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FIGURES

TABLES

5. REHABILITATION AND DECOMMISSIONING

5.1. ENVIRONMENTAL VALUES

The environmental values that have been considered in relation to rehabilitation and decommissioning at the South Galilee Coal Project (SGCP) include:

- the health and well-being of people
- the diversity of ecological processes and associated ecosystems
- maintaining soil resources and agricultural land suitability
- maintaining water quality and flows in waterways
- the creation of safe, stable, non-polluting and sustainable landforms.

5.2. GUIDELINES AND OBJECTIVES

Mine rehabilitation is an important component of any mining project and is an integral part of the mining process. The rehabilitation program at the SGCP will consist of detailed planning and design of post-mine landforms, inclusive of erosion control and design for long-term geotechnical stability. This Section considers the rehabilitation and decommissioning aspects of the SGCP.

The Department of Environment and Heritage Protection (DEHP) *Guideline 18: Rehabilitation requirements for mining projects* (2008), (DEHP Guideline 18) provides information on both progressive and final rehabilitation requirements for mining projects operating in Queensland under the provisions of the *Environmental Protection Act 1994* (*EP Act*). This is the overarching guideline used in determining the SGCP rehabilitation and decommissioning management strategy.

The Proponent will adhere to DEHP Guideline 18 by:

- setting rehabilitation goals and objectives, in consideration of the rehabilitation hierarchy
- setting rehabilitation indicators and appropriate monitoring programs
- setting completion criteria to be achieved prior to release of rehabilitated land.

In addition to DEHP Guideline 18, the rehabilitation strategy for the SGCP will meet the requirements contained in:

- Environmental Management Policy for Mining in Queensland 1991 (Department of Mines and Energy, 1991)

- A Policy Framework to Encourage the Progressive Rehabilitation of Large Mines (Environmental Protection Agency [EPA], 2004)
- Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland 1995 (Department of Minerals and Energy, 1995)
- Leading Practice Sustainable Development Program for the Mining Industry Landform Design for Rehabilitation (Environment Australia, 1998)
- Leading Practice Sustainable Development Program for the Mining Industry Mine Rehabilitation (Department of Resources, Energy and Tourism, 2006a)
- Leading Practice Sustainable Development Program for the Mining Industry Mine Closure and Completion (Department of Resources, Energy and Tourism, 2006b).

The Proponent is committed to the rehabilitation goals listed in the DEHP Guideline 18. This states that the rehabilitated landform is to be safe to humans and wildlife, non-polluting, stable, self-sustaining and free of maintenance, and able to sustain an agreed post mining land use.

Specifically, the rehabilitation strategy for the SGCP will have the following objectives:

- mining and rehabilitation will aim to create a landform with land use suitability similar to that prior to disturbance unless other beneficial land uses are pre-determined and agreed
- mine wastes and disturbed land will be rehabilitated to a condition that is self-sustaining or to a condition where the maintenance requirements are consistent with an agreed post-mining land use
- the water management system will aim to capture all mine affected water and maximise on-site storage capacity so existing and future use of downstream water is not compromised.

5.3. MINING PROCESSES

Combining mining operations and rehabilitation works at the SGCP will be complex, requiring coordination between numerous physical elements and operational processes. For clarity, the pre-mining and mining processes are detailed below, and the rehabilitation processes are detailed in **Section 5.5**.

5.3.1. Land Disturbance and Clearing

During the life of the mine, approximately 585 hectares (ha) of remnant vegetation is expected to be cleared for the SGCP for open-cut mining, waste rock emplacements and infrastructure. According to DEHP's *Conservation Status of Queensland's Bioregional Ecosystems*, some of these areas of vegetation are classified as Endangered Regional Ecosystems (ERE) and are of conservation significance.

Where disturbance of an ERE is unavoidable, control strategies will be implemented to minimise disturbance and vegetation offsets will be provided for the disturbed areas, as required. Details of management and mitigation measures for EREs and areas of ecological significance are outlined in **Section 8—Nature Conservation**.

The SGCP will adopt a sustainable approach to land clearing. Flora and fauna and cultural heritage surveys will be undertaken in the area to be cleared where they have not previously been completed. If significant artefacts or protected species are identified, appropriate management measures will be applied.

Where vegetation has no direct commercial value, it will be cleared and stockpiled. Stockpiled vegetation will be assessed to determine its suitability to be spread on final landforms to assist natural habitat establishment. Where it cannot be used, stockpiled vegetation may be burned in a controlled manner under the required permit.

5.3.2. Topsoil Salvage

The Proponent is committed to the salvage and use of all topsoil suitable for rehabilitation. Topsoil will be strategically stripped ahead of mining in accordance with a Topsoil Management Plan. The Topsoil Management Plan will indicate how topsoil is to be removed, transported and stored to maximise soil condition. A topsoil stockpile inventory will be developed indicating the locations, types, volumes and storage timeframes.

Stripping operations will be staged so that the minimum area is disturbed at any one time. Topsoil from all areas cleared of vegetation will be segregated for rehabilitation purposes where suitable. Topsoil will not intentionally be mixed with waste rock or subsoil unless proven to be structurally or chemically advantageous.

Soil types and recommended topsoil stripping depths are contained in **Section 7—Land**. Soil assessment indicates there will be sufficient topsoil for the rehabilitation program.

Stripped topsoil will be placed directly onto final landforms where practicable. This avoids double handling, eliminates the need to stockpile, and maintains the quality of topsoil. If the topsoil cannot be placed on prepared landforms immediately, it will be stockpiled in pre-determined locations as close as practicable from where it was removed and within the area suitable for future rehabilitation works. This allows topsoil to be used in the progressive rehabilitation of areas where mining, backfilling and final shaping have occurred.

Some topsoil can be detrimental to rehabilitation due to the presence of weeds. A visual assessment for weeds will be undertaken prior to topsoil stripping. If weeds are present within the topsoil stripping area, appropriate measures will be applied in accordance with the Weed Management Plan (refer to **Section 8—Nature Conservation**). If there is a high risk of weeds spreading during stripping, specific measures will be taken to prevent such spread (e.g. equipment will be washed down prior to starting work in a new area).

The SGCP includes considerable reserves of topsoil that may be used in mine rehabilitation programs. As a general guide, all soils used in rehabilitation should be applied to no less than 100 millimetres (mm) depth, where practicable. This will provide sufficient depth for re ripping should follow-up maintenance work be required.

Section 7—Land provides further details of the available soil types, volumes and stripping and stockpiling recommendations for all soils in the SGCP area.

5.3.3. Mining Operations

Following land clearing, removal of topsoil resources and construction activities, specific mining operations will commence. For the SGCP, these will generally include blasting, removal of overburden material to waste rock emplacements, removal of coal for processing at the Coal Handling and Preparation Plant, transport of the product coal off-site for export and transport of the coal rejects on-site to the waste rock emplacement (refer to **Figure 5-1** to **Figure 5-11**). Further details of the SGCP mining process can be found in **Section 4—Project Description**.

5.3.4. Waste Rock Characteristics

Characterisation of the waste rock, both pre-mining and post-mining, is essential in understanding the physical and chemical properties of the material to be rehabilitated.

5.3.4.1. Pre-Mining

The results of analyses undertaken to date indicate that:

- the bulk of the overburden and interburden material is likely to be non-acid forming (NAF)
- the roof within 5 metres (m) of the D1 seam appears to be the main potentially acid forming (PAF) horizon, with a number of other lower capacity PAF horizons associated with coal seams and also within interburden between seams D1 and D2
- PAF materials are likely to be fast reacting, with little or no lag time (days to weeks) once exposed to atmospheric conditions.

Geotechnical assessments combined with the exploration program have indicated that a significant portion of the overburden is unconsolidated and this provides opportunity to minimise the degree of drill and blast required.

5.3.4.2. *Post-Mining*

Physical disruption during the mining process has the potential to change the nature of waste rock materials and their interaction with the surrounding environment in a number of ways. Changes which can potentially occur include:

- exposure of unweathered material to oxidation processes near the post mining landform surface can result in the release of oxidation products that are prone to transport by surface runoff or infiltration (e.g. salts and acid)
- soils and rock expand when loosened through blasting and excavation, can swell by 15 to 18 %. As a result, not all waste rock can be contained within the mined out excavations, leading inevitably to slopes and elevated areas above the original landform. The post-mining material will also have a higher initial porosity than the original *in-situ* overburden. Some residual settlement is expected, but this will have little effect on the final landform
- soil that supported a specific type of plant growth on the pre-mining landform may not be able to support the same plant growth on the post-mining landform due to physical and chemical changes that have occurred
- poorly structured and dispersible soils and waste rock will be prone to erosion, particularly on slopes.

As part of the mining process, the overburden material will be placed in waste rock emplacement areas to pre-planned heights. Once final height and grades are achieved, this material will be rehabilitated.

5.3.5. Coal Reject Characteristics

Coal rejects are a combination of coarse and fine materials that are removed as part of the coal crushing and washing processes.

Coarse and fine rejects will be disposed of using the following methods:

- coarse rejects will be conveyed to a reject surge bin
- fine rejects will be thickened and conveyed on the rejects conveyor to the reject surge bin
- combined reject material will be transported by truck and discharged within the waste rock emplacements
- reject material will be covered with a 10 m NAF cover and topsoil.

The overall characteristics of the rejects are summarised as follows:

- the material includes solutes containing sodium chlorides and sulphates at elevated levels that may restrict plant growth

- sulfate concentrations are proportionately high indicating some sulphur based mineralogy (possibly pyrites)
- negligible net acid production potential (i.e. pH >4)
- pH range approximately 7-8.5
- EC range from 900-1,450 micro Siemens per centimetre (considered by the Department of State Development, Infrastructure and Planning [DSDIP] to be saline)
- no elevated trace metal concentrations.

A Coal Rejects Management Plan will be developed to manage the treatment and storage processes for coal rejects over the life of the SGCP.

5.3.6. Waste Rock Emplacements

Waste rock emplacements will be located within and to the east of the mine pits. The waste rock emplacement design is based on the need to store overburden in a managed and environmentally controlled location that will allow efficient and safe on-going mining operations, consistent with final rehabilitation objectives. These objectives primarily aim to:

- maintain low soil losses consistent with adjacent lands of equal land suitability by encouraging a self-sustaining vegetation cover on all landforms
- limit erosion potential through surface cladding and implementation of appropriate control measures
- minimise off-site impacts.

The material to be placed in the waste rock emplacements will include waste rock, coarse coal rejects and fine coal rejects. The outer slopes of the out-of-pit waste rock emplacements will not be steeper than a 1(V):3(H) gradient.

Contour banks will be sloped towards rock armoured drains. The downslope drains will be spaced at an appropriate distance apart depending on the final landform shape. The top of the out-of-pit waste rock emplacements will be divided into several smaller catchments to control the surface runoff from any particular section. This layout will enhance soil infiltration and minimise runoff from the emplacement. Slopes will be appropriately battered using NAF material to minimise erosion and allow for a stable final rehabilitation surface. The outer slopes of the out-of-pit waste rock emplacements will be seeded with a mixture of native grasses to augment the erosion control.

As mining progresses, the mined out-pit will become available for waste rock emplacement. The in-pit waste rock emplacement will be shaped to encourage internal ponding to reduce runoff to other areas. Rainfall will collect in these depressions and will initially dissipate through seepage into the waste rock. As vegetation becomes established, some water will also be dissipated through evapotranspiration. A bund will be constructed to prevent ponded water from flowing back towards the void as this could potentially result in erosion cutting back through the reshaped landform. The upper surface and outer slopes will be shaped to form a stable landform as per the out-of-pit waste rock emplacements.

5.3.7. Geotechnical Assessment

The SGCP mining operations will cut through the Bandanna Formation, targeting the D1 and D2 seams. The maximum mining depth for the proposed open-cut will be 140 m. The mining depth for the underground is between 140 m and 450 m.

A geotechnical assessment has been undertaken to identify any significant constraints to operations. The principal source of data for the geotechnical assessment has been samples obtained from 16 fully cored geotechnical drill holes, which:

- were spread along strike of the D1 seam sub-crop in the northern part of EPC 1049
- were generally concentrated on the Creek Farm and 'Sapling' properties in the area proposed for initial open-cut mining
- extended down dip (to the west) to the approximate B1 seam sub-crop of the open pit areas near the Creek Farm and 'Sapling' properties.

No significant impediments to open-cut mining of the D1 and D2 seams have been identified in these initial areas, although economic constraints and high wall heights will limit the western down dip extent of mining.

Based on the assessment undertaken to date, the following key geotechnical conditions will apply to the SGCP open-cut mining:

- **Pit wall stability** – application of the pit wall design parameters detailed in **Table 7-11** and **Figure 7-12** (refer to **Section 7—Land**) are expected to maintain adequate levels of stability for the low and highwalls formed during progressive mining. Provision of pre-split drill and blast for the highwalls is considered mandatory in this regard but will not avoid the effects of adversely oriented faults that may be encountered at various stages. Wall stability will be further enhanced by good operational scaling practice.
- **Material excavatability** – overburden removal should be readily accomplished through all Tertiary materials and to approximately 80 % of the depth of weathered Permian rock by large excavation equipment in face shovel or backhoe configuration. The remaining approximately 20 % of weathered Permian and all fresh Permian rock will require drill and blast to uncover coal economically.
- **Trafficability** – trafficability on the D2 seam floor will be affected to some degree by the predominance of siltstone and carbonaceous mudstone over sandstone in this stratigraphic position. However, most floor rock is medium strength and only one of the 16 geotechnical drill holes contained carbonaceous mudstone which would be classified as low strength rock.
- **In-pit waste rock emplacement** – instability is unlikely to be an issue at SGCP through a combination of low floor dip and the apparent absence of bedding parallel shears in the floor rock types.

Design parameters based on the geotechnical assessment are provided in **Section 7.3.3.3** (refer to **Section 7—Land**).

5.4. POTENTIAL IMPACTS ON ENVIRONMENTAL VALUES

Site activities with potential to impact on the rehabilitation and decommissioning environmental values are:

- land disturbance (vegetation clearance, topsoil stripping, stockpile management) causing erosion and degradation of topsoil resources
- land disturbance resulting in a reduction in agricultural land suitability, and capacity to support native ecosystems
- construction of overburden emplacement areas and potential acid mine drainage (AMD) generation
- construction of access tracks, haul roads and pits
- disposal of coarse rejects and tailings
- creation of final voids
- potential land contamination from the inadequate management of hazardous materials including fuels, oils and chemicals.

5.5. REHABILITATION PROCESSES

Rehabilitation of coal mines has been undertaken throughout Central Queensland for several decades, continually building upon existing knowledge and experience, and establishing optimum methods of landform stabilisation and revegetation.

This experience has been incorporated into the SGCP rehabilitation planning processes, along with information from site-specific studies.

5.5.1. Design Criteria

Rehabilitation design at the SGCP will be based on the following criteria:

- all areas significantly disturbed by mining activities (inclusive of the infrastructure corridor but not the final void) will be rehabilitated to a stable landform with a self-sustaining vegetation cover
- outer waste rock emplacement slopes will be designed at no greater than 1(V):3(H) average gradient

- the surface of waste rock emplacements will be shaped with a gently undulating topography to mimic the surrounding landscape and naturally promote some localised ponding where appropriate, thereby enhancing habitat values
- the low wall of the final void will remain benched in accordance with geotechnical conditions. The low wall will drain internally into the final void
- the highwall slope will remain at the final batter angles and be made safe in accordance with geotechnical conditions, to minimise the potential for humans and animals to be harmed
- perimeter stormwater diversion drains will be designed and constructed to meet appropriate standards
- appropriate fencing will be utilised to restrict access when required.

5.6. PROGRESSIVE REHABILITATION

All areas disturbed by mining activities (inclusive of the infrastructure corridor but not the final void) will be rehabilitated to a stable landform with a self-sustaining vegetation cover. Progressive rehabilitation will commence within one year of when areas become available for rehabilitation purposes. Land will be regarded as successfully rehabilitated when nominated targets for land suitability, land use (including vegetation cover and composition), landform stability, and land contamination have been met.

The disturbance and handling of soils and creation and stabilisation of landforms will be guided by the following principles:

- if not deposited directly onto shaped waste rock, all topsoil and soil forming materials will be stockpiled in a manner that retains soil qualities (i.e. topsoil and subsoil stored separately)
- stockpiles will be fertilised and seeded where necessary
- reuse of all soil-forming materials progressively to enable the establishment of vegetation
- soil stripping will be limited to the minimum area required for operational purposes at any one time
- achieve physically and chemically stable landforms
- achieve appropriate landform profiles, revegetation and surface water management to minimise erosion and sedimentation
- revegetate new landforms with selected plant species, appropriate for achieving stable landforms
- perform rehabilitation trials during the early operational period to refine the rehabilitation design.

The Proponent will progressively rehabilitate where practicable, however there are some areas of disturbed land that will not be available for rehabilitation until later in the mine life for the following reasons:

- the disturbed area is effectively integrated with nearby, unavailable areas
- it necessitates an uneconomic use of resources to undertake the work at the time
- the chemical characteristics of the waste rock may improve with time of exposure, thereby improving the success of rehabilitation.

To manage and monitor progressive rehabilitation, a Rehabilitation Management Plan will be prepared and updated as required.

A progressive rehabilitation program will be implemented throughout the life of the SGCP. The indicative rehabilitation schedule for the SGCP is shown in **Table 5-1**.

A summary of the progressive rehabilitation for the SGCP is provided in the following sections, with mine stage references taken from the mine stage plans presented in **Figure 5-1** to **Figure 5-11**.

Table 5-1 Indicative Mine Rehabilitation Schedule

Mine Year	Cumulative Area Rehabilitated (ha)
Construction	Minor as required
1	0
2	122
3	231
4	360
5	360
10	671
15	1,048
20	1,410
25	1,686
30	1,932
33	2,272

5.6.1. Progressive Rehabilitation Plan – Year 1

Mining will commence in 2015. The first activity associated with mining of the SGCP will be clearing and topsoil recovery ahead of the excavation of the initial box-cut (refer to **Figure 5-1**). Expansion of the pit will continue, with waste rock placed on the waste rock emplacement. Topsoil from this area will be stripped and stockpiled.

5.6.2. Progressive Rehabilitation Plan – Year 2

In Year 2, excavation of the pit will continue to the north and south and the waste rock emplacement will progress north. Topsoil spreading and rehabilitation will have commenced on the southern portion of the out-of-pit waste rock emplacement (refer to **Figure 5-2**).

5.6.3. Progressive Rehabilitation Plan – Year 3

In Year 3, the pit will continue to the west and the in-pit waste rock emplacement will progress to the north. Topsoil spreading and rehabilitation of the out-of-pit waste rock emplacement will continue to the north (refer to **Figure 5-3**).

The first longwall machine will commence underground mining to the south of the open-cut mining area.

5.6.4. Progressive Rehabilitation Plan – Year 4

In Year 4, open pit mining will continue to the west and topsoil spreading and rehabilitation of the out-of-pit waste rock emplacement will continue to the north (refer to **Figure 5-4**).

Underground mining will continue to the south of the open-cut mining area.

5.6.5. Progressive Rehabilitation Plan – Year 5

In Year 5, open pit mining and underground mining will continue (refer to **Figure 5-5**). No additional topsoil spreading or rehabilitation will be undertaken during this period.

5.6.6. Progressive Rehabilitation Plan – Year 10

In Year 10, the southern portion of the open pit mining area will continue to progress to the west, along with topsoil spreading and rehabilitation (refer to **Figure 5-6**). Underground mining will have commenced to the west of the open-cut mining area.

Mining in the northern portion of the open pit mining area will have commenced, with topsoil spreading and rehabilitation undertaken in the north-eastern portion of the out-of-pit waste rock emplacement.

5.6.7. Progressive Rehabilitation Plan – Year 15

Open-cut mining will continue to advance to the west in Year 15. Topsoil spreading and rehabilitation of the waste rock emplacements will also progress westwards (refer to **Figure 5-7**).

Underground mining of the D1 and D2 seams will continue to the south-west and west of the open-cut mining area.

5.6.8. Progressive Rehabilitation Plan – Year 20

Open pit mining will continue to the west, with topsoil spreading and rehabilitation also progressively moving west (refer to **Figure 5-8**). Underground mining of the D1 and D2 seams will continue to the west of the open-cut mining area.

5.6.9. Progressive Rehabilitation Plan – Year 25

Open pit mining will continue to the west, with topsoil spreading and rehabilitation also progressively moving west (refer to **Figure 5-9**). Underground mining of the D1 and D2 seams will continue to the west of the open-cut mining area.

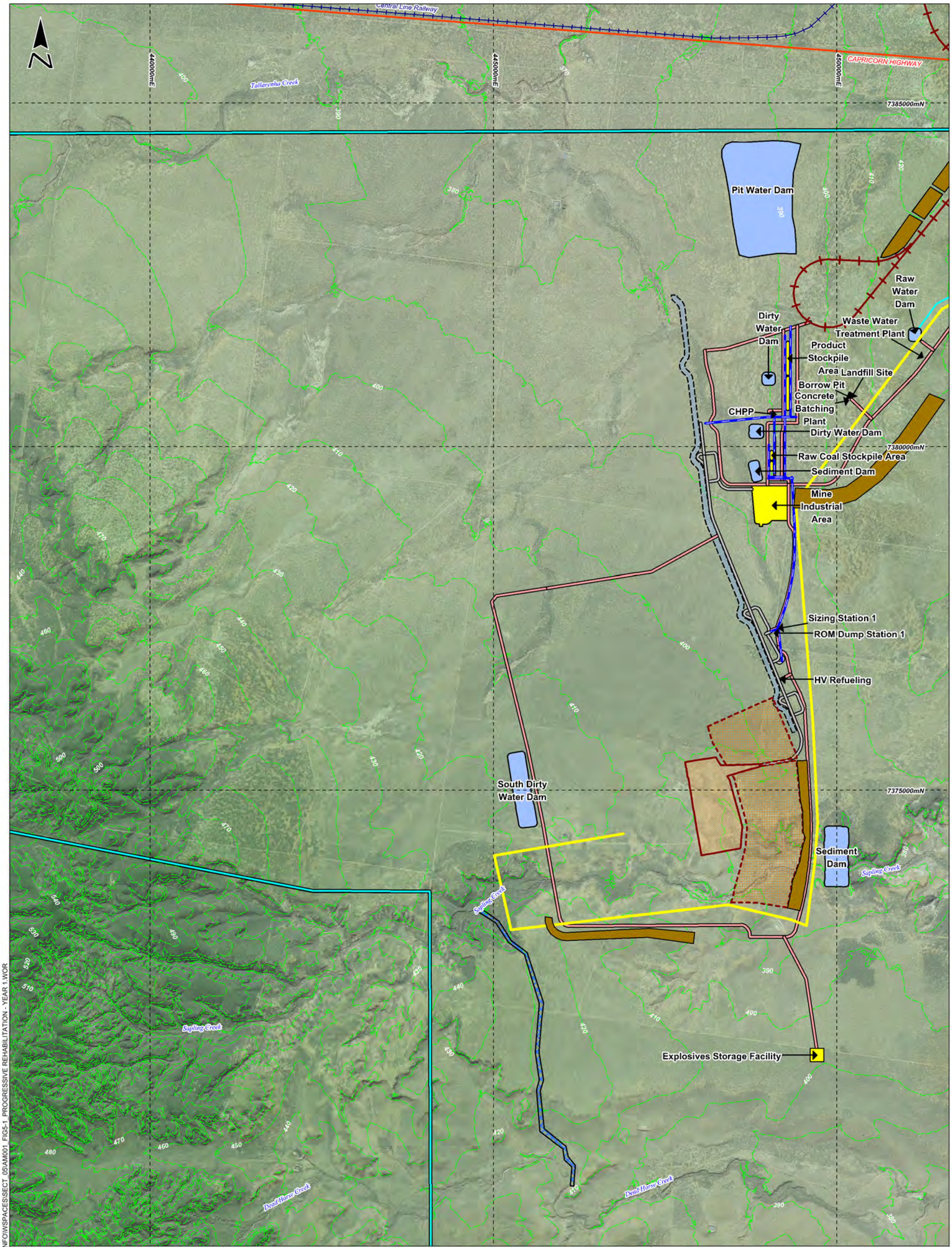
5.6.10. Progressive Rehabilitation Plan – Year 30

Open pit mining will continue to the west, with topsoil spreading and rehabilitation also progressively moving west (refer to **Figure 5-10**). Underground mining of the D1 and D2 seams will continue to the west of the open-cut mining area.

5.6.11. Progressive Rehabilitation Plan – Year 33

By Year 33, the open pit will have reached its maximum footprint. All out-of-pit waste rock emplacements and the majority of the in-pit waste rock emplacements will have been progressively rehabilitated (approximately 2,272 ha), (refer to **Figure 5-11**). The final void of the pit will remain with the western-most in-pit waste rock emplacements ready for final reshaping to form the low wall of the void.

The low wall will be benched from the top of the in-pit waste rock emplacement of the floor of the final void. Rehabilitation of the remaining in-pit waste rock emplacement will be undertaken progressively and will be completed following the cessation of mining in Year 33.



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METSERVE Mining & Energy Technical Services

SouthGalilee

LEGEND

MLA70453
Principal road
Contour AHD (10m)

Mining Activity
Open pit
Waste rock emplacement

Infrastructure
Facility area
Stream diversion
Drainage channel
Water storage dam
Topsoil stockpile
Topsoil spreading and rehabilitation
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor

Utilities
66kV overhead power line
Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch.
Mining Activity - Echelon.

Alpha Coal Pty Ltd

South Galilee Coal Project

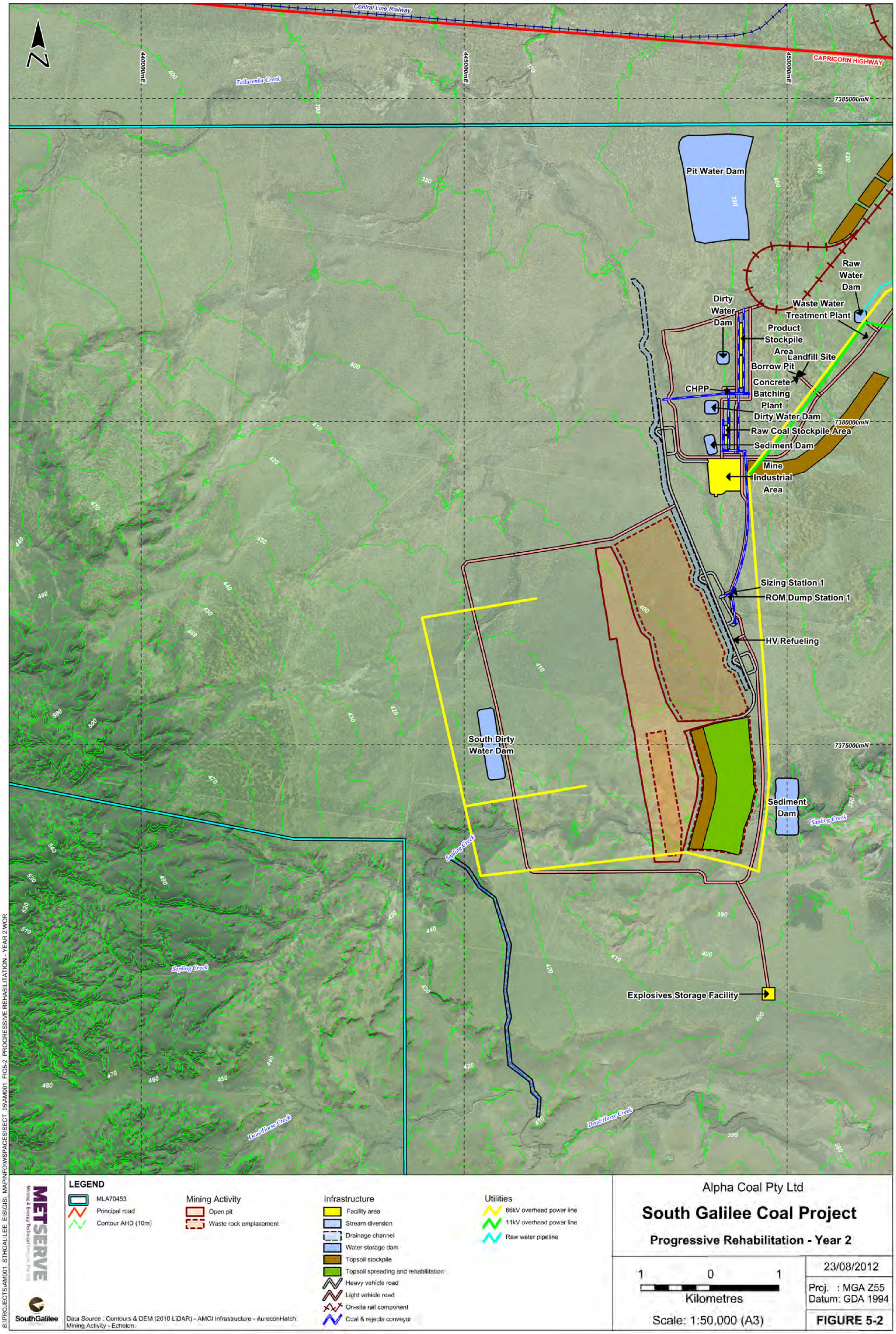
Progressive Rehabilitation - Year 1

1 0 1
Kilometres
Scale: 1:50,000 (A3)

05/09/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-1



Central Line Railway
CAPRICORN HIGHWAY
440000mE
445000mE
450000mE
7385000mN
7380000mN
7375000mN
Tallarenka Creek
Pit Water Dam
Raw Water Dam
Waste Water Treatment Plant
Dirty Water Dam
Product Stockpile Area
Landfill Site
Borrow Pit
Concrete Batching Plant
CHPP
Dirty Water Dam
Raw Coal Stockpile Area
Sediment Dam
Mine Industrial Area
Sizing Station 1
ROM Dump Station 1
HV Refueling
South Dirty Water Dam
Sediment Dam
Sapling Creek
Explosives Storage Facility
Dead Horse Creek
LEGEND
MLA70453
Principal road
Contour AHD (10m)
Mining Activity
Open pit
Waste rock emplacement
Infrastructure
Facility area
Stream diversion
Drainage channel
Water storage dam
Topsoil stockpile
Topsoil spreading and rehabilitation
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.
METSERVE
Mining & Energy Technical Services Pty Ltd
SouthGalilee
Alpha Coal Pty Ltd
South Galilee Coal Project
Progressive Rehabilitation - Year 2
1 0 1
Kilometres
Scale: 1:50,000 (A3)
23/08/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 5-2
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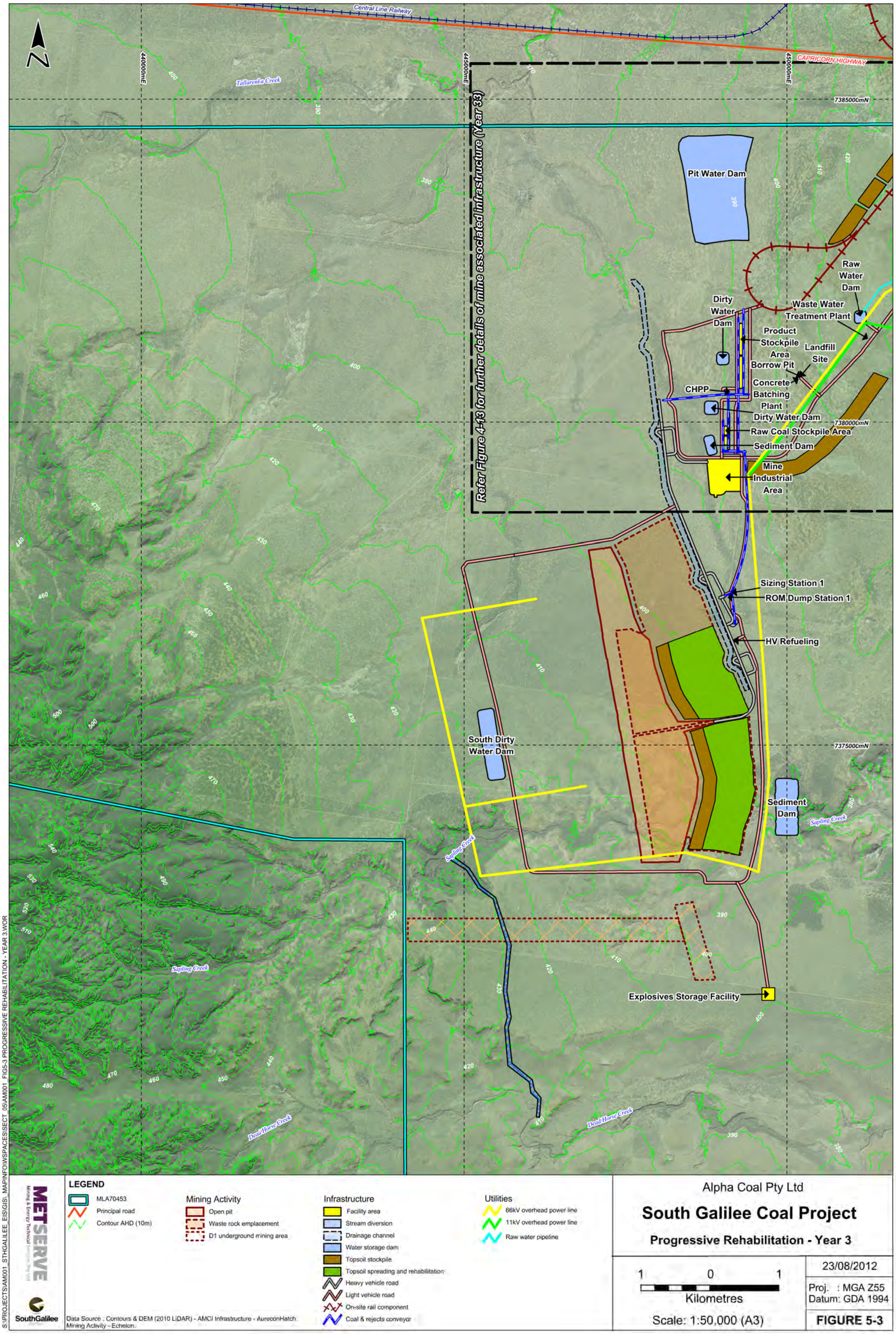
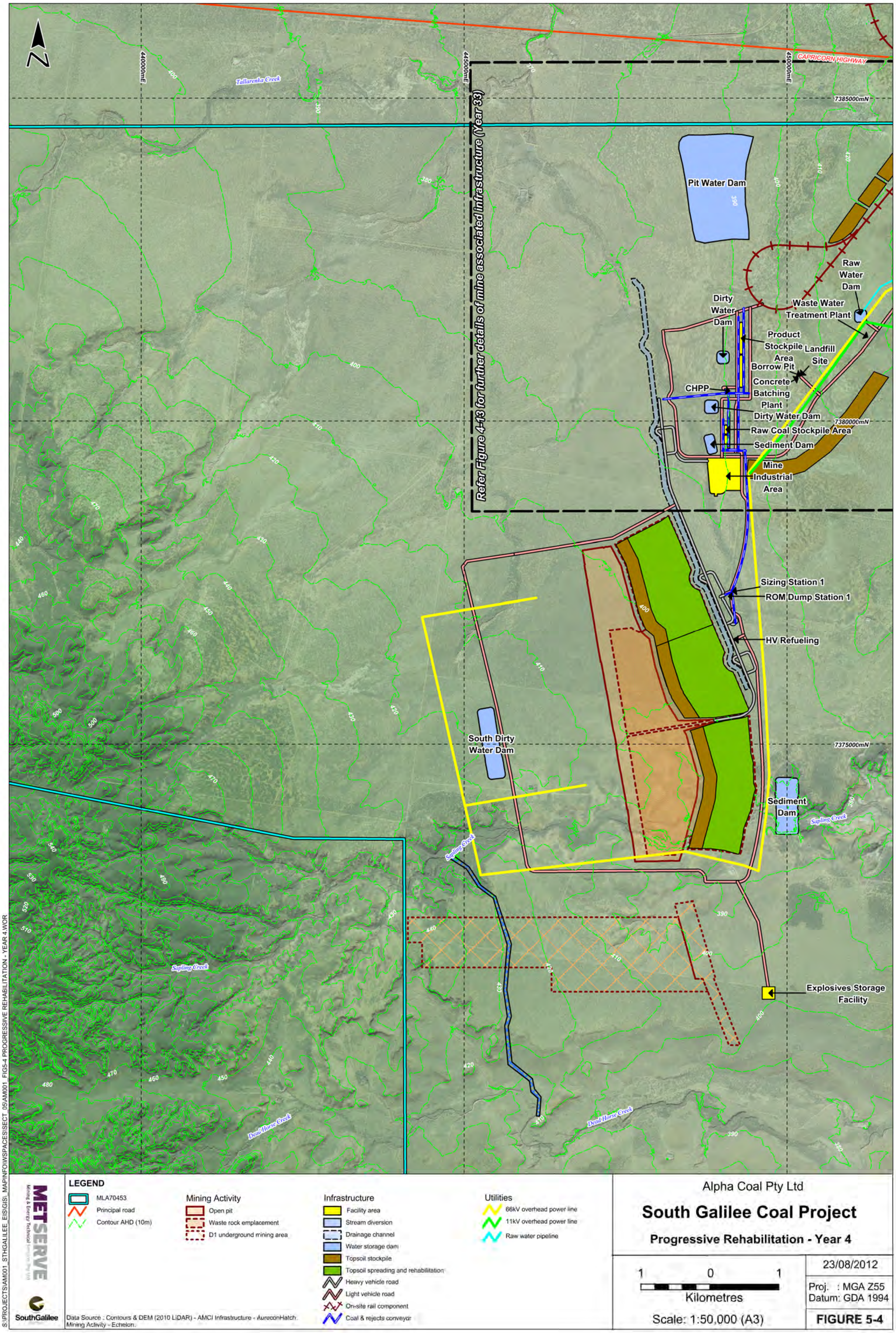


Central Line Railway
CAPRICORN HIGHWAY
440000mE
445000mE
450000mE
7385000mN
7380000mN
7375000mN
Tallarenha Creek
Refer Figure 4-13 for further details of mine associated infrastructure (Year 33)
Pit Water Dam
Raw Water Dam
Dirty Water Dam
Waste Water Treatment Plant
Product Stockpile Area
Landfill Site
Borrow Pit
CHPP
Concrete Batching Plant
Dirty Water Dam
Raw Coal Stockpile Area
Sediment Dam
Mine Industrial Area
Sizing Station 1
ROM Dump Station 1
HV Refueling
South Dirty Water Dam
Sediment Dam
Sapling Creek
Explosives Storage Facility
Dead Horse Creek
LEGEND
MLA70453
Principal road
Contour AHD (10m)
Mining Activity
Open pit
Waste rock emplacement
D1 underground mining area
Infrastructure
Facility area
Stream diversion
Drainage channel
Water storage dam
Topsoil stockpile
Topsoil spreading and rehabilitation
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
METSERVE
SouthGalilee
Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.
Alpha Coal Pty Ltd
South Galilee Coal Project
Progressive Rehabilitation - Year 3
23/08/2012
Kilometres
Scale: 1:50,000 (A3)
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 5-3
S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_05\AM001_FIG5-3 PROGRESSIVE REHABILITATION - YEAR 3.WOR

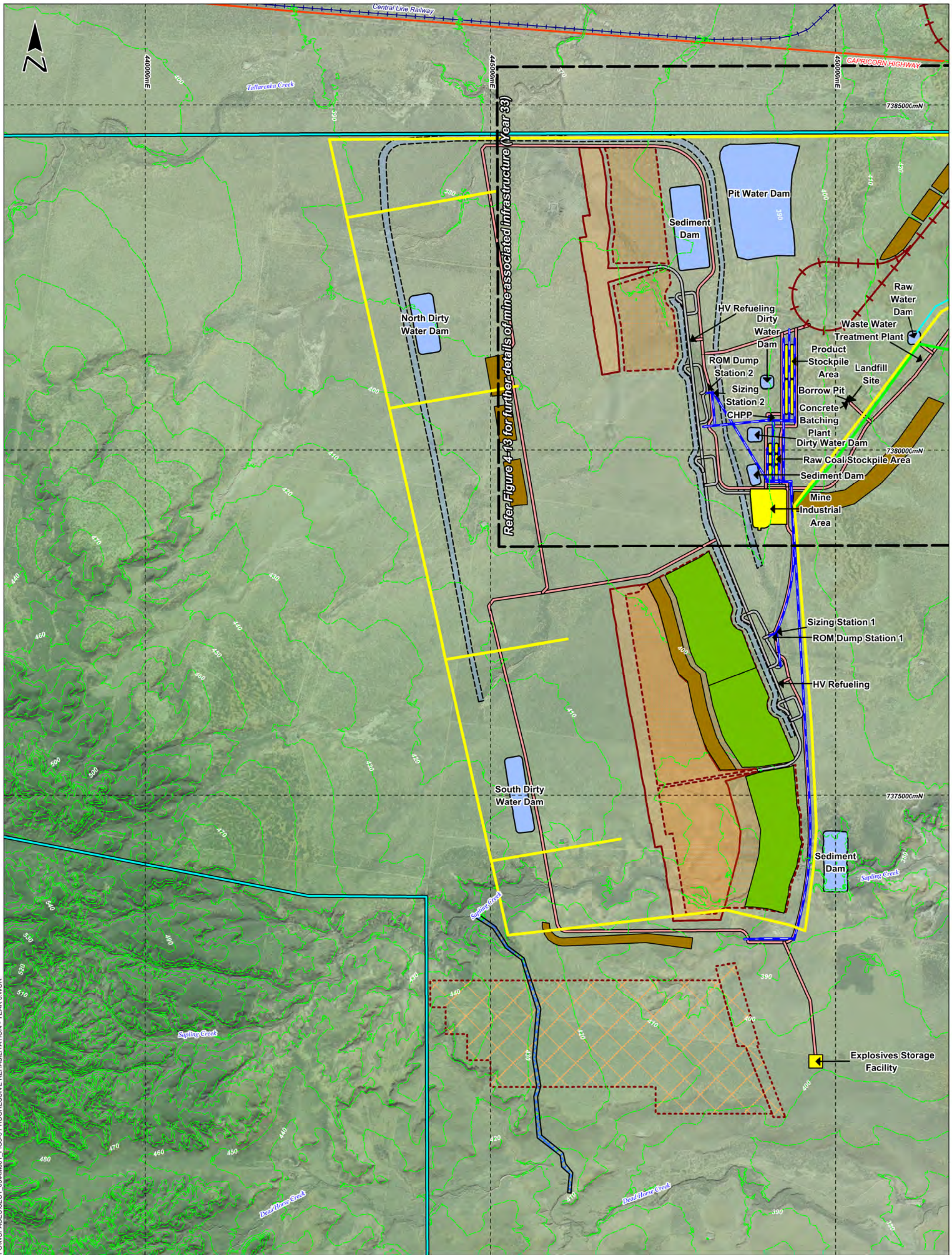


Alpha Coal Pty Ltd

South Galilee Coal Project

Progressive Rehabilitation - Year 4

FIGURE 5-4



S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_05\AM001_FIG5-5 PROGRESSIVE REHABILITATION - YEAR 5.WOR

LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch.
Mining Activity - Echelon.

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

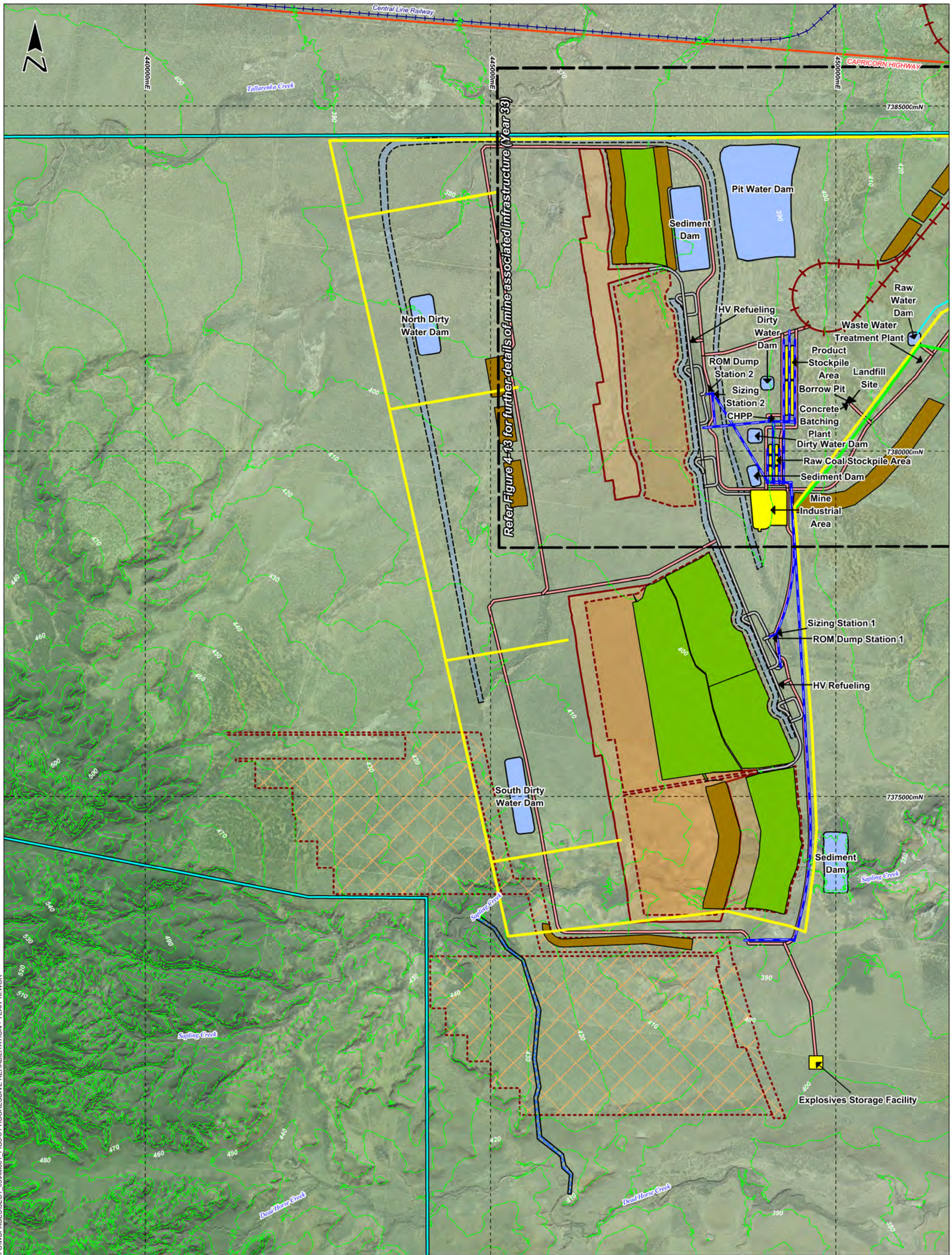
Progressive Rehabilitation - Year 5

1 0 1
Kilometres
Scale: 1:50,000 (A3)

24/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-5



S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_05\AM001_FIG5-6 PROGRESSIVE REHABILITATION - YEAR 10.WOR

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch
Mining Activity - Echelon

Alpha Coal Pty Ltd

South Galilee Coal Project

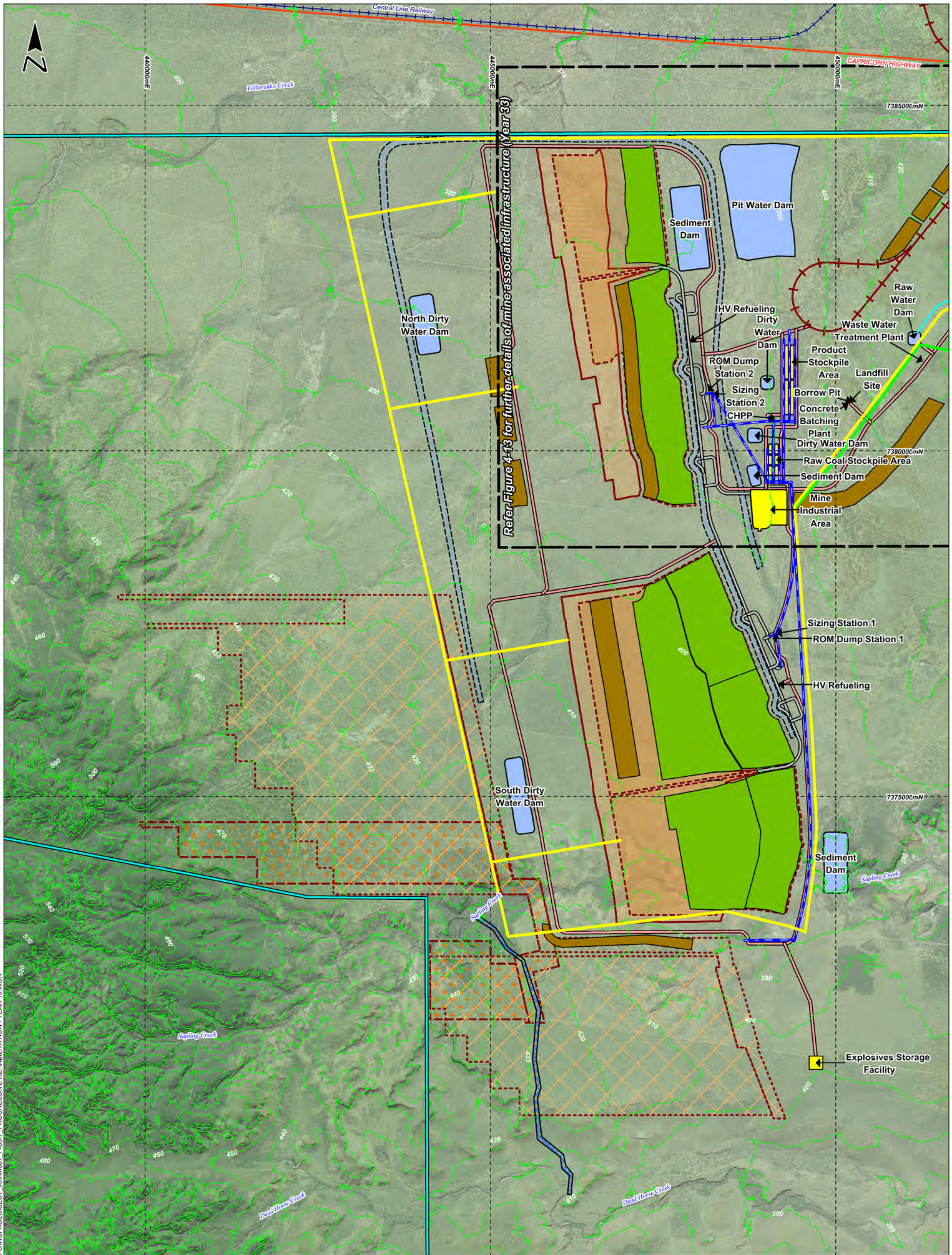
Progressive Rehabilitation - Year 10

1 0 1
Kilometres
Scale: 1:50,000 (A3)

23/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-6



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METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area
- D2 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.

Alpha Coal Pty Ltd

South Galilee Coal Project

Progressive Rehabilitation - Year 15

1 0 1

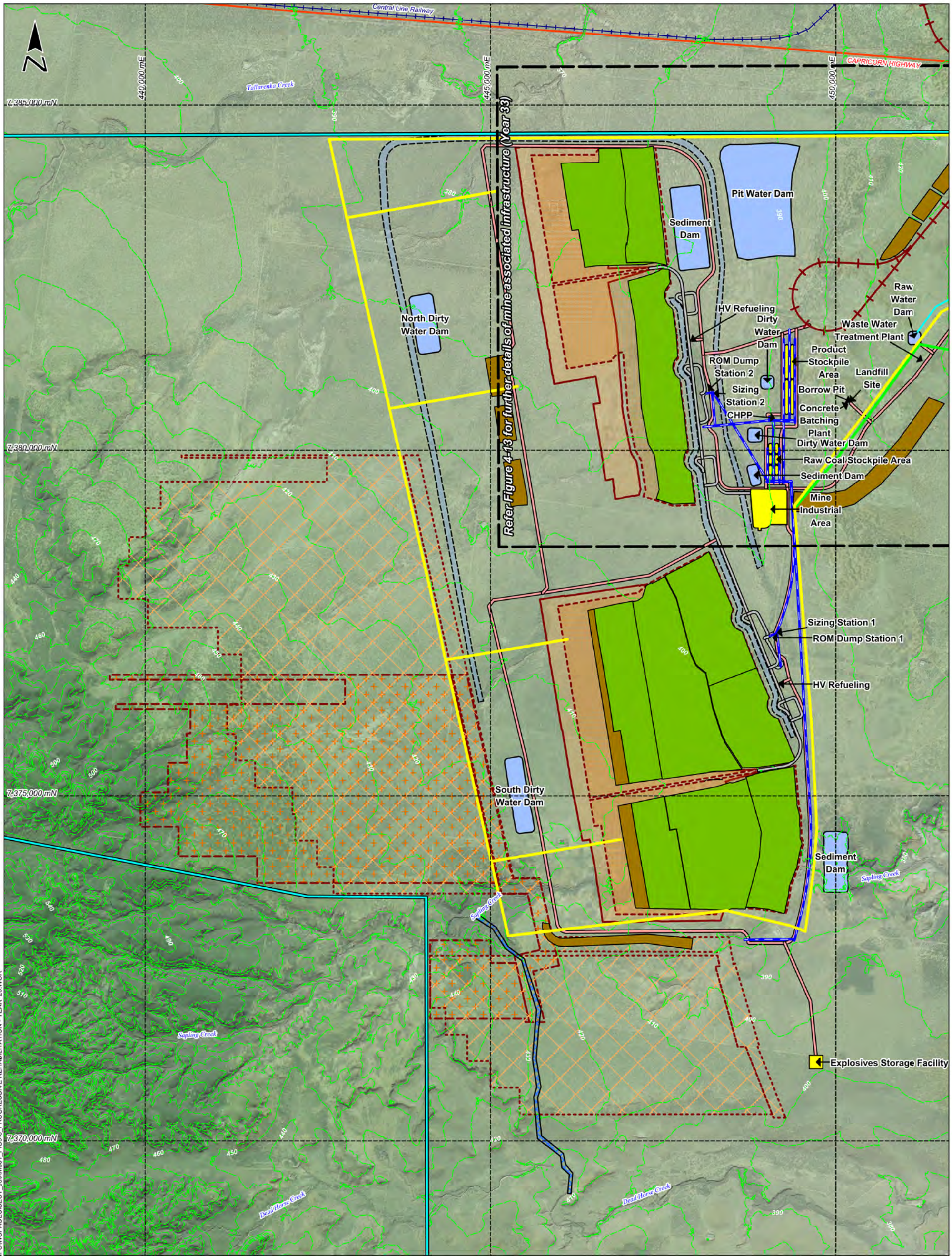
Kilometres

Scale: 1:50,000 (A3)

23/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-7



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METSERVE Mining & Energy Technical Services

SouthGalilee

LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area
- D2 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch
Mining Activity - Echelon

Alpha Coal Pty Ltd

South Galilee Coal Project

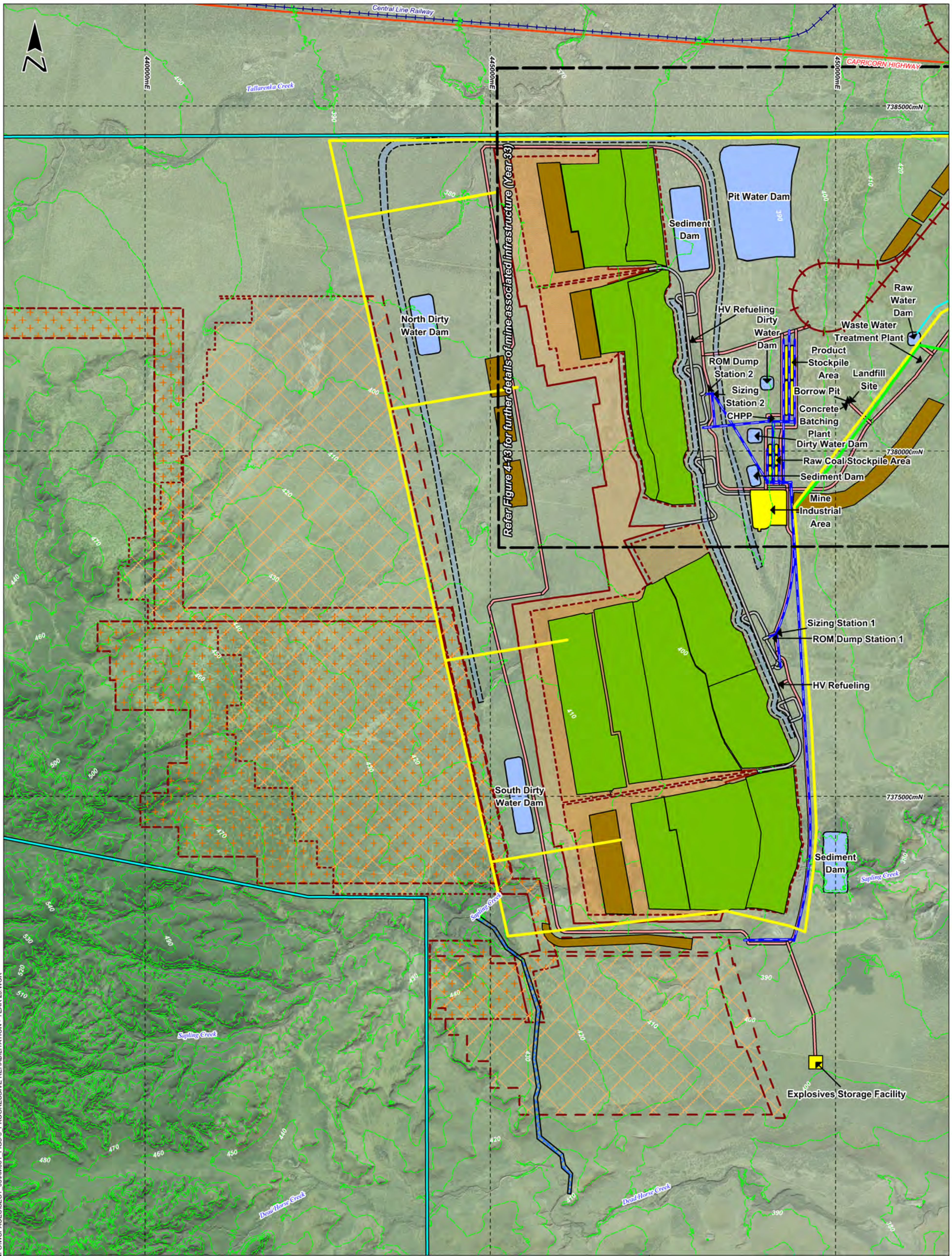
Progressive Rehabilitation - Year 20

1 0 1
Kilometres
Scale: 1:50,000 (A3)

23/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-8



LEGEND

MLA70453	
Principal road	
Contour AHD (10m)	

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area
- D2 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

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SouthGalilee

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.

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South Galilee Coal Project

Progressive Rehabilitation - Year 25

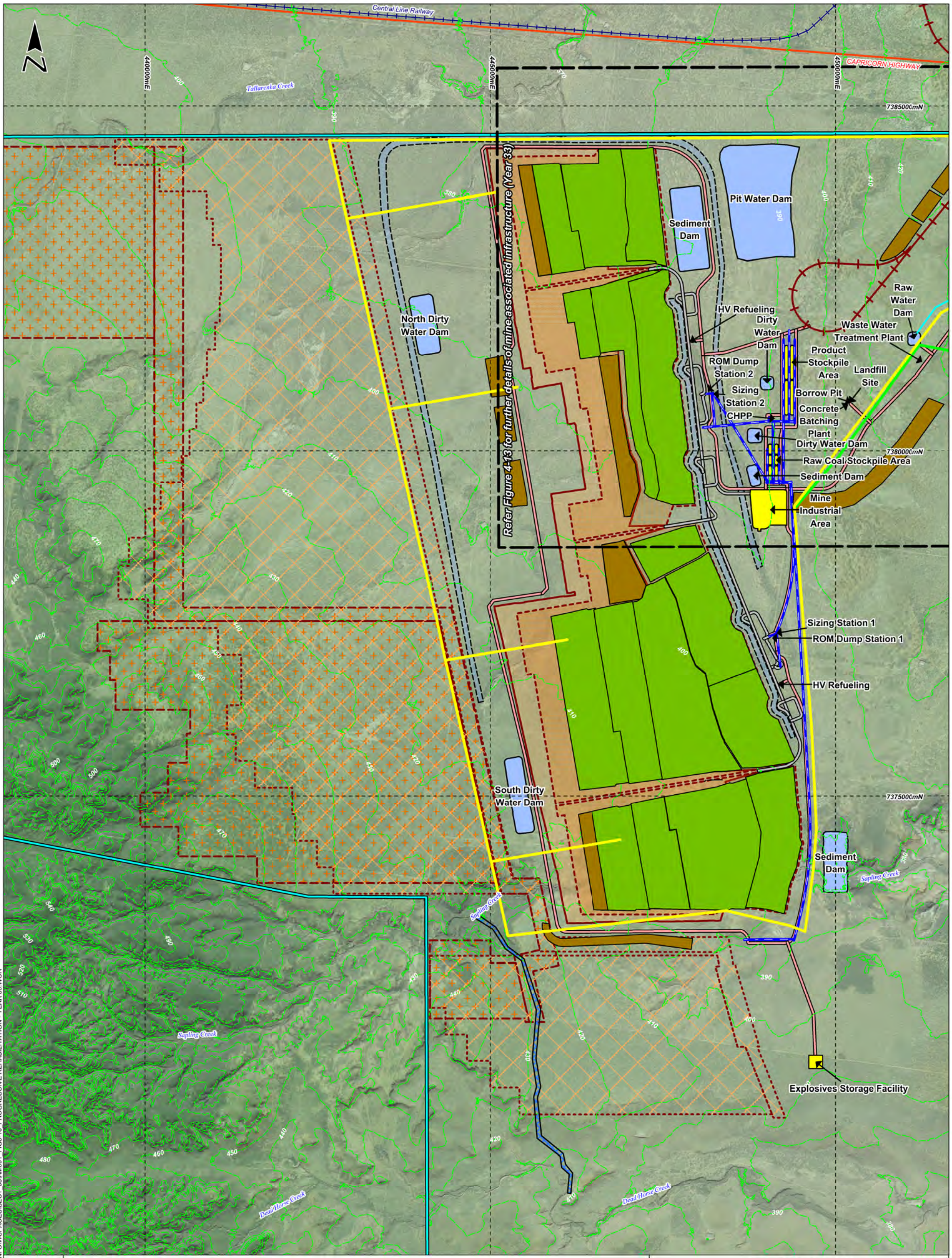
23/08/2012

1 0 1
Kilometres
Scale: 1:50,000 (A3)

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-9

S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_05\AM001_FIG5-9_PROGRESSIVE REHABILITATION - YEAR 25.WOR



LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity

- Open pit
- Waste rock emplacement
- D1 underground mining area
- D2 underground mining area

Infrastructure

- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities

- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

Progressive Rehabilitation - Year 30

1 0 1

Kilometres

Scale: 1:50,000 (A3)

23/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-10

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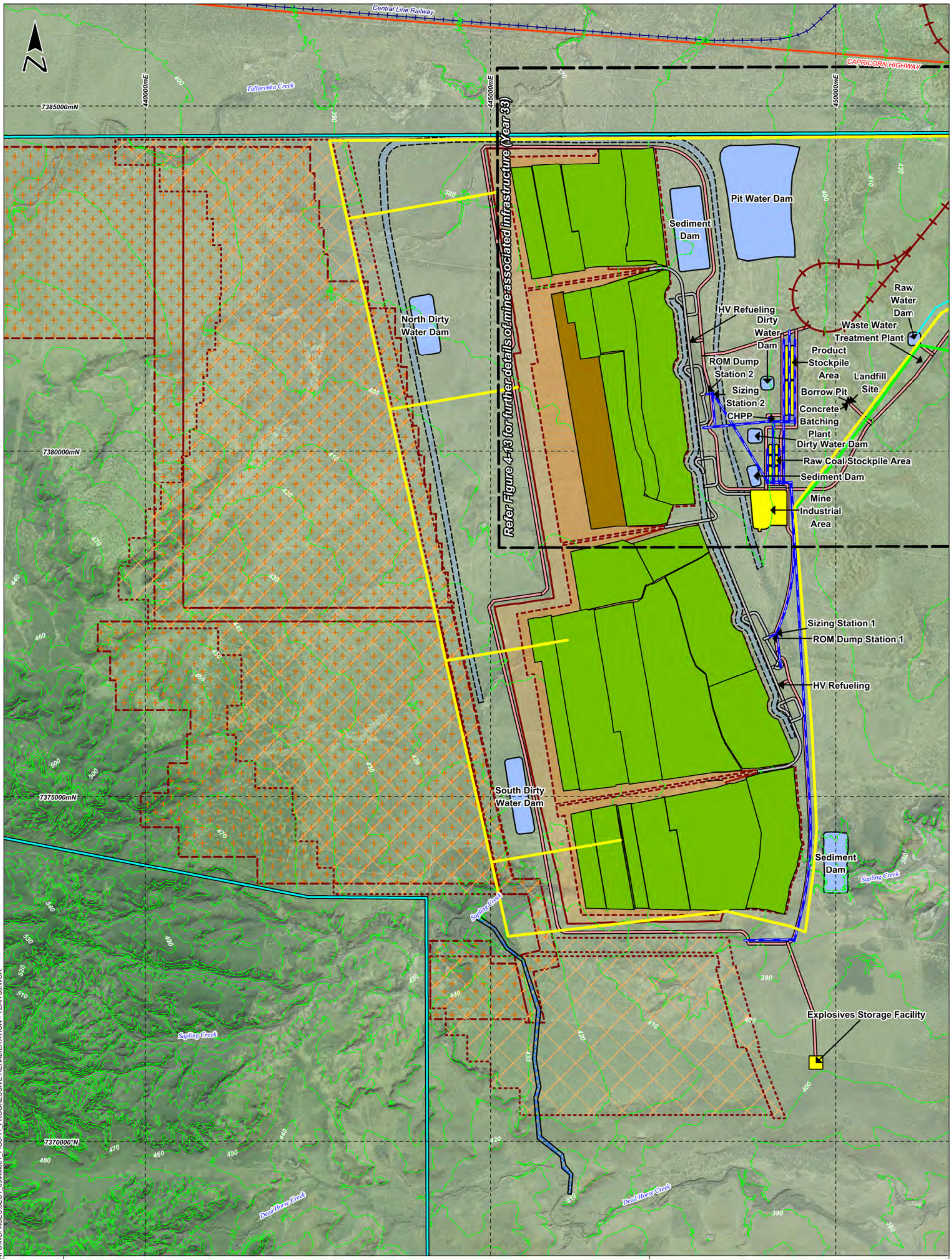

S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_05\AM001_FIG5-11_PROGRESSIVE REHABILITATION - YEAR 33.WOR

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

LEGEND

- MLA70453
- Principal road
- Contour AHD (10m)

Mining Activity
- Open pit
- Waste rock emplacement
- D1 underground mining area
- D2 underground mining area

Infrastructure
- Facility area
- Stream diversion
- Drainage channel
- Water storage dam
- Topsoil stockpile
- Topsoil spreading and rehabilitation
- Heavy vehicle road
- Light vehicle road
- On-site rail component
- Coal & rejects conveyor

Utilities
- 66kV overhead power line
- 11kV overhead power line
- Raw water pipeline

Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon

Alpha Coal Pty Ltd

South Galilee Coal Project

Progressive Rehabilitation - Year 33

1 0 1
Kilometres
Scale: 1:50,000 (A3)

24/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 5-11

5.7. STANDARD REHABILITATION PROCESSES

The standard rehabilitation processes are those that can be applied to any kind of land disturbance on the SGCP.

5.7.1. Shaping and Contouring

To refine the final dimensions of the waste rock emplacement, it is necessary to consider several, sometimes conflicting, requirements. These requirements include:

- minimising emplacement height
- minimising emplacement footprint
- minimising machinery effort
- compliance with emplacement slope gradient criteria.

The final emplacement design will utilise the latest industry knowledge and experience to ensure minimum emplacement erosion and maximum stability. The waste rock emplacements will be built up in layers to suit the dragline operation and waste rock types.

The following strategies will be applied to the final design of the waste rock emplacement:

- reshape and profile to create slopes of 1(V):3(H) gradient, or as otherwise demonstrated, to reduce potential for erosion
- construct to allow for the final land use
- construct to minimise the area of land covered by the waste rock emplacement.

5.7.2. Topsoil Stripping

Significant surface disturbance will occur as a result of mining activities and will require the stripping of topsoil for reuse in rehabilitation programs. Specific recommendations for topsoil stripping for each soil description are summarised in **Table 5-2**.

The basic objective in determining useable depths of topsoil for rehabilitation is to use topsoil with higher quality than the waste rock requiring rehabilitation.

In addition, waste rock can be expected to improve with years of exposure, leaching and plant colonisation and in some cases may provide better coverage than poor topsoil after an appropriate time-span.

Table 5-2 Soil Stripping Depth Guideline

Soil Type	Topsoil Stripping Recommendations[1] (mm)
Rocky sands and sandy loams	100
Ironstone sands and sandy loams	50-100 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth.
Shallow red-yellow earths	300
Deep red-yellow earths	300
Shallow red-grey Texture Contrast (TC) soils	250 to 400 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth. Subsoil salt levels likely to be high.
Deep red-grey TC soils	100 to 350 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth. High to extreme salinity below 1 m depth.
Deep yellow-grey TC soils	100 to 300 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth. Medium salt levels, care will be taken during excavation.
Alluvial red TC soils	300
Alluvial yellow-grey TC soils	150 to 300 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth. Medium salt levels, care will be taken during excavation.

1 The recommended stripping depth includes suitable material from the surface layer and from the underlying subsurface layer (if present) or subsoil.

5.7.3. Handling and Storage of Topsoil

To maintain the integrity of vegetation in areas adjacent to disturbed areas, appropriate erosion, sediment and dust controls will be established prior to and during soil disturbance. Prior to stripping the soil, regrowth vegetation will be cleared and windrowed. Where practicable, windrowed vegetation will be chipped or retained for fauna habitat. As described in **Section 5.3.1**, cleared vegetation without direct commercial value or which is not suitable for use in rehabilitation may be burned on-site.

Topsoil stockpiling should be minimised as deterioration of soil chemical, physical and biological properties can occur during storage. Where stockpiling cannot be reasonably avoided, the stockpiling period will be minimised where practicable.

The recommended soil stripping depths are provided in **Table 5-2**. Some form of surface protection (e.g. quick establishing pastures or mulches) will be used to stabilise stockpiled soil. Rather than stockpiling in a small number of high dumps, soil will be stockpiled in a number of low (e.g. < 2 m high) mounds.

If saline subsoil is required to be stockpiled for a short period, the stockpile will be surrounded by a berm to prevent water ingress from runoff and to detain runoff water from within the stockpile area.

5.7.4. Erosion and Stability

5.7.4.1. Erosion Potential

Wind erosion is usually negligible in semi-arid and wetter agricultural areas where there is sufficient rainfall to maintain adequate ground cover (refer to **Appendix J—Soils and Land Suitability Technical Report**). The overall wind erosion hazard in the SGCP area is nil.

Erosion hazard is a product of soil erodability and topography factors. **Table 5-3** provides the erodability rating and erosion hazard for each identified soil type. Approximately 45 % of the SGCP has an erosion hazard rating of nil or minor, 46 % has a rating of moderate, 2.5 % has a severe rating and 7 % has extreme rating (refer to **Appendix J—Soils and Land Suitability Technical Report**).

Table 5-3 Soil Erodability and Erosion Hazard

Soil Type	Soil Erodability Rating	Erosion Hazard
Rocky sands and sandy loams	Moderate	Extreme
Ironstone sands and sandy loams	Moderate	Moderate—extreme
Shallow red-yellow earths	Moderate	Minor—moderate
Deep red-yellow earths	Moderate	Minor— moderate
Shallow red-grey TC soils	Very high	Moderate
Deep red-grey TC soils	Very high	Moderate
Deep yellow-grey TC soils	High	Minor—extreme
Alluvial red TC soils	Low	Nil
Alluvial yellow-grey TC soils	Very high	Minor—moderate

5.7.4.2. Erosion Mitigation

Erosion and sediment control is an essential component to achieving site stability, particularly on rehabilitated landforms that have steep or long slopes, and is usually achieved through a combination of vegetation establishment, structural cladding and surface drainage control.

Major earth works programs will be scheduled to avoid the high rainfall period between December and March, where practicable.

Disturbed areas will be stabilised as quickly as possible to limit erosion. Progressive revegetation will be undertaken and erosion and sediment control measures will be employed, including:

- minimising the area disturbed
- undertaking topsoil stripping and stockpiling immediately prior to earthworks, where practicable
- progressively rehabilitating available areas
- installing runoff control devices to reduce slope length (e.g. 'whoa boys', berms, temporary sediment fences, straw bale banks or geotextile socks)
- treating runoff in sediment traps and dams
- removing all temporary control measures after the disturbed site is stabilised
- minimising the gradient of the final landform
- establishing groundcover as soon as practicable.

Such requirements are documented in **Section 21—Environmental Management Plan** with awareness training provided for employees and contractors with responsibility in this area.

Areas where the final landform will result in altered slopes include the waste rock emplacements, internal slopes of the final void and Sapling Creek diversion. Specific measures to minimise erosion at each of these areas are provided in **Section 7.3.4.2**.

5.7.4.3. Erosion Monitoring

An indicator of landform stability is the extent of soil loss from rehabilitated sites relative to background rates of soil loss (from reference sites). Rehabilitation sites will be monitored on final slopes to ensure that acceptable levels of erosion are maintained. To aid in the prevention of excessive erosion, ongoing characterisation of potentially dispersive waste rock will be undertaken. The key management strategy to prevent excessive erosion will be to avoid the placement of dispersive materials near the surface. Ongoing investigation into dispersive material management will be undertaken and landform design and management strategies will be modified where necessary.

The erosion monitoring program will include the following:

- the logging of rainfall and climatic conditions
- an assessment of vegetation cover at permanent, representative monitoring sites (i.e. reference sites)
- documenting evidence of failure or instability on rehabilitated slopes at reference sites
- maintaining photographic records at permanent representative photographic stations, recorded on a regular basis

- an assessment of upstream and downstream water quality, including parameters that may be indicative of excessive erosion, such as sediment concentration.

This qualitative surveying will be undertaken to directly determine sediment loss from landforms. Sediment traps may also be used as an indicator of soil loss.

5.7.5. Topsoil Spreading

Any areas of land that have had topsoil removed ahead of mining or have had existing topsoil cover significantly and negatively impacted by mining, will be spread with a layer of topsoil suitable for the proposed rehabilitation purposes.

Any excavated subsoil will be capped with at least 300 mm of suitable topsoil to allow vegetation to achieve a reasonable root layer before encountering potentially saline material.

Application of topsoil to the final graded surface provides the most suitable seed bed for the establishment of ground cover. Material that is suitable for stripping and stockpiling has a low to very low fertility and will require some soil ameliorants (e.g. NPK fertiliser) to ensure successful growth of vegetation. All stockpiled material will benefit from incorporation of composted organics. Spreading of topsoil will be undertaken from the top of slopes to minimise erosion damage created by storm runoff. Topsoil compaction will be minimised during spreading by placing topsoil in windrows on the final surface which can then be distributed by a dozer working on the soil. Subsequent machinery passes will be necessary in order to establish vegetation and to construct erosion control structures if required.

The re-profiled waste rock emplacement will be covered with a minimum of 100 mm of suitable topsoil and/or mulched with rock fragments of a 60 mm diameter on batter slopes.

5.7.6. Seeding

Direct seeding will be used to sow the reshaped and topsoiled rehabilitation areas with varying mixes of native trees, shrubs and grass species, along with selected pasture grasses. Deep ripping on the contour prior to seeding and fertilisation will be undertaken to a minimum depth of 500 mm. Sowing will be completed as soon as possible after cultivation and at the beginning of a typical rain season.

Seed mixes will consist of plant species compatible with local vegetation communities, proven as suitable to the proposed final landform topography and regional climate, as well as meeting the short-term and long-term rehabilitation objectives.

Fertiliser application rates will be developed as required, after review of the soil and waste rock analyses for the area.

Any areas of land that have been reshaped and/or topsoiled will be seeded with the appropriate mix of seed species for the proposed final land use for that area.

5.8. SPECIFIC REHABILITATION PROCESSES

There are a number of potential impacts from mining operations that will require the impacted areas to have specific rehabilitation processes applied, as detailed below.

5.8.1. Sediment Control and Erosion

The design parameters for the construction of erosion control work will be in accordance with leading practice engineering and soil conservation earthworks principles. A number of variables affect earthworks design, including rainfall intensity, erosivity, gradient, scour velocities and flow estimations. Specific measures to minimise erosion are provided in **Table 5-4**.

Table 5-4 Erosion Controls for Mining Activities

Area	Control Measure
Cleared Land	• restrict clearing to areas essential for the works • windrow vegetation debris along the contour • minimise length of time soil is exposed • divert runoff from undisturbed areas away from the works • direct runoff from cleared areas to sediment dams.
Exposed Soils	• minimise length of time subsoil is exposed • direct runoff from exposed areas to sediment dams.
Waste Rock Emplacements	• direct all runoff from waste rock emplacements to sediment dams • avoid placement of sodic waste material on final external batters • control surface drainage to minimise the formation of active gullies • use soil and rock mulching to armour external batters • direct runoff from rehabilitated areas to sediment dams.
Residual Void	• progressive backfill during operations • regrade treatments for erosion and geotechnically unstable void • use of rock mulch to control erosion • apply seed and fertiliser as necessary to ensure rapid re-establishment of vegetation.
Dams	• leave useful water storages to support grazing use, native bushland and fauna habitat • rehabilitate any dam not required post mining by regrading embankments, capping any residual saline material, replacing topsoil, ripping on the contour and seeding.
Infrastructure	• provide protection in drainage lines (e.g. rip rap, grass cover) where water velocity may cause scouring • confine traffic to designated tracks and roads, where practicable • install sediment traps, silt fences, hay bales etc. where necessary to control sediment movement • rehabilitate disturbed areas around construction sites promptly.

Sediment control dams will be constructed to the east of the waste rock emplacement areas to capture potentially contaminated runoff.

Where practicable, the downstream sediment and erosion controls will be installed prior to disturbance activities commencing. All temporary control measures will be removed after the disturbance site is stabilised. The haul roads will have sufficient surface drainage to prevent runoff eroding the road or adjacent areas.

The overall mine site water management and drainage system is described in detail in **Section 9—Water Resources**, and the potential for erosion for each soil type is described in **Section 7—Land**.

Following a significant rainfall event, repair work may be required in rehabilitated areas. Additional topsoil and seed will be utilised as required to repair significantly eroded areas.

Disturbance of areas with an extreme topography constraint (refer to **Appendix J—Soils and Land Suitability Technical Report**) will be avoided where practicable.

5.8.2. Flood Mitigation

Potential impacts from flooding and heavy rainfall events have been assessed for the SGCP area **in Section 9—Water Resources**. The Proponent will manage the impacts of flooding in accordance with *State Planning Policy 1/03-Mitigating the Adverse Impacts of Flood, Bushfire and Landslides* (SPP 1/03).

Flood levees will be constructed to minimise impacts of flooding and any potential for release of contaminants to the environment, including protection of the final void at the end of mine life from the Probable Maximum Flood level, which is above the requirements of SPP 1/03. The location and sizing of flood levees are detailed in **Section 9—Water Resources**. To reduce internal operational water inflows, a bund will be constructed to prevent ponded water on the surface of internal waste rock emplacements from flowing toward the final void down the final low walls.

5.8.3. Geotechnical Stability

Rehabilitation activities will incorporate the management of potential risks associated with the geotechnical stability of waste rock emplacements and the final void. It is recognised that the stability of these final landforms is critical to the overall success of rehabilitation of the SGCP site. Waste rock disposal and mine plan designs for the SGCP will be assessed by qualified engineers and the most appropriate mining and waste rock placement methods to ensure geotechnical stability of working slopes will be implemented.

The stability of pit and waste rock emplacement slopes will be reviewed and designs amended as required throughout the life of the mine. These periodic reviews will be compared against engineering standards and experiences based at similar coal mines in the region, assessing slope geometries with respect to consequence of slope failure and type of slope.

Based on the topography and geography of the SGCP site, it is unlikely that there will be any landslides resulting from natural causes. Disturbance to waterways has the potential to create land slippages and mining activities also have the potential to create minor localised slippages within the mine pits. Despite this low risk, should a land slide/slippage occur, the Proponent will manage the impacts in accordance with SPP 1/03, in consultation with the Queensland Government State Disaster Management Group.

At the end of mine life, an assessment report will be undertaken by a Registered Professional Engineer of Queensland covering the geotechnical issues and erosivity of the proposed final landforms, including final void, to demonstrate long-term landform stability.

5.8.4. Subsidence

Potential subsidence impacts associated with the SGCP are described in **Section 7—Land**. If detected, any minor deleterious surface expressions of subsidence (e.g. surface cracking) will be rectified as soon as practicable. Rehabilitation will include deep ripping to a minimum 300 mm depth to fill and smooth surface disturbance for re-seeding where practicable.

5.9. DECOMMISSIONING

Decommissioning will occur at the cessation of mining operations but prior to formal mine closure and will involve the removal of mine infrastructure and services, and the remediation of all disturbed areas. A disturbed area is one that has been impacted upon by mining construction and/or operational activities, inclusive of construction areas, waste rock emplacement facilities and the infrastructure corridor.

Decommissioning and rehabilitation of the SGCP will be undertaken in a manner that prevents environmental harm and risk to human health. Any dangerous goods or chemicals will be removed from site and any contaminated areas will be managed and rehabilitated to ensure that there is no danger posed to the wider public.

Controls to protect the community include warning signs, fencing-off potentially hazardous areas and safety rills to prevent travel over embankments. The risk to community safety will be low, given that the area will be located on privately owned property.

Mine closure planning for the SGCP will be undertaken once final infrastructure and final landform plans have been approved by the relevant Government departments. The closure strategy will provide for the site to be left in a sustainable condition without the risk of causing harm to the community or the environment.

A Mine Closure Plan will be developed for the SGCP in advance of decommissioning and closure. The Mine Closure Plan will be developed in consultation with appropriate stakeholders and the DEHP.

The decommissioning and final rehabilitation of the SGCP will be staged over several years. A contaminated site assessment will be conducted as part of the Final Rehabilitation Report. This assessment will recommend appropriate remediation activities for any identified contaminated land. Following remediation works, no sites will require registration on the Queensland Contaminated Land Register.

5.9.1. Exploration Areas

Any exploration areas will be rehabilitated in accordance with the *Code of Environmental Compliance for Exploration and Mineral Development Projects* (EPA, 2001). These areas will be seeded and returned to their predetermined post disturbance land use.

5.9.2. Waste Rock Emplacements

The waste rock emplacements will be rehabilitated as described in **Section 5.5** and **Section 5.6** and will remain as final elevated landforms.

5.9.3. Final Low Wall, Void and Ramps

It is standard mining practice for open-cut mines in Queensland to leave the last strip of mining as a final void as there is no economically available waste rock to fill the void. Consequently, the final void will form a significant feature of the post-mining landform, creating a water body that will be fenced off for safety. Please refer to **Section 5.6** to **Section 5.9** for detail on the mitigation measures that will be implemented to minimise the impacts of the final void.

Ramps will be retained in the final landform and where geotechnically stable, the ramp slope benches will be left at angle of repose. Some benching, battering or drainage control works may be required along ramps to control erosion and/or allow for rehabilitation activities.

The highwall slope will remain at the final batter angles and made safe to minimise the potential for humans or animals to be harmed. All exposed coal seams will be covered with inert material wherever practicable.

An investigation into the final void will be undertaken to develop mine decommissioning acceptance criteria. The investigation will at a minimum include:

- a study of options available for minimising final void area and volume
- develop design and success criteria for rehabilitation of final void
- a void hydrology study, addressing the long-term water balance in the void, connections to groundwater resources and water quality parameters in the long-term
- a pit wall stability study, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events
- a study of void capability to support native flora and fauna.

The final void remaining at the end of the SGCP life will cover approximately 329 ha with a depth of approximately 140 m. Open pits have been modelled indicating that they do not overflow during extreme rainfall events. Further details are in **Section 9— Water Resources**.

5.9.4. Water Management Structures

Where nominated as beneficial by the landowner, water management structures may be left in an operational state after mining has ceased. If the water management structure is not required, it will be decommissioned, the walls removed and/or the excavation backfilled and fully rehabilitated.

As a minimum, decommissioning will be conducted such that each dam has been approved or authorised under relevant legislation for a beneficial use.

5.9.5. Diversion Drains

Water diversion drains will be required to divert clean water around the SGCP disturbance areas. Monitoring of impacts associated with alterations to the drainage regime will be conducted on regular intervals and if necessary rectification works will be undertaken to mitigate affected areas.

5.9.6. Access/Haul Roads

At the end of mine life, haul roads will be rehabilitated to blend in with the surrounding landform, or retained if required by the landowner. Decommissioned roads will be revegetated. Any compacted areas will be ripped, topsoiled and re seeded.

5.9.7. Overhead Powerlines

Any overhead powerlines no longer required will be dismantled and disposed of off-site by a licensed contractor. Any compacted areas around powerline footings will be ripped, topsoiled and re-seeded.

5.9.8. Infrastructure

Where nominated as beneficial by the landholder, mine infrastructure (inclusive of the infrastructure corridor) may be left in an operational state after the cessation of mining. Any infrastructure which is not required will be decommissioned.

All infrastructure areas will be assessed for contamination prior to demolition, with contaminated material collected separately and treated in accordance with regulated waste procedures on-site (refer to **Section 13—Waste**). Inert concrete footings and foundations will be buried. Buildings and storage tanks will be dismantled or demolished and removed from site for recycling or disposal.

Once all surface and sub-surface materials have been removed, hardstand areas will be deep-ripped, covered with a layer of topsoil where required and seeded in accordance with the predetermined post-mine land use.

5.9.9. Waste Disposal

All waste material generated during the decommissioning process will be disposed of by an appropriately licenced contractor, with recycling of materials undertaken wherever possible. Hazardous materials, including waste oil, will be disposed of in accordance with the relevant Environmental Management Plan (EM Plan), environmental licence conditions, Material Safety Data Sheet requirements and Queensland waste tracking legislation. Any hydrocarbon contaminated soil identified within operational areas will be disposed of at an approved facility or bioremediated on-site. Further details are contained in **Section 13—Waste**.

5.10. MONITORING AND SUCCESS CRITERIA

Rehabilitation will be monitored during operations and after final rehabilitation has been completed to validate rehabilitation performance and identify any additional work required to meet success criteria. A report will be prepared periodically and submitted to the Proponent to include details of rehabilitation monitoring results and the issues which occurred with rehabilitation processes. This monitoring will include an assessment of:

- plant establishment, growth, diversity and cover
- evidence and type of erosion.

Rehabilitation performance criteria will be submitted to the DEHP for review and comment in a Rehabilitation Management Plan. The Rehabilitation Management Plan will, at a minimum:

- develop design objectives for rehabilitation of disturbed areas and post mining land uses across the mine
- specify soil and waste rock characteristics for use in rehabilitation
- detail rehabilitation methods applied to different areas of the SGCP
- identify rehabilitation performance criteria for different rehabilitation areas
- explain planned native vegetation rehabilitation areas and corridors
- identify rehabilitation sites to be used to develop rehabilitation success criteria
- develop a contingency plan for rehabilitation maintenance or redesign

- describe end of mine landform design plan and post mining land uses across the mine
- propose ERE management and offset protection.

In addition to rehabilitated areas, reference sites will be monitored to allow a comparison of the development and success of the rehabilitation against a control. Reference sites indicate the condition of surrounding un-mined areas that the rehabilitated disturbance area will aim to replicate. Monitoring will be conducted periodically by independent, suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness. If a performance objective or target is not met the responsible person will review the performance and develop a new action plan and budget. SGCP will ensure that the appropriate personnel undertake adequate environmental awareness training covering the requirements of the EM Plan.

5.10.1. Native Bushland

Representative sites deemed to have reached minimum performance criteria (refer to **Table 5-5**) will be selected for the verification of all bushland rehabilitation land. Reference sites will be monitored to provide a reference for planning of rehabilitation sites but not as the criteria for rehabilitation verification.

5.10.2. Grassland Suitable for Grazing

Representative sites deemed to have reached minimum performance criteria (refer to **Table 5-6**) will be selected for the verification of all grassland rehabilitation suitable for grazing. Reference sites will be maintained in adjoining un-mined grazing land to provide a reference for planning of rehabilitation sites but not as the criteria for rehabilitation success.

Table 5-5 Rehabilitation Success Criteria for Native Bushland

Objective	Measurement	Frequency/Location	Success Criteria
Slope	Slope measured by aerial survey.	Check areas that have been rehabilitated in the previous two years.	80 % of areas with slope less than 1(V):3(H)
Ground Cover	Ground cover measured by quadrat method along 100 m transects at nominated monitoring sites. Incorporation of remote sensing techniques for extrapolation of quadrat data (above) across broad areas.	All sites every two years, alternate between wet and dry season. To be determined.	>60 % where ground cover is defined as any cover that assists in controlling erosion and may include live or dead cover and possibly rocky debris.

Table 5-5 Rehabilitation Success Criteria for Native Bushland (cont)

Objective	Measurement	Frequency/Location	Success Criteria
Trees and Shrubs	Species composition, health and density.	All sites every two years, alternate between wet and dry season.	Vegetative community is deemed by suitably qualified third party to have reached an acceptable and self-sustaining state. The communities are to be healthy, regenerating with a mixture of predominantly native trees, shrubs and grasses.
Active Erosion	Field erosion survey. Incorporation of remote sensing techniques across broad areas. (Currently subject of coal industry research).	Every two years. To be determined.	None proposed. Area deemed to have acceptable stability by suitably qualified third party.
Soil Chemistry	Surface soil sampling. Full detailed fertility analysis is to be conducted only on surface soil samples. Subsoil sampling of five layers (10, 20, 30, 40, 50 and 60 centimetres (cm)) for pH, EC, R1 dispersion and major cations (to determine subsoil Ca:Mg, ESP and dispersion).	Every four years, all sites.	EC < 0.6 decisiemens per metre (dS/m) and pH < 8.9 and > 5.0 to at least 35 cm depth. Trending to meet above criteria.

Table 5-6 Rehabilitation Success Criteria for Grasslands Suitable for Grazing

Objective	Measurement	Frequency/Location	Success Criteria
Slope	Slope measured by aerial survey.	Check areas that have been rehabilitated in the previous two years every two years.	80 % of areas with slope less than 1(V):20(H)
Ground Cover	Ground cover measured by quadrat method along 100 m transects at nominated monitoring sites.	All sites every two years, alternate between wet and dry season.	Ground cover > 50 % where ground cover is defined as any cover that assists in controlling erosion and may include live or dead cover and possibly rocky debris.
Vegetation	Vegetation measured by quadrat method along 100 m transects at nominated monitoring sites.	All sites every two years, alternate between wet and dry season.	Legume and pasture species.
Active Erosion	Field erosion survey. Incorporation of remote sensing techniques across broad areas. (Currently subject of Coal Industry research).	Every two years. To be determined.	None proposed. Area deemed to have acceptable stability by suitably qualified third party.

Table 5-6 Rehabilitation Success Criteria for Grasslands Suitable for Grazing (cont)

Objective	Measurement	Frequency/Location	Success Criteria
Soil Chemistry	Surface soil sampling. Full detailed fertility analysis to be conducted on surface soil samples. Subsoil sampling of five layers (10, 20, 30, 40, 50 and 60 cm) for pH, EC, R1 dispersion and major cations (to determine subsoil Ca:Mg, ESP and dispersion).	Every four years, all sites. Every four years, all sites.	EC < 0.6 dS/m and pH < 8.9 and > 5.0 to at least 35 cm depth. Trending to meet above criteria.
Verify Grazing Suitability	A grazing trial to be conducted with measurement parameters appropriate to determine animal production performance at varying stocking rates. Also, limiting factors and severity determined as per Land Resources Branch (1989).	Not yet determined.	Not yet determined.

Rehabilitated areas will be monitored using the selected parameters and trends tracked to demonstrate progress towards a stable, non-polluting, safe and self-sustaining ecosystem.

Water quality monitoring to demonstrate achievement of downstream water quality objectives is detailed in **Section 9—Water Resources**.

5.11. POST-MINE LAND USE

The overriding principle for the rehabilitation program for the SGCP is that areas disturbed by mining activities will be rehabilitated to a stable landform with a self sustaining vegetation cover.

The major post-mine land use goal for the final void, ramps and waste rock emplacements will be native bushland. All other areas will have a post-mine land use that shall enable cattle grazing compatible with the surrounding district (refer to **Table 5-7**).

The development of grazing as the preferred use has developed from stakeholder and land owner expectations, the current adjoining land use and strong indications of successful and sustained grazing use from data of topsoil quality (refer to **Section 7—Land**).

Although it is the intent to maximise the area of rehabilitated land suitable for grazing where practicable, there will be areas of disturbance where a non-grazing outcome is the preferred post-mine objective. Grazing may be unsuitable due to limitations through restricted soil water availability, soil stability and fertility. Such areas will be prone to degradation from stocking pressure and will include steeper outer batters, final void, and riparian zones. These areas will be revegetated with a mixture of local native tree, shrub and grassland species, and returned to native bushland.

It is highlighted that as grazing is the preferred final land use for some of the disturbance, rehabilitation to native bushland may need to include acceptance of Buffel Grass encroaching into the final landform, as this will tend to dominate native grass species.

Table 5-7 Pre-and Post-Mining Land Use

	Disturbance Type					
	Final Void Including High Wall and Low Walls	**Waste Rock Emplacements**	**Waste Rock Emplacements (External Batters)**	**Sediment/ Supply Dams**	**Diversion Channels and Riparian Zones**	**Infrastructure Areas (e.g. roads, infrastructure, stockpile areas, rail)**
Pre-mine land use	Grazing	Grazing	Grazing	Grazing	Grazing	Grazing
Post-mine land use	Waterbody/ native bushland	Grazing	Native bushland	Waterbody/ grazing	Native bushlands	Grazing