Northern Resource CONSULTANTS

Thalanga Environmental Evaluation

Environmental Evaluation Design Document

December 2017

prepared for

Cromarty Resources Pty Ltd

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Introduction

1. Background

Cromarty Resources Pty Ltd has been issued a notice to conduct or commission an environmental investigation under the *Environmental Protection Act 1994*.

The notice to conduct or commission an environmental investigation was issued in respect to activities under the Environmental Authority (EA) EPML00773613 for the Thalanga Project, situated on Mining Leases (MLs) 1392, 1531, 10137, 10185 and 10186.

The grounds for the notice are that the Department of Environment and Heritage Protection (DEHP) is convinced that current and future activities on site are causing or are likely to cause environmental harm.

The stated 'facts and circumstances' forming the basis of the grounds are:

- Ongoing exceedances of trigger level and contamination limits defined in Schedule F – Table 9 (groundwater contaminant and trigger limits) in groundwater monitoring bores over the November 2015 to October 2016 monitoring period.
- Specifically, exceedance of contaminant limits for:
  - Electrical conductivity (EC) at compliance bores C1, C2, W45B1, W45B2 and W45B3.
  - Sulfate (SO_4) at compliance bore C1.
  - Fluoride (F^-) at compliance bores W45B1 and W45B4.
- Exceedance of trigger levels for:
  - Arsenic in compliance bores C1, W45B1, W45B2 and W45B4.
  - Cadmium in compliance bores C1 and W45B1.
  - Copper in compliance bores C1, C2 and W45B1.
  - Zinc in compliance bores W45B1, W45B2, W45B3 and W45B4.
- Additional monitoring results submitted in March 2017 identified that exceedances of trigger and contaminant limits is continuing. In response to the ongoing contaminant limit exceedances, DEHP issued Cromarty Resources with two Formal Warnings for contravention of condition F9-4 of the EA on 14 November 2016 (WARN6832) and 6 April 2017 (WARN7153).
- EHP refers to correspondence from Cromarty Resources dated 10 February 2017 and 28 February 2017, which are said to state that elevated concentrations of contaminants in groundwater bores cannot be attributed to mining activities, rather the limits imposed by the EA are inappropriate. Specifically, Cromarty Resources state that elevated levels of EC and sulfate are reflective of background conditions and that exceedances of fluoride are due to natural seasonal fluctuations. Further, Cromarty Resources are said to state that all exceedances are considered to be within stable trends and historical values, which indicates that there is no active contamination event or impact occurring.

The correspondence was followed by a 'Groundwater EA Amendment 2017 Technical Report' to the Minerals Assessment Centre of DEHP to provide supporting information and justification to amend the limits in the EA, based on site-specific groundwater limits for the Thalanga Project that capture background values.

A review of the Technical Report by the Minerals Assessment Centre decided that there was not sufficient evidence to amend the groundwater limits of the EA as DEHP could not conclude from the information provided that exceedances result from natural groundwater mineralisation and not historical contamination. Further:

- DEHP was not satisfied that the groundwater monitoring network at Thalanga was suitable or adequate to detect potential impacts to groundwater.
- DEHP could not conclude that the existing water management infrastructure at Thalanga was effective in protecting groundwater resources from contamination.
- DEHP noted the lack of information with regards to the adequacy of the existing tailings storage facility (TSF) seepage collection system and whether additional mitigation measures including shallow seepage detection bores are required.
- DEHP noted that reference bore (V1), 'pit impact' monitoring bores (V2, V3, V4 and V7b), 'TSF impact' monitoring bores (A3 and TH4) and compliance monitoring bore (W45B1) show results indicative of interconnection with mining infrastructure and have likely been impacted by mining activities; however, the contamination source and pathways are not investigated or described.
- EHP states that the Technical Report did not describe if actions are being undertaken to address any identified seepage from migrating.
- In addition, DEHP is concerned about the impact potential contaminated seepage may have on one adjacent stock water bore northeast of the ML.

In summary, DEHP is not satisfied that there is sufficient understanding of the extent of groundwater impact, or groundwater connectivity, in the area with respect to the migration of contaminants. Especially with regards to the potential of these identified contaminants to impact (now or in the future) on the surrounding local groundwater resource. DEHP considers that there is the potential that environmental harm is being caused by the ongoing, consistently elevated levels of contaminants at the Thalanga Project, which are likely caused by mining activities.

2. Design document outline

2.1 Design document requirement

As prescribed in the 'Notice to conduct or commission an environmental evaluation' issued to Cromarty Resources Pty Ltd by DEHP on 14 September 2017 (DEHP reference 101/0009448; CR78215; STAT1173), the compilation of an Environmental Evaluation (EE) report has to be preceded by a design document for the investigation.

The design document will essentially outline and illustrate all components of the investigation and shall include an implementation schedule with milestones for all individual tasks proposed.

As such, the compilation and review of the design document will aid the planning and understanding of the tasks ahead, as well as allow for a control mechanism in the form of half yearly progress reports, which can be compared against benchmarks or milestones set out in the initial design document.

2.2 General outline

The design document will address the requirements as outlined in section B: Requirements, pages 4 to 6 of the 'Notice to conduct or commission an environmental investigation'. These requirements are divided into hydrogeological and hydrogeochemical tasks and are listed below.

Following the list, individual list items will be addressed in detail, outlining the proposed methods, expected workflow and anticipated outcome for each task.

The detailed description of each task will be followed by a summary table outlining the implementation schedule for individual tasks and set milestones for the EE of the Thalanga site.

3. Summary of requirements outlined in section B

As set out in the 'Notice to conduct or commission an environmental evaluation', the EE must address the following hydrogeological and hydrogeochemical matters:

1. Identify the dominant underground **hydrogeological features** at the **Thalanga Project** and the **receiving environment**, and describe:
    a) the characteristics of the hydrogeological feature, including, but not limited to, soil and rock porosity, permeability, hydraulic conductivity, transmissivity, stratigraphy and fault and fracture propensity
    b) any geological barriers which are overlaying or underlying the hydrogeological feature
    c) the waters contained in the hydrogeological feature, including its ionic composition
    d) the movement of groundwater in the hydrogeological feature (direction and flow rate, at a minimum)
    e) the interaction of groundwater contained in each hydrogeological feature with any other hydrogeological feature, including the degree of hydraulic connectivity and transmissivity
    f) the interaction of any contaminated waters, with the water in the hydrogeological feature, including a comparison of the ionic composition of the waters
    g) the locations where water contained within the hydrogeological feature does or potentially express at the surface
    h) the spatial locations of environmental values within of dependant on the hydrogeological feature
    i) a conceptual model integrating items (a) – (h)

2. Identify the sources of all contaminants that are being, or have been, released from the Thalanga Project which are likely impacting on groundwater. This investigation must include but not be limited to all dams, storages and ponds containing mine affected water at the Thalanga Project.
3. Determine the types, concentrations and volumes of contaminants that are being or have been released from the Thalanga Project, which are currently impacting on, or have the potential to impact on the groundwater.
4. Identify and describe the pathways and mechanisms for the release and transport of contaminants to groundwater, due to activities conducted at the Thalanga Project.
5. Determine the current lateral and vertical geographical extents of contaminants released to groundwater, due to activities conducted at the Thalanga Project, as well as rates, directions of movement and attenuation of contaminants in groundwater. Undertake solute transport modelling to predict likely patterns of contaminant migration and impact.
6. Undertake sensitivity analysis of the solute transport model
7. Review the existing groundwater network to ensure monitoring bores have sufficient geographical coverage to detect and quantify the magnitude and extent of existing groundwater contamination caused by mining activities at the Thalanga Project. In designing the monitoring bore network, consideration should also be given to potential future impact areas.
8. Assess impacts and potential impact on groundwater and all environmental values. The assessment must include and consider:
    a) A table of descriptive statistics for each groundwater monitoring bore at the Thalanga Project including; date range, count, mean, minimum, maximum, median, 80th and 95th percentiles and
    b) Box plots for all groundwater monitoring bores at the Thalanga Project for each groundwater contaminant showing, the minimum, the median, 20th and 80th percentiles and maximum as well as the relevant water quality objectives for each environmental value.
    c) Spatial trends in groundwater contaminants at the Thalanga Project
    d) Temporal trends in groundwater contaminants including time series plots for all groundwater monitoring bores at the Thalanga Project for all relevant contaminants.
    e) An assessment of groundwater quality against water quality objectives for all relevant contaminants and all environmental values with reference to graphical summaries which include water quality objectives for each environmental value.

    Note: the method for assessing groundwater quality must be consistent with the guideline: *Using monitoring data to assess groundwater quality and potential environmental impacts. Version 1*. Department of Science, Information Technology and Innovation (DSTI)2017, Queensland Government, Brisbane or later version.
9. Identify key indicators which are detectable in all contaminated water that is being or has been released from the Thalanga Project to groundwater. Different key indicators may be nominated for different sources.

10. Identify all potential options to estimate corresponding implementation timeframes and costs for:
    a. The prevention of further contaminant releases from the Thalanga Project to groundwater; and
    b. Remedial measures to reduce contaminant concentrations in groundwater and ensure all environmental values are protected.
11. By 15 December, 2017, provide a design document for the investigation, including an implementation schedule with milestones.
12. From 15 September, 2017, provide progress reports on the progress of the environmental investigation with reference to the milestones in the implementation schedule at a frequency of once every six months.
13. Provide a final Report to address all matters of the environmental investigation. The final report on the environmental investigation must address all relevant matters, and also include:
    a. The methodology applied in conducting this investigation, including any assumptions relied upon and their justification.
    b. A description of the conceptual model
    c. A description of the solute transport model, including consideration of the confidence in the model with reference to assumptions, limitations and sensitivity analysis of the model
    d. The results of any studies, assessments or analysis that were carried out during this investigation
    e. The outcomes and findings of the investigation, including justification for any conclusions and
    f. The raw data for all graphical summaries with a clear indication of which data applies to each graph.
14. The requirements of this investigation must be completed by, or in accordance with advice from, a suitable qualified person.
15. The Final Report on the environmental investigation must be submitted to the department on or before 15 January 2020.

Methodology

1. General approach to fulfil the requirements of the EE investigation

The groundwater situation at Thalanga is potentially the result of three interacting factors: the geological characteristics of the site, climatic influences and mining activities at Thalanga mine. Without investigating and understanding all three of these factors and putting them in context along a historical timeline, an understanding of individual groundwater issues is not possible.

Hence, the general approach will be to conduct a number of clearly defined investigation steps, followed by an assessment of information gaps and proposed actions to fill these information gaps. The investigation will commence with the collation of all available data on the Thalanga Project.

Such data will include site history, historical and current geological reports and data sets, climatic influences and hydrogeological, geochemical and hydrogeochemical reports and data sets.

The investigation will commence by compiling a detailed site history, which will allow an assessment of potential historical and current contamination sources, including locations, volumes and key processes of contaminant transport over time for individual locations. Considering that the Thalanga site has been in operation since 1989, such investigation of the site history will identify historical contamination sources, which owing to changes of the mine layout are no longer recognised today. The compilation of the site history will be accompanied by the collation of climate/rainfall records for the site. The consideration of climatic factors is important as they are the natural drivers of groundwater change.

The collation of the site history and climate data will be followed by the establishment of the geological framework, including the geological history, detailed stratigraphy, possible fracturing, shear zones, faults, geological barriers, as well as soils and weathering characteristics. All geological details will be documented in detail. The documentation will include maps and cross sections, indicating potential aquifer zones, aquicludes, the potential for surface expression of groundwater and spatial locations of environmental values.

The assessment of the site geology will be followed by a review of all available hydrogeological reports and groundwater data sets. Combined with the geology and current hydrogeological information, the occurrence of aquifers, their characteristics and potential for interconnectivity will be discussed. Based on the outcome of the hydrogeological review, recommendations to fill information gaps will be made, which might involve the installation of additional groundwater bores. Once the information gaps have been filled and the hydrogeological assessment completed, a schematic hydrogeological model will be compiled allowing for a detailed understanding of the groundwater situation at Thalanga.

The gained hydrogeological understanding of the Thalanga site will be combined with the hydrogeochemical development of the groundwater at Thalanga including a comparison of the ionic compositions of different groundwaters. This will ultimately allow for a detailed assessment of potential groundwater contaminant migration at the site. Such understanding will be conveyed though the presentation of a conceptual hydrogeological model. As such, the overall approach, further detailed below, will address section B1 of the EE notice.

2. Details, deliverables and timelines

The details, deliverables and timelines for each step are split into individual tasks and sub-tasks following the general approach outlined in the previous section, 'General approach to fulfil the requirements of the EE investigation', of this design report.

2.1 Step 1: Site history

Rationale

Understanding the operational history of a site helps identify potential sources of contamination. An understanding of the site history is necessary for interpreting any groundwater quality or flow regime changes. For example, the simple removal of a contamination source does not eliminate the seepage from the source. Depending on the characteristics of the geological substrata seepage can remain stored, which can have a prolonged impact on the natural environment. Therefore, given the extended time of operation (the Thalanga mine started to operate in 1989), a number of potential historical source areas are likely to be present at Thalanga. Hence, for the purpose of understanding the current and groundwater situation and future groundwater development it is only prudent to establish a detailed site history prior to assessing any groundwater contamination issues.

Task 1A: Collation of information

Historical information sources available for the Thalanga site, not directly aiding further ore exploration efforts, are sparse. Information prior to 2007 consists of isolated reports, aerial and site photographs, computer files and copies of facsimile sheets and hand-written notes, dating back to the early 1980s. Information since 2007 is mainly available in the form of reports. Additional information may be obtained through DEHP who were partially responsible for approving the operations at Thalanga. Additional information may also be available by requesting previous studies and consultancy reports from companies known to have been involved with the Thalanga project over time.

Task 1A will identify all transient and permanent sources and volumes of contaminants at the Thalanga Project as required in sections B2 of the EE notice.

Task 1B: Deliverables

The deliverables for this task include:

- Compilation of a comprehensive site history.
- Provision of a timeline for mine development at Thalanga.

- Locations of all site infrastructure.
- Dimensions of disturbance areas.
- Volumes and dimensions of waste dumps, tailings dams, mine water dams and underground workings over time.
- Provision of a report section that comprehensively describes the site history and its potential impact on the current groundwater situation at Thalanga. To assess potential impacts, the mineralogical composition of any waste rock and the chemistry of any surface water will be considered in the assessment.

Timeline

Work on the site history has already begun as a section within the current EA amendment application process for the proposed Far West mine extension. Delivery of the amended EA application is anticipated prior to the submission date of this EE design document.

For the purpose of this EE, the site history will be further elaborated upon to include additional site information, which is not directly relevant to the current EA application but will be valuable for gaining an understanding of the Thalanga site as a whole.

Completion of the site history is anticipated by 15 March 2018. For a detailed timeline of individual tasks, see Table 1.

2.2 Step 2: Climate

Rationale

In a subtropical savannah region such as Thalanga, the climate can have a significant impact on the groundwater quality. Knowing the climate development and rainfall history of a site will help interpret changes to the groundwater environment. Hence, prior to working on the site hydrogeology, detailed knowledge of the site climate and rainfall history is necessary.

Task 3A: Collation of information

The establishment of the climatic conditions at Thalanga is largely a data gathering and graphing exercise. Historical and current data is available from the Bureau of Meteorology and possibly the mine site itself.

Task 3B: Evaluation

Evaluation of the data will highlight periods and days of high rainfall, drought conditions and evaporation. This information will be graphed for easy comparison with changes to the hydrogeological conditions on the site.

Task 3C: Deliverables

Deliverables will be in the form of tables and graphs allowing for a quick visual assessment of trends and significant events that could have an impact on the groundwater situation at Thalanga. As such, this section will aid in answering sections B3, B4, B8c and B8d of the EE notice.

Timeline

Deliverables are primarily meant to be an internal evaluation tool, with work on the climatic conditions to be completed prior to the start of the hydrogeological section. For a detailed timeline of individual tasks, see Table 1.

2.3 Step 3: Site geology

Rationale

The geological characteristics of the Seventy Mile Range Group and the associated Mount Windsor Volcanics at the Thalanga site have been well documented and continued exploration drilling progressively furthers this knowledge with regards to ore geology. Nevertheless, with regards to groundwater, previous reports commonly only state the low aquifer potential of the Volcanics. Similarly, the adjacent Campaspe Beds have been studied for their aquifer potential with recharge mechanisms to the significant aquifer system having received little attention. The groundwater occurrences within the Mount Windsor Volcanics, the potential presence of aquifer zones in the surrounding bed rock and its relation to surrounding Campaspe Beds, creek bed alluvium and the weathered near surface geology have received little attention. Hence, the EE will focus on the characteristics of these potential aquifer zones and provide an assessment of potential interconnectivity with the focus on contaminant migration over time.

Task 2A: Collation of information

The collation of information will be based on the review of existing geological reports and drill logs. Particular attention will be paid to the occurrence of water and the reporting of fracture zones. Additional geological information will be acquired from local geological maps and exploration records. The geological information will be supplemented by information from Cromarty Resources' own geology department.

Task 2B: Investigate unweathered volcanic bedrock

The EE will review available geological information with regards to aquifer potential of the Mount Windsor Volcanics and the surrounding bedrock. This information will be gathered by reviewing these reports and data with respect to fracturing and shear zones that may provide void spaces for groundwater storage or transport. It will provide information on the hydrogeological parameters stated in section B: Requirements of the notice to conduct or commission an EE.

Task 2C: Investigate weathered horizon

This section will investigate the hydrogeological nature of the weathered strata overlying the fractured bedrock and potentially underlying the Campaspe Beds in the vicinity of the mine site. The EE will do so by reviewing historical and recent drilling logs with regards to depth, groundwater occurrence and potential hydrogeological testing. Additional information may be gathered by further testing the Campaspe Beds/weathered bed rock boundary exposed within the Vomacka Pit walls.

Task 2D: Investigate Campaspe Beds

The Campaspe Beds have been consistently identified since 1981 as the only aquifer of any significance in the vicinity of Thalanga. Since sections of the Campaspe Beds reach into the Thalanga lease it is only prudent to describe the nature of this aquifer at Thalanga. Of particular importance may be the contact between the Campaspe Beds and the volcanic bed rock sequence (weathered or unweathered).

Task 2E: Investigate alluvial occurrences

In addition to the above, the geological investigation will investigate the characteristics and depth of potential alluvial aquifers in the vicinity of the mine site. The investigation will be primarily based on a bore survey of registered and non-registered private bores within 10km of the Thalanga ML. Survey heights of the bores may be acquired by a differential GPS or GNSS Receiver.

Task 2F: Deliverables

The information on the geological characteristics of the strata in the vicinity of the Thalanga site will be collated and potential aquifers or aquifer sections delineated.

Structures with aquifer potential and geological groundwater flow barriers will be described and mapped in the form of cross sections to allow for a 3-dimensional understanding of the geological situation at Thalanga. The 3-dimensional mapping will show the locations and dimensions of existing and proposed underground workings. A familiarisation with these underground workings, together with an appreciation of the site history, are essential for an understanding of the hydrogeological development at Thalanga.

The results of the geological investigation will be compiled into a report section that comprehensively describes the site geology and its influence on the current groundwater situation at Thalanga.

As such, this section is absolutely essential to address section B4 of the EE notice.

Timeline

Work on the site geology has already begun as a section within the current EA amendment application process for the proposed Far West mine extension. Delivery of the amended EA application is anticipated to occur prior to the submission date of this EE design document.

For the purpose of this EE, the site geology will be further elaborated upon to include additional site information, which is not directly relevant to the current EA application but will be valuable for gaining an understanding of the Thalanga site as a whole.

Completion of the site geology may need additional information as outlined in sub-task 2C and hence might need third party input. Therefore, completion of Step 3 is anticipated by July 2018. For a detailed timeline of individual tasks, see Table 1.

2.4 Step 4: Site hydrogeology

Rationale

The hydrogeology at Thalanga is the result of the site history, climatic factors and site geology. All of these factors have to be considered and understood if one strives for an understanding of the current hydrogeological situation at Thalanga.

Task 4A: Collation of information

Despite the fact that a lot of the original environmental documentation has been lost, Cromarty Resources is still in the possession of a significant amount of digital data. This data in combination with the remaining hard copy information will be sighted, tabulated and, where possible, graphed to present a history of the groundwater development at Thalanga. Preliminary investigations suggest the presence of additional historical groundwater bore locations, water level measurements and chemical analysis. In some cases, these predate the start of mining operations and dewatering activities. The historical data will be compared to recent information.

Task 4B: Bore data statistical assessment

A comprehensive assessment of all historical and current bore data will be conducted. The information to be presented will be, where available, bore locations, bore construction, time of bore operation and any available data (e.g. groundwater levels/water chemistry/bore testing/ geology). The data will be compiled in tables and, where possible, graphed and subjected to statistical evaluation as listed under point 8 of Section B: Requirements of the notice to conduct or commission an EE.

Task 4C: Bore data hydrogeological assessment and interpretation

While the statistical assessment will be able to highlight trends at individual locations or even groups of bores, the statistical evaluation cannot interpret the results or causes of such trends. Hence, a detailed hydrogeological assessment and interpretation will be conducted following the statistical evaluation.

The hydrogeological assessment will consider all previous findings, such as site history, geology, climate and the bore assessment to explain the hydrogeological development at Thalanga. The explanation of the hydrogeological development will be aided by the calculation of hydrogeological gradients and, where crucial, will be further supported by available, or to be measured, hydraulic conductivity values. In addition, where spatial gaps are identified, Northern Resource Consultants (NRC) will recommend the installation of additional monitoring bores.

It is proposed to divide the hydrogeological assessment and interpretation initially into four separate domains. Namely unweathered bed rock, weathered bed rock horizon, Campaspe Beds and, where necessary, alluvial sequence. An initial separation of the individual units will allow for a focused approach and will quickly identify spatial information gaps. In addition, an initial separation into separate domains will allow for an evaluation of the degree of hydraulic connectivity between the sections and interaction between the potentially separated aquifers. At a later stage, the separate domains will be combined into a detailed conceptual model. The conceptual model will provide information on groundwater gradients, flow directions and flow rates within and between the separate domains. The conceptual model, based on factual data,

will, where identified, show spatial locations of environmental values and areas of potential groundwater/surface water interaction.

Task 4D: Deliverables

Deliverables will include a detailed and complete hydrogeological assessment of the Thalanga mine site and its surrounds. The report section will provide information on groundwater flow direction and flow velocity on and from the site. As such, this section will address sections B3 and B4, and will be needed to address section B5 of the EE notice.

Timeline

The collation of available current data has been an ongoing process since NRC was first commissioned by Cromarty Resources in 2012. A semi-comprehensive review of groundwater data is currently being conducted with regards to the EA amendment application process for the proposed Far West mine extension. A preliminary assessment identified additional historical data in hardcopy format. Evaluation of that data is ongoing. The hydrogeological section of this EE investigation shall be completed 12 months from the acceptance of the design documentation. For a detailed timeline of individual tasks, see Table 1.

2.5 Step 5: Site hydrogeochemistry

Rationale

The hydrogeological development of the Thalanga groundwater is the result of the site history, site geology and climatic factors and resulting hydrogeology. All of these factors have to be considered and understood to comprehend the current hydrogeochemical situation at Thalanga.

Task 5A: Data collection and statistical evaluation

Task 5A will be essentially completed by the conclusion of the previous Tasks 4A and 4B. Statistical evaluation will show the geochemical composition of any groundwater and contamination sources. The statistical evaluation as outlined in section B8 will also assess the groundwater quality development against water quality objectives and potentially identified environmentally values.

Task 5B: Hydrogeochemical assessment and interpretation

The hydrogeochemical assessment and interpretation will follow the hydrogeological assessment of the Thalanga site. As such, the hydrogeochemical interpretation will identify key indicators for contamination at Thalanga and determine the current lateral and vertical geographical extend of potential contaminant in the groundwater on and around the site.

Based on time series and previously determined groundwater flow directions and flow rates, rates of theoretical and actual contaminant migration rates will be compared and used to construct solute transport models for potential migration pathways at the site. The attenuation rates of the solute transport models will be compared to attenuation rates of similar geological materials available in the literature and tested via sensitivity analysis using hydrogeochemical and hydrogeological software packages.

The outcome of the hydrogeochemical assessment will be used to review the current groundwater monitoring network and make recommendations on additional needs for groundwater monitoring bores at Thalanga as well as identifying key groundwater indicators, or key groundwater indicator groups, which could be used to delineate mining impacts at Thalanga.

Task 5C: Deliverables

The outcomes of the hydrogeochemical investigation will be compiled into a comprehensive report section, following the hydrogeological assessment. The hydrogeochemical section will address all hydrogeochemical issues stated in section B: Requirements of the notice to conduct or commission an EE. As such, this section will address sections B5, B6, B7, B8 and B9 of the EE notice.

Timeline

The collation of available current data has been an ongoing process since NRC was first commissioned by Cromarty Resources in 2012. A semi-comprehensive review of groundwater chemistry is currently being conducted with regards to the EA amendment application process for the proposed Far West mine extension. The hydrogeochemical section of this EE investigation shall be completed 18 months from the acceptance of the design documentation. For a detailed timeline of individual tasks, see Table 1.

2.6 Step 6: Potential mitigation and remediation measures

Rationale

Following the detailed assessment of the site, the options to prevent potential contaminant release from the Thalanga Project to the groundwater and measures for remediation of potentially impacted groundwater environments will be discussed.

Task 6A: Review of site- specific prevention and remediation options

A review of site-specific potential contaminant seepage prevention and remediation options will compare geotechnical and geochemical means of contaminant control with regards to their potential effectiveness at Thalanga.

Task 6B: Deliverables

The discussion will address different techniques with regards to preventing contaminant release and remediation measures, describe their effectiveness with regards to the specific settings of each individual case where groundwater contamination could be an issue or has been identified and outline potential costs for preventative measures and remediation works under consideration.

Timeline

The review of different techniques with regards to preventing contaminant release and remediation measures and their potential costings shall be concluded in line with the completion

of the hydrogeochemical section. Hence, this shall be completed 18 months from the acceptance of the design documentation. For a detailed timeline of individual tasks, see Table 1.

3. Treatment of information gaps

The presence of information gaps is a natural occurrence in any type of environmental investigation. For the purpose of this investigation, information gaps will be explicitly identified when detected. Where appropriate, these information gaps will be filled with the gathering of additional information via geological drilling, additional bore installation or strata testing. Where deemed appropriate and justifiable, data gaps may be filled by assumptions. These assumptions will be clearly identified and the reason for their employment discussed.

Table 1: Thalanga EE tabulated timeline

STEP	TASK	15.03.2018	15.09.2018	15.03.2019	15.09.2019	15.01.2020
		PROGRESS REPORT	PROGRESS REPORT	PROGRESS REPORT	PROGRESS REPORT	SUBMISSION
Step 1 Site history	Task 1A Collation of Information	November 2017 to March 2018				
	Task 1B Deliverables	**15.03.2018**				
Step 2 Climate	Task 3A Collation of information	By January 2018				
	Task 3B Evaluation	By February 2018				
	Task 3C Deliverables	**15.03.2018**				
Step 3 Site geology	Task 2A Collation of information	November 2017 to March 2018				
	Task 2B Investigate un-weathered volcanic bedrock	By April 2018				
	Task 2C Investigate weathered horizon	By May 2018				
	Task 2DInvestigate Campaspe Beds	By June 2018				
	Task 2E Investigate alluvial occurrences	By July 2018				
	Task 2F Deliverables		**15.09.2018**			

STEP	TASK	15.03.2018	15.09.2018	15.03.2019	15.09.2019	15.01.2020
Step 4 Site hydrogeology	Task 4A Collation of information	November 2017 to March 2018				
	Task 4B Bore data statistical assessment		By October 2018			
	Task 4C Bore data hydrogeological assessment and interpretation			By January 2019		
	Task 4D Deliverables			**15.03.2019**		
Step 5 Site hydrogeochemistry	Task 5A Data collation and statistical evaluation	November 2017 to October 2018				
	Task 5B Hydrogeochemical assessment and interpretation				November 2017 to June 2019	
	Task 5C Deliverables				**15.09.2019**	
Step 6 Potential remediation measures	Task 6A Review of site-specific prevention and remediation options				November 2017 to June 2019	
	Task 6B Deliverables				**15.09.2019**	