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4. TOPOGRAPHY, GEOLOGY, SOILS AND GEOMORPHOLOGY

4.1. Topography

One submission noted the statement "There are mountains on either side of the Severn River at the proposed dam location" is not a valid description. The proposed dam is located in a valley – surrounded by steeper terrain with peaks greater than 900 m AHD.

4.2. Soil Mapping and Identification

One submission requested a map of the pipeline route with soil map units, soil characteristics and appropriate management measures. A key concern was the location of texture contrast soils as they have been identified to have moderate environmental risk.

Gritty, uniform, coarse sands predominate across the project area. Figure 4.7 of the EIS presented three soil types (B, C and D) along the pipeline route based on field work undertaken for the EIS (GTES 2007) and existing mapping of soils in the region. Additional soil sampling along the pipeline route in areas mapped as potential strategic copping land was undertaken in 2013 (GTES, 2013). A further two soil types (T1 and T2), and two variations of existing soil types B(sp) and C(v) were identified. The characteristics of each soil type along the pipeline route are described in Table 4-1. The location of the texture contracts soils are shown in Figure 4-1.

Table 4-1 Soil mapping units of the pipeline route

Soil Mapping Unit	Description
B	Dark grey to brown, uniform, loamy sand (coarse) overlying hardpan or granite bedrock. These soils are acidic, non-saline, non-dispersive, imperfectly drained with low to moderate fertility.
B(sp)	A fairly common variant of these soils occurs when the coarse sand is underlain by mottled clay subsoil which may be sodic.
C	Uniform sandy soils often with red mottled subsoil overlying weathered or fresh granite bedrock. Occasional granite outcrop. The soil profile is non-saline, non-dispersive, has an acid reaction trend with areas of imperfect drainage and red mottling. Fertility is low to moderate.
C(v)	A variant of these soils occurs as deep, gritty, dark grey sands over coarse sands or mottled brown to grey acidic clay subsoils.
D	Dark grey to brown, gritty, coarse sands to duplex soils often very shallow with acidic reaction trend and often underlain by bleached subsoils with hardpans. Variable depth (usually shallow) soils and extensive rocky areas.
T1	Loamy sands over sandy clay loams that are strongly acidic, non-sodic and not prone to dispersion. These soils have low fertility throughout.
T2	A variant of these soils exists that are texture-contrast clayey or loamy sands overlying grey clay loams or light clays, These soils are strongly acidic, non-sodic, not prone to dispersion, and have low fertility.

The texture-contrast soils do not necessarily pose an increased environmental risk unless the heavier textured clay subsoils are prone to dispersion due to high levels of sodium (sodic clay subsoils). Sodic texture-contrast soils (Sodosols) require specific environmental management and will be surveyed at an appropriate scale in order to determine their extent and for the preparation of a Soil Management Plan prior to the commencement of construction (refer to EMP). The sodic texture-contrast soils of the project area are those soils in Soil Mapping Unit (SMU) B(sp). Other soil types with gradational or uniform texture profiles may be sodic and prone to dispersion, and will be managed similarly to the sodic texture-contrast soils.

The heavier textured subsoils of the texture-contrast soils (T1 and T2) will be stripped and stockpiled separately to the lighter textured sandy topsoils.

All sodic soil materials will be stockpiled separately from both topsoils and non-sodic subsoils and, when exposed for any length of time, these materials will require stabilising to minimise the risk of erosion. One method that may be implemented to stabilise is these subsoils is the incorporation of gypsum.

The proposed Soil Erosion and Sediment Control Measures during construction are outlined in the Environmental Management Plan (refer to Section 4.1, Appendix I).

One submission stated that a showing Soil Map Units A, B and C should have been provided in the EIS. Figure 4-5 of the EIS showed the location of Soil Map Units for the inundation area. For clarification Soil Map Units A, B, and C correspond to the following map units described in the legend of Figure 4-5 of the EIS:

- A - 'Alluvial'
- B - 'Shallow to Mid Depth Sands'
- C - 'Mid to Deep Sands'.

LEGEND

- Proposed Pipeline
- Full Supply Level (738m AHD)
- Regeneration Area
- T1 - Texture Contrast, loamy sands to sandy clay loam with low slope
- T2 - Texture contrast, loamy sands to clay loam/light clay

N
W E
S

0 1 2 3 4

Kilometres

Scale - 1:150,000

Projection: GDA94 MGA56

EMU SWAMP DAM
SUPPLEMENTARY REPORT
Figure 4-1
Location of Texture Contrast Soils on Pipeline Route

SINCLAIR KNIGHT MERZ
SKM

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4.3. Soil Permeability and Geology

Two submissions raised the issue of high soil permeability in the inundation area as having potential to affect the performance of Emu Swamp Dam. Performance of the dam is mainly affected by factors such as rainfall, evaporation, geology, catchment area and the depth of water in the dam. The inundation area soils are found on granite bedrock of low to moderate permeability so the permeability of soils is unlikely to affect the performance of the dam. Notwithstanding this further testing of the site by way of pits and trenches across the dam axis will be undertaken to confirm sound cut-off conditions can be established for the Project.

4.4. Strategic Cropping Land

One submission highlighted a need to assess the Project against the *Strategic Cropping Land Act 2011*. In August 2013, Schedule 13A of the *Sustainable Planning Regulation 2009* was amended to exclude community infrastructure (as defined in Schedule 2) from the requirements of the *Strategic Cropping Land Act 2011* (SC Act). Schedule 2, Part 2 defines water cycle management infrastructure as community infrastructure. Accordingly the requirement to assess the project against the SCL Act is not required.

4.5. Erosion Management

A number of submitters requested further details and clarification on the soil erosion and sediment control measures proposed in the EIS. An Erosion and Sediment Control Plan (ESCP) will be prepared and implemented to avoid or minimise erosion and sedimentation that may occur in association with the construction of the Project. The Plan will be prepared with reference to the guidelines *Best Practice Erosion and Sediment Control* (IECA 2008) and will include the following details:

- construction access points;
- proposed construction activities and limits of disturbance;
- retained vegetation;
- soils information;
- environmental features e.g. watercourses;
- existing topography;
- general layout of proposed works;
- location of all drainage, erosion and sediment control devices;
- construction specifications for adopted erosion and sediment control measures;
- site revegetation requirements; and
- site monitoring and maintenance program.

Erosion and Sediment Control measures will be certified by a suitably qualified professional (CPESC). Table 4-2 provides a summary of indicative Soil Erosion and Sediment Control Measures which could be included in the ESCP. Clarification to specific submissions regarding soil and erosion control measures in provided in Table 4-3.

Table 4-2 Indicative Soil Erosion and Sediment Control Measures

Area	Indicative Control Measures
Cleared areas	Restrict clearing to areas essential for the works Windrow vegetation debris alongside the working corridor Minimise the length of time soils are exposed Divert run-off from undisturbed areas away from the works in areas of high slope
Subsoil stockpiles	Avoid placement of dispersive soil materials on the surface Stockpile dispersive soils separately Use non-dispersive soil or cover material to stabilise and protect slopes Progressive backfilling during operations Construct using dozers to reduce minimise the degradation of soil structure
Topsoil stockpiles	Practise return of topsoil where practicable Use non-dispersive soil or cover material to stabilise and protect slopes Construct using dozers rather than scrapers to minimise structural degradation
Infrastructure	Confine traffic to maintained tracks and roads Rehabilitate disturbed areas around construction sites promptly
Dams, banks and creek crossings	Install sediment traps, silt fences or hay bales where necessary to control sediment loss Rehabilitate disturbed areas around construction sites as soon as practicable

Table 4-3 Clarifications on proposed Soil Erosion and Sediment Control Measures

Control Measures proposed by submitter	Proponent Response
Surface soils should be reinstated along the pipeline route to natural ground level with sufficient compaction to reduce the likelihood of subsidence. Backfill will need to be compacted and spread to ensure that excess spoil does not divert surface runoff resulting in erosion.	This has been accepted and incorporated in the Environmental Management Plan (Appendix I, Section 4.1). Where sufficient compaction may not be achieved during final re-profiling of the pipeline construction area, a low crown of soil mounded over the trench may be necessary to compensate for consolidation. Sufficient breaks in the crown of soil will be incorporated to mitigate surface water runoff diversion and erosion.
The issue of weeds, particularly invasive, exotic species growing on stockpiles	Stockpiles will be included in monthly inspections (with disturbed areas) for identification of weeds.
Concern that Section 4.3.2.1 of the EIS inadequately addresses the issue of plant cover growing on stockpiles and stockpile erosion.	Longer term stockpiles will be shaped and fertilised and seeded immediately to pastures and annual cover crop. Combined with limiting stockpiles to <3 m in height these measures are considered adequate measures for the management of stockpiled materials that are not at a high risk of erosion. Further detail on the management of stockpiles is provided in the Environmental Management Plan.
Temporary erosion control works	Temporary erosion control works will be described in the Erosion and Sediment Control Plan to be prepared prior to the commencement of construction (refer to Appendix I, Section 4.1).

Control Measures proposed by submitter	Proponent Response
Consider options to maximise vegetation preservation	Options to manage vegetation prevention may include: ▪ Establishing non-disturbance/exclusion areas ▪ Identify/isolate protected vegetation ▪ Protection zones/areas around vegetation not to be removed. These zones/areas are to be at least 10 times the distance of the tree trunks diameter or the width of the canopy at its widest width, whichever is the greater. ▪ Exclusion areas are to be maintained to reduce damage to the truck or canopy of the tree. Any near miss/incident involving existing vegetation to be recorded and reported.
Hydroseeding or other appropriate processes to provide a protective cover	▪ Hydroseeding will be utilised in areas where exposed soils/surfaces are disturbed through work practices and is required to re-establish vegetation. ▪ Exposed areas will be protected as soon as possible after finishing by hydroseeding or other appropriate processes to provide a protective cover.

The proposed Soil Erosion and Sediment Control Measures during construction are outlined in the Environmental Management Plan (Appendix I, Section 4.1).

One submitter disagrees that sandy granite soils of the area have low erosion potential and believes that this issue needs further investigation. Erodibility is determined by the rate of infiltration at the surface, permeability of the soil profile, coherence of the soil particles, lack of vegetative cover, loss of soil organic matter and surface sealing. The coarse, sandy granitic soils are deemed to have a low erosion risk due to their high permeability (infiltration will be rapid) and due to the low gradient across the landscapes in which they occur.

One submission questioned whether the design of sedimentation traps and detention basins for a "24 hour storm event of a return period of 10 years" (Table 4.7) may not be adequate as result of climate change. Erosion and control measures designed with reference to the guidelines Best Practice Erosion and Sediment Control (IECA 2008). Design rainfall events used for the design of sediment or detention basis will be based on current climatic data and account for rainfall conditions which could potentially occur during the construction period.

4.6. Erosion Monitoring

One submitter requested further details of erosion monitoring (e.g. how far downstream, at what intervals in time and distance such monitoring is to occur and required appropriate mitigation strategies be devised.

The Construction Environmental Management Plan for geology and soils in the EIS proposed the following monitoring activities.

- Regular inspection of sediment and erosion control structures and measures. In wet weather or when using large quantities of water in construction works more frequent monitoring may be necessary.
- Implement detailed monitoring programs to assess the impacts on the immediate construction site and sensitive receiving environments (i.e. water ways and aquatic ecosystems).

Additional details on the proposed erosion monitoring procedures are provided in Table 4-4 and have been incorporated into the Environmental Management Plan (Appendix I, Section 4.1).

Table 4-4 Proposed Erosion Monitoring Procedures

Control Measures	Proponent Response
Sampling locations	Three locations will be selected. One ▪ Upstream approximately 100 m; ▪ In the most southern area of earthworks/disturbance; and ▪ Downstream approximately 100 m.
Sampling intervals	Prior to any earthworks/disturbance at the three locations – Obtain background levels. For high disturbance areas (Dam area/located adjacent to waterways), initially once a day for the first week and then every second day (e.g. Mon, Wed, Fri). If there are no significant changes to results in the first month then the interval may be reviewed/reduced. For low disturbance areas (pipeline area/areas not adjacent to waterways) (within 100 m), initially start of project, and end of working week for the first month, reduced to once a week unless earthworks/disturbance area increase to high disturbance.
Sampling parameters	pH Electrical conductivity (EC) Dissolved Oxygen (DO) Temperature Total suspended solids (TSS) Turbidity Grease/oil (visual).

In the event erosion monitoring results show no significant increase from background levels, mitigation strategies will be maintained.

In the event erosion monitoring result show significant increase or disturbance to waterways, then the erosion and sediment controls will be reviewed and upgraded appropriately. Communication with onsite managers will be undertaken to determine the cause of any increases.

4.7. Soils and Sediment in Inundation Area

One submission stated the bedload in the Severn River is largely coarse granitic sand and this material could be excavated during periods of low supply level, thus extending the useful life of the storage. Consideration in regard to the need to excavate materials during periods of low supply will be made during the operation of the dam.

One submitter raised concern that "Storm King Dam be used as an alternative supply during any necessary desilting operations. If dam is built and predicted growth in demand occurs, the alternative water supply would be inadequate." Desilting will only occur during droughts when the water is probably low in both dams. Desilting operations will be devised to optimise the works, water quality and water security. Having two dams will provide flexibility for desilting if it is required.

One submission raised concern that Section 4.4.2 reveals no studies of sedimentation at the site. Section 4.4.2 identified that sedimentation of Emu Swamp Dam will occur. Storm King Dam has not been desilted although the dam has existed since 1958.