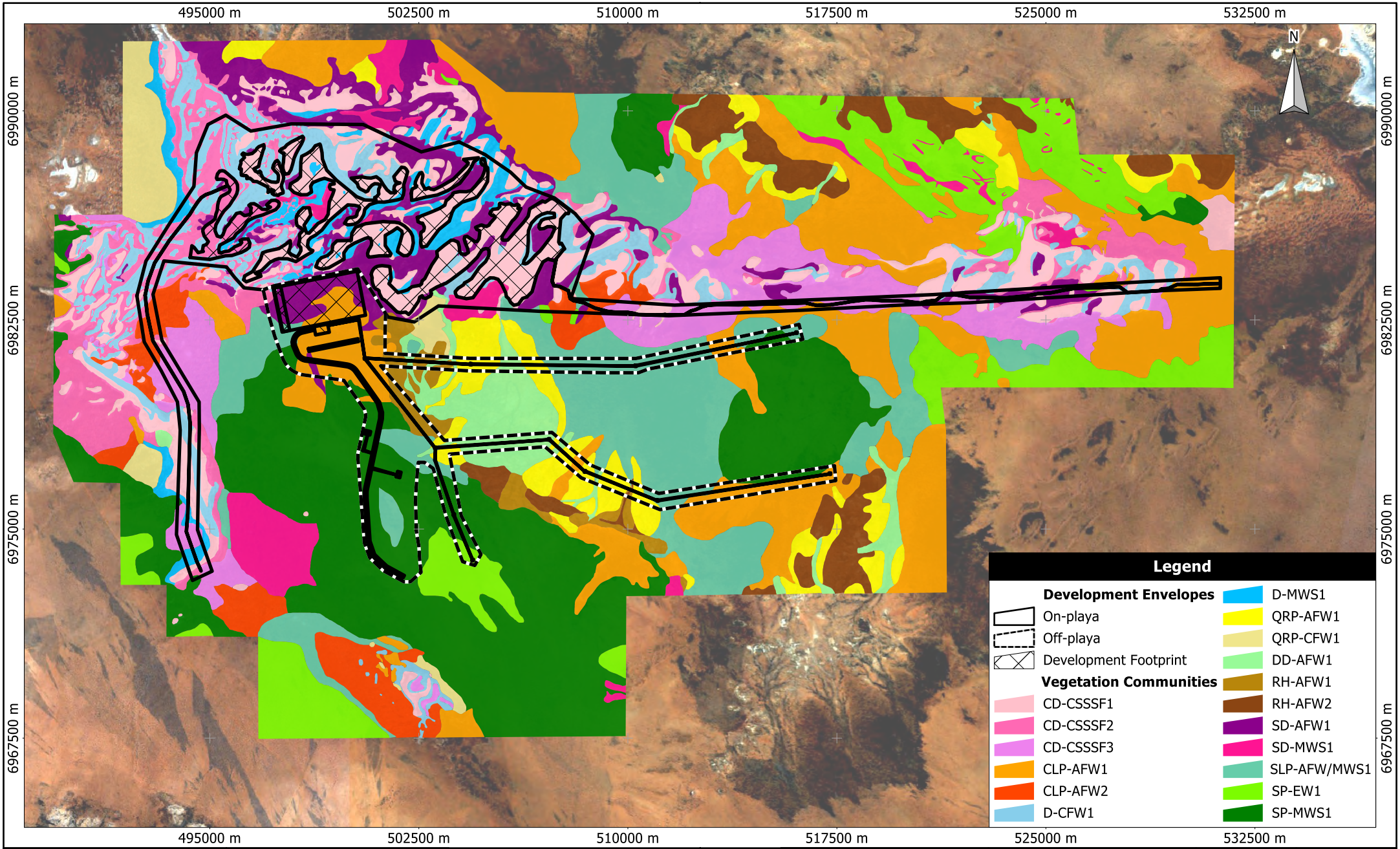
A repeat survey was completed in January 2019, aiming to collect reproductive specimens (Botanica Consulting 2019b). One specimen was confirmed as *Tecticornia peltata*, which is known to be widely distributed across the Wheatbelt, Carnarvon, Coolgardie, Gascoyne, Geraldton Sandplains, Great Victoria Desert, Little Sandy Desert, Mallee and Murchison regions (WAH 1998). The other five specimens, representing three species, remained sterile and could not be identified by the Western Australian Herbarium (WAH).

No description is available for the potentially distinct taxon, *Tecticornia* aff. *undulata*. The specimen of this plant was identified by taxonomic specialist Kelly Shepherd of the WAH as a potentially new taxon that shows an affinity to *Tecticornia undulata*.

Additional survey work in January 2019 attempted to determine the population size of *Tecticornia willisii* (P1) and *Tecticornia* aff. *undulata*. As the species occurred at high densities, an estimate of the population was conducted using extrapolation based on population area. To determine extrapolated population counts, average plant density of the species within 100 $m^2$ was determined. The boundary of the population was then traversed on foot to determine the total area of the population. The number of plants per square metre was then multiplied by the number of square metres covered by the population. Based on the assessment, an estimated 6,731 plants of *Tecticornia* aff. *undulata* were recorded of which approximately 61% of the total known extent occur within the Proposal footprint. An estimated 141,605 plants of *Tecticornia willisii* (P1) were recorded of which 0% occur within the Proposal footprint (Botanica 2019c).

#### *5.1.3.5 Introduced Flora*

Five introduced species were identified within the survey area; *Bidens bipinnata* (Spanish needles), *Citrullus lanatus* (Pie Melon), *Cucumis myriocarpus* (Prickly Paddy Melon), *Sonchus oleraceus* (Common Sowthistle), *Tribulus terrestris* (Caltrop) (Botanica Consulting 2019a). None of these species are listed as a Declared Plant under Section 22 of the *Biosecurity and Agriculture Management Act 2007*.




Scale: 1:180000
Original Size: A4
Air Photo Date: March 2016
Grid: MGA94(51)

0 5 km

Australian Potash
Lake Wells
Environmental Review Document

**Figure 10**

**Vegetation Community Mapping**

Martinick Bosch Sell Pty Ltd
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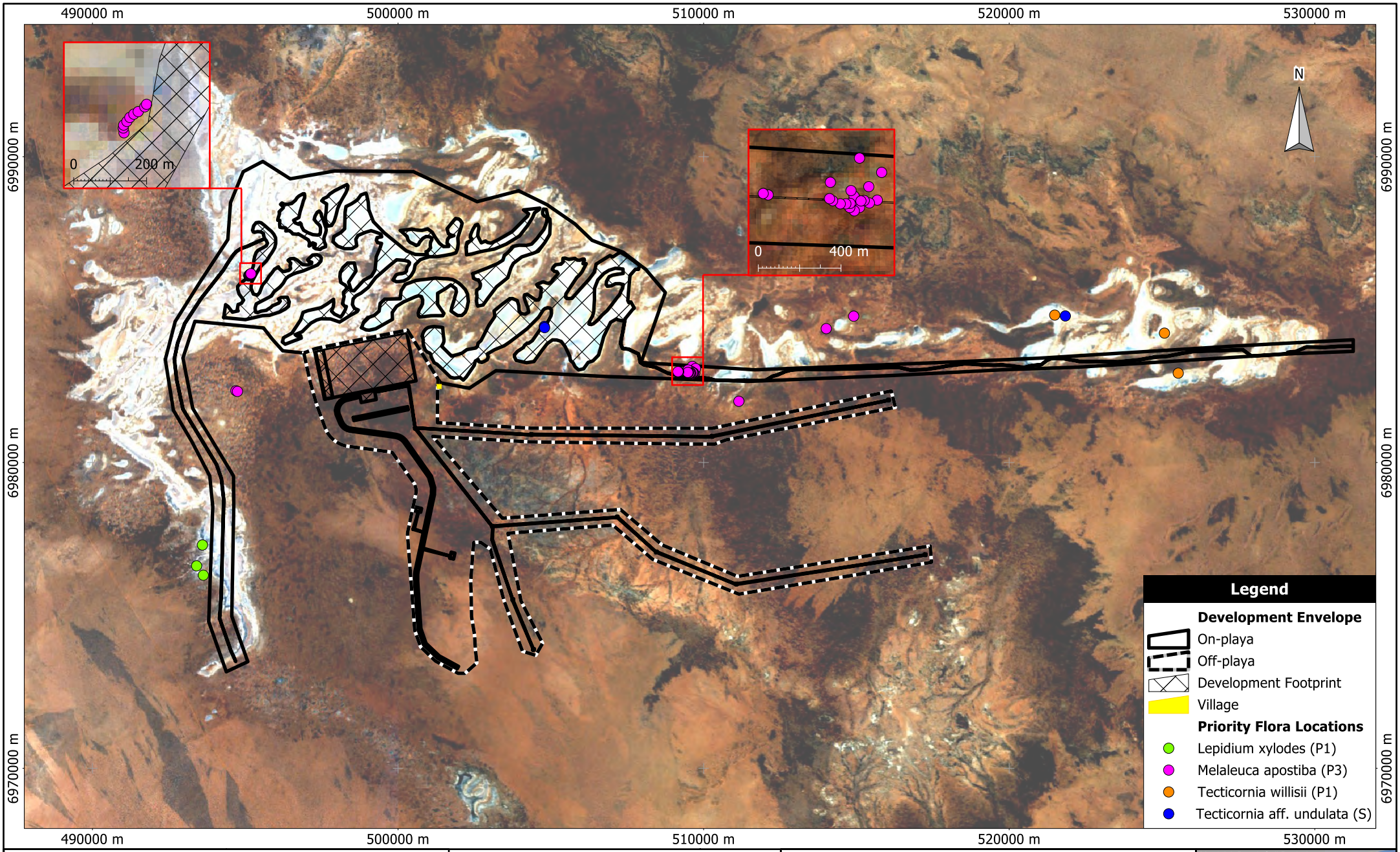
W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\VegetationCommunities.map 24/03/2020 F10 Vegetation Communities Layout




Scale: 1:160000
Original Size: A4
Air Photo Date: March 2016
Grid: Australia MGA94 (51)

0 5 km

Australian Potash
Lake Wells
Environmental Review Document

**Figure 11**

**Priority Flora Species Mapping**

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W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\VegetationCommunities.map 24/03/2020 F11 Priority Flora Layout

#### *5.1.3.6 Groundwater Dependent Ecosystems*

An assessment of the potential for ecosystems within the Development Envelope and surrounds to be dependent on groundwater (i.e. represent a Groundwater Dependent Ecosystem or 'GDE') was conducted by Hydrobiology (2017) using data for Normalised Difference Vegetation Index (NDVI), Normalised Difference Wetness Index (NDWI or Wetness Index) and Evapotranspiration (ET) from 2006 and 2008. NDVI provides an indication of the 'greenness' of vegetation and can be used to interpret vegetation condition. The years 2006 and 2008 were chosen for analysis of Landsat 4-5 imagery (NDVI and NDWI) based on suitable dry season conditions and availability of high-quality, cloud-free imagery.

No vegetation community showed consistently high and unvarying NDVI and NDWI indices (the spectral signature typically associated with a 'GDE'). Two vegetation units (CD-CSSSF1 and D-CFW1) showed low, but relatively constant, NDVI values (for both years) and moderate NDWI values for 2008, which would indicate areas of sparse vegetation or bare soil.

Taking into account the outcomes of the GDE study, combined with knowledge of the underlying geology, groundwater and floristics of the vegetation communities, it was considered that vegetation surrounding the Playa may opportunistically access stored rainfall within shallow (approximately 1 – 5 m) alluvial and colluvial soil profiles, but it is unlikely that they represent true GDEs (Hydrobiology 2017).

### 5.1.4 Potential Impacts

#### *5.1.4.1 On Playa*

- Localised loss of vegetation from clearing.
- Loss of significant flora and vegetation.
- Loss of biological diversity and reduced regional representation of flora and vegetation communities.
- Fragmentation of vegetation communities within the On Playa area.
- Alteration to vegetation communities resulting from changed drainage patterns.

#### *5.1.4.2 Off Playa*

- Localised loss of vegetation from clearing.
- Loss of significant flora and vegetation.
- Introduction of new, and spread of existing weed species due to increased activity in the local area.
- Damage or loss of vegetation due to increased fire risk.
- Impact to vegetation due to saline water spills or leaks.
- Alteration to vegetation communities resulting from changed drainage patterns.
- Reduction in vegetation condition due to dust emissions.

### 5.1.5 Assessment of Impacts

#### *5.1.5.1 Localised Loss of Vegetation From Clearing (On and Off Playa)*

The Proposal will impact on flora and vegetation through localised direct loss of vegetation as a result of clearing within the proposed Development Envelopes. The proposed direct disturbance and mapped area for each community is provided in Table 12.

An On Playa Proposal footprint of up to 2,470 ha will be cleared for Bitterns Ponds, Concentrator/Crystalliser Ponds, Brine Borefield and other On Playa Infrastructure. The vegetation within the On Playa Development Footprint

consists principally of low samphire shrubland (vegetation type CD-CSSSF1) in 'good' condition, with 48.7% of the mapped extent located within the Development Envelopes and up to 31% of the mapped extent within the footprint (Table 12, Figure 10). This vegetation community is well represented at a regional scale within adjacent Playa systems as it was mapped extending to the east and west beyond the survey area (Figure 10). The next most impacted On Playa vegetation types are 'mid-heathland of *Cratystylis subspinescens* over low open chenopod shrubland of *Atriplex vesicaria* and open forbland of *Frankenia* spp. on Playa edge' (CD-CSSSF2) (loss of up to 6.2% of mapped extent within footprint and 25.1% within the Development Envelopes) and 'low woodland of *Acacia caesaneura* / *A. incurvaneura* over tall open shrubland of *Eremophila* spp. / *Senna* spp. / *Melaleuca interioris* and low open hummock grassland of *Triodia basedowii* / low open tussock grassland of *Eragrostis eriopoda* in dunefield' (vegetation type SD-AFW1) (2.2% of mapped extent within footprint and 10.6% within Development Envelopes) (Table 12).

An Off Playa Development Footprint of up to 750 ha will be developed, with up to 150 ha required for infrastructure, up to 90 ha for the production borefields and up to 510 ha for the Harvest Ponds and Processing Plant. Within the Off Playa Development Envelope, the majority of clearing will occur in vegetation types SD-AFW1 (up to 10.3% total of mapped area including both On and Off Playa footprints) and CLP-AFW1 (up to 2.2% of mapped extent including both On and Off Playa footprints). Both communities are well represented within the wider area and were mapped extending to the north beyond the survey area (Table 12, Figure 10).

The proposed clearing will result in a loss of no more than 31% of the local mapped extent of a vegetation community, with all impacted communities considered to be regionally common and widespread.

Table 12: Potential Direct Impacts of Vegetation Types

| Code | Description | Proposed On Playa Clearing Area (ha) | Proposed Off Playa Clearing Area (ha) | Area in Envelopes (ha) | Total Area Mapped (ha) | Proportion Within Footprint (%) | Proportion Within Envelopes (%) |
|---|---|---|---|---|---|---|---|
| Chenopod Shrublands, Samphire Shrublands and Forblands | | | | | | | |
| CD-CSSSF1 | Low samphire shrubland of *Tecticornia indica* subsp. *bidens*/ *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS522) in Playa | 1,925 | 0 | 3,033 | 6,233 | 30.9 | 48.7 |
| CD-CSSSF2 | Mid heathland of *Cratystylis subspinescens* over low open chenopod shrubland of *Atriplex vesicaria* and open forbland of *Frankenia* spp. On Playa edge | 251 | 2 | 1,022 | 4,068 | 6.2 | 25.1 |
| CD-CSSSF3 | Mid open shrubland of *Eremophila paisleyi*/ *Lawrencia squamata*/ *Lycium australis* over low open chenopod shrubland of *Atriplex* spp. and open forbland of *Frankenia* spp. On Playa edge | 10 | 1 | 577 | 4,124 | 0.3 | 14.0 |
| Acacia Forests and Woodlands | | | | | | | |
| CLP-AFW1 | Low open forest of *Acacia incurvaneura* over mid shrubland of *Eremophila margarethae* and low open tussock grassland of *Eriachne mucronata*/ *Eragrostis eriopoda* on clay loam plain | 2 | 253 | 1,207 | 11,345 | 2.2 | 10.6 |
| CLP-AFW2 | Low woodland of *Acacia caesaneura* over mid open shrubland of *A. burkittii* and mid chenopod shrubland of *Maireana pyramidata*/ low open hummock grassland of *Triodia desertorum* on clay loam plain | 2 | 0 | 178 | 2,014 | 0.1 | 8.8 |
| DD-AFW1 | Low open forest of *Acacia caesaneura* over mid open shrubland of *Senna artemisioides* subsp. *filifolia* and low open tussock grassland of *Eragrostis eriopoda* in drainage depression | 0.01 | 12 | 299 | 2,013 | 0.6 | 14.8 |
| QRP-AFW1 | Low open woodland of *Acacia caesaneura*/ *A. incurvaneura* over mid open shrubland of *A. burkittii*/ *Eremophila fraseri* and low open shrubland of *Ptilotus obovatus*/ *sparse tussock* grassland of *Eragrostis eriopoda* on quartz/rocky plain | 0 | 13 | 329 | 2,877 | 0.5 | 11.5 |
| RH-AFW1 | Low open forest of *Acacia quadrimarginea* over mid open shrubland of *Senna artemisioides* subsp. *filifolia*/ *Senna sp. Meekatharra* (E. Bailey 1-26) and low open shrubland of *Ptilotus obovatus* on rocky hillslope | 0 | 8 | 266 | 820 | 1.0 | 32.4 |
| RH-AFW2 | Low woodland of *Acacia incurvaneura* over mid open shrubland of *Eremophila jucunda* and tussock grassland of *Eragrostis eriopoda*/ *Eriachne mucronata* on rocky hillslope | 0 | <1 | 5 | 2,472 | 0 | 0.2 |

| Code | Description | Proposed On Playa Clearing Area (ha) | Proposed Off Playa Clearing Area (ha) | Area in Envelopes (ha) | Total Area Mapped (ha) | Proportion Within Footprint (%) | Proportion Within Envelopes (%) |
|---|---|---|---|---|---|---|---|
| SD-AFW1 | Low woodland of *Acacia caesaneural A. incurvaneura* over tall open shrubland of *Eremophila spp./ Senna spp./ Melaleuca interioris* and low open hummock grassland of *Triodia basedowiil* low open tussock grassland of *Eragrostis eriopoda* in dunefield | 81 | 311 | 2,020 | 3,821 | 10.3 | 52.9 |
| Casuarina Forests and Woodlands | | | | | | | |
| D-CFW1 | Low open forest of *Casuarina pauper* over tall open shrubland of *Acacia burkittii* and low sparse chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 118 | 1 | 1,611 | 3,461 | 3.4 | 46.5 |
| QRP-CFW1 | Low woodland of *Casuarina pauper* over mid shrubland of *Eremophila paisleyi* subsp. *paisleyi/ Senna artemisioides* subsp. *filifolia* and low open shrubland of *Ptilotus obovatus* on quartz/rocky plain | 0 | 0 | 38 | 1,334 | 0 | 2.9 |
| Mallee Woodlands and Shrublands | | | | | | | |
| D-MWS1 | Mid open mallee forest of *Eucalyptus gypsophila* over mid open shrubland of *Senna artemisioides/ Eremophila* spp. And low open chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 67 | 0 | 899 | 1,436 | 4.7 | 62.6 |
| SD-MWS1 | Mid mallee woodland of Eucalyptus concinna over low open shrubland of *Aluta maisonneuvei* subsp. *auriculata/ Dodonaea viscosa* and low closed hummock grassland of *Triodia desertorum* in dunefield | 12 | 0 | 201 | 1,806 | 0.7 | 11.1 |
| SP-MWS1 | Mid mallee shrubland of *Eucalyptus* spp. over mid open shrubland of *Acacia* spp. and low closed hummock grassland of *Triodia basedowii* on sandplain | 0 | 96 | 1,287 | 13,205 | 0.7 | 9.7 |
| Acacia Forests and Woodlands/Mallee Woodlands and Shrublands | | | | | | | |
| SLP-AFW/MWS1 | Low open forest of *Acacia caesaneural* mid mallee woodland of *Eucalyptus lucasii* over mid open shrubland of *Eremophila latrobei* subsp. *glabra* and low hummock grassland of *Triodia desertorum* on sand-loam plain | 0.4 | 46 | 901 | 7,592 | 0.6 | 11.9 |
| Eucalypt Woodlands | | | | | | | |
| SP-EW1 | Low woodland of *Eucalyptus gongylocarpa* over mid open shrubland of *Eremophila platythamnos* subsp. *exotrachys* and low hummock grassland of *Triodia desertorum* on sandplain | 0.6 | 1 | 77 | 5,958 | 0 | 1.3 |
| | Total | 2,470 | 744* | | 74,579 | 4.3 | |

** Total of 744 ha does not include 6 ha for minor Off Playa infrastructure (drainage, topsoil stockpiles) (refer Table 3) for which disturbance locations are not currently known.*

#### 5.1.5.2 Loss of Significant Flora and Vegetation (On and Off Playa)

The Proposal may impact on flora and vegetation through localised loss of significant flora species or significant vegetation communities as a result of clearing or other disturbance within the proposed Development Envelopes.

Three Priority flora taxa were recorded in the survey area:

- *Lepidium xylodes* (P1). As can be seen in Figure 11, three locations of *Lepidium xylodes* were recorded within the survey area with an estimated total of 10,500 plants. None of these locations are within the On or Off Playa Development Envelopes.
- *Tecticornia willisii* (P1). Three specimens were recorded within the survey area. All are located outside of the On and Off Playa Development Envelopes (Botanica Consulting 2019b). This species has also been widely recorded from seven salt lake locations in proximity to Kalium Lakes Potash Pty Ltd's Beyondie proposal (approximately 385 km north west of the Proposal), three of which will not be impacted (Preston Consulting 2019).
- *Melaleuca apostiba* (P3). Thirty of the 35 specimens of *Melaleuca apostiba* identified in the survey area are located within the On Playa Development Envelope. Four are located within the Proposal footprint and may be impacted by the borefield access track or bore infrastructure (Figure 11). This species is also known from several Playa wetland populations outside of the Development Envelopes within the wider Lake Wells lake system to the east and also from the salt lake systems east of Leonora, approximately 220 km south east of the Proposal (Western Australian Herbarium, 2019a). Clearing for the Proposal would remove about 11% of the known locations within the survey area.

One potentially distinct taxon was also identified; *Tecticornia* aff. *undulata*. This taxon was recorded from two locations within the survey area, with an estimated total of 6,731 plants recorded (Botanica Consulting 2019a, 2019b). Approximately 61% of total recorded plants occur within the On Playa Development Envelope and footprint (Figure 12) (Botanica Consulting 2019c). Several different species, also with an affinity to *Tecticornia undulata*, were recorded at Lake Way and Lake Maitland, but in the absence of genetic sequencing the degree of difference between these species are not known.

Of the five specimens, representing three species, of *Tecticornia* sp. that remained sterile and could not be identified by the WAH, only one, '*Tecticornia* sp. sterile 1', was located in the On Playa Development Envelope and within the Proposal footprint (Figure 12), and could potentially be directly impacted. This specimen will be retained, with a 50 m clearance buffer put in place to prevent direct impacts, until its identification and regional abundance can be confirmed. In the event its identification and regional abundance has not been confirmed prior to development of the impacting pond, the pond will be constructed to ensure the surrounding 50 m area, at a minimum, is not disturbed, and that the baseline inundation regime is maintained. This will likely involve the construction of a stand-alone pond wall to the west of the flora location, to allow surface water flows from the south west or north to be maintained.

Potential direct loss of significant flora will be limited, with all species known from, or very likely to occur, considering the large areas of similar salt lake fringing habitats in the region, outside of the Development Envelopes.

Indirect impacts to significant flora and vegetation could occur associated with potential changes in flooding extent within the On Playa, and to a lesser extent within the adjacent Off Playa, environments. Figure 13 shows the existing 0.01 annual exceedance probability (AEP) flood (equivalent to a 1 in 100-year event) and the predicted changes to this as a result of implementation of the Proposal. It is noted that the changes in extent of flooding are predicted to be minor with the additional areas of flooding located at the margins of the exiting flood extent. The locations of Priority flora are also shown on Figure 13. From this it can be seen that:

- All priority species are located within the existing 0.1 AEP apart from a single record of *Melaleuca apostiba* which is on the margins of the existing flood extent.

- A single record of *Melaleuca apostiba* will be within the predicted extent of 0.1 AEP resulting from implementation of the Proposal.

The location of the Priority species within relatively low-lying and flood prone areas suggests a degree of tolerance to flooding. Studies have found that the distribution of *Tecticornia* spp. is determined by the extent of flooding, soil salinity and drought, and how these factors interact (Moir-Barnetson 2014). Thus, if a significant impact to each of these factors can be avoided, indirect impacts are likely to be avoided. The Proposal is not predicted to significantly alter the flood levels or surface water flow rates compared to those occurring under baseline conditions (Golder 2017). The soil salinity outside of the Concentrator/Crystalliser Ponds is also not expected to change significantly. The Proposal is not expected to lead to significant indirect impacts to Priority flora.

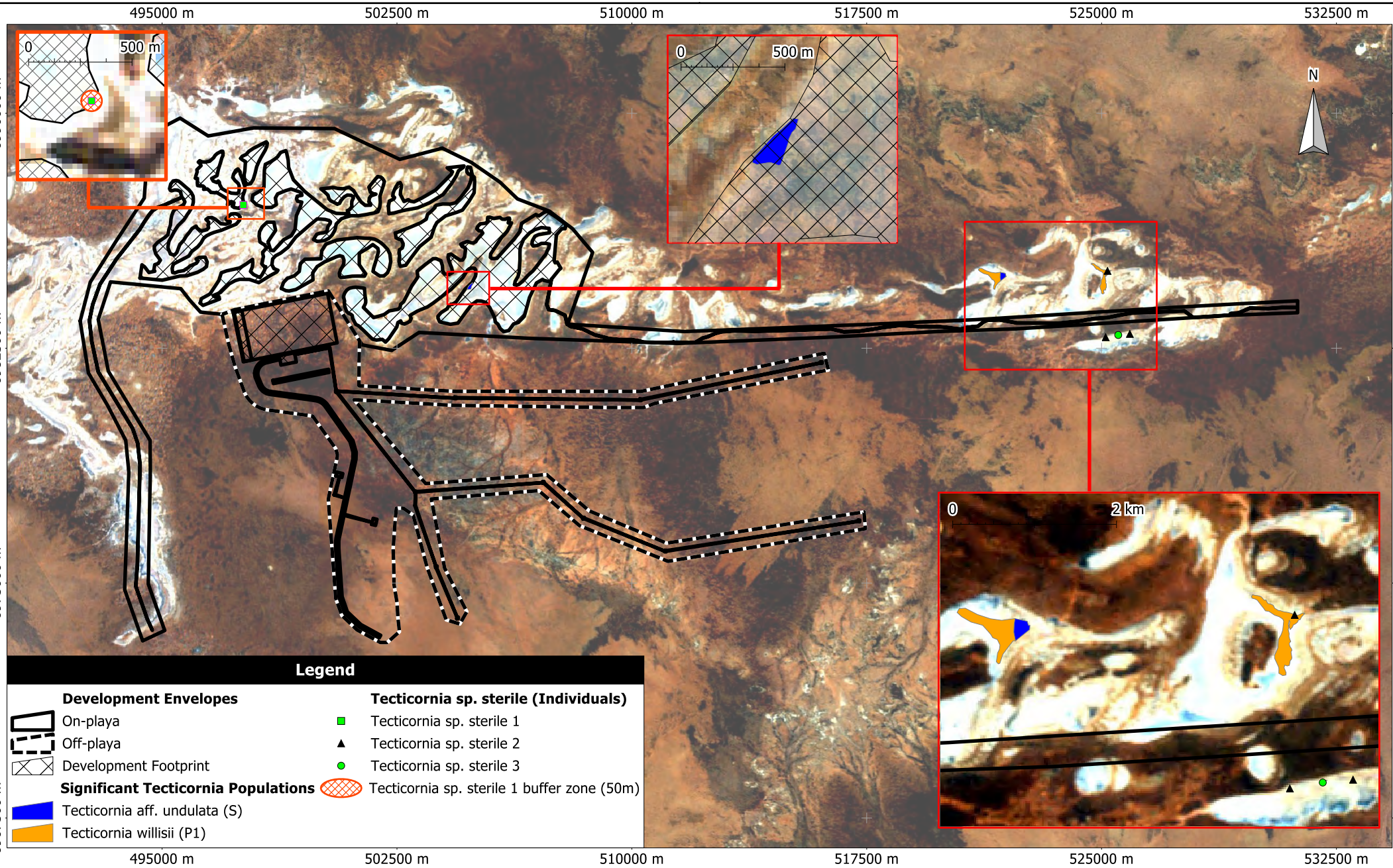
#### *5.1.5.3 Loss of Biological Diversity and Reduced Regional Representation of Flora and Vegetation Communities (On and Off Playa)*

A reduction in the variability within and among flora could occur on the genetic, species and community level as a result of implementation of the Proposal. This may occur through a substantial loss of individual plants of each recorded species and/or a substantial loss of a particular vegetation community assemblage. If not well represented within the wider regional area, this loss may also cause a reduction in regional representation of these species and communities.

The Development Envelopes intersect five Beard (1990) vegetation associations (Botanica Consulting 2019a, Appendix 3), all of which currently remain at close to 100% of the pre-European extent (Section 5.1.3).

Locally surveyed and described 'Low samphire shrubland' (CD-CSSSF1) vegetation type has been calculated to have the potential largest impact from implementation of the Proposal with up to 31% of the mapped extent being directly impacted (Table 12). Impacts to all other vegetation communities are predicted to be less than ~10% of the locally mapped extents (Table 12). Given that the species and vegetation communities to be impacted by the Proposal are considered to be well represented within the wider regional system of salt lake playa, it is not expected that localised loss will have a significant impact on wider regional biological diversity or representation.

Additionally, the area does not support any formal recognised biologically diverse or significant vegetation communities. Refer to Section 5.1.5.2 for discussion of impacts to significant flora and vegetation.




Scale: 1:160000
Original Size: A4
Air Photo Date: March 2016
Grid: Australia MGA94 (51)

0 5 km

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**Figure 12**

**Location of Tecticornia aff. undulata, Tecticornia willisii, and Tecticornia sp. sterile (1, 2 and 3) Occurrences in Relation to Proposal Footprint**

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W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\VegetationCommunities.map 24/03/2020 F12 Tecticornia willisii, undulata and sterile

1087500 1095000 1102500 1110000 1117500

6975000

6967500

6960000

N

Legend

**Development Envelope**

- Off-playa
- On-playa
- Development Footprint

**AEP 0.01 Flood Boundary Changes**

- New Flood Inundation Areas
- Existing AEP 0.01 Extent

**Priority Flora Records**

- Lepidium xylodes (P1)
- Melaleuca apostiba (P3)
- Tecticornia aff. undulata (S)
- Tecticornia willisii (P1)

Scale: 1:90000
Original Size: A3
Aerial Photo: ESRI Satellite
Grid: GDA94 / MGA zone 51 (EPSG:28351)

0 1 2 3 4 5 km

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**Figure 13**

**Priority Flora Locations in Relation to Modelled Changes in Flooding Extent (0.01 AEP Event)**

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#### 5.1.5.4 Fragmentation of Vegetation Communities (On Playa)

The potential for vegetation community fragmentation is most likely to occur where flora taxa with limited populations or vegetation communities with limited extents exist within or immediately adjacent to areas of proposed disturbance.

The On Playa communities are well represented locally and are expected to be present regionally, within similar habitat. Due to the absence of TECs and PECs within the Proposal area, the broad representation of the vegetation communities mapped outside of the Development Envelopes (Figure 10) and the current low cumulative impacts to the mapped vegetation communities represented across the survey area, the potential for fragmentation, leading to changes to genetic diversity, colonisation, or recruitment, within or adjacent to the On Playa Development Envelope is considered low.

#### 5.1.5.5 Alteration to Vegetation Communities Resulting from Changed Drainage Patterns (On and Off Playa)

Altered drainage patterns through diversions associated with Proposal infrastructure may have an impact on the patterns of inundation within the adjacent area. This may alter the survival of species adapted to certain inundation regimes, consequently altering vegetation communities downstream of any altered drainage.

Inflow to the Playa currently occurs primarily from areas to the north and south along two drainage lines. These drainage lines converge adjacent to the western end of the Playa with the drainage line then heading east. This drainage line continues some 25 km eastwards to a larger Playa system which, although still part of Lake Wells, is aligned north-south (Figure 14). Where these drainage lines approach the proposed Concentrator/Crystalliser Ponds, they will be bunded off, by the creation of berms joining adjacent dunes to create a continuous pond wall, to divert flows and prevent inflow into the ponds.

Modelling indicates that following construction of On Playa Ponds, a marginal decrease in flood storage volume will occur, as flows are diverted around the evaporation ponds, causing a localised increase in flood depths (of approximately 0.3 to 0.7 m) following events exceeding a 0.02 AEP event (Golder Associates 2017, MBS Environmental 2018b). It is therefore possible that a very minor increase in the volume of water discharging from the playa system eastwards, into the larger regional system, could occur. Additionally, a marginal increase in flow velocities will also occur, but would remain below approximately 1 m/s (Golder Associates 2017).

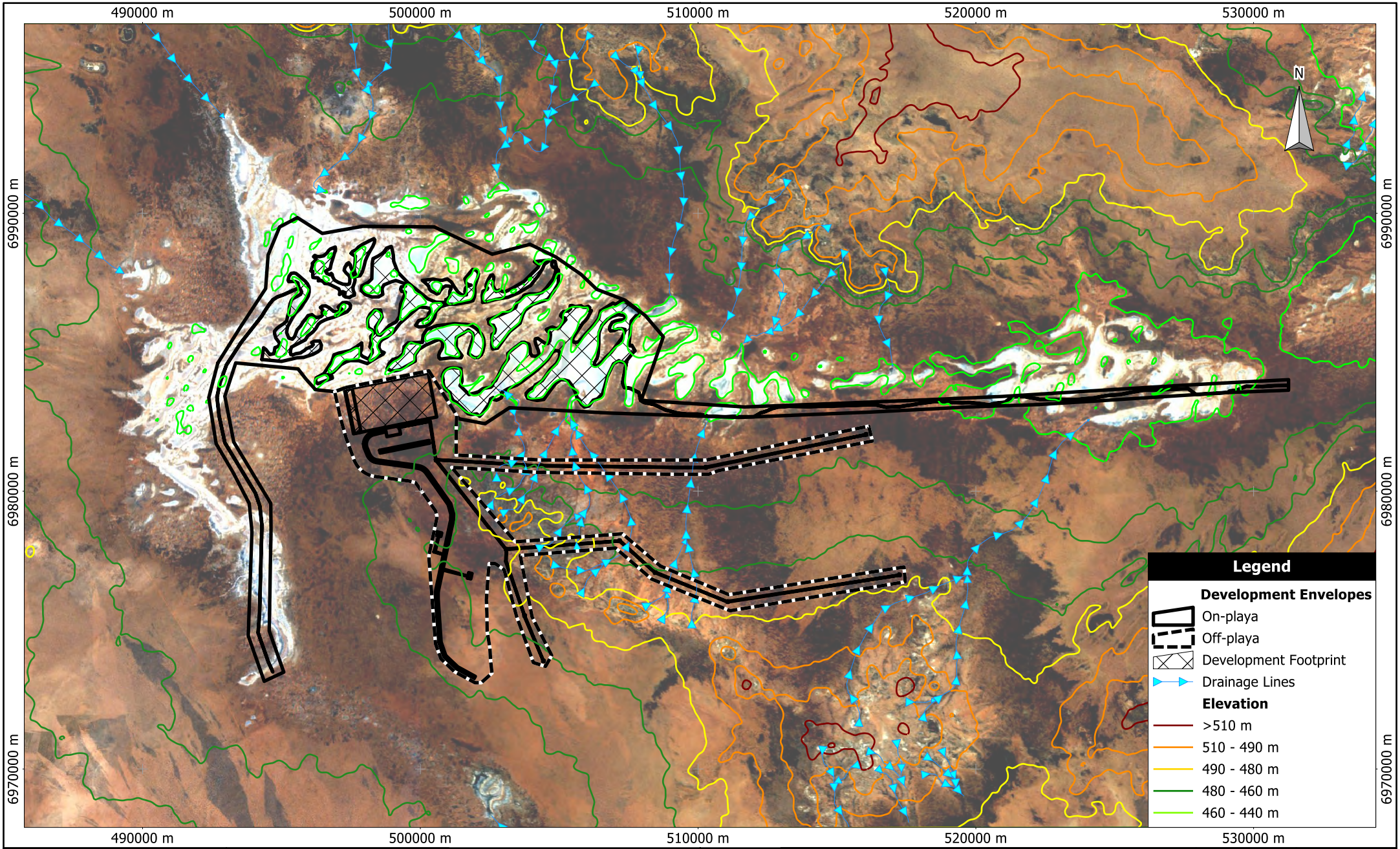
Temporary ponding of surface water is expected behind the berms following a rainfall event (if sufficient to result in surface water flows into the Playa), before water infiltrates into the surrounding dunes or flows to the east. Modelling (Golder Associates 2017) indicates that following construction of Proposal infrastructure, a minor increase in the extent of flooding following a 0.01 AEP event may occur (Figure 15), and following a 0.02 AEP event, flood depths may increase slightly compared to the baseline case.

Some vegetation communities adjacent to the On Playa footprint would experience flooding under a 0.01 AEP event following infrastructure construction, but not under baseline conditions (i.e. an increase in flooding). Table 13 shows the estimated direct impact amounts and the indirect impact amounts, as related to an increase in localised flooding extents, within both the On Playa and Off Playa Development Envelopes.

On Playa vegetation communities have adapted to conditions that include intermittent flooding. Plant tolerance or adaptation to waterlogging generally correlates well with the degree of flooding in the natural habitat of any given species (Visser *et al.* 2000). Flood events in dryland systems are often unpredictable, infrequent and short-lived (Ruprecht and Ivanescu 2000). Therefore, dryland plant species typically exhibit moderate flooding tolerance with capacity to recover quickly once flooding has subsided (Argus et al. 2014). The Chenopod Shrublands, Samphire Shrublands and Forblands vegetation type (MVG 22) recorded within the playa and on the playa margin (represented by vegetation types CD-CSSSF1, CD-CSSSF2 and CD-CSSSF3 (Figure 10)) are all expected to be highly tolerant to the minor increases to inundation that may occur as a result of the Proposal (as mapped in Figure 15 and quantified in Table 13). The Off Playa communities may be impacted in the short term, but are well represented locally and regionally (Table 13, Figure 15).

Potential impacts to vegetation due to a decrease in the extent of flooding during a 0.01 AEP event, following the construction of infrastructure, are also included within the indirect impact calculations presented in Table 13. The majority of areas expected to experience a reduction in inundation are within the On Playa Development Footprint and are included within the direct impact calculations presented in Table 13. Figure 15 shows the additional areas, outside of the Development Footprints, predicted to experience a decrease in flooding under a 0.01 AEP event. The main On Playa areas (totalling 20 ha) predicted to experience a decrease in flooding are shown in the inset within Figure 15. Only very limited Off Playa areas are predicted to experience a decrease in inundation associated with the proposed infrastructure.

It can be seen from Table 13 that the following vegetation communities are potentially impacted the most (cumulative direct and indirect impacts in brackets): CD-CSSSF1 (31.3%), CD-CSSSF2 (7.9%), SD-AFW1 (18.5%), D-CFW1 (8.5%) and D-MWS1 (13.3%).




Scale: 1:180000
Original Size: A4
Aerial Photo Date: March 2016
Grid: MGA94(51)

0 5 km

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**Figure 14**

**Drainage Lines in Proximity to the Development Envelope**

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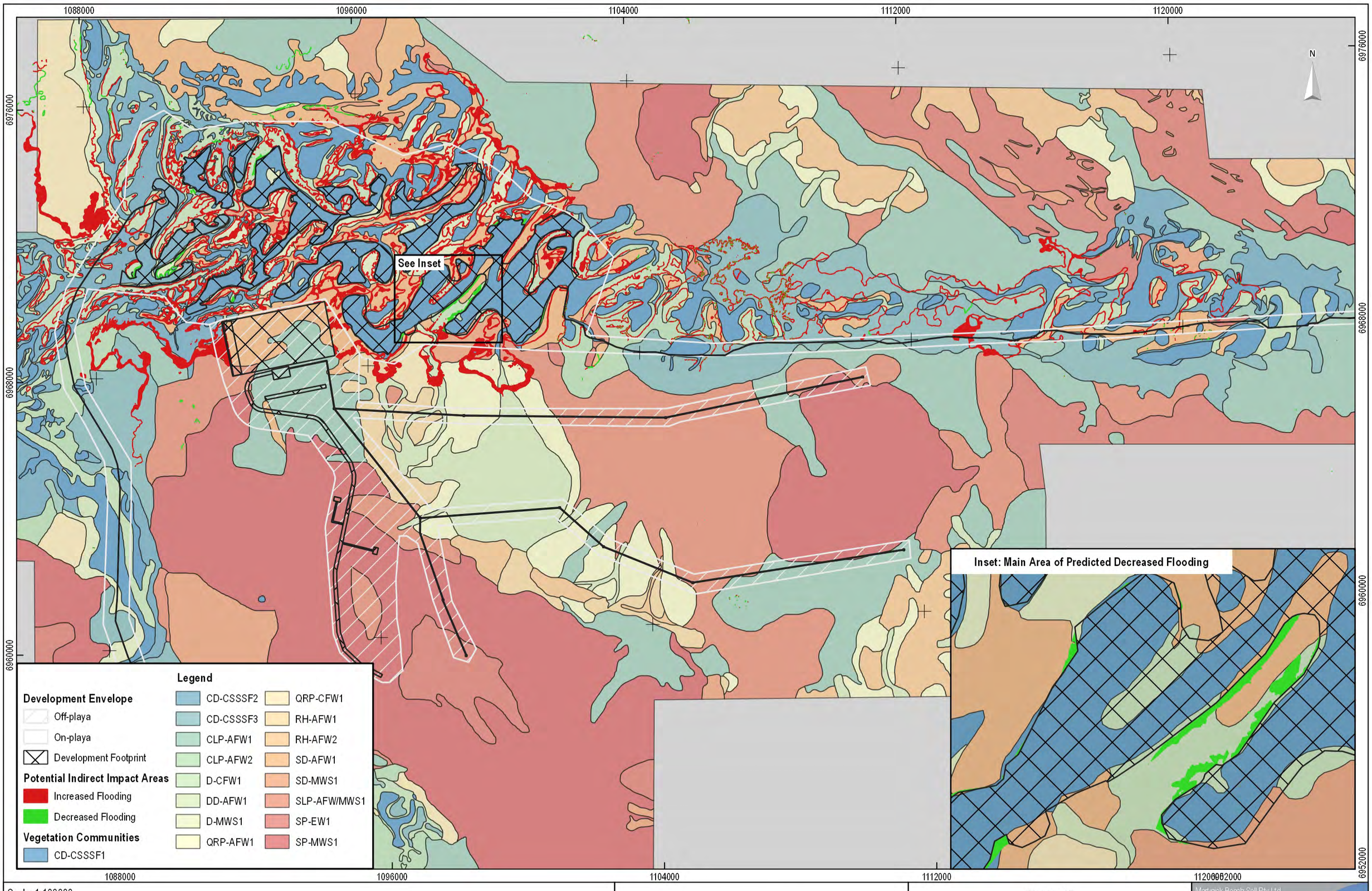
W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\General Map.map 24/03/2020 F14 Drainage Lines Layout




Scale: 1:100000
Original Size: A3
Aerial Photo: ESRI Satellite
Grid: GDA94 / MGA zone 51 (EPSG:28351)

0 1 2 3 4 5 km

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**Figure 15**

**Vegetation Communities in Relation to Modelled Changes in Flooding Extent (0.01 AEP Event)**

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Table 13: Potential Indirect Impacts to Vegetation Communities due to Changes in Flood Extent

| Code | Description | Potential Direct Loss Within Footprint (ha)* | Potential Indirect Impacts (ha)** | Total Area Mapped (ha) | Proportion of Total Mapped Area Impacted (%) |
|---|---|---|---|---|---|
| Chenopod Shrublands, Samphire Shrublands and Forblands | | | | | |
| CD-CSSSF1 | Low samphire shrubland of *Tecticornia indica* subsp. *bidens*/ *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS522) in Playa | 1,925 | 25 | 6,233 | 31.3 |
| CD-CSSSF2 | Mid heathland of *Cratystylis subspinescens* over low open chenopod shrubland of *Atriplex vesicaria* and open forbland of *Frankenia* spp. On Playa edge | 253 | 69 | 4,068 | 7.9 |
| CD-CSSSF3 | Mid open shrubland of *Eremophila paisleyi*/ *Lawrencia squamata*/ *Lycium australis* over low open chenopod shrubland of *Atriplex* spp. and open forbland of *Frankenia* spp. On Playa edge | 10 | 65 | 4,124 | 1.8 |
| Acacia Forests and Woodlands | | | | | |
| CLP-AFW1 | Low open forest of *Acacia incurvaneura* over mid shrubland of *Eremophila margarethae* and low open tussock grassland of *Eriachne mucronata*/ *Eragrostis eriopoda* on clay loam plain | 254 | 67 | 11,345 | 2.8 |
| CLP-AFW2 | Low woodland of *Acacia caesaneura* over mid open shrubland of *A. burkittii* and mid chenopod shrubland of *Maireana pyramidata*/ low open hummock grassland of *Triodia desertorum* on clay loam plain | 2 | 22 | 2,014 | 1.2 |
| DD-AFW1 | Low open forest of *Acacia caesaneura* over mid open shrubland of *Senna artemisioides* subsp. *filifolia* and low open tussock grassland of *Eragrostis eriopoda* in drainage depression | 12 | 13 | 2,013 | 1.2 |
| QRP-AFW1 | Low open woodland of *Acacia caesaneura*/ *A. incurvaneura* over mid open shrubland of *A. burkittii*/ *Eremophila fraseri* and low open shrubland of *Ptilotus obovatus*/ *sparse tussock* grassland of *Eragrostis eriopoda* on quartz/rocky plain | 13 | 26 | 2,877 | 1.4 |
| RH-AFW1 | Low open forest of *Acacia quadrimarginea* over mid open shrubland of *Senna artemisioides* subsp. *filifolia*/ *Senna sp. Meekatharra* (E. Bailey 1-26) and low open shrubland of *Ptilotus obovatus* on rocky hillslope | 8 | 19 | 820 | 3.3 |
| RH-AFW2 | Low woodland of *Acacia incurvaneura* over mid open shrubland of *Eremophila jucunda* and tussock grassland of *Eragrostis eriopoda*/ *Eriachne mucronata* on rocky hillslope | <1 | 0 | 2,472 | 0.0 |

| Code | Description | Potential Direct Loss Within Footprint (ha)* | Potential Indirect Impacts (ha)** | Total Area Mapped (ha) | Proportion of Total Mapped Area Impacted (%) |
|---|---|---|---|---|---|
| SD-AFW1 | Low woodland of *Acacia caesaneura/ A. incurvaneura* over tall open shrubland of *Eremophila spp./ Senna spp./ Melaleuca interioris* and low open hummock grassland of *Triodia basedowii/* low open tussock grassland of *Eragrostis eriopoda* in dunefield | 392 | 313 | 3,821 | 18.5 |
| Casuarina Forests and Woodlands | | | | | |
| D-CFW1 | Low open forest of *Casuarina pauper* over tall open shrubland of *Acacia burkittii* and low sparse chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 119 | 175 | 3,461 | 8.5 |
| QRP-CFW1 | Low woodland of *Casuarina pauper* over mid shrubland of *Eremophila paisleyi* subsp. *paisleyi/ Senna artemisioides* subsp. *filifolia* and low open shrubland of *Ptilotus obovatus* on quartz/rocky plain | 0 | 91 | 1,334 | 6.8 |
| Mallee Woodlands and Shrublands | | | | | |
| D-MWS1 | Mid open mallee forest of *Eucalyptus gypsophila* over mid open shrubland of *Senna artemisioides/ Eremophila* spp. And low open chenopod shrubland of *Atriplex vesicaria* on gypsum dune | 66 | 125 | 1,436 | 13.3 |
| SD-MWS1 | Mid mallee woodland of Eucalyptus concinna over low open shrubland of *Aluta maisonneuvei* subsp. *auriculata/ Dodonaea viscosa* and low closed hummock grassland of *Triodia desertorum* in dunefield | 12 | 59 | 1,806 | 3.9 |
| SP-MWS1 | Mid mallee shrubland of *Eucalyptus* spp. over mid open shrubland of *Acacia* spp. and low closed hummock grassland of *Triodia basedowii* on sandplain | 96 | 1 | 13,205 | 0.7 |
| Acacia Forests and Woodlands/Mallee Woodlands and Shrublands | | | | | |
| SLP-AFW/MWS1 | Low open forest of *Acacia caesaneura/* mid mallee woodland of *Eucalyptus lucasii* over mid open shrubland of *Eremophila latrobei* subsp. *glabra* and low hummock grassland of *Triodia desertorum* on sand-loam plain | 46 | 29 | 7,592 | 1.0 |
| Eucalypt Woodlands | | | | | |
| SP-EW1 | Low woodland of *Eucalyptus gongylocarpa* over mid open shrubland of *Eremophila platythamnos* subsp. *exotrachys* and low hummock grassland of *Triodia desertorum* on sandplain | 2 | 2 | 5,958 | 0.1 |

** Total does not include 6 ha for minor Off Playa infrastructure (drainage, topsoil stockpiles) (refer Table 3) for which disturbance locations are not currently known.*

*** Indirect impacts were calculated based on those areas predicted to experience an increase in flooding, and decrease in flooding, under a 0.01 AEP event, following infrastructure construction.*

#### 5.1.5.6 Vegetation Damage due to Increased Fire Risk (On and Off Playa)

Loss of vegetation from fire is a persistent threat in the Australian landscape, with bushfires often caused by lightning. Bushfires are considered a natural part of the environment as they can assist with regeneration of some species and ecosystems. As well as naturally occurring fires, controlled burning is conducted by land managers as part of pastoral activities and regional fire management programs. Activities associated with the Proposal have the potential to cause bushfires, leading to potentially increased fire intensity and / or frequency, which can impact vegetation through localised loss or reduced recovery between burns.

A small amount of vegetation clearing will be required both On and Off Playa during construction of the Proposal. Given the solution mining process, limited vehicle traffic will be required during operations in the On Playa Development Envelope. The majority of activity during operations will be located in the Off Playa Development Envelope. Vegetation both On and Off Playa typically has a low cover and is unlikely to sustain bushfires. Potential sources for fire and the risk of a bushfire originating from the Proposal are considered low given the nature and location of the Proposal.

#### 5.1.5.7 Introduction of New, and Spread of Existing, Weed Species due to Increased Activity in the Local Area (Off Playa)

Weeds have the potential to outcompete and displace native vegetation if introduced or conditions are altered to favour their growth. Additionally, weeds can displace palatable feed for stock, reducing carrying capacity of pastoral areas (DoEE 2018). Weeds may be spread and/or introduced by poor hygiene practices on vehicles and equipment, resulting in soil and weed vegetative material or seeds being transported around site, or into site or offsite.

All five weed species identified within the Development Envelopes; *Bidens bipinnata* (Spanish needles), *Citrullus lanatus* (now known as *Citrullus amarus*) (Pie Melon), *Cucumis myriocarpus* (Prickly Paddy Melon), *Sonchus oleraceus* (Common Sowthistle) and *Tribulus terrestris* (Caltrop), are known to be widely distributed through the region and other parts of WA.

A small amount of vegetation clearing will be required both on and off playa during construction of the project. Specialised earth moving equipment will be introduced to the Proposal area for these works and removed on completion. Given the solution mining process, limited vehicle traffic will be required during operations in both the On and Off Playa Development Envelopes. The potential for weed introduction and spread in the On Playa Development Envelope is considered low given the highly saline nature of the soils which is hostile to seed germination. Given the saline to hypersaline nature of the contents of the various ponds and process liquors, the potential for establishment and spread of weeds near such infrastructure is also considered low.

Given the location and nature of the Proposal, it is considered unlikely that the introduction of a new weed species or the proliferation of an existing weed species will occur.

#### 5.1.5.8 Death of Vegetation due to Saline Water Leaks or Spills (Off Playa)

There is potential for brine to leak or spill from the ponds or borefield pipelines, either from seepage through the Off Playa Harvest Ponds, Harvest Pond overflow or pipeline leaks. Brine is highly saline, and although On Playa vegetation is well adapted to a saline environment, elevated salinity within Off Playa soils is likely to be harmful to the flora and vegetation in this area.

The Harvest Ponds will be constructed with a HDPE liner to prevent lateral and downward seepage of brine, so the risk of leaks is considered low. The risk of a Harvest Pond overflow is low given pond levels and pumping rates will be monitored and strictly controlled to prevent loss of product. Similarly, the risk of a brine borefield pipeline leak or rupture resulting in a significant loss of brine is low given the pipelines will be appropriately designed, constructed and tested. The proposed brine borefield pipelines occur within the On Playa Development Envelope and primarily overlie saline environments associated with the playa. Therefore significant mortality of vegetation would not be expected in the event of a minor leak or spill of brine.

In the event of an extreme weather event involving significant heavy rainfall and regional flooding, some loss of brines from the Concentrator Ponds or Harvest Ponds could potentially occur. Concentrator Pond walls will be designed to have approximately 0.3 m of freeboard, and the Harvest Ponds a 0.5 m freeboard at any time, to minimise the risk of pond overflow. In the event of an overflow, brine would be expected to flow into/remain within the playa system, slowly draining to the east. Given the widespread flooding (and therefore dilution) that would occur during and immediately following an extreme weather event, significant impacts to Off Playa vegetation from a pond overflow would not be expected.

During operations, magnesium chloride brine will be used for dust suppression on the unsealed access road. Drainage adjacent to the access road will prevent the spread of this brine into adjacent vegetation.

#### *5.1.5.9 Reduction in Vegetation Condition due to Dust Emissions (Off Playa)*

Accumulation of dust particulates on leaf surfaces can potentially occur as a result of exposure to dust, resulting in a reduced ability for plants to photosynthesise and transpire, potentially causing a decline in health and eventual plant death. Elevated quantities of dust that may impact on vegetation are likely only to be generated during construction as a result of clearing, or during operations immediately adjacent to the unsealed access road. Impacts from dust generation are likely to be short-term during the land clearing process and not result in permanent impacts to vegetation health. Impacts during operations are likely to be limited to within 50 m of the access road and are likely to lead to reduced vegetation condition rather than death.

Given the vegetation communities are well represented locally and regionally, a local loss of vegetation would be unlikely to result in an adverse impact on the biological diversity and ecological integrity of regional vegetation.

### 5.1.6 Mitigation and Predicted Outcome

The proposed mitigation measures to address potential impacts to flora and vegetation as a result of the Proposal and the predicted outcome are provided in Table 14.

The EPA objective 'to protect flora and vegetation so that biological diversity and ecological integrity are maintained' will be met.

Table 14: Mitigation Measures and Predicted Outcome for Flora and Vegetation

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Localised loss of vegetation from clearing<br>Loss of biological diversity and reduced regional representation of flora and vegetation communities | Measures to avoid:<br>• Concentrator/Crystalliser Ponds have been located on predominantly bare salt flat areas within the On Playa environment.<br>Measures to minimise:<br>• Disturbance of Off Playa vegetation has been minimised through careful design of the site layout.<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>Measures to rehabilitate:<br>• A conceptual Mine Closure Plan has been developed, including objectives for rehabilitation of disturbed areas (Appendix 2). | The proposed clearing is of vegetation communities that are well represented outside of the Development Envelopes. APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation across the Lake Wells Playa system and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br>Limited removal of Priority species will occur as a result of implementation of the Proposal. All Priority species likely to be impacted are known to occur beyond the Development Envelopes and Proposal footprint. |
| Loss of significant flora and vegetation | Measures to avoid:<br>• Specimen of 'Tecticornia sp. sterile 1' to be retained, with a 50 m clearance buffer put in place to prevent impacts.<br>• Alignment of brine borefield disturbance to minimise impact on Melaleuca apostiba (P3 locations). Four of 35 recorded individuals (11%) are located within the Off Playa Proposal footprint. These individuals will be retained where practicable.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>Measures to rehabilitate:<br>• NA | APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of flora and vegetation will be maintained.<br><u>Monitoring</u><br>Inspections/survey to confirm no clearing beyond Development Envelope.<br>Monthly assessment, following Proposal implementation, of the mapped populations of *Tecticornia* sp. Sterile 1.<br>Any decline in the extent of the population attributable or potentially attributable to the Proposal will be reported to the EPA and the potential causes investigated and appropriate management measures implemented, in consultation with the EPA. |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Fragmentation of vegetation communities (On Playa) | Measures to avoid:<br>• Project design has considered use of existing disturbed areas and these will be used wherever possible to minimise total ground disturbance.<br>Measures to minimise:<br>• Clearing activities will be managed to ensure clearing is strictly limited to that necessary.<br>• Concentrator and Crystalliser Ponds will predominantly be bound by existing dunes, thereby minimising any additional fragmentation of vegetation.<br>Measures to rehabilitate:<br>• Surface water flow paths between ponds will be re-established, if altered, on closure. | Fragmentation may affect flora and vegetation within and immediately adjacent to the On Playa Development Footprint, though it is noted that the playa is currently divided by numerous internal dunes. The On Playa *Tecticornia* spp. vegetation communities are widespread throughout the region.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation across the Lake Wells Playa system and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Alteration of vegetation communities resulting from changed drainage patterns | Measures to avoid:<br>• Suitable floodways, drains and culverts will be installed Off Playa to maintain, as much as possible, natural flow patterns adjacent to infrastructure.<br>Measures to minimise:<br>• Project design has considered the location of drainage lines and flood levels in Off Playa areas with the aim of minimising changes to drainage patterns.<br>Measures to rehabilitate:<br>• Upon closure, reinstatement of the natural flow paths will occur after removal of the project infrastructure. | Modification to surface water flows are considered to be minor at a local scale and as such are unlikely to affect the survival of, or reduce the condition of, vegetation within or adjacent to the Development Envelopes.<br>Vegetation communities within the Development Envelopes are well represented locally and regionally, and are resilient to both drought and short term inundation associated with seasonal rainfall events.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation, and the biological diversity and ecological integrity of the present flora and vegetation will be maintained.<br><u>Monitoring</u><br>Monthly assessment, following Proposal implementation, of the mapped populations of *Tecticornia* sp. Sterile 1, *Tecticornia* aff. *undulata* and *Tecticornia willisii* including:<br>• Population extent, density (plant density), health (plant health).<br>• Observations for signs of surface water impacts within or adjacent to population (scour, surface water ponding). |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| | | • Observations for signs of other actual or potential impacts (grazing, fire, land clearing).<br>Any decline in the extent, density or health in any monitored population, if outside of the baseline variation and attributable or potentially attributable to the Proposal, will be reported to EPA, the potential causes investigated and appropriate management measures implemented, in consultation with the EPA. |
| Introduction of new, and spread of existing, weed species | Measures to avoid:<br>• Earth moving machinery will be required to be clean of soil and vegetation prior to entering the Development Envelopes.<br>• No weed affected soil, mulch or fill will be brought into the Development Envelopes.<br>• During operations, vehicles and equipment will keep to designated roads and tracks.<br>Measures to minimise:<br>• Vehicle and equipment hygiene procedures will be implemented to minimise entry of weed and soil borne diseases.<br>Measures to rehabilitate:<br>• Weed inspection and control to be implemented during operations and closure stages as required. | Increased presence of weeds (species and abundance) may affect the health and quality of vegetation. The vegetation types are all well represented regionally, and several weed species already occur. The saline nature of the majority of the operational area of the Proposal will minimise the risk of weed introduction and spread as a result of the Proposal.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Vegetation damage due to increased fire risk | Measures to avoid:<br>• Project infrastructure located in cleared Off Playa areas to be surrounded by appropriate fire break.<br>Measures to minimise:<br>• Fire breaks will be installed in Off Playa areas to protect key infrastructure (where required).<br>• Firefighting equipment will be located in vehicles and buildings, and personnel will be trained in fire response.<br>Measures to rehabilitate:<br>• NA | Increased incidence of fire has the potential to affect the survival or condition of vegetation.<br>APC considers that the risk can be managed such that significant residual impacts to flora and vegetation are unlikely, and the biological diversity and ecological integrity of flora and vegetation will be maintained |

| Potential Impact | Mitigation Measures | Predicted Outcome |
|---|---|---|
| Death of vegetation due to saline water spills or leaks (Off Playa) | Measures to avoid:<br>• Concentrator/Crystalliser Ponds located On Playa within saline environment.<br>Measures to minimise:<br>• Pipelines will be fitted with leak detection systems.<br>• Water flows will be automatically shut off if leaks are detected.<br>• Pipelines will be inspected regularly, especially during extreme heat or fire events.<br>• Investigations will be conducted into the cause of any spills, and remedial actions will be taken to minimise the chance of reoccurrence.<br>Measures to rehabilitate:<br>• NA | Leaks or spills of saline water have the potential to cause adverse impacts to flora and vegetation. Impacts could result in localised effects on the health, abundance and structure of vegetation communities.<br>The majority of the Proposal area is located in the On Playa Development Envelope which is saline in nature and as such supports limited vegetation, with this primarily being fringing samphire vegetation communities adapted to varying salinity ranges.<br>All vegetation communities are well represented in the region and loss would not result in loss of a community or significant species.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |
| Reduction in vegetation condition due to dust emissions | Measures to avoid:<br>• NA<br>Measures to minimise:<br>• Dust control measures will be implemented during construction and operations.<br>• Speed limits will be implemented in project areas to minimise dust emissions.<br>Measures to rehabilitate:<br>• NA | Dust emissions during construction will be short-term and unlikely to result in permanent impacts to vegetation.<br>Dust emissions during operations will be localised and limited primarily to the site access road (<50 m from source). Vegetation in areas adjacent to land clearing activities and the proposed access road is well represented locally and regionally. Impacts may result in reduced vegetation condition, but are considered unlikely to result in vegetation death.<br>APC considers that the potential impacts to flora and vegetation can be managed such that there are no significant residual impacts to flora and vegetation and the biological diversity and ecological integrity of the present flora and vegetation will be maintained. |

# 5.2 KEY ENVIRONMENTAL FACTOR 2 - TERRESTRIAL FAUNA

## 5.2.1 EPA Objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

## 5.2.2 Policy and Guidance

The following policy and guidance documents were taken into consideration in the design of the Proposal, the completion of the environmental impact assessment and through the development of this ERD:

- EPA - Statement of Environmental Principles, Factors and Objectives (EPA 2018c).
- Environmental Impact Assessment (EIA) (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA 2016a).
- EIA (Part IV Divisions 1 and 2) Procedures Manual 2016 (EPA 2018a).
- EPA Factor Guideline – Terrestrial Fauna (EPA 2016d).
- Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016e).
- Technical Guidance – Terrestrial Fauna Surveys (EPA 2016f).
- Technical Guidance – Sampling of Short Range Endemic Invertebrate Fauna (EPA 2016g).

## 5.2.3 Receiving Environment

A number of Proposal specific terrestrial fauna surveys have been carried out as outlined in Table 15.

Table 15: Summary of Terrestrial Fauna Surveys

| Survey Date | Consultant | Description |
|---|---|---|
| September 2016 - (Phase 1)<br>April 2017 - (Phase 2) | Greg Harewood | Level 2 Fauna Survey Lake Wells Potash Project |
| November 2017 | Bennelongia | Lake Wells Potash Project Wetland Ecology Baseline Survey |
| May 2018 | Bennelongia | Short Range Endemic Fauna Survey |
| November/December 2018 | Western Wildlife | Lake Wells Potash Project: Level 2 Vertebrate Fauna Survey Including Targeted Surveys for Significant Fauna. |
| February 2020 | Bennelongia | Lake Wells Potash Project Wetland Ecology and Migratory Bird Survey |

### *5.2.3.1 Fauna Habitats*

Nine fauna habitats have been identified and described in the survey area of 74,579 ha noting this is significantly larger than the combined Development Envelope area of 13,951 ha. The area of these within the Off and On Playa Development Envelopes is contained in Table 16 and shown in Figure 16. The dominant terrestrial habitat types are Sandplain and Mulga Woodland which account for 38,100 ha or 51.1% of the total survey area (Western Wildlife 2019a, Appendix 3).

Table 16: Fauna Habitats in the Survey Area and Development Envelopes

| Habitat | Habitat Description | Significant Species Association | Total Mapped Area (ha) | Area in Development Envelopes (ha) | Area in Development Footprint (ha)** | Area in Development Footprint (%) |
|---|---|---|---|---|---|---|
| Salt Lake (vegetated areas and open playa) | Series of closed playa depressions ranging from almost totally vegetated to marginally vegetated. | Potential habitat for Migratory birds after significant rain events | 10,301 | 4,100 | 2,180 | 21.2 |
| Claypans and Clay-Loam Dunes | Series of closed claypan depressions, each surrounded by low semicircular clay loam dunes. Claypans may be bare or sparsely vegetated with chenopod shrubland (*Maireana pyramidata* and *Atriplex* spp.) over forbs (*Frankenia* spp). | Potential habitat for migratory birds after significant rain events | 6,138 | 757 | 13 | 0.2 |
| Sand Dunes | Aeolian sand dunes composed of fine orange-red sand, occurring in association with salt lake habitat and often in a complex with gypsum dune habitat. | Potential habitat for Southern Marsupial Mole (P4)* Potential habitat for the Night Parrot (Critically Endangered) | 5,627 | 2,219 | 400 | 7.1 |
| Gypsum Dunes | Sparsely vegetated with open woodland of Casuarina pauper, sometimes with Kopi Mallee (*Eucalyptus gypsophila*), over *Acacia burkittii*, *Grevillea sarrissa*, Senna and/or Eremophila shrubland and low chenopods (*Atriplex vesicaria*). | Potential habitat for Buff-snouted Blind Snake (P2)* | 4,897 | 2,474 | 189 | 3.9 |
| Sandplain | Deep orange-red sands supporting grassland of Spinifex (*Triodia desertorum* and/or *Triodia basedowii*). Some areas of open grassland, with most relatively well vegetated with an open mallee woodland (*Eucalyptus* spp.) over Acacia shrubland. | Known habitat for Great Desert Skink (Vulnerable) and Brush-tailed Mulgara (P4) Potential habitat for the Night Parrot (Critically Endangered) | 19,163 | 1,355 | 98 | 0.5 |
| Mulga Woodland | Sandy-loam and clay-loam plains. Vegetation varies from spinifex (*Triodia basedowii*) to tussock grass (*Eragrostris eriopoda* and *Eriachne* | Potential habitat for Central Long-eared Bat (P3)* and | 18,937 | 2,115 | 301 | 1.6 |

| Habitat | Habitat Description | Significant Species Association | Total Mapped Area (ha) | Area in Development Envelopes (ha) | Area in Development Footprint (ha)** | Area in Development Footprint (%) |
|---|---|---|---|---|---|---|
| | *mucronata*), with spinifex occurring where soils are sandier. | Brush-tailed Mulgara (P4) | | | | |
| Drainages | Vegetation along the drainages is similar to that in the mulga woodlands, but denser than on the surrounding stony plains, and consists of Western Blue Mulga (Acacia caesaneura) over Senna artemisiodes over tussock grass (Eragrostris eriopoda). Drainages present running off rocky hills | Potential habitat for Central Long-eared Bat (P3)* | 2,013 | 298 | 12 | 0.6 |
| Rocky Hills | Low stony hills and plains, largely lacking in crevices and exfoliating rock and absent of caves. | Known habitat for Long-tailed Dunnart (P4) | 3,292 | 264 | 8 | 0.2 |
| Stony Plains | Present downslope of rocky hills, soil surface of small stones, often including quartz. Vegetation generally sparse, with a few dense stands, consisting of an open woodland of Western Blue Mulga (*Acacia caesaneura*) and Narrow-leaved Mulga (*Acacia incurvaneura*) over *Acacia burkitii* and *Eremophila* spp. over tussock grass (*Eragrostris eriopoda*) | No specific association with threatened or priority species | 4,211 | 369 | 13 | 0.3 |
| | | Total | 74,579 | 13,951 | | |

** Species not recorded during surveys of Proposal area.*

*** Total does not include 6 ha for minor Off Playa infrastructure (drainage, topsoil stockpiles) (refer Table 3) for which disturbance locations are not currently known.*

The 'Kopai' dunes within the On playa Development Envelope comprise sparsely vegetated, gypsum-cemented sand and loose sand (Plate 2). The Kopai dunes are, in places, 8 - 10 m above the salt lake surface and are sparsely vegetated with an open woodland of *Casuarina pauper*, sometimes with Kopi Mallee (*Eucalyptus gypsophila*), over *Acacia burkittii*, *Grevillea sarrissa*, *Senna* and/or *Eremophila* shrubland and low chenopods (*Atriplex vesicaria*) (Appendix 3F).

Plate 2: On Playa Kopai Dune at Lake Wells

The sand dunes within the Off Playa Development Envelope are composed of '*a fine orange-red sand*' and support either an open mulga woodland (*Acacia caesaneura* and *Acacia incurvaneura*) over Eremophila spp. and spinifex (*Triodia basedowii*) and tussock grass (*Eragrostris eriopoda*) or Yellow-leaved Mallee (*Eucalyptus concinna*) over *Aluta maisonneuvei*, *Dodonaea viscosa* and spinifex (*Triodia desertorum*) (Plate 3, Appendix 3F).

It was noted that in some areas the Kopai dunes and 'Red' sand dunes occur together in a complex (Appendix 3F).

Plate 3: Off Playa 'Red' Sand Dunes at Lake Wells

#### *5.2.3.2 Vertebrate Fauna*

Desktop assessment of the potential occurrence of conservation significant fauna identified several species as being known to occur, or have a moderate chance of occurring, within or adjacent to the survey area (Table 18, Western Wildlife 2019a).

Surveys (refer to Table 17 and Figure 16 for a summary of survey effort) recorded 192 native and nine introduced vertebrate fauna species. Native species included five amphibians, 70 reptiles, 92 birds and 25 mammals (Western Wildlife 2019a).

#### *5.2.3.3 Significant Fauna*

Targeted surveys were conducted to search for species or evidence of species that are not readily trapped, and to search for signs of significant fauna where potential habitat was found (Table 17). Secondary signs of significant

species were searched for such as scat latrines and burrows of the Great Desert Skink (*Liopholis kintorei*), burrows, tracks, scats or diggings of the Brush-tailed Mulgara (*Dasycercus blythi*), burrows, tracks, scats or diggings of the Greater Bilby (*Macrotis lagotis*) and mounds, tracks or feathers of the Malleefowl (*Leipoa ocellata*). Species such as the Princess Parrot (*Polytelis alexandrae*), Grey Falcon (*Falco hypoleucos*) and Peregrine Falcon (*Falco peregrinus*) were also targeted on both transects and search sites.

Table 17: Summary of Terrestrial Vertebrate Fauna Survey Effort

| Survey Date | Survey Duration (Days) | Number of Trapping Sites | Summary of 'Non-trapping' Effort |
|---|---|---|---|
| Level 2 Fauna Survey Lake Wells Potash Project | | | |
| September 2016 (Phase 1) | 10 | 6 (1,764 trap nights) | • 20 minute unbounded surveys<br>• Traverses on foot<br>• Bird counts at freshwater wetlands<br>• Opportunistic observations of avifauna<br>• Acoustic recording (bats) (2 sites x 6 nights)<br>• Camera traps (8 sites x < 6 months) |
| April 2017 (Phase 2) | 8 | 6 (1,764 trap nights) | • 20 minute unbounded surveys<br>• Traverses on foot<br>• Bird counts at freshwater wetlands<br>• Opportunistic observations of avifauna<br>• Acoustic recording (bats) (2 sites x 4 nights)<br>• Camera traps (4 sites x 7/8 days)<br>• Acoustic recording (Night Parrot) (2 sites x 1 night)<br>• Camera traps (Night Parrot) (2 sites x 2/3 days) |
| Lake Wells Potash Project Wetland Ecology Baseline Survey | | | |
| November 2017 | 4 | NA | • Bird surveys (9 sites x 15 minutes) |
| Lake Wells Potash Project: Level 2 Vertebrate Fauna Survey Including Targeted Surveys for Significant Fauna. | | | |
| November/December 2018 | 12 | 9 (2,646 trap nights) | • Bird surveys (9 sites x 6 surveys (each of 20 minutes))<br>• Acoustic recording (bats) (16 sites x 1 night)<br>• Camera traps (32 sites x 5/6 days)<br>• Acoustic recording (Night Parrot) (12 sites x 5/6 nights) |
| Lake Wells Potash Project Wetland Ecology and Migratory Bird Survey | | | |
| February 2020 | 4 | NA | • Aerial survey (1 day)<br>• Waterbird counts (7 sites) |

One Threatened fauna species as defined in the Federal *EPBC Act* and WA *Biodiversity Conservation Act 2016* and two Priority species designated by DBCA were recorded within the survey area (Western Wildlife 2019a, Appendix 3). These were the:

- Great Desert Skink (Vulnerable).
- Brush-tailed Mulgara (P4).
- Long-tailed Dunnart (P4).

The nearest known record of the Southern Marsupial Mole (P4) is over 150 km south east of the Development Envelope. This species was described as 'Unlikely to Occur' as '*the study area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment*' (Appendix 3E). Appendix 3F states '*though not recorded in the Study Area, this species is known to occur in sand dune habitats in the Great Victoria Desert'*. Thus while the species is known from the bioregion, and individuals could occur within the survey area, it was not recorded during surveys.

The location of these are shown in Figure 17. Further details about these species, and migratory birds, is presented in the following subsections.

Bat calls were recorded during the fauna surveys in 2016, 2017 and 2018 (Harewood 2017, Western Wildlife 2019a). Between the 2016/2017 and 2018 surveys the following species were recorded, across a range of habitats:

- *Austronomus australis* (White-Striped Freetail Bat).
- *Ozimops petersi* (Inland Free-tailed Bat).
- *Chaerephon jobensis* (Northern Freetail Bat).
- *Nyctophilus geoffroyi* (Lesser Long-Eared Bat).
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat).
- *Chalinolobus gouldii* (Gould's Wattled Bat).
- *Scotorepens balstoni* (Inland Broad-Nosed Bat).
- *Vespadelus finlaysoni* (Finlayson's Cave Bat).

None of the recorded bat species are of conservation significance. The Central Long Eared Bat (*Nyctophilus major*) (P3) was not positively identified, however the calls are difficult to distinguish from other species of *Nyctophilus.* Therefore, the Central Long Eared Bat may potentially occur in the Development Envelope. The Central Long-eared Bat, if present, roosts in tree hollows which are present mainly in the gypsum dune, mulga woodland and sandplain habitats (Western Wildlife 2019a).

Table 18: Summary of Desktop Assessment of Significant Fauna

| Species | Conservation Status[4] | | | | Records within 100 km | Likelihood of Occurrence[5] |
|---|---|---|---|---|---|---|
| | EPBC Act | BC Act | DBCA Priority | Locally Significant | | |
| **Threatened Species** | | | | | | |
| *Pezoporus occidentalis* (Night Parrot) | En | Cr | | | None | Low |
| *Sminthopsis psammophila* (Sandhill Dunnart) | En | En | | | Record ~85 km from Development Envelope | Low |
| *Liopholis kintorei* (Great Desert Skink) | Vu | Vu | | | None | Low |
| *Leipoa ocellata* (Malleefowl) | Vu | Vu | | | Four historical records | Very Low |
| *Polytelis alexandrae* (Princess Parrot) | Vu | | P4 | | None | Moderate |
| *Macrotis lagotis* (Bilby) | Vu | Vu | | | Two records (2012) | Very Low |
| *Falco hypoleucos* (Grey Falcon) | | Vu | | | None | Low |
| **Migratory Species** | | | | | | |
| *Charadrius veredus* (Oriental Plover) | Mi | Mi | | | None | Moderate |
| *Calidris acuminata* (Sharp-tailed sandpiper) | Mi | Mi | | | None | Moderate |
| *Calidris ruficollis* (Red-necked Stint) | Mi | Mi | | | None | Moderate |
| *Calidris melanotos* (Pectoral Sandpiper) | Mi | Mi | | | None | Moderate |
| *Tringa glareola* (Wood Sandpiper) | Mi | Mi | | | None | Moderate |
| *TrInga hypoleucos* (Common Sandpiper) | Mi | Mi | | | None | Moderate |
| *Tringa nebularia* (Common Greenshank) | Mi | Mi | | | None | Moderate |
| *Tringa stagnatilis* (Marsh Sandpiper) | Mi | Mi | | | One Record (2017) | Known to Occur |
| *Sterna nilotica* (Gull-billed Tern) | Mi | Mi | | | Two Records ~95 km from Development Envelope | Moderate |
| *Apus pacificus* (Fork-tailed Swift) | Mi | Mi | | | None | Moderate |

[4] Refer Western Wildlife 2019a for listing descriptions.
[5] Refer Western Wildlife 2019a for likelihood of occurrence descriptions.

| Species | Conservation Status[4] | | | | Records within 100 km | Likelihood of Occurrence[5] |
|---|---|---|---|---|---|---|
| | EPBC Act | BC Act | DBCA Priority | Locally Significant | | |
| **Specially Protected** | | | | | | |
| *Falco peregrinus* (Peregrine Falcon) | | Sp | | | Two Records (2007 & 2010) | Moderate |
| **Priority Species** | | | | | | |
| *Anilios margaretae* (Buff-snouted Blind Snake) | | | P2 | | None | Moderate |
| *Nyctophilus major tor* (Central Long-eared Bat) | | | P3 | | None | Moderate |
| *Amytornis striatus* (Striated Grasswren sandplain)) | | | P4 | | None | Moderate |
| *Dasycercus blythi* (Brush-tailed Mulgara) | | | P4 | | Nine Records (1994-2012) | Known to Occur |
| *Sminthopsis longicaudata* (Long-tailed Dunnart) | | | P4 | | None | Known to Occur |
| *Notoryctes typhlops* (Southern Marsupial Mole) | | | P4 | | None | Moderate |
| **Locally Significant** | | | | | | |
| *Aspidites ramsayi* (Woma) | | | | LS | None | Low |

*Source: Western Wildlife 2019a)*

500000 m 510000 m 520000 m 530000 m

6990000 m

6980000 m

6970000 m

N

**Legend**

**Development Envelope**
- On-playa
- Off-playa
- Development Footprint

**Fauna Survey Sites**
(Western Wildlife 2018; Harewood 2016 & 2017)
- Bat Recording Site
- Camera Trap Site
- Acoustic Monitor (Night Parrot)
- Trap Site

**Fauna Habitat Types**
- Claypans and clay-loam plains
- Drainage
- Gypsum dunes
- Mulga woodland
- Rocky hills
- Salt Lake
- Sand dunes
- Sandplain
- Stony plains

Scale: 1:100000
Original Size: A3
Air Photo Date: March 2016
Grid: Australia MGA94 (51)

0 5 km

Australian Potash
Lake Wells Project
Environmental Review Document

**Figure 16**

**Fauna Habitats in the Survey Area**

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MBS ENVIRONMENTAL

W:\Australian Potash\Lake Wells Project\Approvals\ERD\Drawings\Fauna Habitat.map 4/06/2020 F16 Fauna Habitats in Survey Area Layout