Erosion & Sedimentation Management Plan

TELLUS

PROPOSED CHANDLER FACILITY DRAFT EROSION AND SEDIMENT CONTROL PLAN

Draft Report | October 2016

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ABBREVIATIONS

CLC	Central Land Council
DME	Department of Mines and Energy
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
Km	kilometres
NT	Northern Territory
MLA	Mining Lease Area
MMP	Mine Management Plan
RCP	Rehabilitation and Closure Plan
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan

1 INTRODUCTION

1.1 Purpose

The Draft Environmental Management Plan (EMP) for the proposed Chandler Facility (the Proposal) within Northern Territory (NT) Mining Lease Area (MLA) 30612 is being submitted as a requirement of the Final Terms of Reference for the Environmental Impact Statement (EIS) under the NT *Environmental Assessment Act*.

This draft Erosion and Sediment Control Plan (ESCP) has been prepared to describe the Erosion and Sediment Control (ESC) measures planned for the Proposal. The plan is intended to assist minimise potential environmental harm by applying best practice ESC measures that are specific to the soils, topography and hydrological setting of the site. The objective of these measures are to minimise sediment generation at the source and thus reducing downstream control measures.

The ESCP provides an overview of the site specific conditions relevant to ESC planning and outlines the framework that will be applied in selection and design of measures and suggested timeline for implementation.

1.2 Scope

The ESCP applies to the Chandler Proposal and has been developed using the following preliminary studies and background data:

- Water assessment
- Soils Assessment
- Proposed site layout

The ESCP has been structured in the following sections:

Section 2 Relevant Guidelines, Industry Standards and Requirements

- Outlines Commonwealth and Northern Territory guideline and standards and relevance to the Project.

Section 3 Site Conditions

- Summary of site conditions from previous assessments undertaken at the Project including the description of soils, vegetation and hydrological setting of the site.

Section 4 Drainage control

- Describes measures to control stormwater at the site.

Section 5 Stockpile locations

- Describes site layout and location of sediment stockpiles

Section 6 Erosion and Sediment Control

- Outlines the environmental management measures and controls specific to the site

Section 7 Installation Sequence

- Suggests phases of installation of control measures over life of project

Section 8 Provisional ESCP

- Describes approach to development of the ESCP

Section 9 Recommendations for the ESCP in the Water Management Plan

- Provides a summary of the integrated approach to water, sediment and erosion management at the site.

1.3 Environmental objectives

The ECPM is intended to assist minimise potential environmental harm by applying best practice ESC measures that are specific to the soils, topography and hydrological setting of the site. The objective of these measures are to minimise sediment generation at the source and thus reducing downstream control measures.

1.4 Document review

This draft ESCP is a 'live' document, and will be reviewed and revised as the Project progresses through the design/planning stage to the construction and operation phases.

2 RELEVENT GUIDELINES, INDUSTRY STANDARDS AND COUNCIL REQUIREMENTS

This document was developed in accordance with the relevant sections of the *Best Practice Erosion and Sediment Control* guidelines ("ESCP guidelines"; IECA (2008)). It should be noted that these guidelines were developed primarily for the urban construction industry, and do not strictly apply to mine sites in every aspect. However, the key design principles outlined in the guidelines were followed where appropriate, and advice for "rural" practitioners was followed wherever it was available.

3 SITE CONDITIONS

3.1 Site Details

3.1.1 Topography

The southern region of the NT, where the Proposal is located, is characterised by rolling hills and

dunes, and sand ridges. However, the general area of the Proposal is bisected by a number of orogenic mountain belts (i.e. created by tectonic activity) to the north, east and west.

The James Ranges and the Oliffe Ranges, a series of west-east trending ridgelines, rise to 788 m Australian Height Datum (AHD) and 428 m AHD respectively to the north of the Proposal area. These ridgelines lie at the southern edge of the Orange Creek Syncline and are predominantly composed of basement rock.

To the east of the Proposal area lies the Rodinga Ranges and the Pillar Range, a series of southwest to north-east trending ridgelines that rise to a maximum height of 350 m AHD.

The Charlotte Range lie directly west of the Chandler Facility, and the Maryvale Hills directly to the south west. These topographic highs interrupt the low lying areas dominated by sand dunes and flood plain deposits.

3.1.2 Climate

Southern NT is characterised by a semi-arid to arid climate with hot dry summers and mild winters (Coffey 2012). Historic rainfall, temperature and evaporation data for the general area was acquired from the Bureau of Meteorology (BoM) for the Alice Springs Airport weather station (BoM: 015590), which is located approximately 113 km north of the Proposal area. The monthly rainfall and temperature dataset extends from January 1940 to July 2016. The mean daily evaporation record extends from 1959 to 2016.

Tellus operate an automated weather station (AWS) at the proposed Chandler Facility that extends from November 2015.

3.1.3 Rainfall

The BoM rainfall gauges in the general area are listed in Table 5.2. The nearest rainfall gauge to the Proposal area is located at Maryvale, approximately 21 km north-east of the Chandler Facility. Unfortunately, the record at Maryvale and adjacent sites contains a significant proportion of data gaps (>20% of missing data).

Data from BoM stations within 25 km of the mine site, namely Maryvale and Idracowra indicates that long term mean annual rainfall at the proposed mine site is likely to be approximately 204 millimetres (mm) (Table 5.3). Annual rainfall totals are highly variable from year to year and almost

50 percent of annual rainfall can occur within a single month, with rainfall greatest over the summer months and below regional averages during the winter months (see Figure 5.2).

The total annual rainfall recorded at the Alice Springs Airport weather station (BoM 015590) ranges from 76 mm to 782 mm (over the 74-year monitoring period), with an annual mean of 283.5 mm.

Table 3-1 Rainfall gauges

Gauge number	Name	Latitude	Longitude	Record start	Record end	Record length (years)	Distance from Chandler Facility (km)[1]	Mean Annual Rainfall (mm)[2]
15519	Palmer Valley	24.75	133.23	1953	Open	63	74	253.5
15524	Idracowra	24.99	133.79	1950	Open	66	25	203.6
15536	Maryvale	24.67	134.07	1948	Open	68	21	205.3
15532	Henbury	24.55	1343.25	1897	Open	129	77	224.2
15590	Alice Springs Airport	23.80	133.89	1940	Open	76	113	283.5

Source: Bureau of Meteorology, 2016. Notes:

1.km=kilometres.

2.mm=millimetres.

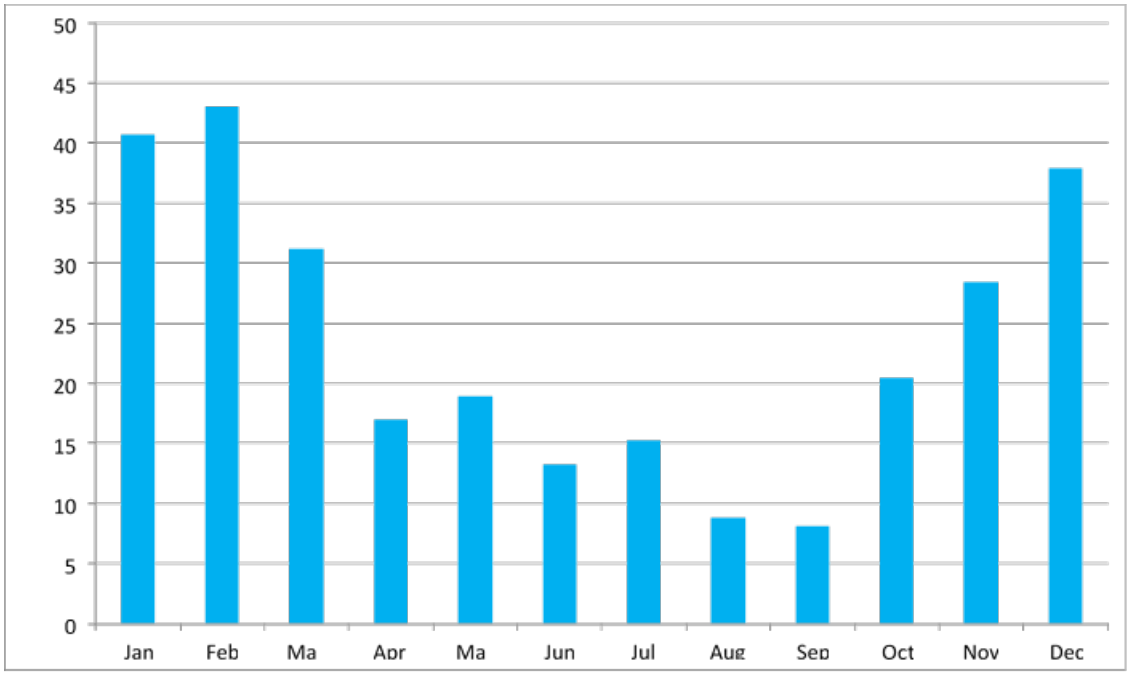


Figure 3-1 Monthly mean rainfall distribution Alice Springs Airport

3.1.4 Rainfall Intensity

Average Recurrence Intervals (ARIs) have been determined by the BoM). ARIs show predicted rainfall intensities for a range of storm durations and average recurrence intervals. For example, a 100- year ARI 24-hour rainfall intensity (7.4 mm/hr) is almost twice the 10-year ARI 24-hour rainfall intensity (3.87 mm/hr) and one eighth of the 100-year ARI 1-hour rainfall intensity (55.7 mm/hr). In general, higher rainfall intensity occurs over short durations, also higher rainfall intensity events are a less frequent occurrence than lower intensity rainfall events.

3.1.5 Vegetation

The Proposal area contains 17 different vegetation formations, including forests, woodlands, shrublands, palmlands, grasslands, forblands and an inland salt lake. Forty-two different vegetation types occur across the 17 vegetation formations (DLRM 2011). The dominant vegetation type across much of the Proposal area is Hard Spinifex (*Trioda basedowii*), Low Open Hummock Grassland with an open shrubland of Desert Cassia (*Senna artemisiodes* subsp. *filifolia*), Mulga (*Acacia aneura*), Witchetty Bush (*Acacia kempeana*), *Aristida holathera* and *Allocasuarina decaisneana* (DLRM 2011) (see Plate 1 and Plate 2).

Plate 1Trioda basedowii

Plate 2 Acacia aneura

Several ephemeral creeks intersect the Proposal area and are lined by riparian woodlands, comprising:

- River Red Gum (*Eucalyptus camaldulensis* var. *obtusa*) Woodland, containing Coolabah (*Eucalyptus coolabah* subsp. *arida*) with an understorey of Couch (*Cynodon dactylon*), Silky Browntop (*Eulalia aurea*) and Spiny Sedge (*Cyperus gymnocaulos*); and
- Coolabah Woodland, with an understorey of Lignum (*Muehlenbeckia florulenta*), Mulga, Desert Cassia, Water Clover (*Marsiliea spp.*), Couch and Buffel Grass (*Cenchrus ciliaris*).

3.1.6 Surface water

The Hugh and Finke rivers are the key ephemeral surface water features in the vicinity of the Proposal area. These watercourses are considered to be drainage channels that convey surface water flows to discharge areas. Flow events in these rivers are characteristically infrequent, however when flowing, they support permanent wetlands and waterholes that provide internationally significant habitats for waterbirds and aquatic flora and fauna (Miles et al 2015). Dryland rivers, such as the Fink River and Hugh River, also support consumptive and recreational water users and are widely used for agricultural and town supplies in inland Australia. These rivers are usually also important to Indigenous peoples with sacred sites and other culturally important requirements (Robson 2008).

Several ephemeral drainage lines discharge to the Finke River and Hugh River along the reaches adjacent to the Proposal area. These are predominantly topographical controlled by various sand dunes, ranges and outcropping basement rock visible across the Proposal area. The Charlotte Ranges to the west of the Proposal are a source of ephemeral drainage for the Finke River, while the ranges to the north of the Proposal (Oliffe Range and James Ranges) drain to the Hugh River.

3.1.7 Soil types

Soil types are shown in Figure 2 and described in

Figure 3-2 Soil types

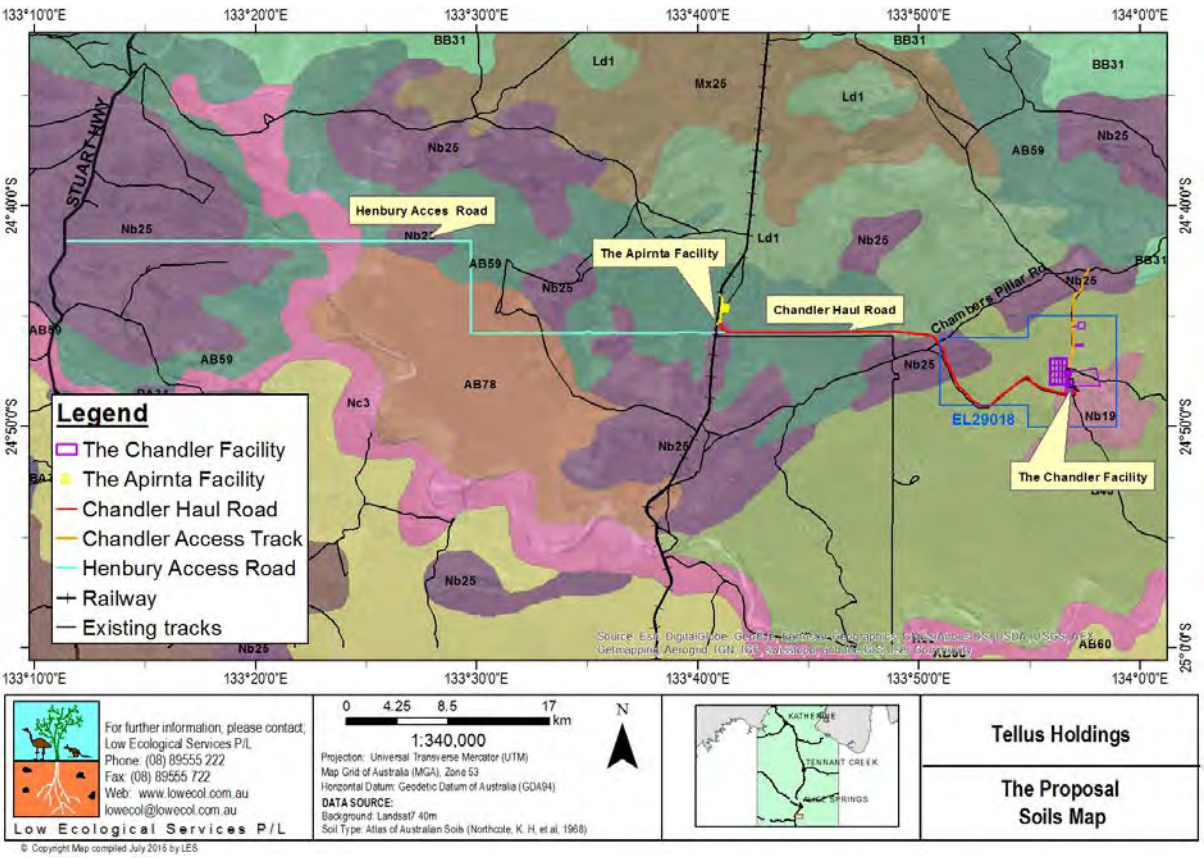


Table 3-2 Description of soil types

Map unit	Australian Soils Atlas Description (Northcote, K. H., *et al*, 1968)	ASC Conversion (Ashton & McKenzie, 2001)	Limiting properties
Ab59	Sandy plains with some dunes: chief soils are red earthy sands and red siliceous sands on the plains. Other soils include and massive earths and crusty red duplex soils on the plains.	Tenosol: Tenosols have a weakly developed soil profile which is typically very sandy and without obvious horizons. Tenosols form from highly salicious parent material and where rainfall is from 0 to 1400 mm. Generally tenosols have a very low agricultural potential with very low chemical fertility, poor structure and low water-holding capacity. Ground-water contamination can be a potential problem due to the high permeability of these soils.	• Succeptible to windsheet and watersheet erosion, when vegetation cover is reduced. • Interdunal swales and drainage depressions experience short periods (up to several days) of inundation after high rain events. • Claypans experience periods of inundation as a result of high rainfall events.
Ab78	Sandy plains with some dunes and claypans: chief soils are red earthy sands and deep red siliceous sands on the plains. Associated are loose siliceous sands on the dunes and clays in claypans.		
B43	Dune fields with dunes generally trending NW to SE; dune crests are inclined to drift readily; narrow inter-dune swales and corridor plains: chief soils are red siliceous sands but yellow and white siliceous sands and also some powdery calcareous loam) sands occur too. In general there is a grading from red to yellow and white sands from north to south; white sands are more common also in proximity to drainage-ways, pans, and lakes and grade through yellow to red sands away from these situations. Soils of the interdune areas are variable, and include sands such as deep red sands and earths such as non-calcareous alkaline earths. Also brown clays and other soils including yellow and yellow-grey duplex soils. There are also small inclusions of sandstone hills, mesas, claypans and clay flats.	Rudosol: Soil with negligible (rudimentary) pedologic organisation apart from (a) minimal development of an A1 horizon or (b) the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.	• Succeptible to windsheet and watersheet erosion, when vegetation cover is reduced. • Interdunal swales experience short periods (up to several days) of inundation after high rain events.

Ld1	Undulating to hilly limestone country: chief soils are calcareous earths. Associated are firm calcareous sands and shallow loam soils on steep sites. Areas of alkaline duplex soils and red sand soils and also alkaline soils may occur locally.	Calcerosol: Soils that are calcareous throughout the solum - or calcareous at least directly below the A1 or Ap horizon, or a depth of 0.2 m (whichever is shallower). Carbonate accumulations must be judged to be pedogenic (either current or relict), and the soils do not have clear or abrupt textural B horizons. Hydrosols, Organosols and Vertosols a re excluded.	• Moderately susceptible to erosion – scalding, rilling and and gullying can occur adjacent to natural drainage lines
Nb25	Flat-topped hills, mesas, and cuestas on shales, limestones, and sandstones and stony lowlands all covered by dense silcrete stone and gravel pavements: chief soils are crusty loamy soils (both neutral and alkaline). Associated are shallow sandy soils and with rock outcrop on areas of strong relief. Small areas of red sands and crusty red duplex soils occur in the narrow valleys, and calcareous earths may occur locally.	Sodosol: Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid. Hydrosols and soils with strongly subplastic upper B2 horizons are excluded.	Nb25: • Soils tend to be dispersive • Soils may be shallow in areas. • Soils may be susceptible to erosion - rilling and and gullying, as a result of reduced vegetation. Nb19: • Soils may be shallow in areas. • Soils may be dispersive and susceptible to erosion - rilling and and gullying, as a result of reduced vegetation. • Gilgai depressions and soils with a high clay content experience inundation after high rainfall events for a periods of days to weeks. Nc3: • Floodplains succeptible to scalding and rilling erosion, when vegetation cover is reduced. • River and floodplains succeptible to flooding after high rain events, although soils are well drained.
Nb19	Dissected stony plateaux with silcrete cappings on shale, claystone, and sandstone; surfaces are mantled by siliceous gravels and stones: chief soils are crusty loamy soils that occur on plateau summits and pediment slopes. Associated are brown clays in gilgai depressions on plateau summits; various shallow stony soils such as - firm calcareous sands and firm shallow calcareous loams on areas of strong relief; and grey self-mulching cracking clays on fringing plains.		
Nc3	Riverine plains: chief soils are crusty loamy soils. Associated are a variety of deep sandy soils.		

Table 3-3 Description of land systems

Code	Land System	Landform	Soil description	Vegetation	Limiting properties	Photograph
An	Angas	Undulating sandy plains with sandstone and limestone ridges.	Reddish brown sandy loams and calcareous earths.	Open to scattered mulga and witchetty bush over emubush, cassia and bluebush. Understory consists of coppurburrs, sida and forbs.	Slightly succeptible to windseet and watersheet erosion if vegetation removed.	
Au	Amulda	Sandy foothill fans with broad drainage depressions and creeks.	Red clayey sands and sandy clay loams.	Over storey of Mulga, blue mallee and ironwood over witchetty bush and emu bush. Understory of spinifex, woollybutt grass and kerosene grass.	• Moderately succeptible to erosion – scalding, rilling and and gullying can occur adjacent to creeks drainage lines. • Drainage depressions experience short periods (up to several days) of inundation after high rain events.	
Cn	Chandlers	Mesas, low ranges and stony plains with clayey stony slopes and silcrete or shale outcrop.	Stony clayey soils, and shallow calcareous soils.	Generally treeless, scattered bluebush emubush and cassia over copperburrs and sida.	• Skeletal soils, clayey stoney slopes are highly succeptible to watersheeting, rill erosion, and gullying if rock cover is removed. Open woodlands moderately susceptible to water sheeting.	
Fi	Finke	Sandy alluvial plains adjacent to major rivers including active floodplains and dunes.	Sand bed. Levees with loamy sands and fine sands. Dunes with reddish sands.	Tall open woodland of river red gum over colony wattle and sticky hopbush with an understory of buffel grass, couch and sand hill cane grass.	• Floodplains succeptible to scouring floodwater erosion, particularly when vegetation cover is reduced. • Ephemeral River and floodplains succeptible to flooding after high rain events, although soils are well drained.	

Gi-1	Gillen	Rugged quartzite and sandstone ranges.	Rock and shallow stony soils.	Absent or scattered mulga and witchetty bush over low shrubs, spinifex and forbs.	• Very shallow soils • Succeptible to rill and gully erosion, when rock and vegetation cover is reduced.	
Gi-2	Gillen	Colluvial and alluvial fans and plains.	Red brown sandy clay loams and deep red loamy sands.	Ironwood, mulga, corkwood and witchetty over kerosene grass, mulga grass and other perennial grasses.	• Shallow soils • Succeptible sheet and rill erosion when rock and vegetation cover is reduced.	
Rn	Renners	Undulating limestone slopes and rises.	Calcareous earths and shallow gravelly soils.	Sparsely vegetated. Mulga and witchetty bush with a shrub layer of dead finish, emu bush and bluebush over copperburrs, sidas and forbs.	• Shallow soils. • Moderately succeptible to erosion – scalding, rilling and and gullying can occur on broad slopes adjacent to natural drainage lines, particularly if rocky mantle is removed.	

Ru	Rumbula ra	Plateaux, mesas and stony slopes.	Rocky and stony surfaces, stony sandy clay loams, shallow calcareous earths.	Scattered mulga on the plateaux. Low shrubs - cassia, emu bush, bluebush over perennial grasses and forbs.	• Succeptible to rill and gully erosion, when vegetation or rocky cover is reduced.	
Si	Simpson	Sand dunes and swales.	Red sands on dunes, red clayey sands, sandy loams and calcareous earths in swales.	Desert oak over cassia and emu bush. Understory consists of spinifex and seasonal forbs.	• Succeptible to windsheet, watersheet and pedicil erosion, when vegetation cover is reduced. • Roads constructed parellel to wind direction through dunes will wind erode. • Interdunal swales experience short periods (up to several days) of inundation after high rain events.	
Sn	Singleton	Level to slightly undulating plain. Occasional low rises and very broad swales including broad drainage depressions.	Red clayey sands and red earths.	Sparse trees (mulga, mallee, desert oak, and beefwood) and shrub layer over spinifex. Small areas with mulga over woolybutt and kerosene grass.	• Moderately succeptible to erosion – scalding, rilling and and gullying - adjacent to natural drainage lines or on gentle slopes • Drainage depressions experience short periods (up to several days) of inundation after high rain events.	

3.2 Land systems

A total of nine broad land systems have been mapped over the Proposal area. The dominant land systems over the Chandler Facility are Singleton and Rumbalara. The Apirnta Facility is mapped on Singleton and the dominant land systems on the Chandler Haul Road and Henbury Access Road are Chandlers, Simpson, Angas and Singleton. Table 3-4 summarises the land systems in the Proposal area which are shown in Figure 3

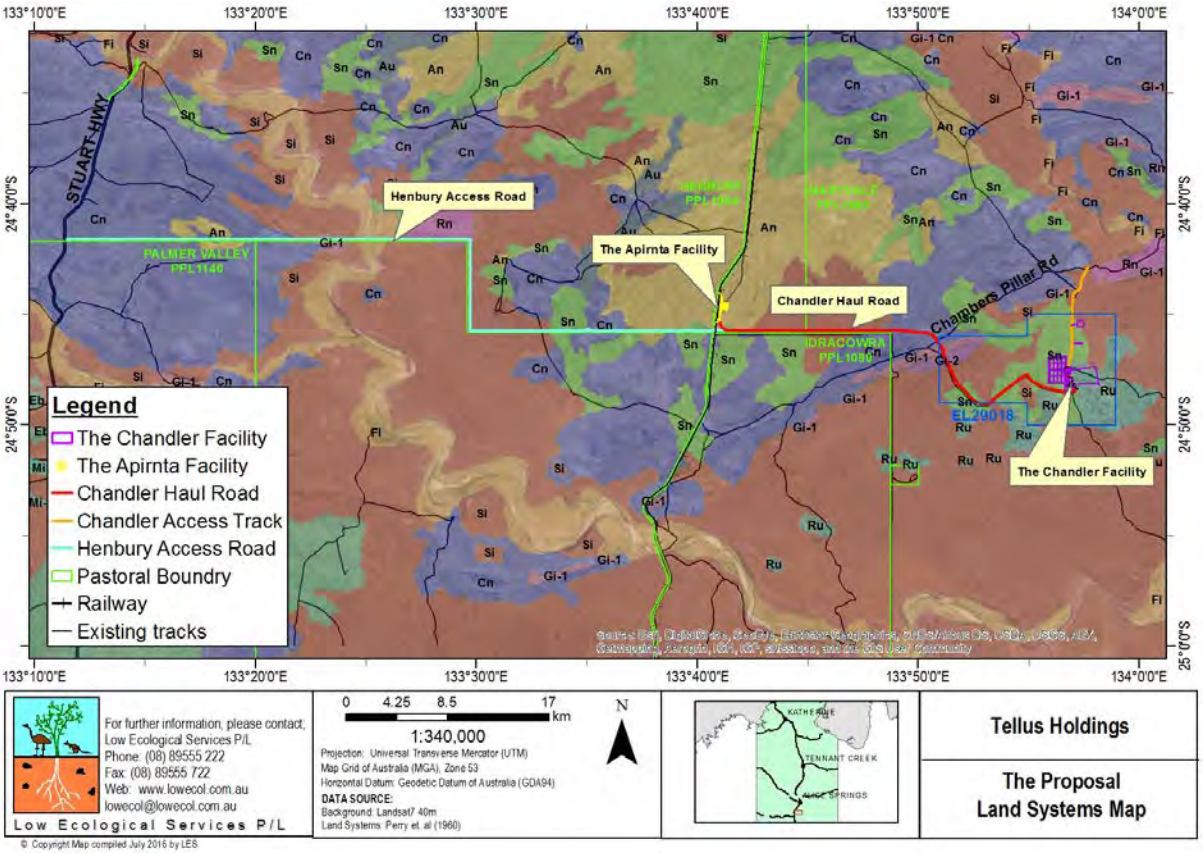


Figure 3-3 Land systems map

3.3 Vegetation Management

Vegetation will be managed following best practice controls and measures which include not destroying, removing or clearing vegetation to an extent greater than is necessary for the execution of works.

Vegetation management strategies will be implemented such as:

- Excluding access to significant vegetation areas
- Selecting appropriately sized clearing machinery and equipment
- Minimising worksite area
- Protecting vegetation driplines
- Locating ancillary activities (e.g. stockpile sites, camps, parking locations, vehicle hardstands)
- within existing disturbed areas

Should a threatened species be identified onsite, in addition to those identified in the EIS be found, the following steps will be enforced:

- stop works in the immediate area.
- notify the Mine Manager and Environmental Supervisor.
- install a temporary protective barrier to protect the species.

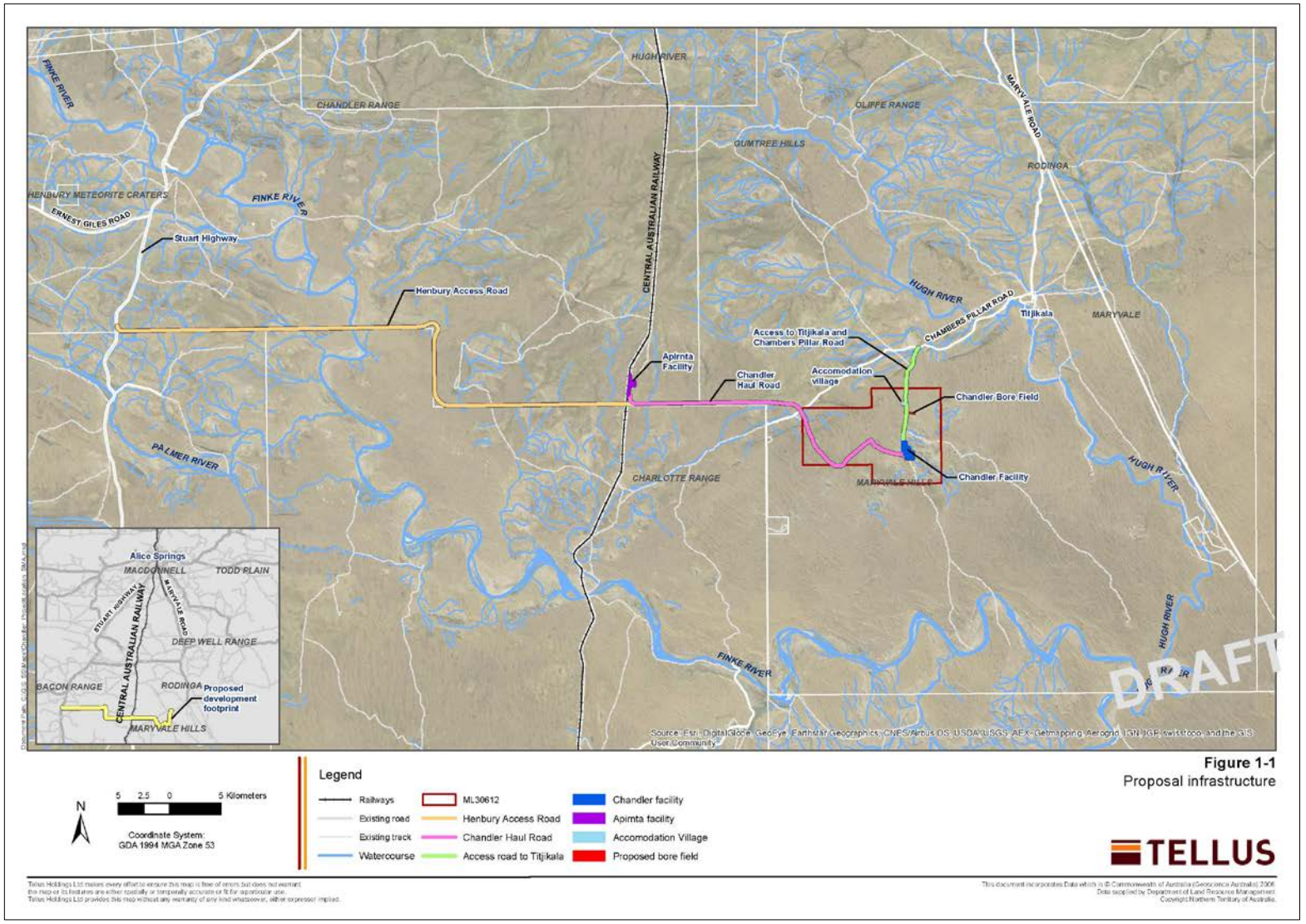
3.4 Site Plans

The Proposal site layout and plan is included in Figure 3-4

3.5 Stabilised site entry and exit points

High volume traffic areas will be constructed in accordance with best practice guidelines and specifications suitable for their intended use.

Figure 3-4 Site layout



4 DRAINAGE CONTROL

4.1 Control of upslope stormwater

Flow diversion structures such as banks and drains will be constructed to divert all storm water surface flows around the main work areas, this will minimise the potential water volume that would need to be managed within the site (Figure 4-1).

Design will include consideration of peak flow rates that may typically occur during short, intense storms rather than gradual or longer storm events. Construction material will include gravel material and native soil materials compacted, to be sufficiently resistant to erosion. Revegetation with ground cover will increase stability and aid integrity of the structure.

4.2 Control of disturbed area stormwater

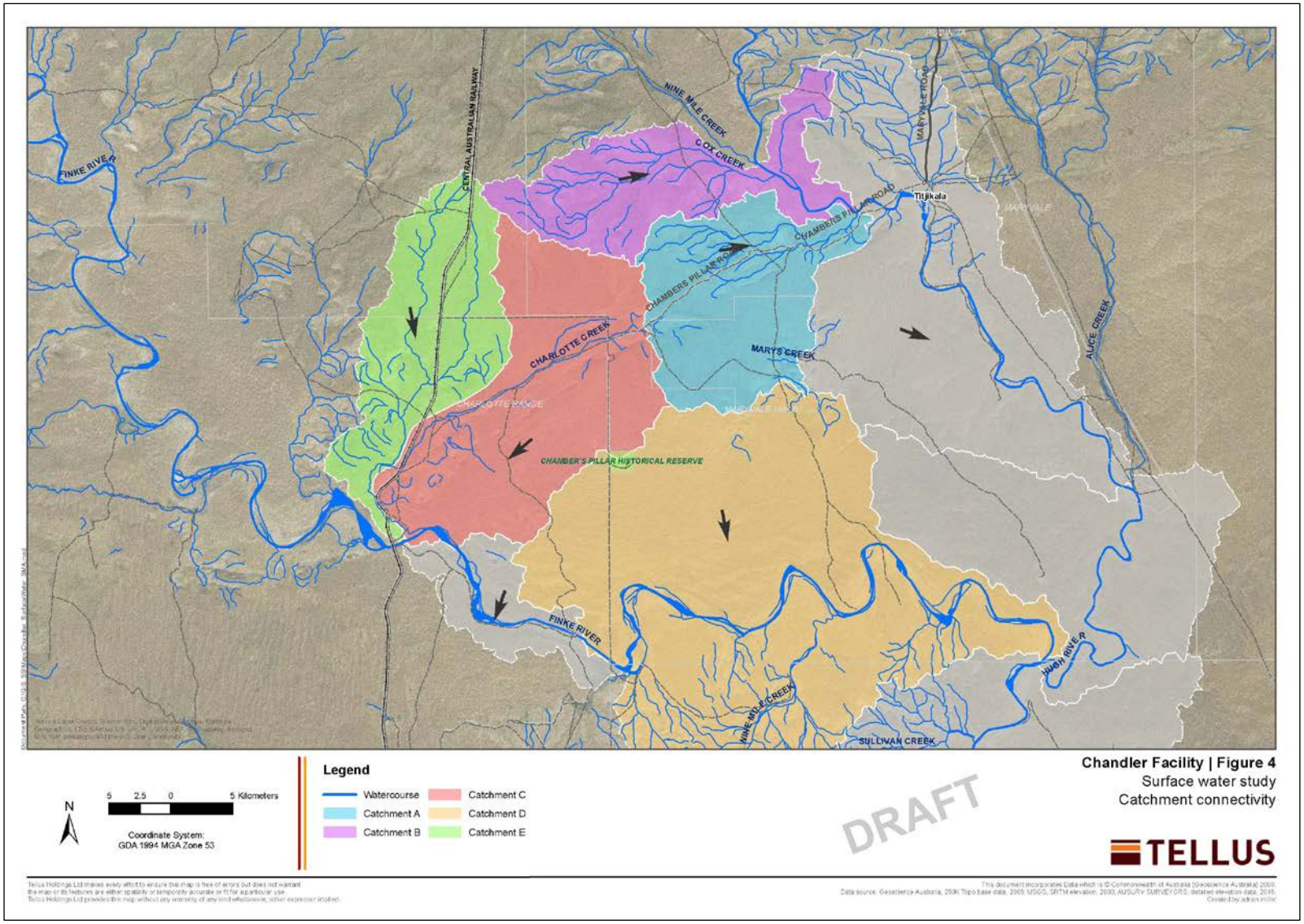
The main operational areas will be gently sloping to flat and constructed to minimise potential of surface flow erosion. Surface flow will be diverted to suitable natural or constructed collection areas.

Site layout design will take into consideration peak flow rates and intensity, this will be further developed during final design of the project.

4.3 Roof water

Storm water will be diverted into water tanks for use during construction and operations (e.g dust control, grey water use). Tanks will be designed for peak capacity with overflow and diversion measures in place.

Figure 4-1 Pre-mine surface flow directions



5 STOCKPILE LOCATIONS

Locations of stockpiles required developed during construction of the Proposal and in place during operations are shown on site layout plan at Figure 4

6 EROSION AND SEDIMENT CONTROL

6.1 Disturbed areas erosion controls

6.1.1 Operational work areas

The main operational work areas will be gently sloping to flat, which will be constructed by compacting the natural soil profile. Sediment traps will be installed to collect and remove any sediment that is generated from these areas.

6.1.2 Roads

Haul and access roads will be designed to be water shedding to avoid flow accumulation which could lead to scouring and erosion of the road surface and embankments. Roads will be constructed using best practice guidelines and techniques.

Gravel surface material will be used with the addition of sandstone or waste rock material where the upper soil profile is found to be unsuitable or substandard for road construction.

Roads may be sprayed with saline water to minimise dust generation and to improve the structural integrity of the roads, to minimise sediment erosion and runoff potential.

Any roads intersecting water crossings or diversion structures will be constructed as to not interfer with the function of the water diversions (eg by use of bridges or culverts). Compacted floodways would be installed in lowest lying areas to maintain road integrity.

6.1.3 Stockpiles

Topsoil stockpiles will be constructed no higher than 2m and subsoil stockpiles no higher than 10m with a slope less than 15 degrees to help minimise erosion. Stockpiles may be bunded around the perimeter to minimise sediment runoff.

6.1.4 Dust control

Wind erosion will be controlled by combination of surface material and water spraying. Surfaces that require additional dust control measures, such as roads, will be sprayed with water periodically as required.

Any cleared areas that are no longer required will be progressively rehabilitated in accordance with the RCP. This will restore native plant cover and reduce the risk of erosion and dust generation from exposed soil surfaces.

6.2 Sediment runoff controls

Sediment runoff measures will include the appropriate construction of operational work areas, to minimise effects of wind erosion and surface flow runoff, which in-turn will assist in minimising potential for sediment runoff. Where required the installation of bunding around perimeters of such areas will be implemented.

Roads will be constructed based on site conditions and take into consideration the prevailing wind directions and potential for surface water flow. Embankments, windrows and surface water diversions, if required will be constructed in accordance to department guidelines and best practice.

7 INSTALLATION SEQUENCES

The design of erosion and sediment control measures will be further developed during the final design of the Proposal, based on findings and recommendations of the EIS and further site geotechnical investigations.

Based on the long term nature of the Proposal, ongoing review and monitoring of measures will allow for most suitable controls to be tested and improved as knowledge of site conditions over time develops.

8 PROVISIONAL ESCP PLANS

This ESCP has been developed concurrently with the following complementary documentation as part of the project planning process:

- Biodiversity management plan
- Water Management Plan
- Dust Control Management Plan
- Landscape Concept Plan

The draft ESCP is a ‘live’ document, and is provisional in nature, it will be reviewed and revised as the Project progresses through the design/planning stage to the construction and operation phases

9 RECOMMENDATIONS FOR THE ESCP IN THE WATER MANAGEMENT PLAN

9.1 General notes

Management of erosion and sedimentation is based on principles that involve:

- Minimising the extent and duration of soil disturbance
- Controlling the location and velocity of flow.
- Minimising soil erosion initiated by rain or concentrated flows.
- Minimising sediments leaving site.
- Revegetating or stabilising exposed areas or unstable soils.
- Installing, operating and maintaining appropriate measures put in place.

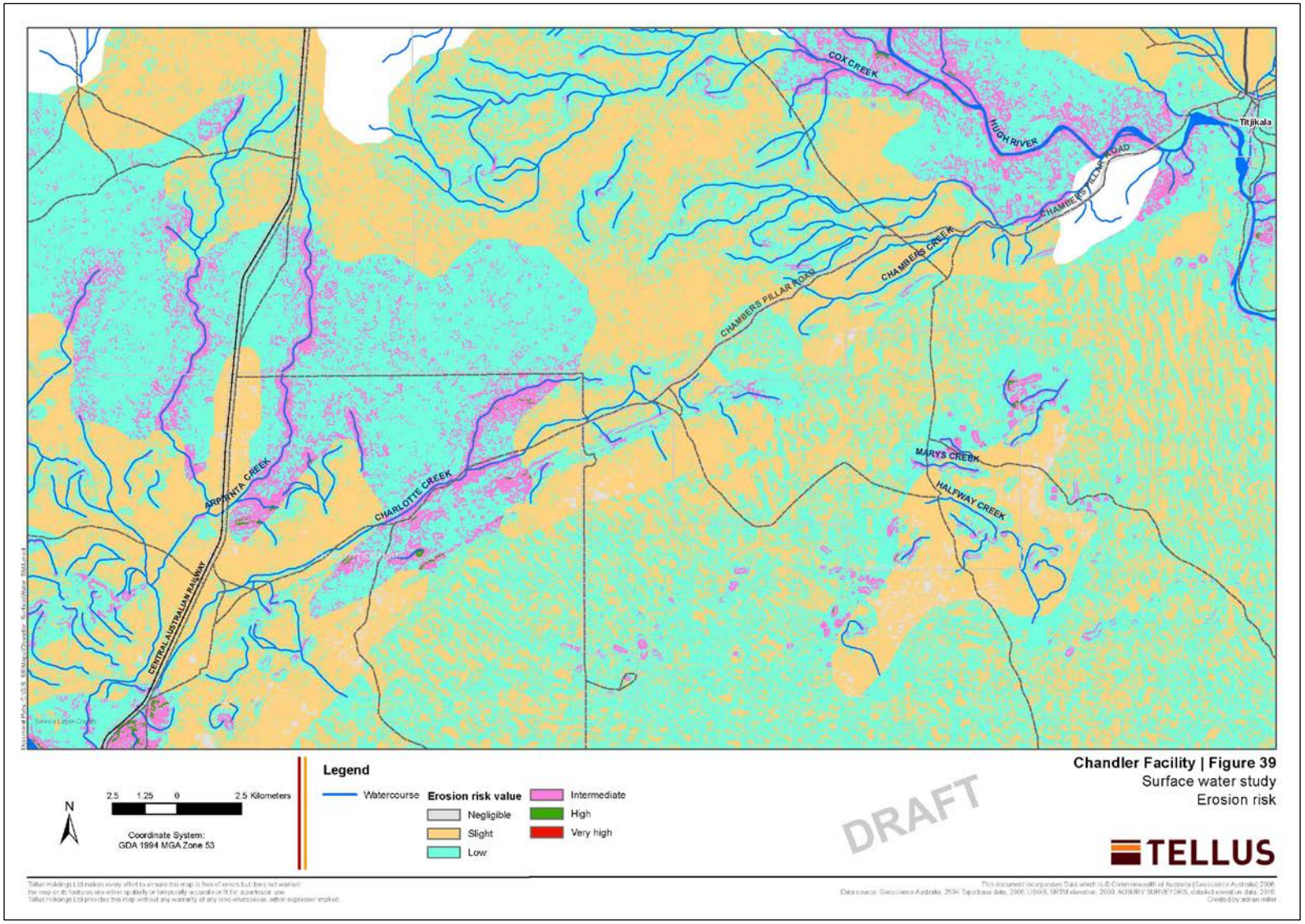
The type of measures depends on the likelihood and intensity of expected rainfall and sheet flows. The measures recommended in this document are based on:

- Drainage controls.
- Erosion and sedimentation controls.

Where areas have been cleared, they would not be left without treatment for more than 24 hours. Bunding and drainage would be constructed to ensure runoff from disturbed areas is discharged without appropriate erosion and sediment control treatments.

Areas of potential erosion risk have been mapped and categorised into areas of low, medium and high risk (see Figure 9-1). This map will be used for detailed design and updated following that task.

Figure 9-1 Erosion risk map



9.2 Drainage Controls

All works would be undertaken with consideration to detailed design addressing drainage controls. The drainage control measures would be design to:

- Divert un-impacts areas from runoff of up-gradient areas around disturbed areas.
- Contain and transport potentially contaminated stormwater through disturbed areas to treatment measures.

When detailed design has been completed, this section of the document will be updated to reference the final drainage control measures. In summary, they could include drains and bunds to contain flow and direct it towards an appropriate discharge point or treatment area.

Open channels and drains would be stabilised with the dimensions and layouts in line with relevant standards to minimise the risk of erosion and sedimentation.

Bunding would be installed around all areas of infrastructure and disturbed areas. This would be done to divert un-impacted runoff from up-gradient areas and to contain potentially impacted runoff for treatment if discharge is required. The bunds would be established and stabilised to reduce maintenance requirements. They would be design to take account for flashy rainfall events within an arid zone environment.

If culverts are required, they would be designed to industry standards. Floodways at the High River and Finke River are recommended. In areas of where sheet flows have high potential to result in downstream impacts, culverts should be spaced at short intervals.

The design of all structures would be checked by hydraulic and hydrologic modelling prior to construction.

9.3 Erosional and sediment controls

A range of erosion and sediment control measures would be required for the Proposal. The objective of such measures are to minimise the movement and loss of sediments at the source. Detailed design will confirm what measures are to be put in place but they could include:

- Minimising the areas of disturbance
- Minimising soil and stockpile erosion caused by wind or rain or both.
- Minimising turbidity levels in stormwater runoff by minimising the exposure of soil to rain and/or stormwater flows.

Large cleared zones are most at risk of erosion. These areas should be bunded and located away from floodplains and watercourses. During windy days, these areas should be dampened to minimise wind erosion.

Stabilising disturbed areas should be undertaken within 24 hours of an event or as soon as practical. Stabilisation options could include:

- Physical protection against raindrop impact.
- Barriers between the earth and flow of water.
- Increase surface roughness to reduce flow velocities.
- Increased absorption of rainfall by the soil profile, therefore reducing the volume of runoff.

Re-vegetation of disturbed areas should be undertaken as soon as practical and in accordance with the Landscape Management Plan and Biodiversity Management Plan.

Sediment controls would be installed to trap and retain sediments to ensure sediments do not enter waterways. Trapping sediment as close to its source is a key objective. Due to high maintenance requirements, sediment control structures would require monthly inspections or as soon as practical following a rainfall event.

Sheet flows are expected to be greatest along the northern boundary of the Chandler Haul Road and the Apirnta Facility. Options for sediment controls in this area may include sediment fences and buffer zones or increasing surface roughness on the up-gradient sides of the Haul Road.

Where required, sedimentation basins would be installed. Due to extremely high evaporation rates within the Proposal area, any water contained within a sediment basin would evaporate and therefore, require little maintenance.

9.4 Rehabilitation and landscaping

To be completed following detailed design.

9.5 Maintenance

Maintenance of all sediment and erosion control measures would occur on a monthly basis or after a rainfall event.

A monitoring checklist of all structures will be kept, with entries made following inspection and maintenance activities detailing the following:

- Condition of all structures.
- Removal of erosion and sedimentation structures.
- Repair of all structures.
- Rainfall, including volume and duration.

Actions should be investigated and implemented within 24 hours of rainfall or as soon as practical.

9.6 Monitoring

Monitoring of all sediment and erosion control measures would occur on a monthly basis or after a rainfall event.

10 MANAGEMENT OF INFORMATION AND DATA

All environmental management information and data, including previous versions of this ESCP will be stored in Tellus' Environmental Management System (EMS) which is located on the Q drive of the Sydney server. The Tellus EMS is accredited to ISO 14001 standard and is regularly audited internally, and annually audited by an external party.

Each record, including raw data and monitoring reports will be saved electronically in the EMS with a unique reference number.

Appropriate data management policies (including off site data back up and security) are in place.