NEW HOPE GROUP

J.3 Topsoil Management Plan

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TOPSOIL MANAGEMENT PLAN

New Acland Coal Mine Stage 3 Project

JANUARY 2014

Contents

1. Introduction

NAC currently operates the Mine as a 4.8 million tonne (product coal) per annum (Mtpa) open cut coal mine on Mining Lease (ML) 50170 and ML 50216, adjacent to Mineral Development Licence (MDL) 244, under the approval of Environmental Authority EPML00335713. The Mine reserve is forecast to be depleted by 2017. The revised Project involves the extension and operation of the Mine, while increasing production from 4.8 Mtpa up to 7.5 Mtpa of thermal product coal.

The revised Project involves the extension of the Mine's operating life to approximately 2029 with the inclusion and progressive development of two new resource areas within MLA 50232. These resource areas are identified as the Manning Vale and Willeroo resource areas. The revised Project will include mining in three new mine pits, namely Manning Vale West, Manning Vale East and Willeroo mine pits.

This Topsoil Management Plan (TMP) has been prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition in order to allow successful mine rehabilitation. The TMP is to be implemented during clearance of topsoil in preparation for mining activities. The TMP includes procedures for storage of topsoil during the life of the revised Project and appropriate use of topsoil during progressive pit closure and rehabilitation. The TMP provides the following information:

- a description of the existing soils within the revised Project site;
- a topsoil stripping procedure that aims to maximise volumes of suitable topsoil removed thereby maximising topsoil available for mine closure and rehabilitation works;
- a stockpile design and maintenance procedure;
- erosion control techniques – for stockpiled topsoil and exposed subsoil following stripping and during mine rehabilitation;
- a topsoil application procedure – to be used during mine rehabilitation; and
- reporting and review requirements.

2. Existing Topsoil Resources

A typical soil profile is shown in Figure 2-1.

A Horizon (Topsoil): This layer is generally darker than other horizons and may contain decomposed organic materials (humus). Topsoil includes the O layer (organic) which contains organic material in varying stages of decomposition. The A horizon has the maximum biological activity for any given soil profile.

B Horizon (Subsoil): Layer has a distinctly different structure or consistency to the A horizon and usually contains a higher clay content. Plant roots penetrate through this layer although it has very little humus.

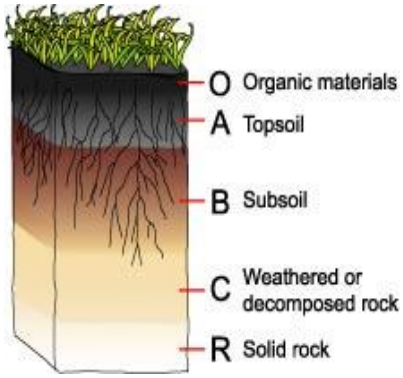
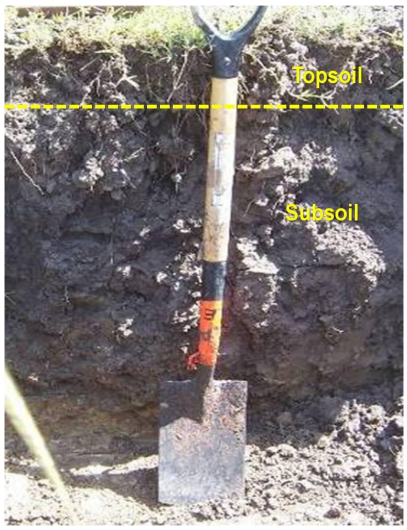
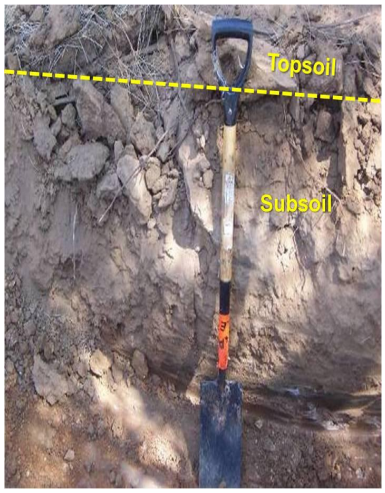


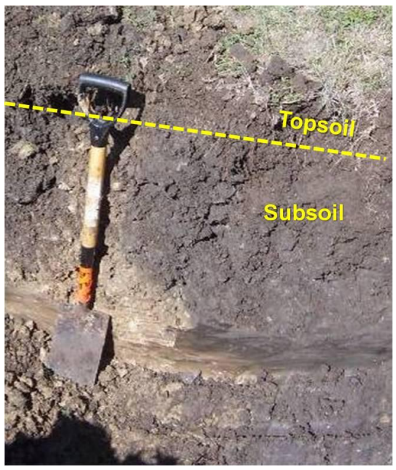
Figure 2-1 Soil Profile (Figure Source: Government of Western Australia)

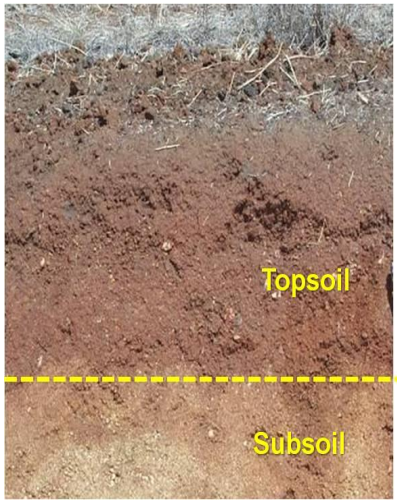
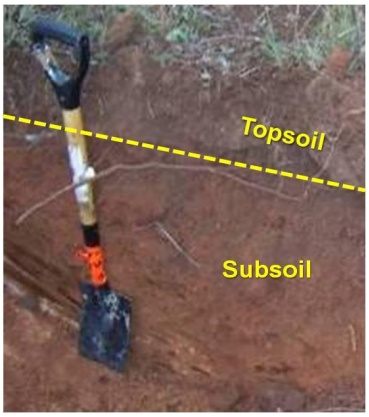
The A horizon is referred to as 'topsoil' and the B horizon is referred to as 'subsoil' in this document. The revised Project's topsoils and subsoils will be selectively handled (stripping depth and depth of return) dependant on the soil type, and will either be directly returned or stockpiled for later use dependant on the rehabilitation requirement and the stage of mine development. Topsoil and subsoil stockpiled for later use in rehabilitation will require different management during storage and reuse. Subsoil recovery across the revised Project site for re-vegetation purposes will be limited due to its general adverse physical nature (e.g. sodic and/or saline).

Soil types within the Project site were surveyed in 2007 to determine land suitability and topsoil depth. The surveyed soil types are described in Table 2-1 and the distribution of soils within the revised Project site is shown in Figure 2-2.

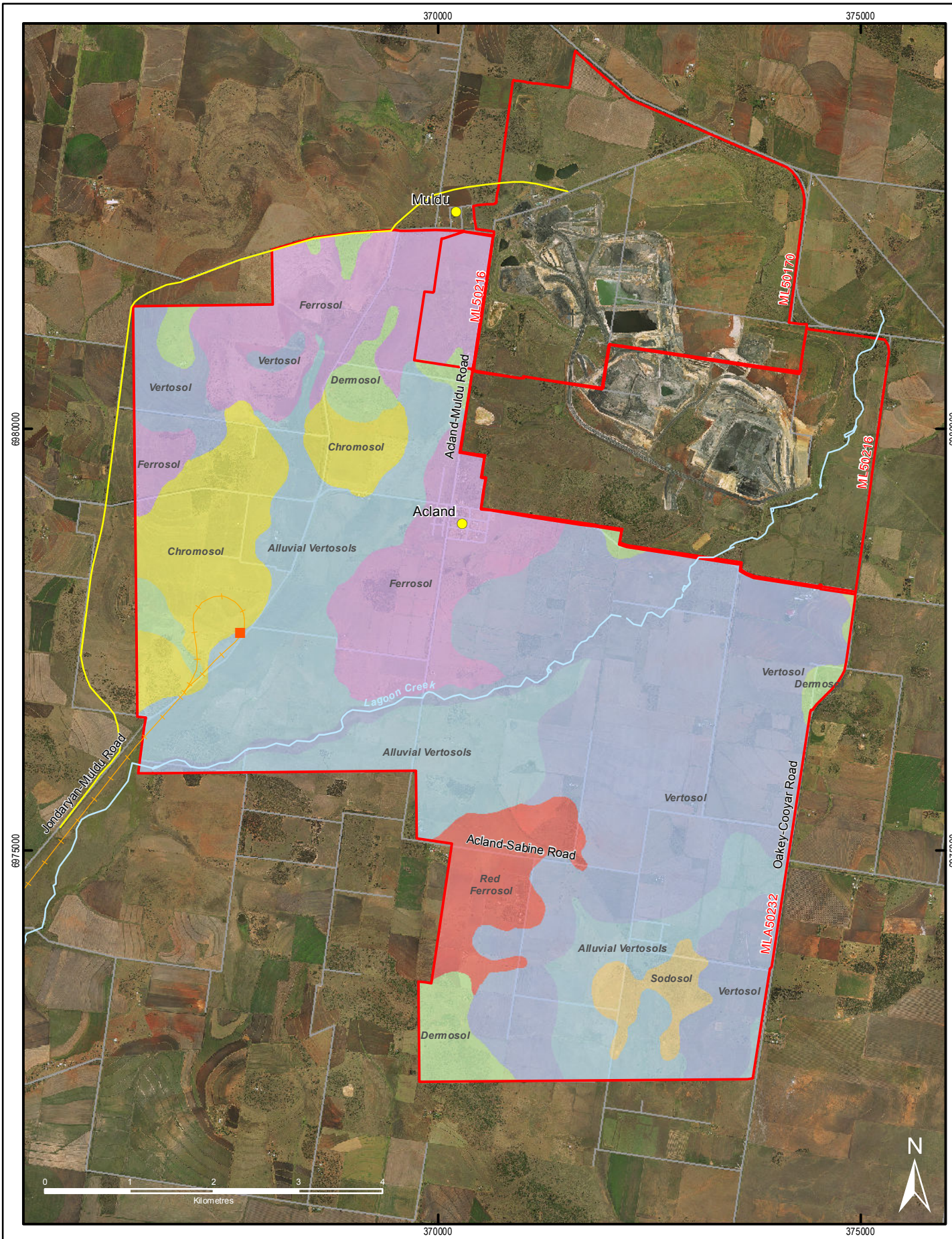
Table 2-1 Soils within Study area

Soil Type	Typical Profile	Typical Landform
Vertosol – Cracking Clays		
Key Features Clay-rich and often well structured. Clay often cracking and surface may be self-mulching. Often dark grey or yellowish brown. Susceptible to water logging and compaction. Highly sticky when wet. **Erosion** Vulnerable to sheet and gully erosion on moderate slopes. **Erosion and Sediment Control** Surface cover should be maintained where possible. On site drainage should be diverted to reduce water flow velocity and to separate clean and dirty water. Sediment controls may require sediment basins and the use of flocculants to settle out clays.		**Landform and Distribution** Widespread across project area on alluvial plains, gently undulating plains. Melon holes may be present. 
Sodosol – alkaline and sodic soils with sharp texture contrast		
Key Features Sharp contrast between sandy topsoils and clay rich subsoils. Fine thin dark brown sandy loam over hard reddish brown clay subsoils. Often with bleached A horizon. Surface is hard setting and termite mounds common. **Erosion** Highly erodible. Vulnerable to sheet, tunnel and gully erosion due to highly		**Landform and Distribution** Southern part of project area on relic alluvial plain. 

Soil Type	Typical Profile	Typical Landform
dispersive subsoils. **Erosion and Sediment Control** Refer to Vertosol erosion and sediment control measures. Contour ripping & gypsum application.		
Chromosol – neutral to alkaline soils with sharp texture contrast		
Key Features Sharp texture contrast between sandy topsoils and clay rich subsoils. Topsoil is thin and grey with good fertility and good structure. Subsoils are saline & sodic below 50cm and usually yellowish brown. **Erosion** Prone to sheet erosion. Clay rich subsoils vulnerable to erosion by dispersion. **Erosion and Sediment Control** Sediment fences, sediment basins and the use of flocculants to settle out clays.		**Landform and Distribution** Undulating plains of uplands in western part of project area. Open woodland of Poplar Box and Brigalow. Used for grazing. 

Soil Type	Typical Profile	Typical Landform
Ferrosol – Crumbly deep light/medium clays		
Ferrosol Friable (crumbly) red soils generally derived from basalt. High iron oxide content promotes good structure. The soil profile grades from a fine brown light clay over a well-structured red brown medium clay over hard brown clay or weathered basalt. **Erosion** Low erosion potential but will erode on slopes if left bare. **Erosion and Sediment Control** Diversion of on-site drainage to reduce water flow velocity and to separate clean and dirty water. Sediment basins and the use of flocculants to settle out clays.		**Landform and Distribution** Undulating low hills usually on basalt, northern part of project area. 
Red Ferrosol – Red deep sandy light clays		
Ferrosol Thin red brown sandy clay loam or light clays on hard alkaline red brown clay subsoil on mixed sediments. **Erosion** Erosion from rainwater can be severe on slopes if soils left bare. **Erosion and Sediment Control** Diversion of on-site drainage to reduce water flow velocity and to separate clean and dirty		**Landform and Distribution** Undulating low hills usually on basalt. 

Soil Type	Typical Profile	Typical Landform
water. Sediment basins and the use of flocculants to settle out clays.		
Dermosol - Rocky topsoils with texture contrast subsoils		
Dermosol Shallow topsoils within rocks and structured subsoils with minor texture contrast. **Erosion** Highly erodilble even on shallow slopes when bare. Because subsoils are clay-rich, they are vulnerable to dispersion. **Erosion and Sediment Control** Diversion of on-site drainage to reduce water flow velocity and to separate clean and dirty water. Sediment basins and the use of flocculants to settle out clays.		**Landform and Distribution** Generally basaltic rocky upland areas. 



LEGEND

- Towns and Localities
- Train Loadout Facility
- Rail Spur
- Roads
- Creeks
- Jondaryan-Muldu Road Diversion
- Mining Tenements

Soil Type Distribution

- Chromosol
- Dermosol
- Ferrosol
- Red Ferrosol
- Sodosol
- Vertosol
- Alluvial Vertosols

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Figure 2-2 - Soils Distribution

Scale 1:60,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Produced: 29/08/2013 Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\TopSoilManagementPlan\130829_NewHope_TopSoilMgtPlan_Figure2-2_SoilsDistribution.mxd

3. Topsoil Stripping

This Section provides details of the depths of topsoil to be stripped according to soil type and a stripping procedure.

Topsoil stripping is necessary wherever land is planned to be disturbed by mining activities to recover the soil resource for rehabilitation purposes. Topsoil stripping will be undertaken in areas of planned mining activity including the coal preparation and handling plant, the active pit areas, out-of-pit dumps, haul roads, hardstands, access roads and other general infrastructure (e.g. dams).

Initially stockpiling of topsoil will be necessary until the out-of-pit dumps are constructed and in-pit backfilling of spoil has advanced enough to allow rehabilitation activities to safely commence behind the active mine path.

As the mine pits expand, there will be more opportunity to strip topsoil and apply it directly to re-contoured areas, thus avoiding topsoil stockpiling. Freshly stripped and placed topsoil retains more viable seed, micro-organisms and nutrients than stockpiled soil. Vegetation establishment is generally improved by the direct return of topsoil and is considered 'best practice' topsoil management.

3.1. Topsoil Stripping Planning

Suitable topsoil will be stripped for use in the rehabilitation program. The topsoil will either be stockpiled until suitable re-contoured areas are available, or preferably be directly returned immediately across the areas to be rehabilitated.

Topsoil material resource assessments will be carried out in advance of mining to confirm the accuracy of the pre-mine topsoil survey data. These assessments may include:

- topsoil depth confirmation;
- possible additional chemical analysis to confirm suitability (pH, EC, Cl-, CEC and Cations), particularly around soil type boundaries or where variation is suspected in relation to the original soil survey;
- dispersion characteristics for erosion potential; and
- review of existing soils data and experience gained in topsoil recovery of adjacent mining areas.

Topsoil stripping should not extend to soils with an electrical conductivity (EC) over 0.9 mS/cm or a chloride content (Cl^-) which exceeds 900 mg/kg as these soils are generally too saline for pastures. The cation exchange capacity (CEC) should be over 5 meq/100 g as it is an indicator of sufficient nutrients (soil fertility) for pasture growth. The assessments will enable detailed volume calculations and preparation of stripping plans prior to removal. The stripping plans will be incorporated into the mine planning process and will also include designated respreading areas or stockpile locations.

NAC has prepared a Standard Work Procedure to define the topsoil stripping process for the revised Project. This is located in Appendix A.

3.2. Disturbance Areas

NAC is proposing to disturb a total of approximately 2, 030 ha over the life of the revised Project. Table 3-1 outlines the expected disturbance for each of the revised Project's main

disturbance types – mining area, elevated and depressed landforms, and mine infrastructure. The disturbance area calculations comprise the current Mine area (Stage 1 and 2) and the revised Project site.

In relation to the revised Project's planned disturbance, certain areas will be progressively disturbed and rehabilitated over the life of the revised Project (e.g. mining areas), while other areas will be disturbed at the start or early in the life of the revised Project and remain disturbed until rehabilitation is conducted as part of the mine closure process at the end of the revised Project's life (e.g. mine infrastructure area).

Table 3-1 Total disturbance over the life of the Project

Type of Disturbance	Disturbance Area (ha)
Mining Areas	921
Elevated Landforms	314
Depressed Landforms	621
Mine Infrastructure	174
Total	**2030**

3.3. Topsoil Stripping Depth and Volumes

Overall, the revised Project site possesses large reserves of topsoil and subsoil of sufficient volume to be used in mine rehabilitation programs. The actual depth of stripping is dependent on the particular soil types (Figure 2-2) which determine soil properties.

The basic principle in determining useable depths of topsoil for rehabilitation is its quality in comparison to the spoil requiring rehabilitation. In general, the quality of the topsoil must exceed that of the spoil.

From the large quantity of soils data compiled for the revised Project site, it is apparent that some soils become sodic and are moderately saline at depth. The depth to the salt accumulation layer (or salt bulge) is variable. However, in most cases it is greater than 40 cm. This assessment specifically evaluated subsoil conditions and found evidence of inhibitive salinity in certain soil types. The most severe salinity was found within the Saline Vertosols below 0.4 m depth which predominately occur on alluvial plains. Mixing of these subsoils can potentially introduce salinity to the topsoil if stripping is too deep and should be avoided. The basaltic soils were found to be non-saline to bedrock.

Table 3-2 provides a summary of the soil types present on the revised Project site and their topsoil stripping depth.

Table 3-2 Topsoil Stripping Summary

Soil Type	Description	Recommendations and Comments	Typical Topsoil Strip depth
Vertosol	Clay-rich and often cracking and surface may be self-mulching. Often dark grey or yellowish brown. Susceptible to water logging and compaction. Highly sticky when wet.	These soils are very well structured clays with no real problems to 90cm depth. The entire profile is non-saline and non sodic, fertility is high and water holding capacity is good. Stripping depth can extend to 100 cm if required. These soils are high quality suited to all areas of mine site rehabilitation.	60 – 90 cm
Saline Vertosol	Clay rich, often well-structured cracking clays predominately on old alluvial plains.	These Saline Vertosols predominantly occur on sandy alluvial plains and are saline and often dispersive (high ESP) at depth. These soils should not be stripped below 40 cm and their use in rehabilitation should be confined to lower sloping areas to avoid excessive erosion.	40 cm
Sodosol	Fine thin dark brown sandy loam over hard reddish brown clay subsoil.	Poor soil with a restricted reuse potential for rehabilitation. The hard setting fine sandy loam A horizon has reuse potential but the high fines content will cause sealing, and low infiltration leading to erosion. The soil also has low fertility. The clayey subsoil is very poorly structured and highly dispersive and should be avoided completely. Care should be taken not to include the B horizon into stripped topsoil. It is recommended that stripping of this soil be avoided in favour of deeper stripping on other better soils if possible.	10 – 15 cm
Chromosol	Thin dark cracking and duplex dark grey soils over hard yellowish brown alkaline subsoils on sandstone.	These soils can be managed in an identical manner to Vertosols in that the surface 40 cm is high quality clay but increasing salinity and dispersion potential occurs below this depth. The surface layer is light sandy medium clay with only minor physical problems. Fertility is quite good. Stripping depth should not exceed 40 cm unless further conductivity tests indicate otherwise. The surface 40 cm is suited to all areas of mine site rehabilitation.	40 cm
Red Ferrosol	Thin red brown sandy clay loam or light clays on hard alkaline red brown clay subsoil on mixed sediments.	These soils may have a tendency to set hard and seal (due to high fine sand content in association with moderate clay content). Soil unit has fairly low fertility. Soils are non-saline or sodic throughout showing strong basaltic influence. When used on rehabilitation, the sealing tendency and high erosion potential on sloping land should be considered.	40 cm

Soil Type	Description	Recommendations and Comments	Typical Topsoil Strip depth
Ferrosol	Fine brown light clay over well-structured red brown medium clays over hard brown clay or weathered basalt.	Highly productive good quality soil. The whole soil profile to weathered basalt may be used in rehabilitation programs. The lighter textured surface horizon would be better suited to more sloping areas of rehabilitation than heavier clay Vertosols.	70 – 90 cm
Dermosol	Shallow generally basaltic rocky upland areas	Any soil that can be physically stripped is suitable. However, quantities are low and usually very rocky.	0 – 10 cm

3.4. Topsoil Stripping Supervision

NAC's Technical Services and Mining Departments will be responsible for the recovery, handling and management of site soils. These Department's responsibilities will include:

- clearance of vegetation prior to stripping – this will enable salvage of all suitable topsoil material and avoid loss of stripped topsoil quality caused by mixing with unsuitable soils;
- training of earthmoving plant operators so that stripping operations are conducted in accordance with Topsoil Stripping Procedures and in situ soil conditions;
- prior to stripping activities, acquisition of appropriate clearance approvals (e.g. vegetation and Aboriginal cultural heritage clearance approvals);
- supervision of stripping to determine recovery depths and to identify suitable soils;
- delineation of areas to be stripped and date of stripping;
- delineation of suitable stockpile areas (as required);
- delineation of planned areas for direct return of topsoil (as required);
- maintenance of acceptable dust levels during topsoil stripping;
- recording of volumes stored;
- application of the top soil stripping SOP; and
- management of topsoil placement within storage and/or direct return locations, with due consideration of economic factors, mine access constraints, machine availability, weather conditions and ground conditions.

3.5. Topsoil Stripping Procedure

A general protocol for soil handling during topsoil stripping is presented below and includes soil handling measures which optimise the retention of soil characteristics (in terms of nutrients and micro-organisms) favourable to plant growth and propagules for natural regeneration (e.g. seed banks).

- Topsoil will be recovered using appropriate equipment. Depending on compaction and recovery rates, deep ripping may be required to maximise topsoil recovery with care taken not to mix topsoil with sodic subsoil.

- During the stripping process there may be some unexpected changes in the depth and the nature of the soil. Where practical the inclusion of obviously poorer quality material will be avoided such as subsoil clay with mottles, saline material and material dominated with stones. Proposed pre-stripping assessments will help manage unexpected topsoil changes.

- It is preferable for material to be stripped when it is in a lightly moist condition; soil is slightly moist when colour is darker than when it is dry and the soil cannot be rolled by hand into a bolus.

- Contractors bringing machinery onto the site will be required to present such machinery in a weed-free condition. Advice regarding local weed species should be obtained from the local government or the Department of Agriculture, Fisheries and Forestry.

- Disturbance areas will be stripped progressively, as required, in order to reduce erosion and sediment generation, to reduce the extent of topsoil stockpiles and to utilise stripped topsoil as soon as possible for rehabilitation. Rehabilitation of disturbed areas, such as roads, embankments and batters, will be undertaken as soon as practicable after these structures are completed or as areas are no longer required for operational purposes.

Covering vegetation can make the removal of specific topsoil depths difficult and excessive quantities of vegetative matter in long-term stockpiles may promote chemical and biological degradation of the seed reserves that are a future source of natural regeneration during rehabilitation. Therefore, prior to stripping, vegetation will be removed or reduced by grazing and/or clearing. All cleared vegetative material may be buried in-pit, or if suitable, placed as habitat within the proposed or current conservation areas. In general, the requirement to clear larger vegetation (shrubs and trees) within the Study area is comparatively small as a result of the area's long history of agricultural production. If feasible, cleared vegetation may be chipped to provide a cost-effective mulch and soil amendment.

4. Topsoil Stockpiling

This Section provides topsoil stockpile management measures which aim to conserve topsoil in a condition as close as possible to its original state.

4.1. Stockpile Location

Stockpile locations will be subject to the following management actions.

- Grazing stock, machinery and vehicles will be excluded.
- Overland water flow onto or across stockpile site will be kept to a practical minimum.
- Where possible, stockpile sites will be selected to maximise protection from `the prevailing winds, particularly if the material is friable in nature (e.g. sand or silt). Establishing stockpiles within a buffer treed zone or in the lee of hills, may be appropriate for these circumstances.
- All long-term topsoil material stockpiles will be located outside the active mine path and away from drainage lines.
- Drainage from higher areas will be diverted around stockpile areas to prevent erosion.
- As required, sediment controls will be installed downstream of stockpile areas to collect any run-off.
- Topsoil stockpile locations will be strategically located to assist the sequence of future rehabilitation.

4.2. Topsoil Stockpile Design

Separate stockpiles for topsoil and subsoil will be formed in low mounds of minimum height (3 m maximum) and maximum flat surface area, consistent with the storage area available. Stockpiling using a greater number of low (<2 m high) mounds, rather than a few high spoil-type dumps, is preferable. Long term stockpiles will be revegetated to minimise loss of soil quality. Rrevegetating stockpiles will minimise weed infestation, maintain soil organic matter levels, maintain soil structure and microbial activity and maximise the vegetative cover of the stockpile.

Stockpiles to be retained for a period greater than six months will be sown with a cover crop if a natural vegetative cover does not establish. Topsoil stockpiles will be clearly signposted for easy identification and to avoid any inadvertent losses. The establishment of declared plants on the stockpiles will also be monitored and control programs implemented as required.

4.3. Topsoil Stockpile Management

Stockpiling of topsoil should preferably be kept to the shortest possible period. Dispersive clays (Sodosol and Vertosols on sandy alluvial plains) should not be stockpiled over any wet season without erosion control measures being used.

Where it is necessary to store material over more than one growing season, some form of protective surface cover is likely to be needed.

In general, topsoil stockpiles will be managed so that:

- storage time is minimised;
- Sodosols will be stockpiled separately (if they are to be used in rehabilitation);
- locations are accurately surveyed and data is recorded relating to the soil type and volume;
- stockpiles are located outside proposed mine disturbance areas and outside of the Lagoon Creek floodplain;
- stockpiles are located in areas away from drainage lines or windy areas in order to minimise the risk of soil and wind erosion;
- stockpile surfaces are seeded (if natural revegetation does not provide adequate cover);
- good vegetative cover will be maintained on stockpiles and on top-dressed areas until ground cover is well established by excluding stock and controlling weed growth;
- appropriate weed control strategies are implemented particularly for any noxious weeds (Immediate revegetation will provide vegetative competition to assist with the control of undesirable plant species.);
- where practical and applicable, stockpiles will have sediment control measures installed and be located within the catchment of sediment control dams;
- stockpiles are delineated to avoid vehicle and pedestrian traffic and accidental removal/disturbance; and
- topsoil stockpiles possess a suitable embankment grade to limit the potential for erosion of the outer pile face.

5. Erosion Potential and Control

This Section describes erosion hazard of recently replaced topsoils, exposed subsoils and stockpiles and provides control measures to reduce erosion risk.

5.1. Erosion Hazard

The main potential erosion hazard for the revised Project's topsoils is early in the rehabilitation process while returned topsoils are awaiting the re-establishment of vegetation. Site clearance ahead of infrastructure developments such as haul roads, hard stands, pipes and access tracks, under the right conditions may also predispose these areas to erosion risks. Erosion hazard within the revised Project site is primarily driven by sodicity, slope angle, slope length and the status of vegetation cover.

5.2. Sodic Soils

Sodicity or Exchangeable Sodium Percentage (ESP) is a measure of the proportion of sodium ions present in a soil; it is expressed as a percentage as:

$$\text{ESP} = \frac{\text{Exchangeable Sodium}}{\textit{Cation Exchange Capacity}} \qquad \text{EQ1}$$

A soil with high sodicity has a tendency to lose aggregation and develop clay dispersion, cause an impermeable (low hydraulic conductivity) profile, surface crusting and poor aeration. Soil profiles with these properties in layers, if exposed, will disperse which can lead eventually to significant dispersion and erosion.

When ESP values are medium to high (6 to >15%) and Mg/Ca ratio >1, there is a greater susceptibility to dispersion (Baker 1991). Non-saline soils ($EC_{1:5}$ <400 µS/cm) which are sodic are also more likely to disperse. However in general, soil ESP exceeding 6% at the surface (15% at depth) warrant consideration as potentially dispersible soils which will influence surface structure and water movement.

Soils that are sodic (ESP 6 to 14%) to strongly sodic (ESP >15%) have been found in the upper 60 cm of the soil profile at several sample locations during the EIS field survey. These occurrences include one sample taken from the following soil units: Sodosol, Chromosol, Ferrosol and Vertosol.

5.3. Types of Soil Erosion

Erosion takes many forms owing to the effects of climate, topography, land use, groundcover and the erodibility of the soil type. The main types of erosion across a landscape are shown in Figure 5-1 *and described in* Table 5-1.

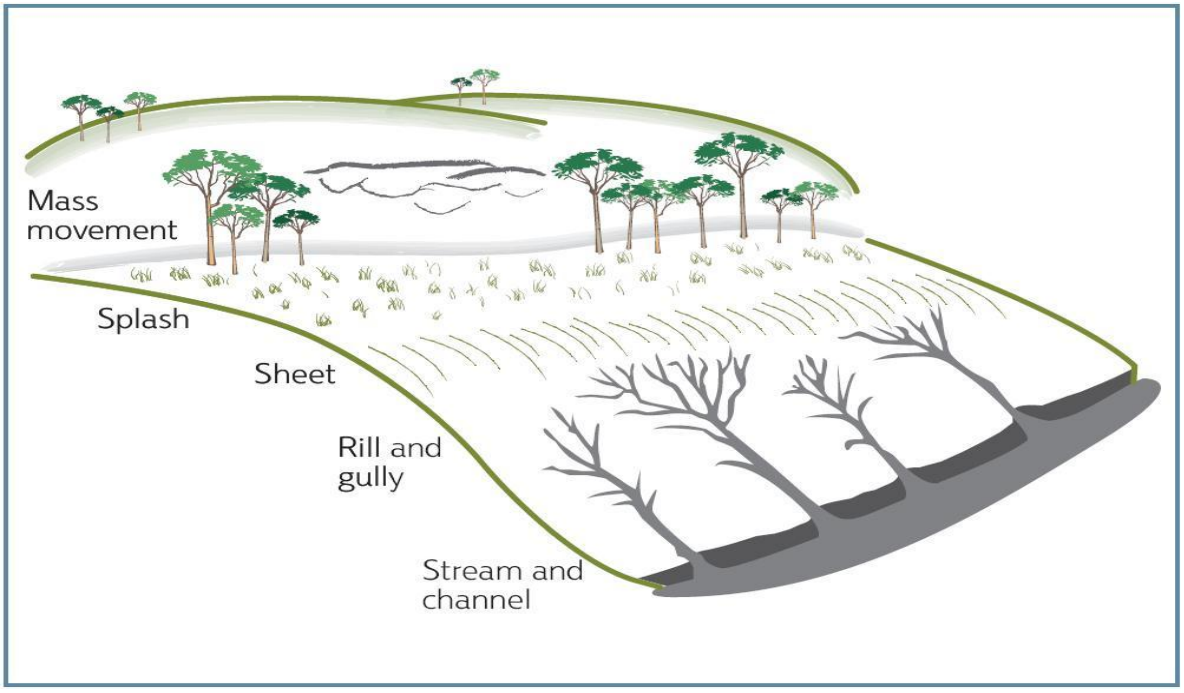
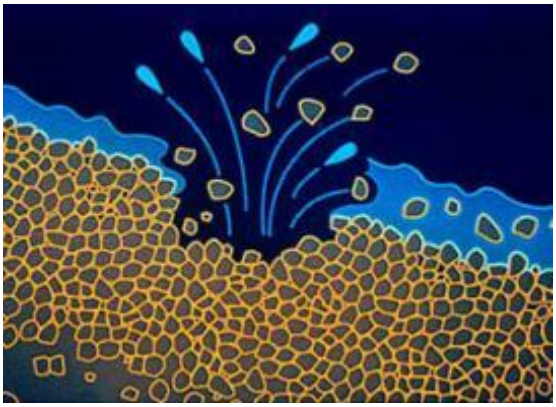
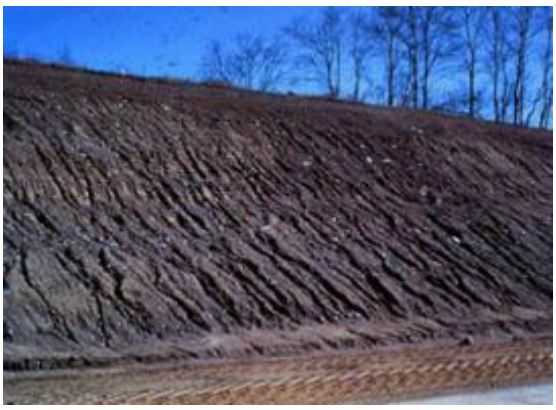


Figure 5-1 Types of Erosion

Table 5-1 Description of Erosion Types

Erosion Type	***Description***
Rain Splash Erosion	
 Source: www.partnershipsforchange.cc	*Erosion due to the impact of raindrops blasting soil particles from the soil surface. Particles can then be transported easily by sheet and other erosion types.*

Erosion Type	*Description*
Rill Erosion	
	*Removal of soil from surface whereby small channels rills up to 300 mm deep are formed. These form where run-off concentrates into depressions caused naturally or by wheel tracks.*
Tunnel Erosion	
 Source: State of the Environment Tasmania	*Tunnelling occurs when infiltrating rainwater or overland flow causes subsoils to disperse, leading to subsurface piping and erosion. Dispersive soils particularly the strongly sodic Sodosols are especially prone to tunnelling. If the topsoil collapses, sinkholes and gullies can form.* *Once tunnels have formed they are difficult to control and severe cases will need reprofiling.*
Gully Erosion	
 Source: NSW Office and Environment and Heritage	*Gully erosion involves the removal of soil from the surface and subsurface caused by concentrated run-off eroding channels greater than 300 mm deep.*

Erosion Type	*Description*
Sheet Erosion	
 Source: www.soer.justice.tas.gov.au	*Sheet erosion involves the removal of shallow, uniform layer of soil from the surface. It is often difficult to see as no channels are formed, with the downslope accumulation of eroded material being the only indication.*

5.4. Erosion Control

Progressive rehabilitation will be undertaken to stabilise disturbed areas as quickly as practical and to limit erosion. Erosion and sediment control measures will be employed, which are consistent with the practices described in DME (1995).

The design parameters for the construction of erosion control work such as rock armoured or grass lined waterways will be in accordance with established principles for engineering and soil conservation earthworks. A number of variables must be considered, such as time of concentration, rainfall intensity, erosivity, gradient, scour velocities and flow estimations.

The erosion control options that may be employed throughout the life of the revised Project are summarised in Table 5-2.

Table 5-2 Erosion Control Measures

Area	Control Measure
Erosion control and cleared land	• restrict clearing to areas essential for the works • windrow vegetation debris along the contour • minimise length of time soil is exposed • divert run-off from undisturbed areas away from the works • direct run-off from cleared areas to sediment dam
Exposed Subsoils	• minimise length of time subsoil is exposed • direct run-off from exposed areas to sediment dam (s) • use erosion control measures such as: • bonded fibre matrix • composite blankets • erosion control blankets • gravelling

Area	Control Measure
	• mulching • revegetation • soil binders and surface stabilisers • surface roughening • sediment fences • check dams • grass filter traps • rock filter traps • compost/mulch berms • drop inlet protection • gypsum application on exposed sodic soils
Contour cultivation	All cultivation used to prepare the rehabilitation area should be on the contour. On steep slopes, this approach requires the land to be terraced or benched.
Contour Deep Ripping or 'Contour Furrowing'	These procedures should be used to relieve soil compaction and improve water infiltration on exposed sodic subsoils and the Sodosol topsoil stockpile. These actions should be undertaken in conjunction with gypsum application.
Contour or Levee Banks	Earth mounds or similar structures are the most common physical control measures. The size of these structures is determined by the size of their catchment area. These structures should not be constructed out of dispersive or highly erodible materials.
Absorption and Pondage Banks	These banks are similar in design to contour banks but laid out such that they pond water - thereby causing greater infiltration and less run-off. They are applicable only to low slopes (less than 1%) and should be avoided in materials which become dispersive when saturated. They should not be used on spoil dumps.
Diversion Banks	These banks are commonly used to reduce or eliminate the catchment to the heads of gullies. They need to be located such that they spill water to stable areas - preferably away from the rehabilitation area.
Spillways/Grassed Waterways	These structures are used to confine run-off from any or all of the above structures into a stable vegetated flow path. Because these structures effectively take all excess run-off from a rehabilitation area, they should be installed first and well vegetated prior to the actual construction of the diversion structures. However supplementary irrigation water may be required to sustain the vegetation.
Lined Waterways	Additional treatment and special precautions may be required to protect waterways from erosion. The on-site suitability of the following available treatment measures will be made: • jute mesh may be used to line channels • rip-rap or stone pitching involves the use of stone • concrete filled bags with an underlying filter blanket of sand and gravel • gabions and mattresses (rockfilled wire baskets)

Area	Control Measure
Sedimentation Dams - Gully Trap Dams	These structures are an interim measure to confine the movement of soil to the rehabilitated area. In effect they act as settling areas to ensure that soil eroded from the rehabilitated area does not pass beyond that area. Ideally their role in erosion control should diminish over time as the rehabilitated area is stabilised by other measures.
Sodosol Erosion Control	Gypsum should be applied to Sodosols to improve aggregate stability (gypsum displaces sodium ions with calcium ions). Where practical, half the recommended dosing rate will be applied to the surface of the soil material prior to stripping. The other half should be applied to the top-dressed material immediately after spreading. Alternatively gypsum will be applied to the soil surface after its spreading and incorporated into the soil by ripping. The use and quantities of gypsum will be determined on a site by site basis prior to topsoil stripping.

6. Topsoil Application Procedure

6.1. Post Mining Land Use

The overriding principle for the rehabilitation program of the revised Project is to ensure the disturbed land is returned to a post-mine condition that is stable, self-sustaining, requires minimal maintenance and supports the proposed post mine land use. The revised Project's Final Land Use and Rehabilitation Plan will reference this plan and will require the successful application of this plan to ensure its rehabilitation outcomes are achieved to promote a sustainable final land use for the revised Project. The main post-mine land use for the revised Project will be grazing based on a self-sustaining vegetation community using appropriate pasture grasses and scattered plantings of native tree and shrub species. A smaller area of the revised Project site will be dedicated for conservation purposes including Lagoon Creek's riparian zone. Final landforms will be constructed to protect downstream water quality and facilitate a long-term sustainable outcome for the revised Project.

6.2. Mine Rehabilitation

A progressive rehabilitation program will be implemented throughout the life of the revised Project and reported in each Plan of Operations, and will commence when areas become available within the operational land.

The main features of the progressive rehabilitation process are:

- use of suitable topsoil, sourced either from stockpiles or respread immediately after stripping across available recontoured areas;
- contour ripping as an erosion control measure;
- seeding with an appropriate seed mix (grass, shrub and tree species) prior to the commencement of the wet season to maximise the benefits of subsequent rainfall;
- application of appropriate fertiliser for plant establishment if required; and
- application of gypsum if required.

6.3. Topsoil Application Procedure

The volume of growth media material available will be reconciled with the estimated volume needed for successful rehabilitation. The application procedure is essentially the reverse of the stripping procedure. First, the overburden materials will be profiled or landformed to the design slopes, then if suitable, secondary media (subsoil) should be placed in position, followed by the primary media (topsoil).

The EIS found that most soil tested from the revised Project site is likely to be suitable for revegetation. Salinity levels are generally below 0.35 dS/cm (very low to medium salinity) in the top 30 cm of soil. Sodicity levels in the area mapped as Sodosols are very high in the top 60 cm of soil and therefore, if necessary, topsoil stripped from this mapped area should be reused on flat areas to minimise erosion by dispersion.

In general, all soils used in rehabilitation will be applied with a minimum thickness of 250 mm. This measure provides sufficient depth for re-ripping, should follow-up maintenance work be required.

The mine rehabilitation strategy may include the following measures which are designed to minimise the loss of topsoil material respread on rehabilitated areas and promote successful vegetation establishment.

- Balance the topsoil requirement for rehabilitation areas against stored stockpile inventories and proposed stripping volumes.
- Maximise the opportunities for direct placement of topsoil from pre-strip to rehabilitation areas.
- Minimise the length of time that topsoil material is to be stockpiled.
- During removal of soils from the stockpiles, take care to minimise structural degradation of the soils.
- Respread topsoil material in even layers at a thickness appropriate for the landform and land capability of the area to be rehabilitated.
- Use gypsum to stabilise sodic soil.
- Contour rip to encourage rainfall infiltration and minimise run-off.
- Soon after respreading, seed with sterile cover crops and pasture grasses and/or native tree species to establish revegetation cover as early as possible.
- Construct contour banks in accordance with the applicable landform design criteria to limit slope lengths and control run-off.
- Construct collection drains and sedimentation dams to collect run-off and remove suspended sediment.
- Regularly inspect and maintain rehabilitation areas to facilitate sediment and erosion control and revegetation success.
- Rehabilitation areas of returned topsoil will be ripped, with care taken not to bring subsurface materials to the surface (e.g. large rocks). Ripping should only be sufficient to allow equipment to work efficiently. Ripping along slopes should be along contour.
- Regularly inspect rehabilitated areas for declared plants and environmental weeds, and control significant weed outbreaks using chemical or mechanical control methods.
- Apply appropriate fire, grazing, and hygiene management procedures.
- Continue to implement the SOP to ensure topsoil application is conducted in a consistent manner to ensure rehabilitation success.

6.4. Post Mine Land Form

The primary design objective is the creation of stable final landforms that are compatible with the surrounding landscape and the proposed final land use. NAC will use experience gained at the Mine and other mines in Queensland and internationally to meet this objective. Importantly, the final landform design will be consistent with NAC's Final Landform Management Plan for the revisedProject.

In general, stable landforms will be established following mining, using soils capable of supporting vegetation communities adapted to the local environment. The stability of the

post-mine landform will be achieved by applying sound rehabilitation practices. The disturbed land will be rehabilitated to a condition that is self-sustaining or to a condition where the maintenance requirements are consistent with the proposed post-mining land use.

Surface run-off from all disturbed areas will pass through sedimentation controls to reduce the levels of suspended solids. Where possible, sedimentation dams will discharge to an environmental dam before eventual discharge off-site. Water in the environmental dams will be recycled to minimise the potential for off-site discharge.

NAC's rehabilitation strategy will allow a majority of the former revised Project site to be re-incorporated into Acland Pastoral Company's agricultural activities. The return of the former revised Project land to grazing is consistent with the current land uses practised within the region (grazing and dryland cropping) and is considered a long term sustainable outcome for the revised Project.

In general, while there will be a loss of land capability as a result of mining across the revised Project site. Agricultural production will be possible in the form of grazing, which has been demonstrated at other New Hope Group sites. NAC will develop a sustainable management regime for the former mined land through the on-going site-specific grazing trials and long-term monitoring against approved rehabilitation acceptance criteria.

In addition, NAC will trial the return of selected rehabilitation areas within the revised Project site to dryland cropping. Topsoil management, drainage and slope conditions will be critical factors for the promotion of a successful outcome. NAC will engage a suitable academic institution to ensure an appropriate level of scientific rigour is applied to the trial process.

7. Review and Improvement Process

7.1. Review & Improvement

The effectiveness of the topsoil management practices outlined in this TMP will be assessed regularly in conjunction with overall rehabilitation assessments.

The TMP is to be reviewed at least every five years or as otherwise directed by NAC's management in consultation with the relevant government agencies. The review will reflect changes in environmental requirements, technology and operational procedures. The review will include soil depths, topsoil stockpiling locations and topsoil budgets for the proposed mining period.

Results of the assessments will be incorporated into future rehabilitation planning to continually improve the success of the program. The performance outcomes for the TMP are:

- soil survey is conducted prior to stripping;
- soil stripping is scheduled to minimise exposed areas;
- soil material suitable for reuse is recovered and utilised in an appropriate manner; and
- procedures are in place detailing methods to be used for the stripping and stockpiling of soils.

8. References

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Bourne GF and Tuck GA (1993). Resource Information. In: Thwaites RN and Maher JM (eds.) Understanding and Managing Soils in the Central Highlands, Queensland Department of Primary Industries Training Series QE93002.

Department of Environment and Climate Change NSW (2008) MANAGING URBAN STORMWATER, Soils and Construction, Volume 2E Mines and quarries

Department of Minerals and Energy (DME), 1995.Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland

Gunn, RH, Galloway, RW, Pedley, L and Fitzpatrick, EA (1967) Lands of the Nogoa-Belyando Area, Queensland. Land Research Series No. 18, CSIRO, Melbourne.

New Hope Coal Australia (2010), New Acland Coal Mine Stage 3 Expansion Project – Environmental Impact Statement

Shields, P.G. Williams, B.M. (1991), Land resource survey and evaluation of the Kilcummin area, Queensland, Queensland Department of Primary Industries Land Resources Bulletin QV91001

Appendix A Standard Work Procedure Topsoil Management

HEALTH, SAFETY AND ENVIRONMENT STANDARD

STANDARD WORK PROCEDURE

TOPSOIL MANAGEMENT

DOCUMENT OWNER: **Technical Services Superintendent**	**PREPARED BY:** **Paul Statham**
APPROVED BY: **Site Senior Executive** **Kelvin Jamieson** **Signature: ……..** **Date:**	

1. INTENT

This procedure will ensure that topsoil or other growth media is removed, stored and replaced where appropriate according to statutory and operational requirements.

2. SCOPE

This procedure will apply to any disturbance on the New Acland Coal (NAC) Mining leases during which topsoil would be removed, stockpiled, replaced, covered or otherwise significantly altered.

This procedure applies to all employees and contractors of New Acland Coal working within the Mining Leases 50170 and 50216.

3. DEFINITIONS

DISTURBANCE Temporary or permanent alteration or damage to a natural or rehabilitated surface. Any loss of vegetation, removal/placement of topsoil, removal of overburden, road formation, building construction, hardstand formation, diversions formation or tailings dam construction constitutes disturbance.

TOPSOIL DISTURBANCE Removal, stockpiling, re-placement, covering or other significant alteration of soil material covering the natural land surface which has physical and chemical properties conducive to the growth of vegetation**.**

TOPSOIL PLAN Plan outlining topsoil recoverable topsoil depths, volumes and locations.

4. PROCEDURE

4.1 PLANNING REQUIREMENTS

The following planning events will occur to ensure appropriate topsoil is handled in the correct manner.

1. Ten working days prior to conducting any activity which will cause topsoil disturbance, the Mine Planning Engineer will deliver a “proposed disturbance area” to the Environmental Officer in a dxf format.
2. From the disturbance plan the Mine Planning Engineer and the Environmental Officer will confer with the Mining Superintendent and Technical Services Superintendent, to identify suitable topsoil stockpile location/s.
3. The Environmental Officer develops the Topsoil Plan.
4. Truck volumes and locations of topsoil stripped or replaced must be recorded and reported to the Environmental Officer on a monthly basis.

4.2 OPERATIONAL REQUIREMENTS

Where possible, topsoil should be spread directly onto reshaped areas to maintain the natural seed store in the soil. Where this is not possible, topsoil will be stockpiled. The height of stockpiles should be minimised where possible ie. <4 metres. Generally, only A horizon soil (topsoil) will be stripped. Subsoil materials will generally not be removed as “topsoil”.

Due to the topsoil deficiency onsite of 670,000m3, there is a need to collect more than 250 mm of topsoil from all locations (unless directed otherwise by the Environmental Officer). Topsoil stripping depth should be generally no less than 400 mm.

IMPORTANT NOTICE – A topsoil deficit exists on site so there is a need to strip at least 400 mm of topsoil from all disturbed areas.

Topsoil dumping should be carried out to ensure the least possible compaction damage. As a general rule, watering should not be undertaken on the topsoil being picked up or on the topsoil stockpile being created, as it can greatly exacerbate compaction damage. The use of additional machinery to rework topsoil dumps such as graders and dozers should be avoided if possible.

Stockpiles may be sown with a cover crop to minimise erosion if establishment does not occur after the first season.

Topsoil will be applied to all areas of disturbance on site. All areas of disturbance on site will be covered with a minimum of 200 mm topsoil, with an average depth of 250 mm. **Due to the topsoil deficiency on site, topsoil must not be replaced at a depth greater than 250 mm.** Watering of topsoil during spreading can cause long term damage to soil structure and greatly impede germination success.

	**IMPORTANT NOTICE** – A topsoil deficit on site exists so there is a requirement not to replace the topsoil to a depth greater than 250 mm onto rehabilitated areas.

4.3 STATUTORY REQUIREMENTS

In accordance with the Final Land Use and Rehabilitation Plan and the Environmental Impact Statement (EIS), NAC is committed to saving all available A horizon topsoil and replacing topsoil onto reclaimed spoil to a depth of 250 mm.

5. ACCOUNTABILITIES

The **Mining Superintendent** has the responsibility of ensuring sufficient resource allocation to ensure that all topsoil stripping and spreading required can occur in the appropriate depths and thicknesses required as outlined in this Procedure and the Topsoil Plan.

The **Mining Superintendent** must ensure that operations staff, do not cause any disturbance of topsoil without there firstly being a topsoil plan in place.

The **Mine Planning Engineer** will deliver timely "proposed disturbance areas". Record topsoil volumes stripped, stockpiled or replaced on a monthly basis.

The **Environmental Officer** will be responsible for assessing the suitability of the topsoil, which is to be disturbed and devise a Topsoil Plan.

The **Technical Services Superintendent** will oversea that the suitable topsoil volumes are salvaged in accordance with this procedure.

6. REFERENCES

Environmental Authority (EA) MIM 800317705

Plan of Operations

Environmental Impact Statement

Final Land Use and Rehabilitation Plan

New Acland Coal Topsoil Plan