Imperial Oil and Gas

EP 187

Appendix 05

Erosion and Sediment Control Plan

IMP 5-1

EROSION AND SEDIMENT CONTROL PLAN

CARPENTARIA PILOT PROJECT
EP187

CLIENT: IMPERIAL OIL AND GAS PTY LTD

DOCUMENT NUMBER: 23-0254/R3188

VERSION: A

DATE: 27/01/2024

1 SCOPE

Topo were engaged by Imperial Oil and Gas Pty Ltd (Imperial) to develop a CPESC certified Erosion and Sediment Control Plan (ESCP) for works associated with the Carpentaria Pilot Project (CPP) within Exploration Permit 187 (EP187) in the Northern Territory. The CPP follows seismic and drilling exploration undertaken in EP187 since 2019, covered by previously prepared ESCPs.

1.1. GUIDELINES

This ESCP has been prepared in accordance with the following documents:

- Environmental Assessment Act 1982
- The Petroleum Act 2016
- Waste Management and Pollution Control Act 1998
- Soil Conservation and Land Utilisation Act 1969
- Best Practice Erosion and Sediment Control (IECA, 2008)
- Soil, land and vegetation guidelines and fact sheets (NT.GOV.AU)
- Land Clearing Guidelines (Department of Environment and Natural Resources)

1.2. OBJECITVES

This ESCP is part of a hierarchy of documentation prepared to minimise the potential environmental impacts associated with Imperial's CPP appraisal program. With respect to ESC, this plan has been prepared specifically to assist the project in achieving the following objectives:

1. Ensure that the clearing of native vegetation does not unreasonably contribute to environmental degradation of the locality
2. Avoid impacts on environmental significant or sensitive vegetation
3. Avoid impacts on drainage areas, wetland and waterways
4. Avoid impacts on highly erodible soils
5. Take all reasonable and practicable measures to minimise actual or potential environmental harm resulting from soil or water movement as a consequence of either the construction or operational phases (with regard to soil erosion and land rehabilitation) of seismic exploration
6. Maintain, and where practical, enhance the land use capabilities of disturbed areas with respect to land's soil, water and vegetation attributes
7. Ensure temporary ESC measures do not unreasonably impact upon the economic and safety-related attributes of the project

Preliminary slope data derived from SRTM Digital Elevation Modelling (DEM) identified a number of locations across the project where slopes exceeded 2%, and in places 5%. The Land Clearing Guidelines class slope of 2-3% and >3% as having an associated high and very high risk of erosion, respectively (refer Table 1).

Table 1 - Acceptability of erosion risk associated with clearing works based on slope gradient (DENR Land Clearing Guidelines)

Slope (%)	Erosion risk	Recommendation
0 to 1%	Low	Risk is acceptable; management required.
1 to 2%	Moderate	
2 to 3%	High	Required management is prohibitive; clearing not recommended.
>3%	Very High	

The project has previous demonstrated that exclusion of land with slopes greater than 2% is unfeasible. This ESCP has been prepared to demonstrate how the risk will be mitigated and thus satisfy DENR requirements.

1.3. CERTIFICATION

I Tom Bailey certify that this Erosion and Sediment Control Plan (ref: R3188) has been prepared to satisfy the following requirements:

- The intent and outcomes conditioned within the approved Land Clearing Plan (LCP);
- The intent and minimum standards nominated within the IECA (2008) Best Practice Erosion and Sediment Control Guideline and relevant supporting Appendices (IECA, 2015).

If implemented correctly, it will assist Imperial in meeting environmental obligations defined in the *Waste Management and Pollution Control Act 1998* (NT) and the aforementioned LCP (DP19/0007) conditions.

CPESC 6374

1.4. REVISION

VERSION	DATE	AUTHOR	REVIEWER	APPROVED
DRAFT	19/01/24	T. Bailey		T. Bailey
A	27/01/24	T. Bailey	N. Fraser	T. Bailey

2 PROJECT DESCRIPTION

2.1. LOCATION

The project works are located across the eastern margin of the Beetaloo Sub-Basin within the south-west portion of EP187, approximately 200km south-east of Daly Waters, and 150km south-west of Borroloola, in the Barkly area of the Northern Territory. EP187 is situated in the upper reaches of the McArthur River, and lies to the west of the Tablelands Highway, and is crossed east to west by the Carpentaria Highway. A preliminary site layout is presented in Figure 1, along with existing exploration infrastructure. Note that the location of some items may vary, and should be taken as indicative at this stage.

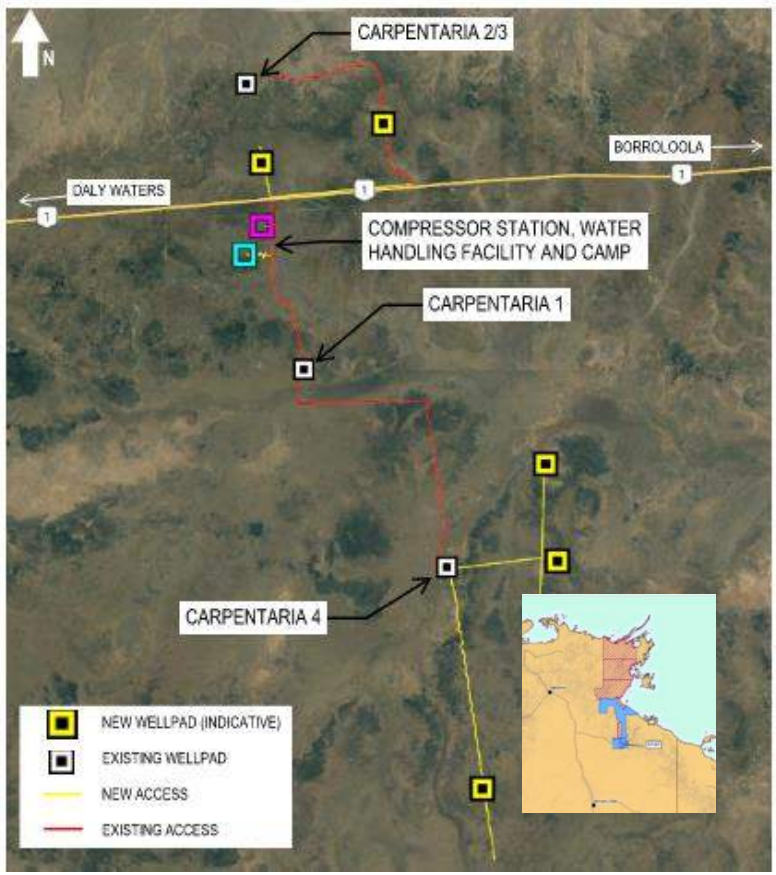


Figure 1 – Site Location

2.2. PROJECT WORKS

Projects works will involve the following major activities:

- Land clearing and earthworks
- Drilling, hydraulic facture, completion, testing, maintenance, suspension and abandonment of wells
- Construction, operation, modification, decommissioning, dismantling/ removal of facilities, gas and wastewater flowlines used for the recovery of petroleum, treat water and produce gas
- Rehabilitation

Associated works are detailed in Section 3 of the EMP, including the following:

1. Establishing up to 4 new well pads, plus the expansion of two existing well pads
2. Excavating up to 9 new gravel pits, plus the expansion of three existing gravel pits
3. Constructing up to 9 new groundwater wells
4. Constructing a new compressor station
5. Constructing a new waste water handling station
6. Constructing a new camp
7. Forming new access tracks and flowlines/pipeline rights-of-ways (ROWs), including maintenance and potential upgrades of existing tracks

The well pads will each have an approximate disturbance area of 12 ha, including fire breaks. The well pad design incorporates stockpiling locations for vegetation and topsoil for subsequent site rehabilitation. The project is being conducted in an EP that has existing clearing and infrastructure. The new works will result in an expansion of the land disturbance footprint by up to 420% from the existing 43.4 ha to up to 226 ha. within the 4,427 km^2 area of EP 187.

2.3. CLIMATE

The historic monthly rainfall for the region is presented below in Figure 2. The climate is described as a tropical savannah climate which can experience rainfall of between 600-800mm per year during the summer wet. The wet season is also characterised by high intensity rainfall and cyclonic winds. With the weather in this region dominated by a stark contrast in wet and dry seasons, erosion, sediment and drainage controls considered in this plan are heavily based on seasonal variability.

Works are expected to commence in mid-2024 so the major logistical and construction operations will be undertaken during the low rainfall period between April and November inclusive, when < 8% of the annual average total rainfall is received. On average, there are 195 days with no rain/year in the CPP Area. However, this arid period is also highly variable, and works with respect to erosion and sediment control should be reviewed regularly.

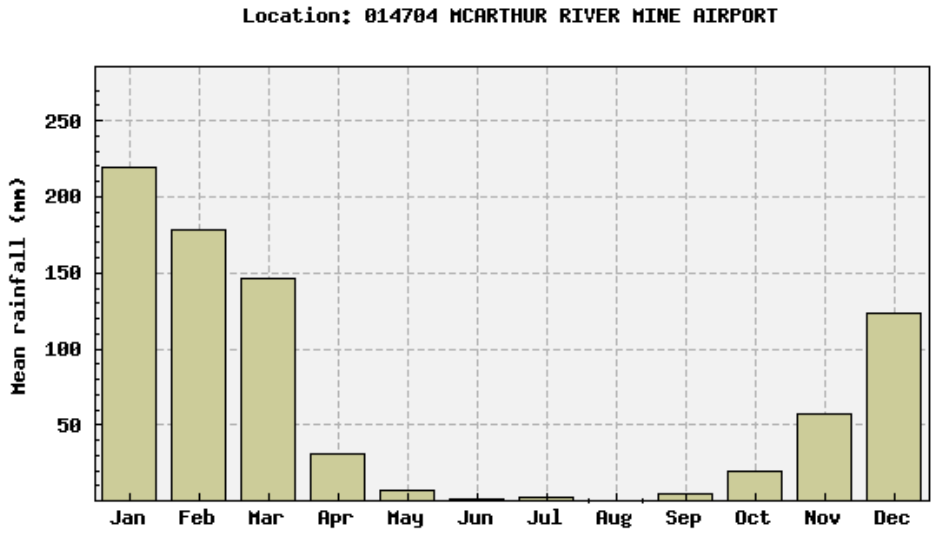


Figure 2 – Historic rainfall (Source: BoM)

2.4. TOPOGRAPHY AND DRAINAGE

The project area is predominantly situated on grassy woodland and the land is generally flat with slopes below 2%. There are some intermittent mapped streams within the area of works, with Relief Creek classed as a Stream Order 4 "creek" as per the Northern Territory Stream Order polyline spacial dataset (2018). Additional unmapped flow paths are present within the area and have been identified in the control plans in Appendix A. The CPP Area is located on the divide between the Limmen Bight River and Macarthur River catchments.

A key consideration in plan development was the orientation of pads and tracks with respect to local fall, whether it be perpendicular or parallel to slope, or passing diagonally up the slope. The impact that these orientations have on drainage, erosion and sediment control is presented in Appendix A.

2.5. SOILS

The Northern Territory Natural Resource Management report (2015) indicates that soils of the Upper McArthur River catchment are dominated by Kandosols and calcareous earths (40%), Tenosol loams (38%), Rudosol loams (19%) and Vertosols (2%).

The parent rocks of most of the soils are on at least their second cycle of erosion or are deeply weathered or both and are generally arenaceous (composed of sand sized particles). This has produced mainly very infertile soils with a near neutral reaction. Large areas are underlain by a laterite sheet, and the laterite is exposed or at shallow depth over some of the area. These 'soils' are akin to alluvial soils in that they show no profile development.

Tenosols have only weak soil profile development and are often shallow. In the Australian Soil Classification, they are defined as having limited subsoil (B horizon) development (less than 15% clay content). These soils may merge with Kandosols as the clay content can be slightly higher than specified as the upper limit for Tenosols (i.e. 15%). Kandosols soils lack strong texture contrast and have massive or only weakly structured B horizons. The B2 horizon is well developed and has maximum clay content in some part of the Horizon which exceeds 15%. They are also not calcareous throughout.

Shallow stony soils with a low moisture holding capacity are widespread. Most of the soil chemical limitations are due to low soil fertility, and soil physical problems are mostly due to sandy or massive and brittle topsoils.

For the purpose of this report, soil maps were extracted from the CSIRO 'Maps of Australian soil loss by water erosion derived using the RUSLE'.

These data sets are described in the following publication; Teng H, Viscarra Rossel RA, Shi Z, Behrens T, Chappell A and Bui E 2016 Assimilating satellite imagery and visible-near infrared spectroscopy to model and map soil loss by water erosion in Australia - Environmental Modelling & Software 77: 156-167.

3 EROSION RISK ASSESSMENT

An erosion risk assessment has been conducted using the Revised Universal Soil Loss Equation (RUSLE). The calculated soil loss is then used to determine the level of sediment control required, as well as stabilisation and staging requirements.

$$A = K \times R \times LS \times P \times C$$ Equation 1 (IECA 2008)

Where:

A is the predicted soil loss per hectare per year
K is the soil erodibility factor
R is the rainfall erosivity factor
LS is the slope length/gradient factor
P is the erosion control practice factor
C is the ground cover and management factor

3.1. K-FACTOR – SOILS

The soil erodibility factor (K factor) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Soil texture is the principle component affecting the K factor, but soil structure, organic matter and profile permeability also contribute.

Based on the description and maps discussed in section 2.5 and based on Table E5 Best Practice Erosion and Sediment Control (IECA, 2008) K-factors ranging between 0.028 and 0.030 were adopted for this risk assessment.

We note that the factors presented in the CSIRO mapping is consistent with the Department of Environment and Natural Resources (DENR) K-factors derived for a range of soil families in the Northern Territory.

3.2. R- FACTOR – RAINFALL

The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. The R factor is defined as the mean annual sum of individual storm rainfall intensity (EI30) values - EI30 being the total storm energy (E) multiplied by the maximum 30 minute rainfall intensity (I30). Under otherwise identical conditions, soil loss is directly proportional to EI30 (Renard et al 1997).

Rainfall data for the site was obtained using the Bureau of Meteorology (BoM) Design Rainfall Data System (2016). Intensity Frequency Duration (IFD) data was extracted over the study area between 500310.2871 (E), 8118456.8329 (N) and 547935.2872(E), 8178252.6663(N). Using the ascii data provided, a rainfall map was created representing the spatial variation of rainfall intensity over the study area. Rainfall mapping is presented in Appendix A.

3.3. LS - SLOPE-LENGTH

Slope length and slope gradient have substantial effects on soil erosion by water. The two effects are represented by the slope length factor (L) and the slope steepness factor (S). In application of RUSLE the two are evaluated together as a numerical representation of the length-slope combination (LS factor).

The CSIRO Data Portal provides a set of maps that represent the RUSLE factors. Reference was made to the Maps of Australian soil loss by water erosion derived using the RUSLE, and data for the combined length and slope (LS) factor was obtained. Using the data provided, a map representing the combined length-slope factor over the study area was created. The resulting LS map is illustrated in Appendix A. It is noted that contour mulch bunds must be placed at a maximum spacing of 200m on site during clearing works.

3.4. COVER (C) AND PRACTICE (P) FACTORS

Within RUSLE, the C and P factors are used to describe management of the site with respect to reducing soil loss. The C factor measures the combined effect of all the interrelated cover and management variables adopted over the site. It also represents non-structural methods for controlling erosion (i.e. covering exposed areas with various erosion control products to minimise raindrop impact or stabilisation by temporary or permanent vegetation).

The P factor measures the combined effect of all support practices and management variables. P factor is reduced by practices that reduce both the velocity of runoff and

the tendency of runoff to flow directly downhill. It also represents structural methods for controlling erosion.

It must be noted that in many areas of disturbance topsoil will not be stripped, leaving a degree of existing gravel cover and leaf, grass litter cover typical of pre-construction ground conditions.

Based on this description and Table E10 of IECA 2008 it would be reasonable to assume a C factor of 0.45 for the dozer cleared areas, and 0.1 for grader cleared areas, representing 0% to 40% cover in areas of long-established grass cover.

However, to conservatively allow for additional areas of disturbance, closer to that resembling a half-stripped well pad or track, a C-factor for both areas of clearing has been set at 0.5. Given that topsoil will not be stripped in many areas, with grass and roots retained a P factor of 0.9 has been adopted, similar to that used for track-walked or straw punched surfaces.

Where areas of well pad, camp, facility or tracks will be entirely stripped a C-factor of 1 and P factor of 1.3 has been adopted.

3.5. ESTIMATED SOIL LOSS

Using Global Mapper GIS software, the aforementioned factors were multiplied to calculate the resulting soil loss for the site, indicating a very low erosion risk (<30t/ha/yr) for linear works according to Table 4.4.7 of IECA, 2008. Figure 3 and Table 2 below indicate the determined erosion risk for the site and surrounding areas.

Table 2 – Erosion Risk Key

Colour	Erosion Risk (t/ha/yr)
Green	0-10
Yellow	10-20
Orange	20-30
Red	30-40
Dark Red	40-50

To account for the compacted and smooth conditions associated with well pads and facilities each well pad has been individually assessed with specific soil loss calculations (using C=1 and P=1.3). The results of these assessments are presented alongside drawings in Appendix A.

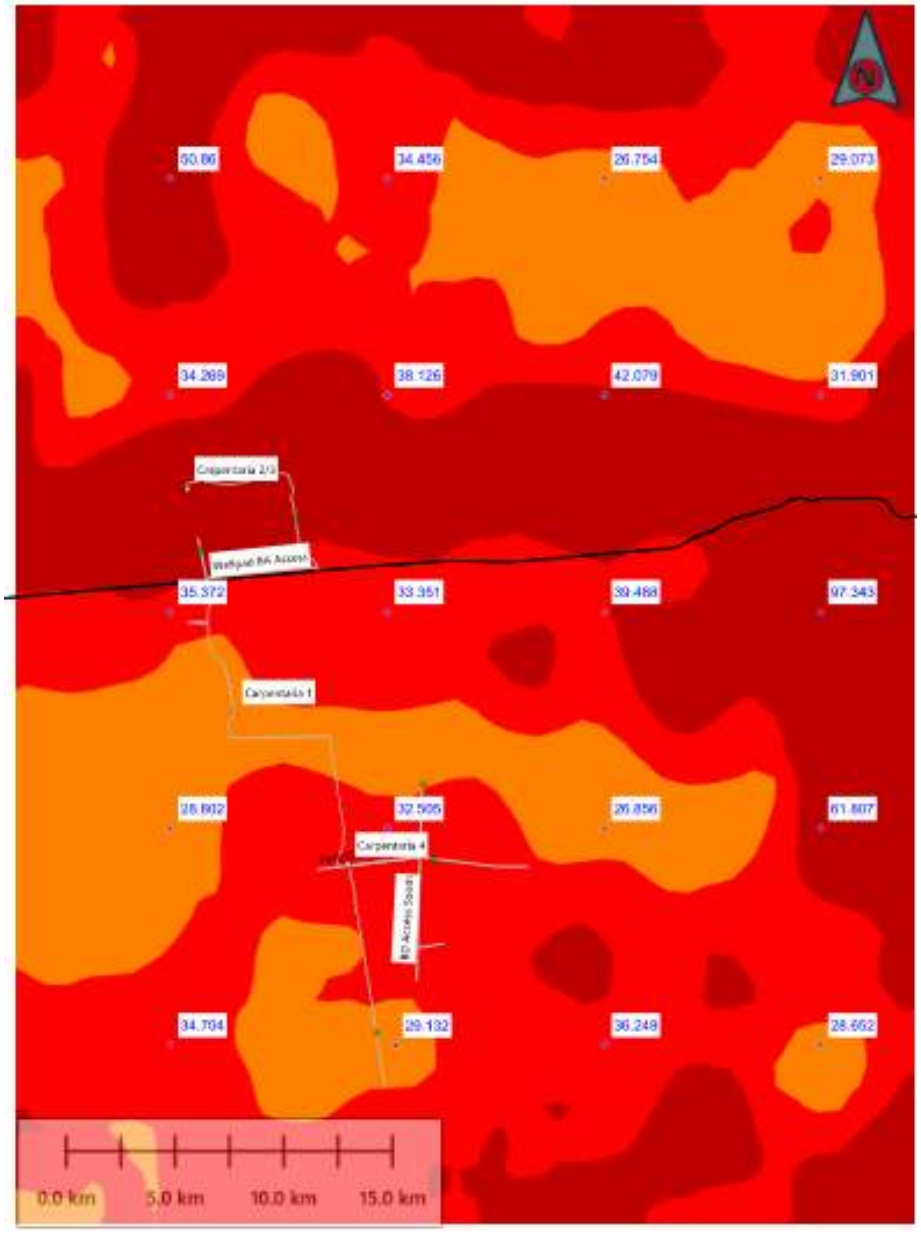


Figure 3 –Soil Loss (Linear areas)

4 SEDIMENT CONTROL

The sediment control standard is typically determined using Table 4.5.1 (IECA, 2008) which defines the sediment control standard based on catchment area and soil loss rate. The revised Table 4.5.1 (IECA, 2008) provided in Appendix B (IECA, 2018) as Table B1 is provide below as Table 3. The revised table includes an additional area limit trigger of 1 hectare to increase the sediment control standard for large sites with an estimated soil loss exceeding 75 t/ha/yr.

Table 3 – Sediment Control Standard (Table B1 Appendix B IECA 2018)

AREA LIMIT (m^2)	SOIL LOSS RATE LIMIT (T/HA/YR)		
	TYPE 1	TYPE 2	TYPE 3
1000	N/A	N/A	All cases
2500	N/A	> 75	75
> 2500	> 150	150	75
> 10000	>75	N/A	75

Based on Table 3 (IECA, 2018), the calculated soil losses (which are very low) permit the use of Type 3 sediment control measures throughout most of the upstripped areas. Specific Type 3 controls have been selected as suitable depending on the scope of works.

Some well pads were found to trigger Type 1 Sediment Control (Sediment Basins) based on local elevations. However given the scale of available mapping (and limitations on available LIDAR) it is anticipated that the location will be adjusted slightly to minimise slope. Alternatively, those areas must be stabilised with soil binder (or similar) at all times to permit the use of Type 3 sediment control.

4.1. ACCESS TRACKS AND PIPELINES

It has been proposed that grass, rocks, branches and shrubs be raked to the downslope extent of works, establishing a control similar to a mulch bund. Where installed as a mulch bund, this control is likely to be considerably effective in trapping the coarse sediment (sandy particles) comprising the site area.

As works extend towards the wetter periods with a potential increase in rainfall, local roads and access tracks will be monitored and closed to Heavy Vehicles, Light Vehicles (or both) based on individual condition assessment. A similar condition assessment will be utilised to inspect and monitor internal areas for disturbance and degradation of the surface conditions, with additional matting added to stabilise high traffic areas.

4.2. WELL PADS AND FACILITIES

Sediment controls installed on the downslope extent of disturbance may include:

<u>Option 1 – Mulch Berm</u>

- Placed along a line of constant elevation
- Be a minimum of 0.5m high
- Ensure 100% contact with soil surface

<u>Option 2 - Coir log sediment trap</u>

- Installed in accordance with the standard drawing
- Extended upslope enough to ensure the ground level is at least 100mm higher than the spill-through weir
- Combined with an excavated sediment trap

<u>Option 3 – Rock Filter Dam</u>

- Installed in accordance with the standard detail provided
- Located at low points along a perimeter topsoil bund, or at key outlets to reduce peak flows
- Provides a lower-maintenance and more effective control that Options 1 and 2 above

A series of returns have been proposed for installation where bunds are aligned down slope to maximise ponding and reduce flow velocity along the face.

5 EROSION CONTROL

The minimum erosion control requirements for various risk ratings in accordance with IECA (2008) guidelines are presented in Table 4.

Table 4 – Minimum erosion control requirements according to IECA (2008) - adapted from Table 4.4.7

EROSION RISK RATING	SOIL LOSS RATE (T/HA/YEAR)	ADVANCE LAND CLEARING ALLOWED (WKS WORK)	MAX DAYS TO STABILISATION (DAYS - % COVER)	STAGED CONSTRUCTION AND STABILISATION OF EARTH BATTERS >6H:1V	STOCKPILES STABILISED
Very Low	0 to 150	8	30 (60%)		
Low	150 to 225	8	30 (70%)		
Moderate	225 to 500	6	20 (70%)	✓	
High	500 to 1500	4	10 (75%)	✓	✓
Extreme	> 1500	2	5 (80%)	✓	✓

With consideration given to the sediment control described in Section 4, and seasonal variability in rainfall discussed in Section 2.3 it is proposed that track construction works adopt an erosion control management standard that far exceeds the minimum given in Table 4. Proposed measures are presented in Table 5.

Table 5 – Proposed minimum erosion control standards to be adopted above that in Table 4.4.7 of IECA (2008)

EROSION CONTROL ELEMENT	DRY SEASON	WET SEASON
Advance land clearing (max)	30 days	5 days
Rainfall forecast trigger for stabilisation of exposed surfaces during construction	> 60% chance of > 50mm	> 50% chance of > 20mm
Minimum ground cover required for stabilisation	70%	90%
Reinstatement/gravel timeframes	30 days	5 days
Stabilisation of material stockpiles	7 days	1 day

In addition to these requirements, erosion controls shall include:

- Geolocation and warning signals utilised to prevent any disturbance outside the clearing boundary
- Establishing stabilised entry/exit points where tracks intersect public roadways
- Utilising existing tracks wherever possible
- Where practicable, adapting the alignment of the track to a path of least disturbance
- Stabilisation of any high traffic areas within well pads using gravel
- Any inactive and exposed areas are to be stabilised with gravel or soil binder until rehabilitation.
- Restricting access tracks and pipe RoWs to minimum width practical, especially where located near watercourses.
- Low-level watercourse crossings for access tracks and flowlines to be excavated and backfilled with rock to watercourse bed level
- Wellpad locations not in areas prone to flooding

5.1. GRAVEL PITS CONSTRUCTION METHODOLOGY

Establishment of these pits will include the following;

- Clearing of vegetation, to be stockpiled around the perimeter of the cleared area for rehabilitation
- Stripping of topsoil (if required)
    - Topsoil will be stockpiled around the upslope side of the gravel pit to divert overland flow from entering the gravel pit
    - If there is no topsoil on-site (e.g. Pea Gravel site), a stabilised diversion bund will be constructed upslope to divert overland flow from entering the gravel pit
- A whoa boy will be constructed at access points where there is a chance for water to flow from the track into the site.
- Batters will not be steeper than 1:1, to allow safe passage for animals, and people
- Gravel pits will intentionally be kept wide and shallow to facilitate rehabilitation

Rehabilitation should be carried out in accordance with the EMP and approved Rehabilitation Management Plan

5.2. ACCESS TRACK CONSTRUCTION METHODOLOGY

Access track construction is to comply with the following requirements by priority:

1) Erosion control – restricting disturbance to a 8m track width, following a path of least disturbance and complying with erosion control requirements identified in Table 4
2) Drainage control – installing and maintaining track drainage in accordance with DLRM requirements

To address these priorities the following methodology is to be adopted.

Step 1: Assess site and select path of least disturbance for 8m width of clearing within infrastructure movement zone. Infrastructure movement zones are defined and indicated in the EMP.

Step 2: Program alignment into clearing machinery to prevent over-disturbance or intrusion of buffer zones

Step 3: Commence clearing, ensuring timeframes between clearing and scheduled constructions works do not exceed those indicated in Table 5.

Step 4: Windrow cleared vegetation on the extent of disturbance

Step 5: Install drainage controls in accordance with the DLRM Road Drainage Factsheet reproduced in Appendix A.

Step 6: Complete works and re-establish minimum ground cover % within minimum timeframes indicated in Table 5 through permanent rehabilitation measures approved in the EMP.

Note that the specific details of track construction may vary along the alignment, however this methodology, and the arrangements presented in the drawings in Appendix A shall be adapted and utilised for all scenarios.

5.3. WELL PAD AND FACILTY CONSTRUCTION METHODOLOGY

Establishment of large static sites will include the following;

- Clearing of vegetation, to be stockpiled around the perimeter of the cleared area for rehabilitation
- Stripping of topsoil (if required)
    - Topsoil will be stockpiled around the upslope side of the exposed area to divert overland flow from entering the site
    - If there is no topsoil on-site (e.g. Pea Gravel site), a stabilised earthen diversion bund will be constructed upslope to divert any overland flow
- A whoa boy will be constructed on the access track so that water does not flow down the access track into the site, or from site down the track
- Any internal batters must be stabilised
- Any high traffic, parking or access points will be stabilised with gravel
- Stabilise/revegetate any inactive areas of disturbance

6 DRAINAGE CONTROL

Drainage control considers three main principles; diverting external flow before it enters site, directing site runoff to an appropriate sediment control, and ensuring runoff is conveyed in a non-erosive manner.

6.1. ACCESS TRACKS, FLOWLINES AND PIPELINES

Flow diversion for linear sites is typically achieved using topsoil bunding or excavated catch drains. Given that a) no topsoil will be stripped on site, and b) drain excavation would result in more exposure than required for work there are limited options for diversion. Additionally, retention of ground cover wherever possible, including topsoil and roots reduces the potential impact associated with lack of diversion of external catchments. Adoption of windrowed vegetation and rock, similar to a mulch bund, as a primary sediment control will maintain sheet flow conditions, except where used for contour bunds. In these locations it is proposed that the windrow be returned upslope and flattened to restore sheet flow conditions (similar to level spreader).

Access track drainage has been considered to specifically address runoff over a variety of topography (discussed in Section 2.4) whether the alignment is orientated perpendicular or parallel to slope, or passing diagonally up/down the slope, with the resulting control arrangements presented in Appendix A.

Another key consideration was the presence of mapped, and unmapped watercourses. Control measures and management practices are presented below:

Mapped waterway	Inspect site, noting that actual waterway may not align with mapped waterway. Adjust width restriction buffer to suit. Install cleared vegetation windrows or woah boys on either side of flow path as required.
Unmapped flow path	Establish stable flow path crossing either through minimal disturbance traffic practices, ground cover mattress or applying heavy application of soil binder (min. Stonewall 2L/m2 or equiv.) Install cleared vegetation windrows or woah boys on either side of flow path.

As works extend towards November with a potential increase in rainfall, local roads and access tracks will be monitored and closed to Heavy Vehicles, Light Vehicles (or both) based on individual condition assessment.

Further detail of proposed drainage, including the layout of temporary measures and flow path crossings has been provided in Appendix A.

6.2. GRAVEL PITS, WELL PADS AND FACILITIES

Specific measures have been described to address drainage control within and around the proposed drill pads with the arrangements presented in Appendix A. The same principles are to be applied to gravel pit and facility locations.

Clean Water Diversion

Stabilised earthen bunds are to be used on the upslope side of the pad/pit to divert runoff around the pad or to dissipate runoff prior to it entering the pad. Where available, topsoil should be used for construction. Where topsoil is unavailable, other, least-erodible material may be used.

Where earthworks are required to level well pads topsoil from the site shall be stripped and windrowed above the cut batter and fire access track, on the upslope extent of the site. Care should be taken to ensure that water intercepted by the topsoil bund does not drain back onto the pad or to dirty water catch drains.

Dirty Water Diversion

Runoff from well pads and facilities is to be directed to the prescribed sediment controls using stabilised earthen bunds formed on the downslope extent of disturbance. Where available, topsoil should be used for construction. Where topsoil is unavailable, other, least-erodible material may be used.

Care should be taken to ensure sediment controls discharge onto a stabilised dissipater to prevent outlet scour. Also, sediment controls should be located with returns along the bund wall to reduce concentration over large areas. For large areas, multiple stabilised outlets may be required to reduce concentration.

Runoff from gravel pits is expected to pond locally.

Intra-Site Drainage

For flat pads, given the level of disturbance and size of site runoff will be allowed to sheet flow to sediment controls without the installation of intra-site drainage.

For any sites will slopes exceeding 1%, contour berms should be used to break up long, continuous slopes according to the grade-based spacing presented in Table 6. In active areas not suitable for contour berm installation, gradient and internal drainage should be formalised or areas should be stabilised to prevent erosion.

Where earthworks are required to level well pads the cut batters will be protected from erosion by the topsoil stockpile/clean water diversion bund preventing significant water volumes from washing over them. Significant volumes of water are expected to runoff from the compacted pad. This water will drain from the wellpad to shallow spoon drains constructed inside the bunds at the top of the fill batters and the toes of the cut batters. These drains will be contoured to take the runoff to the cut/fill point of the wellpad.

Table 6 – Maximum spacing of flow diversion banks down slopes (IECA, 2008)

Open Earth Slopes						Vegetated Slopes		
Slope	Horiz.	Vert.	Slope	Horiz.	Vert.	Slope	Horiz.	Vert.
1%	80m	0.9m	15%	19m	2.9m	< 10%	No maximum	
2%	60m	1.2m	20%	16m	3.2m	12%	100m	12m
4%	40m	1.6m	25%	14m	3.5m	15%	80m	12m
6%	32m	1.9m	30%	12m	3.5m	20%	55m	11m
8%	28m	2.2m	35%	10m	3.5m	25%	40m	10m
10%	25m	2.5m	40%	9m	3.5m	30%	30m	9m
12%	22m	2.6m	50%	6m	3.0m	> 36%	Case specific	

7 ROLES AND RESPONSIBILITIES

Table 7 outlines the responsibilities of project personnel in respect to ESC.

Table 7 - Roles and responsibilities

ROLE	RESPONSIBILITY
Project Manager	+ Overall responsibility for environmental compliance (including ESC implementation)
Construction Superintendent/Manager	+ Notify the Environmental Manager immediately of any non-compliance with ESCP; + Provide resources to ensure installation, maintenance and operation of ESC devices on ground.
Site Supervisor/Foremen	+ Ensure ESC measures are installed prior to commencing any disturbance activities; + Conduct site inspections as required to ensure ESC measures are operational and in good order; + Monitor daily rainfall; + Notify Environmental Advisor when runoff generating rainfall occurs in the previous 24 hours during clearing activity. + Treat, test and dispose of captured runoff as per operation procedures;
Environmental Manager/ Advisor	+ Conduct site inspections and audits as required; + Prepare audit reports based in inspections; + Provide advice, as required regarding ESC site improvement. + Conduct in-situ monitoring as required; + Collect and submit samples to laboratory as required; + Collate results and prepare reports as required; + Maintain current records of rainfall, water quality, treatment practices, discharge activities.
All Personnel	+ Report any damage to ESC devices and any potential or actual environmental harm in line with Duty to Notify under the requirements of the *Waste Management and Pollution Control Act 1998 (NT)*

8 SITE INSPECTION AND MONITORING

Site inspections and monitoring is to be undertaken in accordance with Sections 6.17 and 7.4 of the Best Practice Erosion and Sediment Control Document (IECA, 2008) adapted for this specific site and work activities as detailed below. When a site inspection detects a notable failure in the adopted ESC measures, the source of this failure must be reported, investigated and appropriate amendments made to the site and the ESCP.

ESCPs should be considered live documents that in some instances will require review and updating as site conditions change, or if the adopted measures fail to achieve the required treatment standard.

Best practice site management requires all ESC measures to be inspected at the following frequencies and include the following checks as a minimum:

Daily site inspections (during rainfall) during clearing activity

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- All site discharge points (including dewatering activities as appropriate)

Monthly site inspections (even if work is not occurring on-site)

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

Prior to significant forecasted rain events eg. >50% of more than 20mm (or based on local rainfall/runoff assessment)

- All drainage, erosion and sediment control measures
- All temporary flow diversion and drainage works

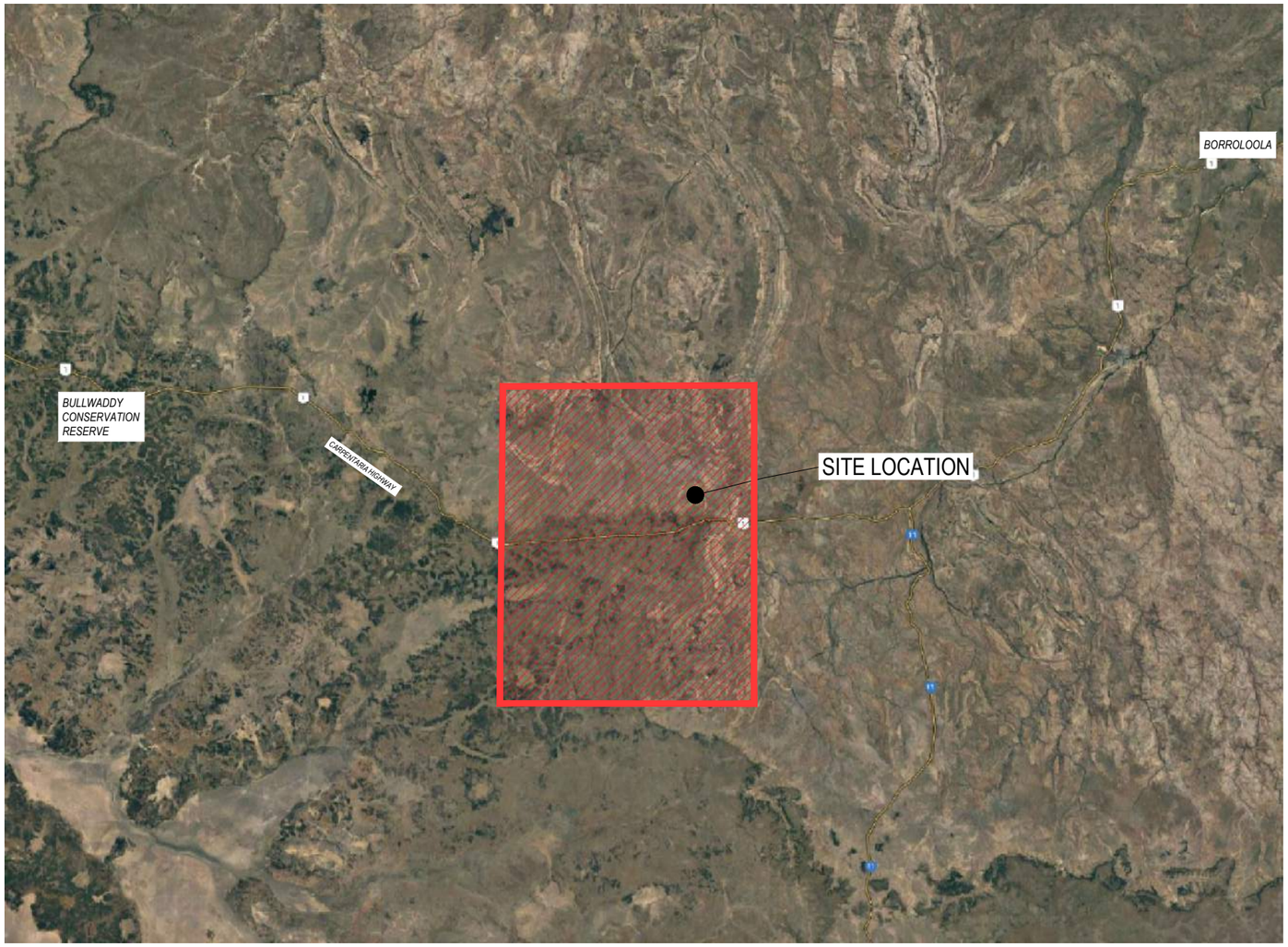
Following significant rainfall eg. 20mm (or based on local rainfall/runoff assessment) – NOTE: May be impacted by access constraints following rainfall.

- All drainage, erosion and sediment control measures
- Occurrences of excessive sediment deposition (whether on-site or off-site)
- Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

APPENDIX A

EROSION AND SEDIMENT CONTROL DRAWINGS

EROSION AND SEDIMENT CONTROL DRAWINGS
EP187 CARPENTARIA PILOT PROJECT



DRAWING LIST:

D00 - COVER SHEET
D01 - R FACTOR
D02 - K FACTOR
D03 - LS FACTOR
D04 - SOIL LOSS (RUSLE)
D05 - ACCESS TRACK AND PIPELINE CONSTRUCTION
D06 - ACCESS TRACK AND PIPELINE CONSTRUCTION
D07 - ACCESS TRACK AND PIPELINE CONSTRUCTION
D08 - ACCESS TRACK AND PIPELINE CONSTRUCTION
D09 - ACCESS TRACK AND PIPELINE CONSTRUCTION
D10 - TEMPORARY EROSION CONTROL
D11 - TYPICAL COMPRESSOR STATION CONSTRUCTION
D12 - TYPICAL WATER HANDLING STATION
D13 - TYPICAL WATER BORE CONSTRUCTION
D14 - TYPICAL WELL PAD CONSTRUCTION
D15 - TYPICAL WELL PAD CONSTRUCTION
D16 - TYPICAL WELL PAD CONSTRUCTION
D17 - CARPENTARIA 4 EXPANSION
D18 - CARPENTARIA 2/3 EXPANSION
D19 - TYPICAL CAMP CONSTRUCTION
D20 - TYPICAL GRAVEL PIT CONSTRUCTION
D21 - STANDARD DETAILS
D22 - STANDARD DETAILS
D23 - STANDARD DETAILS
D24 - GROUND COVER ASSESSMENT

REFER TO REPORT R1564 FOR ADDITIONAL DETAILS RELATING TO GUIDELINES USED, PROJECT AND SITE DESCRIPTION, CLIMATE, TOPOGRAPHY, SOILS, EROSION RISK ASSESSMENT, EROSION, SEDIMENT AND DRAINAGE CONTROL SPECIFICATIONS, ROLES AND RESPONSIBILITIES AND SITE INSPECTION AND MONITORING.

PROJECT MANAGER:
JON BENNETT
[redacted]

REVISION	DESCRIPTION	APPROVED BY	DATE
A	ORIGINAL ISSUE	INITIAL1	DATE1

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN COVER PAGE

PROJECT No	DRAWING No	REVISION
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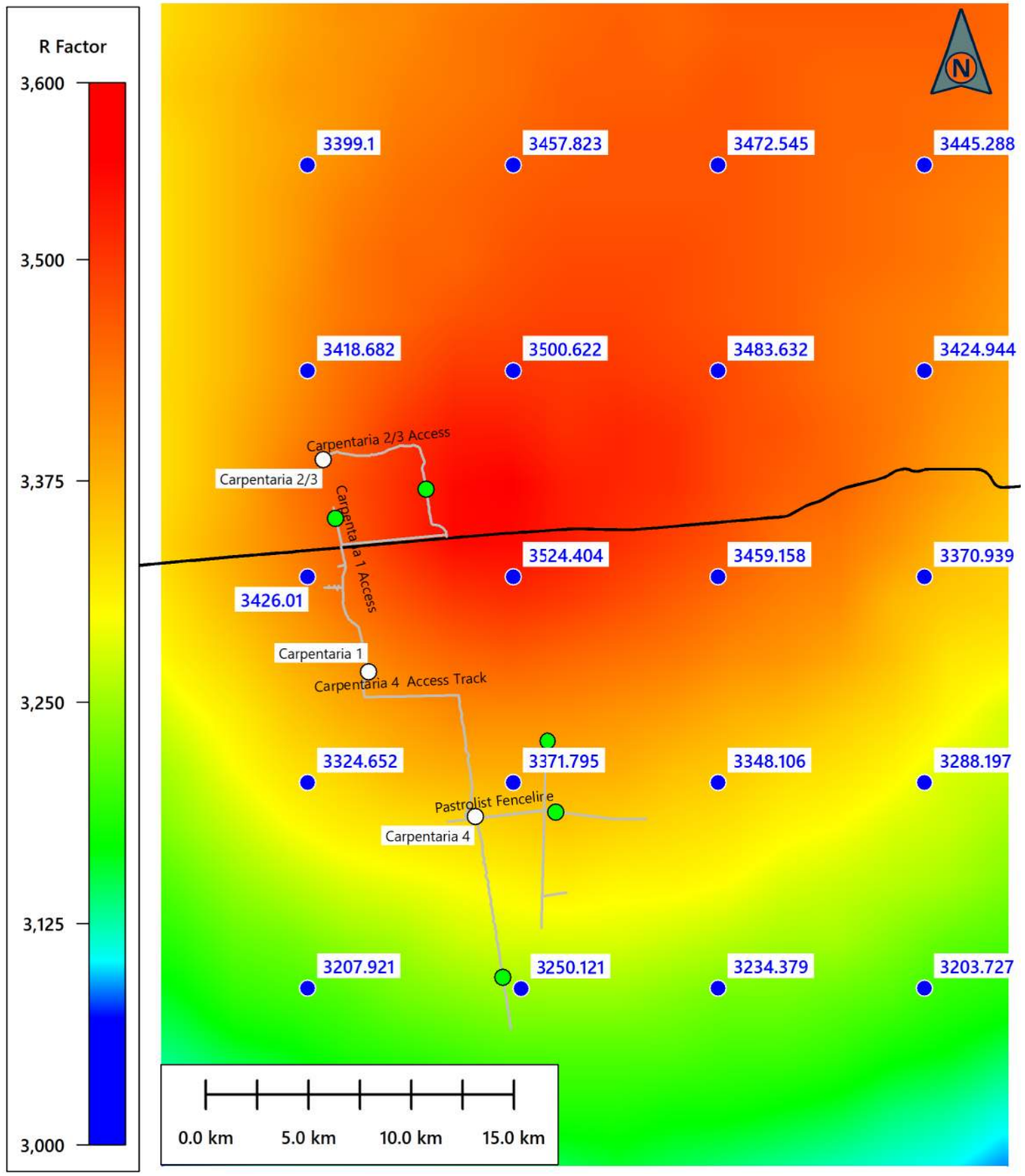

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN
RUSLE ASSESSMENT

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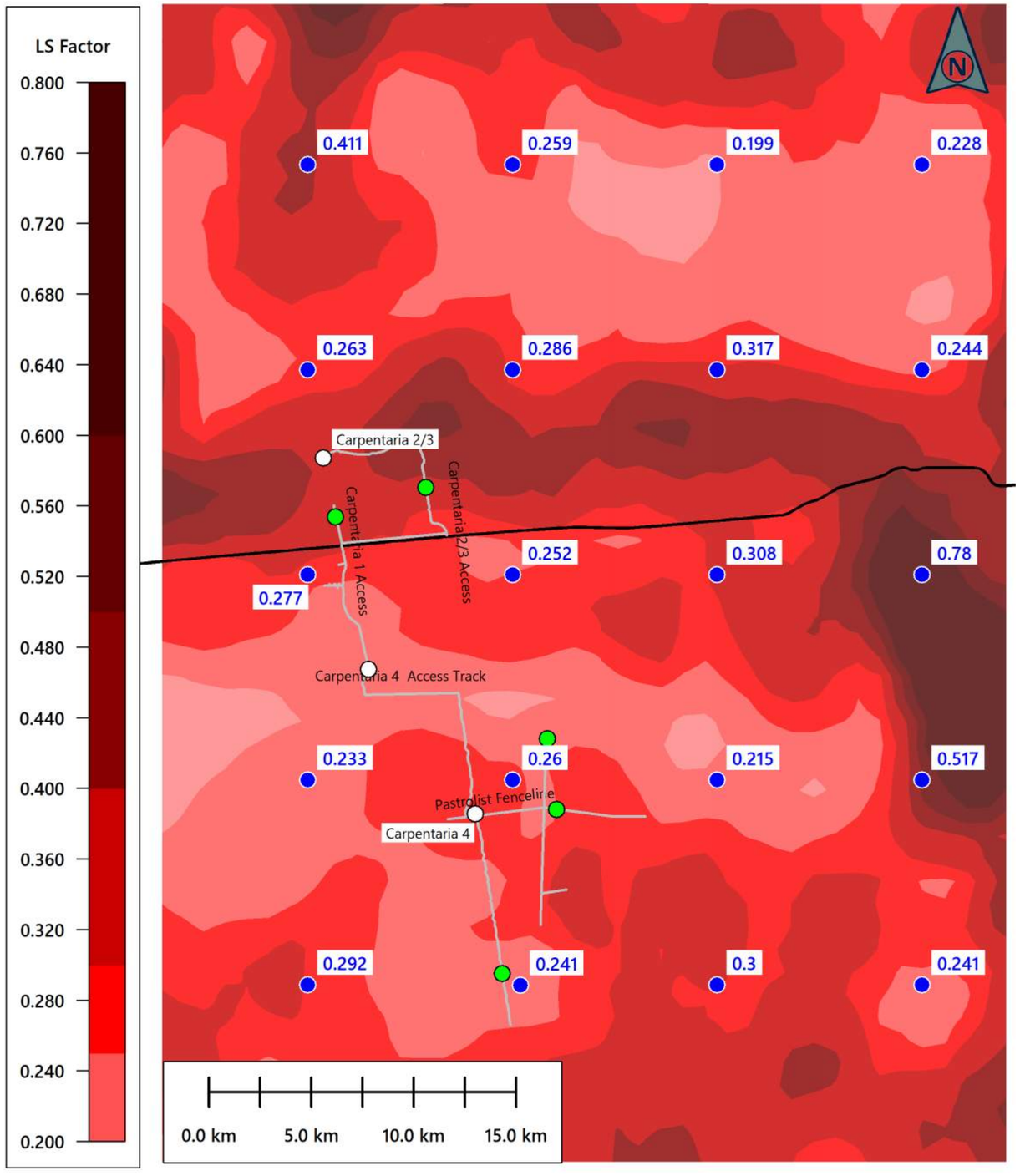

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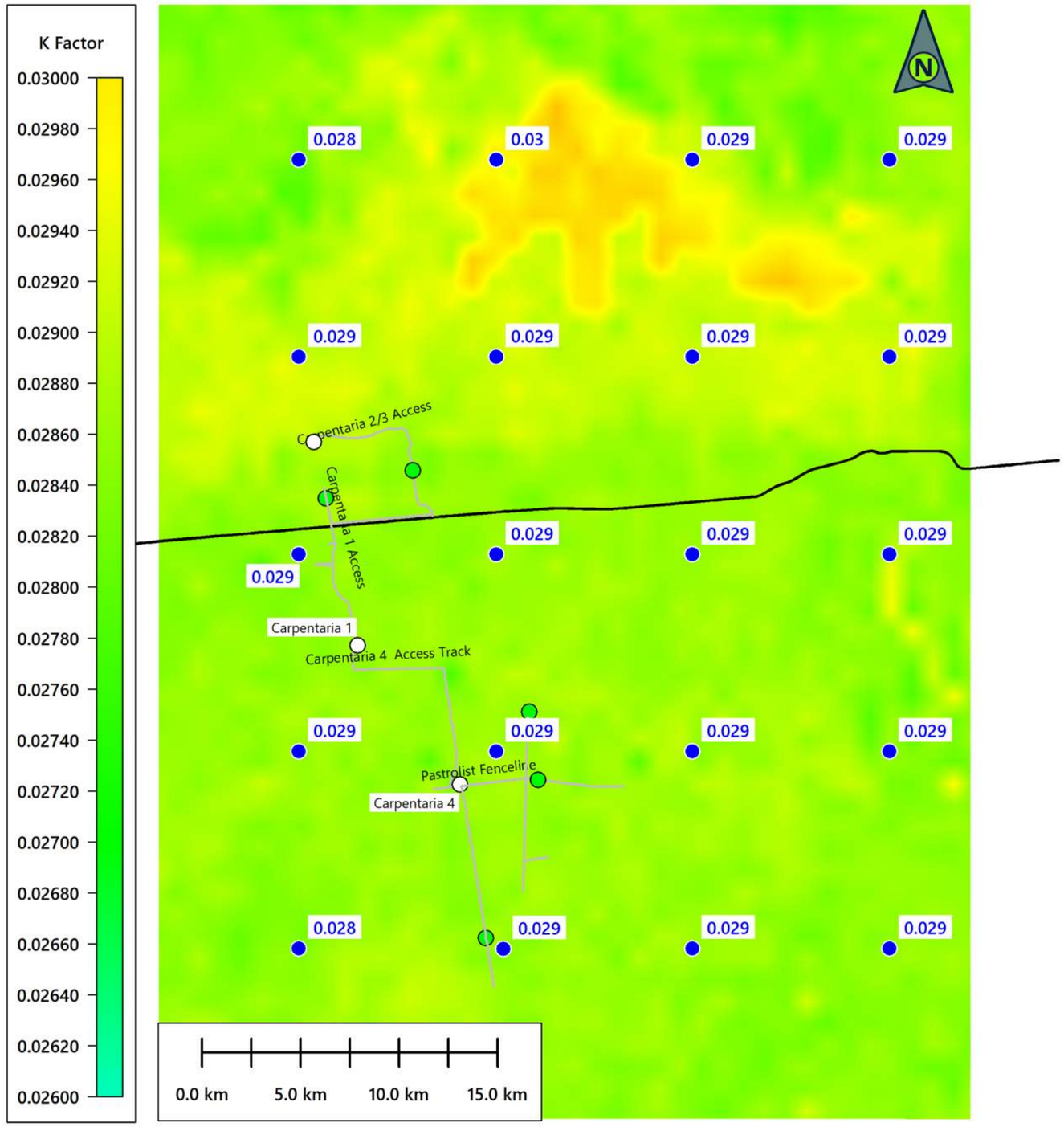

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RUSLE ASSESSMENT

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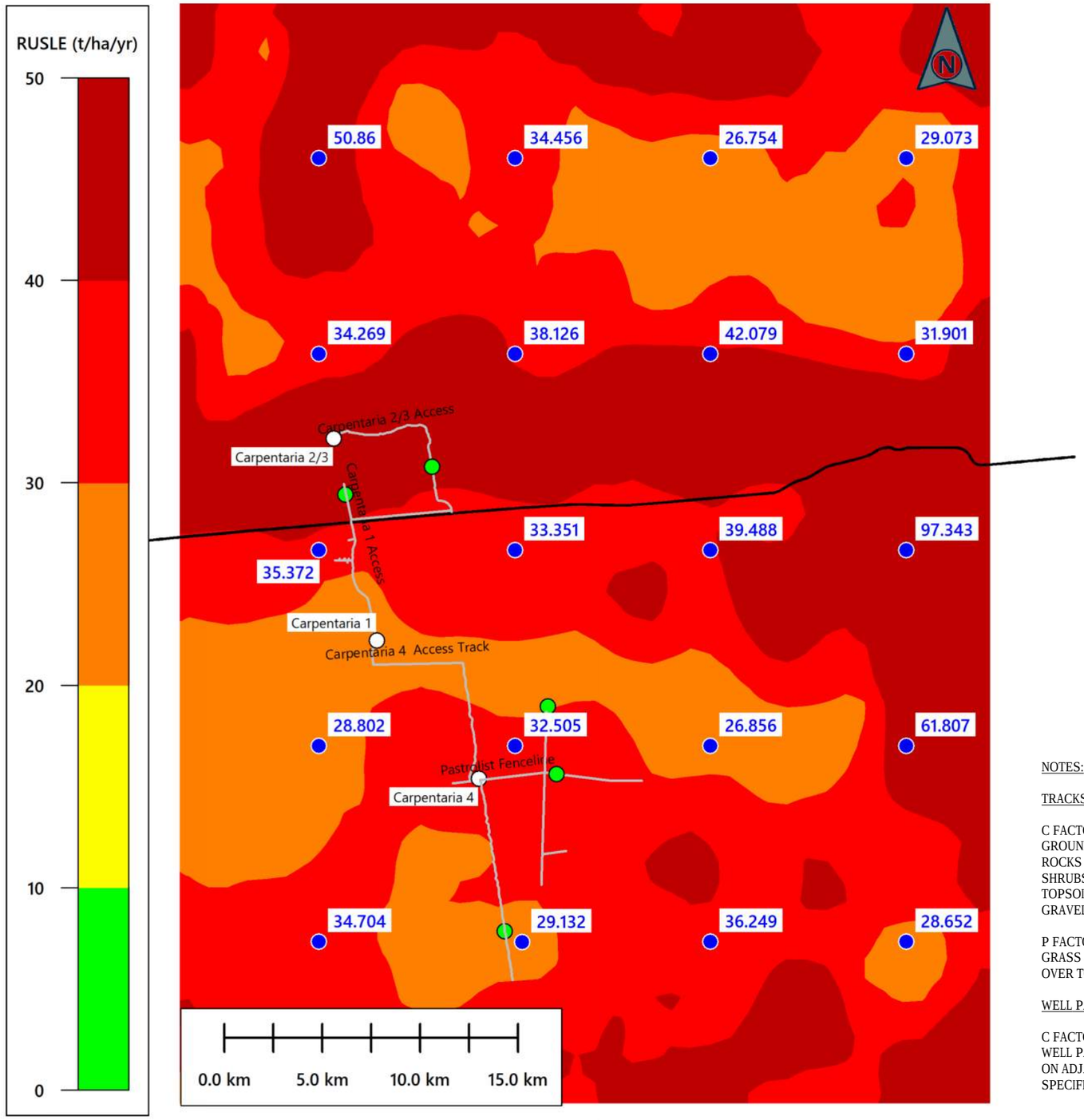

NOTES:

TRACKS, BORES AND PIPELINES:

C FACTOR - 0.5
GROUND DISTURBANCE LIMITED TO REMOVAL OF ROCKS AND FALLEN BRANCHES. GRASS AND SHRUBS REMOVED WITH GROUND COVER, TOPSOIL AND ROOTS TO REMAIN IN PLACE. GRAVEL PLACED OVER TOP.

P FACTOR - 0.9
GRASS AND ROOTS RETAINED/ GRAVEL PLACED OVER TOP

WELL PADS, CAMPS AND FACILITIES:

C FACTOR - 1.0 AND P FACTOR - 1.3 APPLY FOR WELL PADS CAMPS AND FACILITIES. NOT SHOWN ON ADJACENT HEATMAP. REFER TO SITE SPECIFIC RUSLE RISK ASSESSMENTS.

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RUSLE ASSESSMENT

PROJECT No	DRAWING No	REVISION
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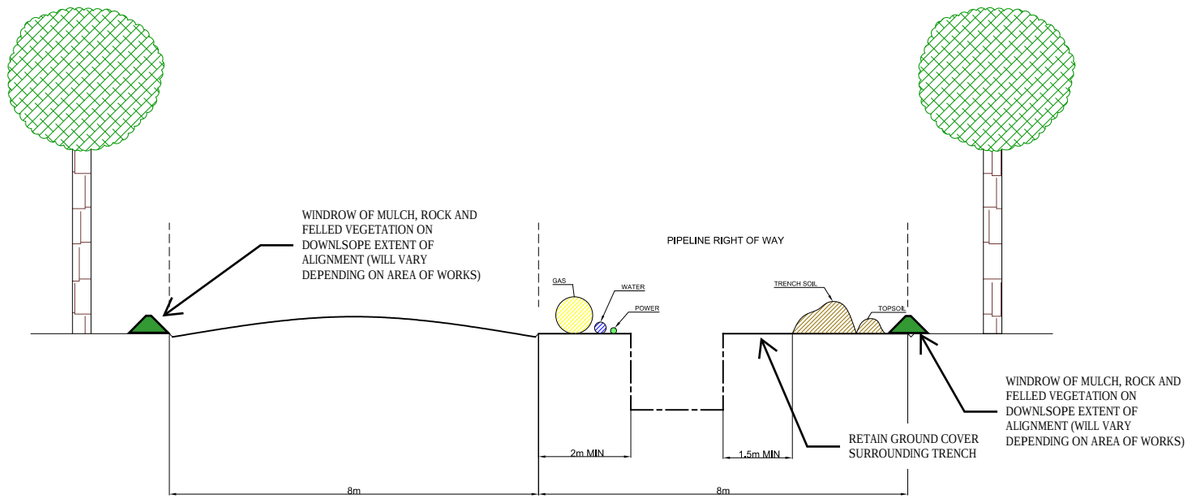
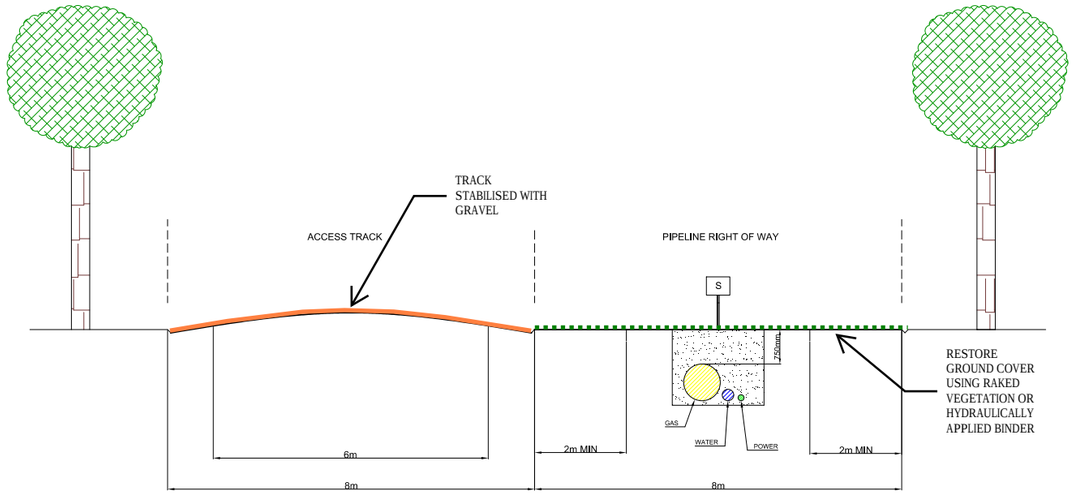
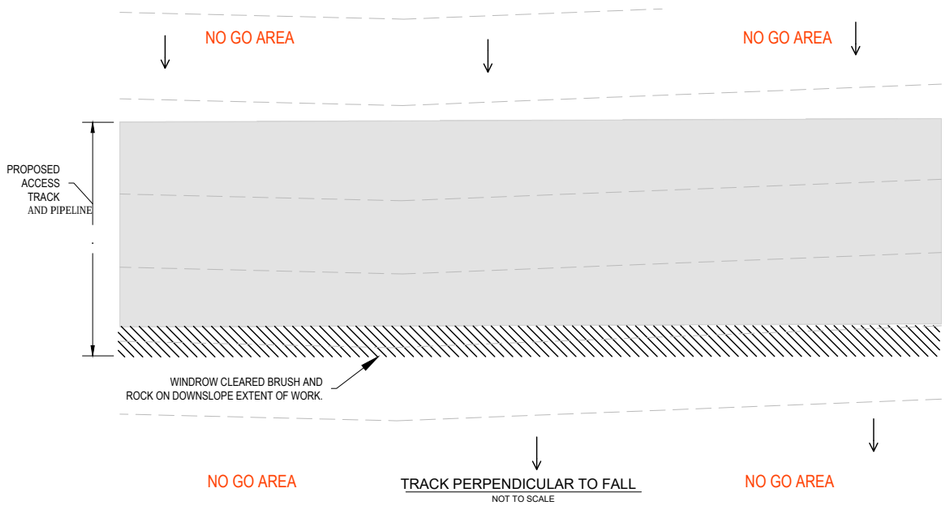
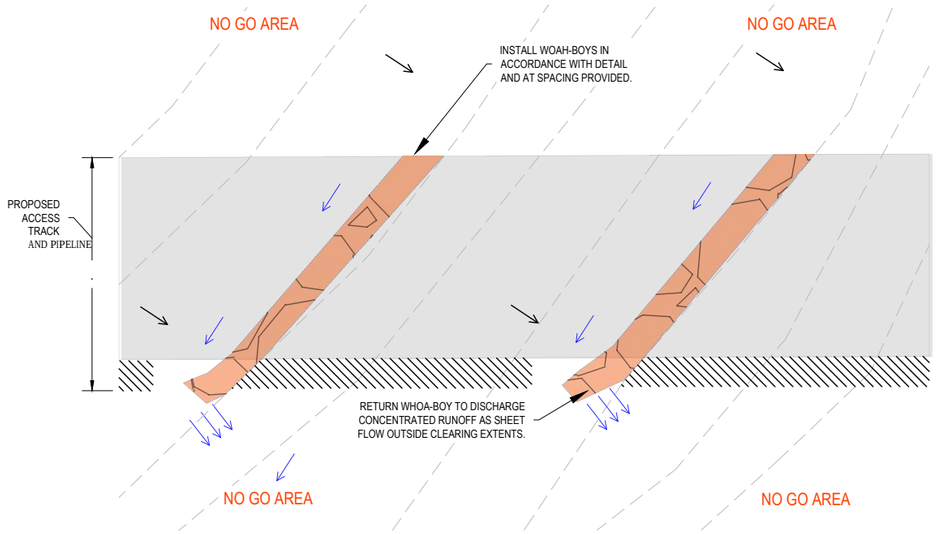






TRACK PERPENDICULAR TO FALL
NOT TO SCALE



TRACK DIAGONAL TO FALL
NOT TO SCALE

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23-0254	D05	A

Open Earth Slopes						Vegetated Slopes		
Slope	Horiz.	Vert.	Slope	Horiz.	Vert.	Slope	Horiz.	Vert.
1%	80m	0.9m	15%	19m	2.9m	<5%	no berm required	
2%	60m	1.2m	20%	16m	3.2m	10%	200m maximum	
4%	40m	1.6m	25%	14m	3.5m	12%	100m	12m
6%	32m	1.9m	30%	12m	3.5m	15%	80m	12m
8%	28m	2.2m	35%	10m	3.5m	20%	55m	11m
10%	25m	2.5m	40%	9m	3.5m	25%	40m	10m
12%	22m	2.6m	50%	6m	3.0m	30%	30m	9m
						>36%	Case Specific	

TABLE 1 - MAXIMUM BERM SPACING ON OPEN EARTH AND VEGETATED SLOPES

Riparian Class	Stream Order	Minimum buffer width (m)	Measured from (Refer to Figure 6 on page 46 of 75 in LCG)
Drainage depression	Not applicable	25	The outer edge of the drainage depression, which is the extent of the associated poorly drained soils and associated vegetation
Intermittent streams	First	25	The outer edge of the riparian vegetation or levee (whichever is the greater). If braided channels are present, the edge of the outer most stream channel
Intermittent streams	Second	50	As above
Creeks	Third and fourth	100	As above
Rivers	Fifth or higher	250	As above

TABLE 2 - BUFFER WIDTHS FOR MAPPED AND UNMAPPED DRAINAGE AREAS/FLOW PATHS

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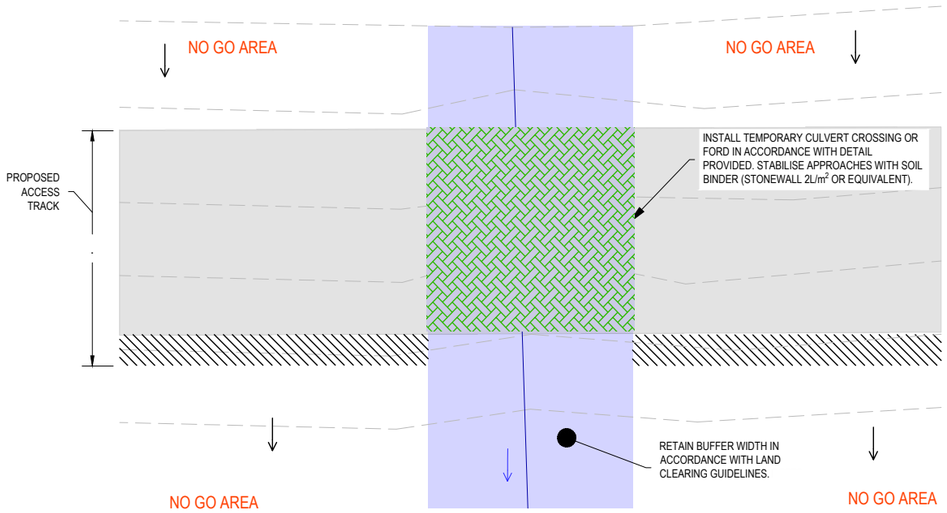
23-0254	D06	A



TRACK PERPENDICULAR TO FALL - UNMAPPED FLOW PATH CROSSING

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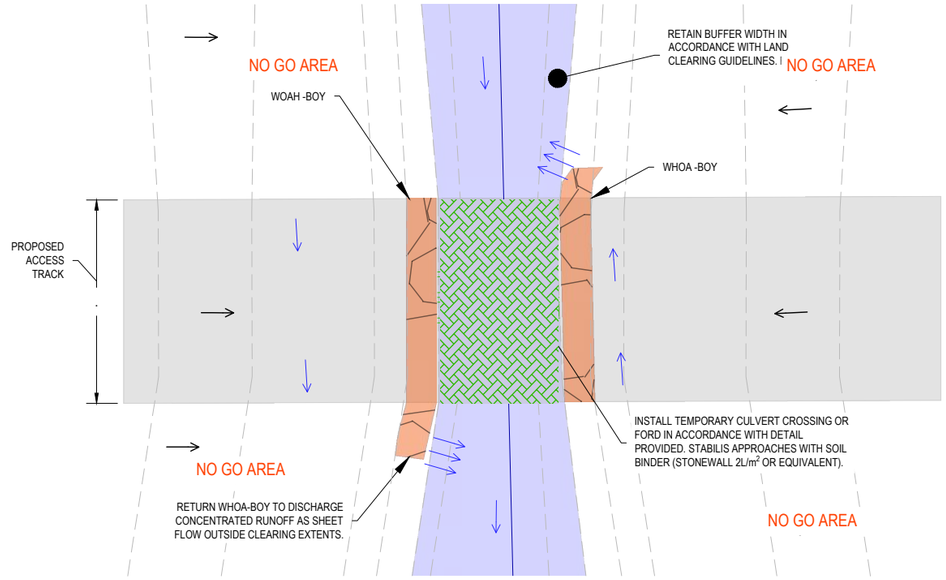
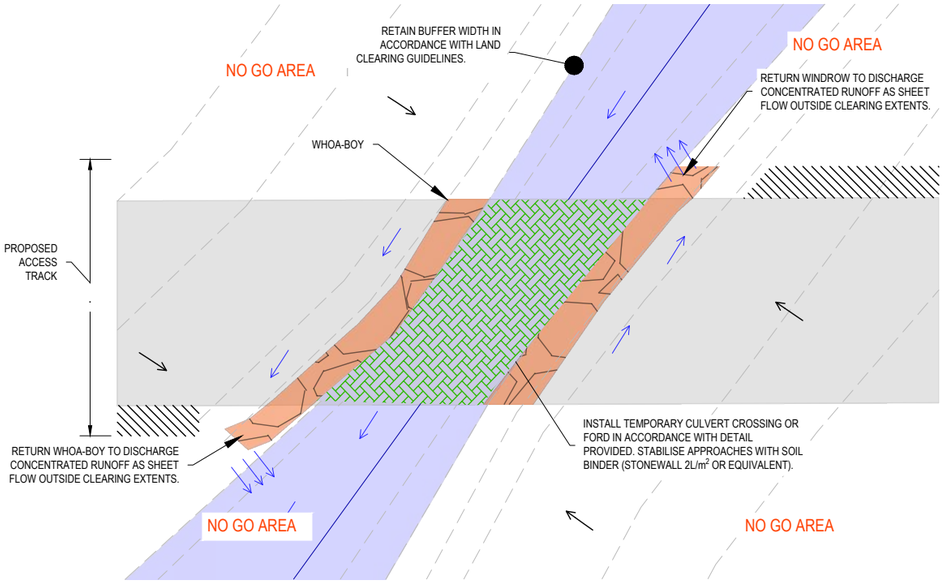


TRACK PARALLEL TO FALL - UNMAPPED FLOW PATH CROSSING

NOT TO SCALE



TRACK DIAGONAL TO FALL - UNMAPPED FLOW PATH CROSSING

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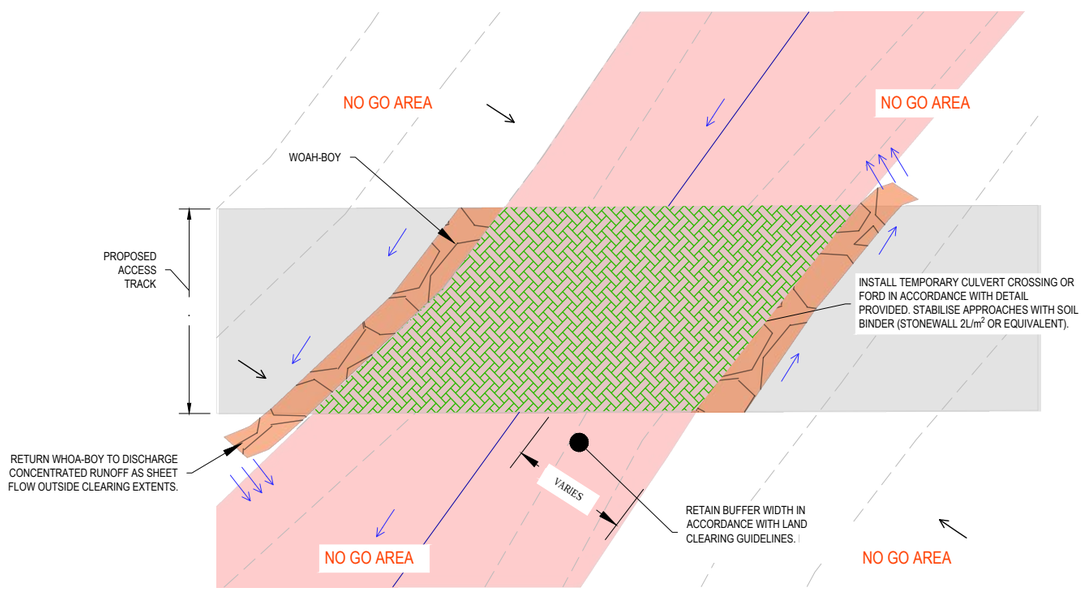

MAPPED WATERWAY BUFFER - TRAFFICABLE WITH NO FORMED BANKS AND NO SURFACE WATER EVIDENT

NOT TO SCALE

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ROAD CROWNING
CROWNING PROVIDES A LOW-GRADE FALL ENABLING DRAINAGE FROM BOTH SIDES OF THE CENTRE OF THE ROAD (SEE FIGURE 1). THIS METHOD IS ONLY EFFECTIVE IF THE CROWN IS SLIGHTLY HIGHER THAN THE NATURAL SURFACE.

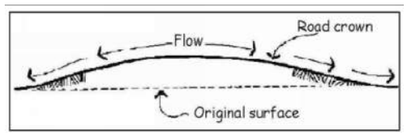

Figure 1: Crowning

ROAD CROWNING SHOULD BE AVOIDED IN AREAS WHERE WATER NATURALLY CROSSES THE ROAD SUCH AS BROAD DRAINAGE FLOORS. FLOODWAYS ARE REQUIRED IN THESE CASED.

INFALL AND OUTFALL DRAINAGE
WHEN ROADS ARE BUILT ACROSS THE SLOPE CONSIDERATION MUST BE GIVEN TO TAKING WATER FROM THE UP SLOPE SIDE OF THE ROAD TO THE DOWN SLOPE SIDE OF THE ROAD. WHEN YOU INSTALL CROSS DRAINAGE YOU MUST MAKE SURE THAT IT DOES NOT CAUSE EROSION OF THE ROAD SURFACE.

CROSSFALL/OUTFALL DRAINAGE
THE SIMPLEST METHOD IS BY PROVIDING THE ROAD SURFACE WITH A CROSSFALL IN THE SAME DIRECTION AS THE SLOPE (OUTFALL DRAINAGE), THEREBY DIRECTING WATER OVER THE ROAD SURFACE TO DISPOSAL AREAS ON THE LOWER SIDE OF THE ROAD (SEE FIGURE 2).

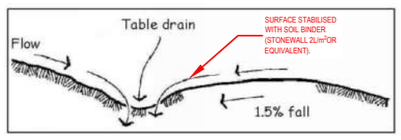

Figure 2: Crossfall/outfall drainage

THE OTHER METHOD IS BY PROVIDING THE ROAD SURFACE WITH INFALL DRAINAGE BACK INTO THE SLOPE, DIRECTING WATER BACK TO THE UP SLOPE SIDE OF THE ROAD (SEE FIGURE 3). IF INFALL DRAINAGE IS NECESSARY THEN TABLE DRAINS, CULVERTS OR INVERTS NEED TO BE CONSTRUCTED. THESE WILL SAFELY DIRECT WATER TO THE DOWN SLOPE SIDE OF THE ROAD.

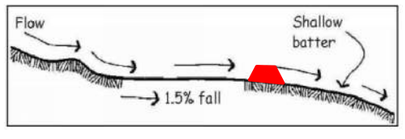

Figure 3: Infall drainage

OUTFALL DRAINAGE IS PREFERRED TO INFALL DRAINAGE AS THERE IS GENERALLY NO NEED FOR OTHER DRAINAGE WORKS SUCH AS CULVERTS, INVERTS, TABLE AND MITRE DRAINS.

WHEN INSTALLING OUTFALL DRAINAGE ON STEEPER SLOPES, BATTERS ON THE DOWNSLOPE SIDE OF THE ROAD MUST NOT BE TOO STEEP. STEEP BATTERS MAY ERODE, IMPACTING ON THE ROAD ITSELF.

THE CROSSFALL OF THE ROAD SURFACE SHOULD BE KEPT AS FLAT AS POSSIBLE TO ENSURE GOOD DRAINAGE. FOR OUTFALL DRAINAGE IT IS RECOMMENDED THAT THE MAXIMUM CROSSFALL SLOPE BE IN THE ORDER OF 1.5 – 2%, WHEREAS INFALL DRAINAGE SLOPES CAN BE AS GREAT AS 4%.

SIDE DRAINAGE

TABLE DRAINS
TABLE DRAINS ARE EXCAVATED OPEN CHANNELS THAT ARE BUILT PARALLEL TO ROADS AND TRACKS. THESE DRAINS DIRECT RUNOFF TO DISPOSAL AREAS FURTHER DOWNSLOPE. TABLE DRAINS SHOULD ONLY BE USED WHEN NATURAL RUN-OFF IS NOT POSSIBLE.

FILL OBTAINED FROM CONSTRUCTING TABLE DRAINS CAN BE USED TO BUILD UP ROAD SURFACES. THE DESIGN OF TABLE DRAINS DEPENDS ON A NUMBER OF FACTORS, INCLUDING THE SIZE AND NATURE OF THE CATCHMENT, THE SLOPE AND WATER VOLUMES AND FLOW. LARGER TABLE DRAINS MAY NEED TO BE DESIGNED BY ENGINEERS OR OTHER SUITABLY QUALIFIED PROFESSIONALS.

TABLE DRAINS SHOULD BE CONSTRUCTED WITH A FLAT BOTTOM (TRAPEZOID SHAPE) (SEE FIGURE 4). IN GENERAL THEY SHOULD BE 0.5 TO 1.0M WIDE AT THE BASE. AVOID USING V SHAPED DRAINS AS THEY MAY CAUSE EROSION IN THE CHANNEL.

WHERE POSSIBLE TABLE DRAINS SHOULD BE REVEGETATED AS SOON AS POSSIBLE AFTER CONSTRUCTION, AND REGULARLY SLASHED. TABLE DRAINS SHOULD NOT BE GRADED.

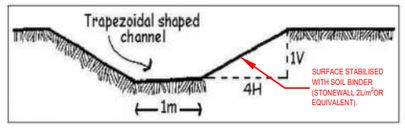

Figure 4: Table & Mitre drain cross section

MITRE DRAINS
WATER SHOULD BE TAKEN OUT OF TABLE DRAINS AT REGULAR INTERVALS USING MITRE (OFFSHOOT) DRAINS. MITRE DRAINS TAKE RUNOFF OUT OF TABLE DRAINS OR DIRECTLY OFF ROAD SHOULDERS WHERE TABLE DRAINS ARE ABSENT. THESE DRAINS DISPOSE OF WATER IN AREAS AWAY FROM THE ROAD (SEE FIGURE 5).

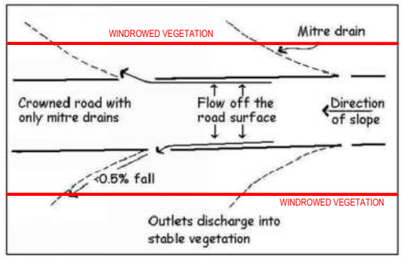

Figure 5: Crowned road with only mitre drains

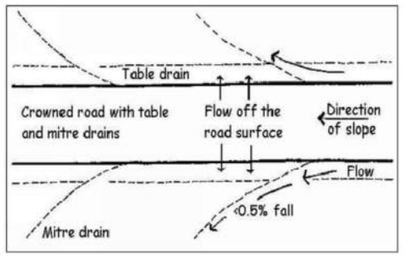

Figure 6: Crowned road witrh table and mitre drains

MITRE DRAINS STOP WATER ACCUMULATING IN TABLE DRAINS OR ON THE ROAD SHOULDER. IDEALLY MITRE DRAINS
SHOULD BE CONSTRUCTED SO THAT THEY HAVE A BROAD FLAT BASE AT LEAST 1M WIDE. MITRE DRAINS ALSO SHOULD NOT BE GRADED TO PRODUCE A V.
MITRE DRAINS SHOULD SLOPE TO DIRECT THE FLOW OF WATER AWAY FROM THE ROAD. TO MINIMISE EROSION THE SLOPE SHOULD BE NO GREATER THAN 0.5% ON ERODIBLE SOILS OR 1% ON STABLE SOILS. MITRE DRAIN OUTLETS EFFECTIVELY CONCENTRATE RUNOFF, FOR THIS REASON THEY SHOULD BE LOCATED IN STABLE UNDISTURBED AREAS.

MITRE DRAIN SPACING IS DEPENDENT ON:
- THE GRADE OF THE TABLE DRAIN OR ROAD
- SOIL TYPE AND ERODIBILITY
- RAINFALL

Table 1: Recommended mitre drain spacing

Slope		Mitre Drain Spacing (m)
%	Gradient	
0.5	1 : 200	170 - 180
1	1 : 100	120 - 130
2	1 : 50	90 - 100
3	1 : 33	70 - 80
4	1 : 25	60 - 70
5	1 : 20	55 - 60
6	1 : 17	50 - 55
10	1 : 10	40 - 45

CROSS DRAINAGE

ENGINEERED, STABLE CROSS DRAINAGE SUCH AS INVERTS, FLOODWAYS OR CULVERTS CAN BE USED TO COLLECT WATER FROM UPSLOPE TABLE DRAINS, OR DRAINAGE LINES. IT IS GENERALLY MORE CONOMICAL AND PRACTICAL TO FORD DRAINAGE LINES USING FLOODWAYS OR INVERTS THAN TO USE MAJOR CULVERTS OR
BRIDGES. ON STEEPER COUNTRY, WHERE CREEKS AND DRAINAGE LINES ARE DEEPER, CULVERTS MAY BE MORE PRACTICAL.

INVERTS AND FLOODWAYS
CARE MUST BE TAKEN IN THE DESIGN AND CONSTRUCTION OF FLOODWAYS AND INVERTS IN ORDER TO CAUSE MINIMAL INTERFERENCE TO NATURAL FLOWS. INVERTS AND FLOODWAYS ARE DESIGNED TO BE TEMPORARILY OVER TOPPED BY WATER FLOW AND MINIMISE BANK AND BED EROSION. THEY SHOULD BE SITED AT LOW POINTS IN THE BANK AND AT RIGHT ANGLES TO THE DIRECTION OF FLOW.

INVERTS
INVERTS SHOULD BE CONSTRUCTED WITH THE FINISHED SURFACE AT, OR JUST BELOW THE LEVEL OF THE EXISTING STREAM BED. CONSTRUCTION OF AN INVERT IS GENERALLY BASED ON EXCAVATING SOFT, ERODIBLE MATERIAL. AT LEAST 300MM SHOULD BE REMOVED, GEOTEXTILE MAY BE NECESSARY AS A BASE. EXCAVATED MATERIAL IS THEN REPLACED WITH COMPACTED GRANULAR MATERIAL TO
PROVIDE A TRAFFICABLE SURFACE (SEE FIGURE 7).

TEXT AND IMAGES SOURCED FROM NORTHERN TERRITORY 'ROAD DRAINAGE FACT SHEET', DEPARTMENT OF LAND RESOURCE MANAGEMENT (www.lrm.nt.gov.au)

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN ACCESS TRACK AND PIPELINE CONSTRUCTION
PROJECT No: 23-0254 | DRAWING No: D08 | REVISION: A

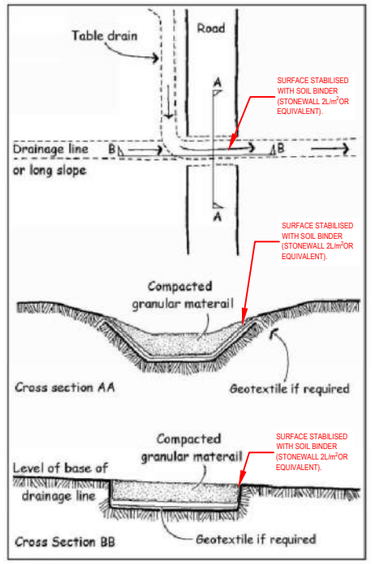

Figure 7: Inverts

FLOODWAYS

FLOODWAYS ARE USUALLY ELEVATED ABOVE THE BED LEVEL OF THE CHANNEL AND OFTEN INCORPORATE CULVERTS TO TAKE "NORMAL" FLOWS WITH THE ROAD ONLY BEING OVERTOPPED DURING FLOOD EVENTS, AS ILLUSTRATED IN FIGURE 8.

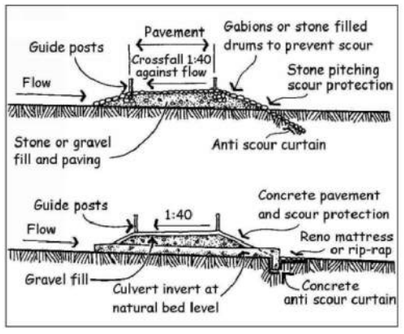

Figure 8: Floodways (Australian Road Research Board, 1993)

THE DESIGN SHOULD HAVE ENDS OF THE STRUCTURE THAT ARE WELL ANCHORED INTO THE BANKS AND OBSTRUCTION TO FLOW KEPT TO A MINIMUM BY USING GENTLE BATTER SLOPES ON THE UP- AND DOWNSTREAM FACES. WHEN IT IS NECESSARY TO CONSTRUCT AN ELEVATED FLOODWAY IT IS RECOMMENDED THAT SPECIALIST ADVICE BE SOUGHT.

AS FLOODWAYS ARE GENERALLY ELEVATED ABOVE BED LEVEL PROTECTION WORKS ARE REQUIRED ON THE DOWNSTREAM SIDE OF THE FLOODWAY TO PREVENT EROSION.

CULVERTS

WHEN CULVERTS ARE USED THEY SHOULD BE ANGLED DOWNWARD AT BETWEEN 1 AND 3%. THIS WILL MINIMISE SILTING OF THE PIPE AND PREVENT EXCESSIVE SCOURING AT THE OUTFLOW. ON DRAINAGE LINES THE CULVERT SHOULD BE KEYED INTO THE STREAMBED BY DIGGING A TRENCH AND SEATING THE CULVERT INTO IT.

THE AREA BELOW THE OUTLET WILL NEED PROTECTION TO PREVENT EROSION. THIS PROTECTION CAN BE ACHIEVED BY ARMOURING (EG: ROCK MATTRESS) THE DRAIN DOWNSTREAM OF THE OUTLET, OR BY CONSTRUCTING A DISSIPATING DEVICE (SEE FIGURE 9).

PROTECTION MAY ALSO BE REQUIRED AT THE INLET. THE LOCATION, SPACING, SIZE AND TYPE OF CULVERT MAY VARY. ADVICE SHOULD BE SOUGHT PRIOR TO CONSTRUCTION.

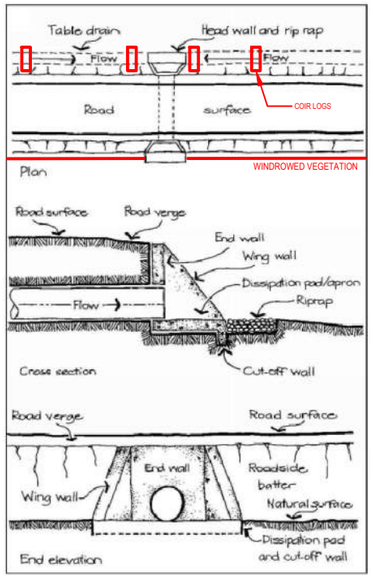

Figure 9: Culverts

WHOA BOYS ON VEHICLE TRACKS

WHOA BOYS CAN VARY IN SIZE. THEY CAN BE A COUPLE OF METRES LONG AND ONLY 10–30CM HIGH ON WALKING TRACKS, OR THEY MAY BE LARGE, GENTLY SLOPING BANKS
UP TO 30-40M AND UP TO 3M HIGH ON DEEPLY ERODED AREAS.

WHOA BOYS CAN BE CONSTRUCTED IN TWO WAYS:

1. BY CUT AND FILL – LINES ARE RIPPED ACROSS THE AREA AT A GRADE OF 0.3 %. A SHALLOW CHANNEL SHOULD BE CUT ALONG THIS LINE. EXCAVATED MATERIAL IS DUMPED ON THE DOWN SLOPE SIDE OF THE CHANNEL, THEN COMPACTED AND SMOOTHED OUT TO FORM A BANK WITH EVEN BATTERS AND A LEVEL TOP (SEE FIGURE 10).

2. USING IMPORTED SOIL MATERIAL TO CONSTRUCT A BANK WITH A GRADE OF BETWEEN 0.3 AND 0.5% ALONG THE UP SLOPE EDGE OF THE BANK.

TO AID TRAFFICABILITY, AN APPROACH AND DEPARTURE RAMP CAN BE CUT INTO THE BANK (SEE FIGURE 11). THE BANK SHOULD BE RUN OFF INTO UNDISTURBED VEGETATION OR INTO AN EXISTING DRAIN (CARE NEEDS TO TAKEN TO ENSURE THAT EROSION DOES NOT OCCUR WHERE THE WATER RUNS DOWN INTO THE DRAIN).

ALTERNATIVELY A LEVEL SILL CAN BE CONSTRUCTED AT THE END OF THE BANK TO ENHANCE THE SPREAD OF WATER.

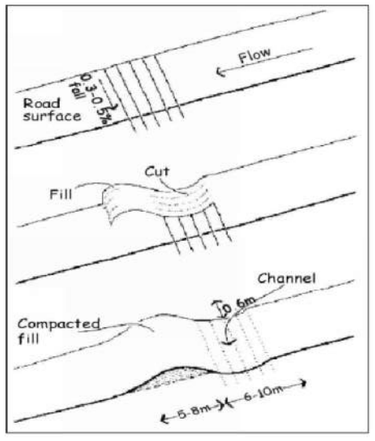

Figure 10: Whoa boy construction

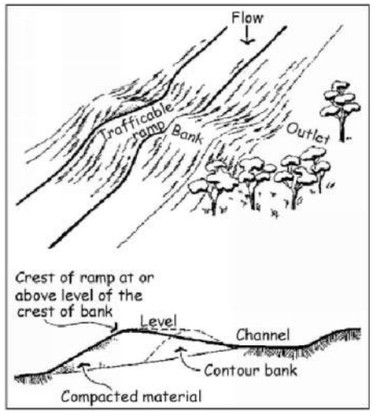

Figure 11: Whoa boy - vehicle track

TEXT AND IMAGES SOURCED FROM NORTHERN TERRITORY 'ROAD DRAINAGE FACT SHEET', DEPARTMENT OF LAND RESOURCE MANAGEMENT (www.lrm.nt.gov.au)

REVISION	DESCRIPTION	APPROVED BY	DATE
A	ORIGINAL ISSUE	TB	27/01/24

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CLIENT: IMPERIAL OIL AND GAS PTY LTD

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PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN ACCESS TRACK AND PIPELINE CONSTRUCTION

PROJECT No	DRAWING No	REVISION
23-0254	D09	A

GROUND OVER MATTRESS:

NOTE: MATTRESS IS PRESCRIBED FOR USE ONLY WHERE WORKS RESULT IN INADVERTENT DISTURBANCE IN AREAS NOT REPORTING TO SEDIMENT CONTROL, OR IN AREAS OUTSIDE THE CLEARING LIMITS ALLOWED FOR IN THIS PLAN. NOTE: EROSION CONTROLS (AND ALL OTHER CONTROLS PRESCRIBED IN THIS PLAN) ARE INTENDED FOR TEMPORARY APPLICATION ONLY. PERMANENT STABILISATION IS OUTSIDE THE SCOPE OF THIS ESCP, WITH REINSTATEMENT ADDRESSED WITHIN THE APPROVED EMP EP187-EMP-XPN-REP-007.

OPTIONS/MATERIALS

1) CLEAN ROCK (50-75mm D50) PLACED OVER GEOFABRIC (MINIMUM GRADE BIDIM A24 OR EQUIVALENT) WHERE MATTRESS MAY BE TRAFFICKED
2) BIODEGRADEABLE EROSION CONTROL MATTRESS (SUCH AS COIR, OR JUTE) - REFER MANUFACTURERS SPECIFICATION FOR DETAIL
3) NON-BIODEGRADABLE EROSION CONTROL BLANKET SUCH AS GEOFABRIC (NOT SUITABLE UNDER TRAFFIC) OR TURF REINFORCEMENT MATTING (REFER MANUFACTURERS SPECIFICATIONS)
4) ALTERNATIVES SUCH AS PLY, SHEET METAL, ROCK/WIRE BASKET OR OTHER BLANKETS MAY BE CONSIDERED APPROPRIATE BUT ARE SUBJECT TO PRIOR APPROVAL.

INSTALLATION

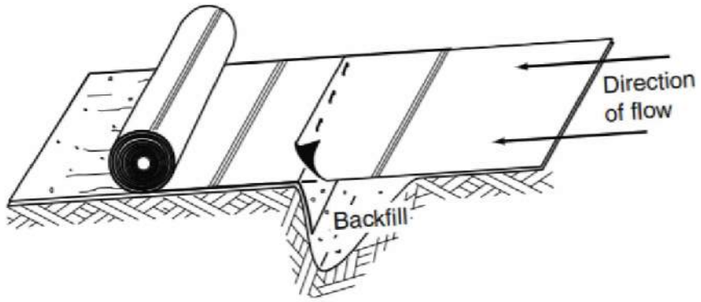
1) PLACE MATTRESS SUCH THAT ALL EXPOSED AREAS REQUIRED FOR STABILISATION ARE SUITABLY COVERED
2) ENSURE ANY PROPRIETARY PRODUCTS USED ARE INSTALLED IN ACCORDANCE WITH MANUFACTURERS DIRECTION
3) APPLY EROSION CONTROL MATTRESS ON UNIFORM SURFACE, FREE OF OBSTRUCTIONS WITH GOOD GROUND CONTACT
4) OVERLAP SHEETS 100-300mm AS A MINIMUM. OVERLAP IN THE DIRECTION OF FLOW IF INSTALLED WITHIN DRAINAGE PATHS
5) PIN SHEETS AT 1m CENTRES
6) INSPECT REGULARLY AND REPLACE DAMAGED OR DETERIORATED BLANKET
7) COVER MATERIALS OR STORE OUT OF DIRECT SUNLIGHT UNTIL READY FOR APPLICATION
8) INSTALL BLANKET WITH UPPER EDGE BURIED TO 300mm WHERE SUBJECT TO LATERAL INFLOW

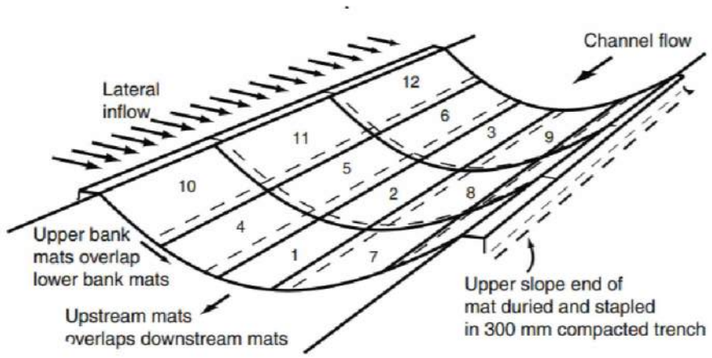
MAINTENANCE

1) INSPECT PRIOR TO RAINFALL TO ENSURE COMPLIANCE WITH ALLNOTES ABOVE, AND FOLLOWING RAINFALL TO IDENTIFY DETERIORATION
2) CHECK FOR DAMAGE RESULTING FROM ACCESS OR TRAFFIC, RUNOFF UNDERMINING FABRICS, GOOD SURFACE CONTACT AND CORRECT OVERLAPPING
3) REPLACE ANY DAMAGED MATERIAL
4) IF UNDERMINING HAS OCCURRED, RE-BURY THE UPPER EDGE AND COMPACT
5) REPAIR ANY RIPS AND TEARS
6) REPLACE ROCK/GRAVEL IF SEDIMENT LADEN
7) UNDERTAKE MAINTENANCE WITHIN 48HRS OR PRIOR TO IMMINENT RAINFALL

REMOVAL

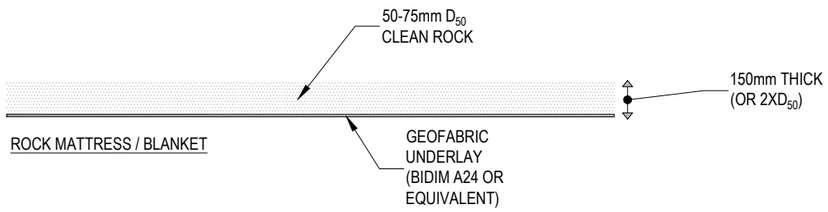
1) IF MATTRESS IS TEMPORARY, CHECK TO ENSURE REMOVAL WILL NOT RESULT IN UNCONTROLLED DISTURBANCE
2) TEMPORARY MATTRESS MUST BE MAINTAINED UNTIL REMEDIATION/REHABILITATION HAS BEEN ARRANGED IN ACCORDANCE WITH THE EMP
3) DISPOSE OF MATERIALS IN ACCORDANCE WITH WASTE MANAGEMENT PROVISIONS





EROSION CONTROL MATTRESS / BLANKET

Source: Catchments & Creeks Pty Ltd



ROCK MATTRESS / BLANKET

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN
TEMPORARY EROSION CONTROL

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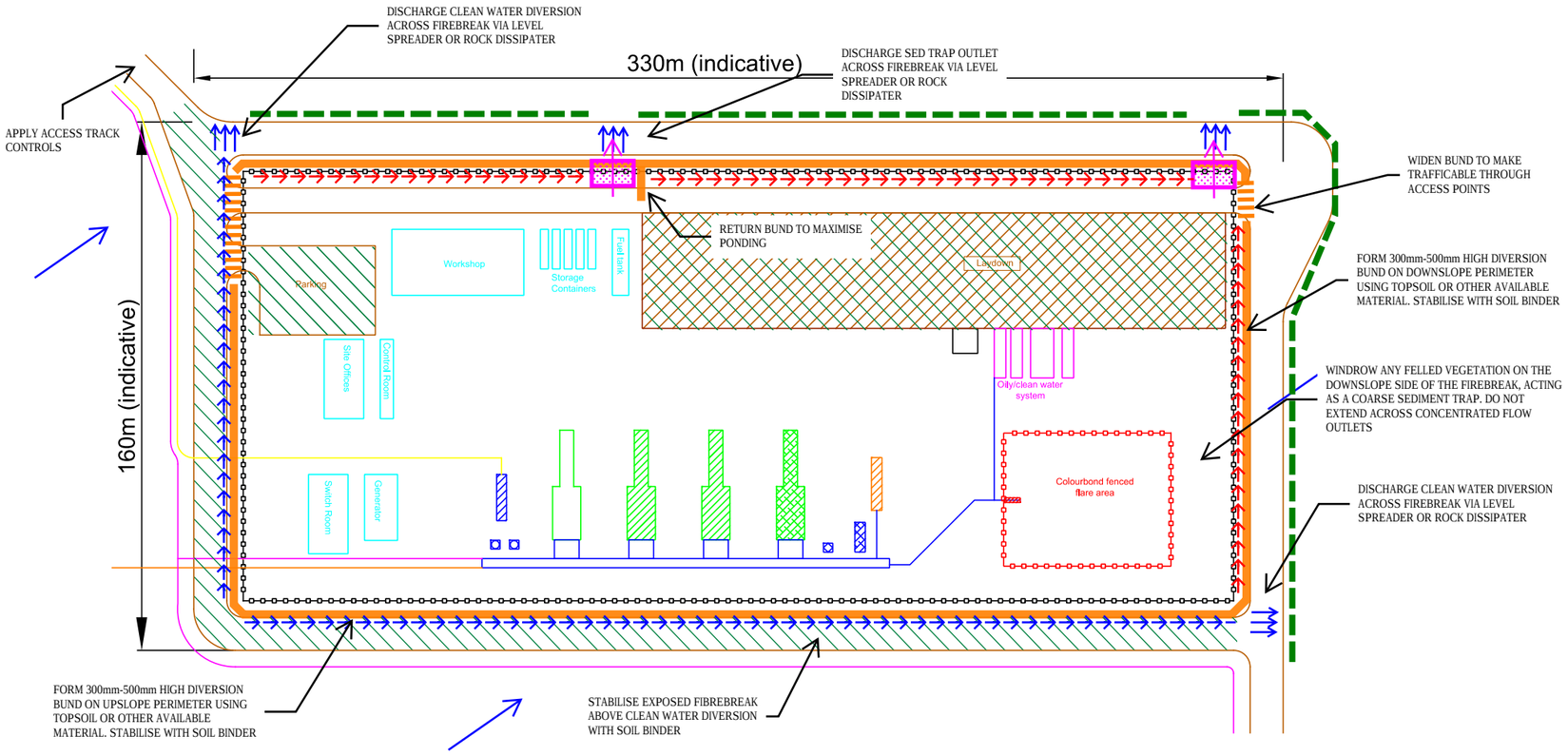

LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- EXPOSED AREA
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

- Personnel fence
- Fire break/Access track
- Laydown
- Buildings

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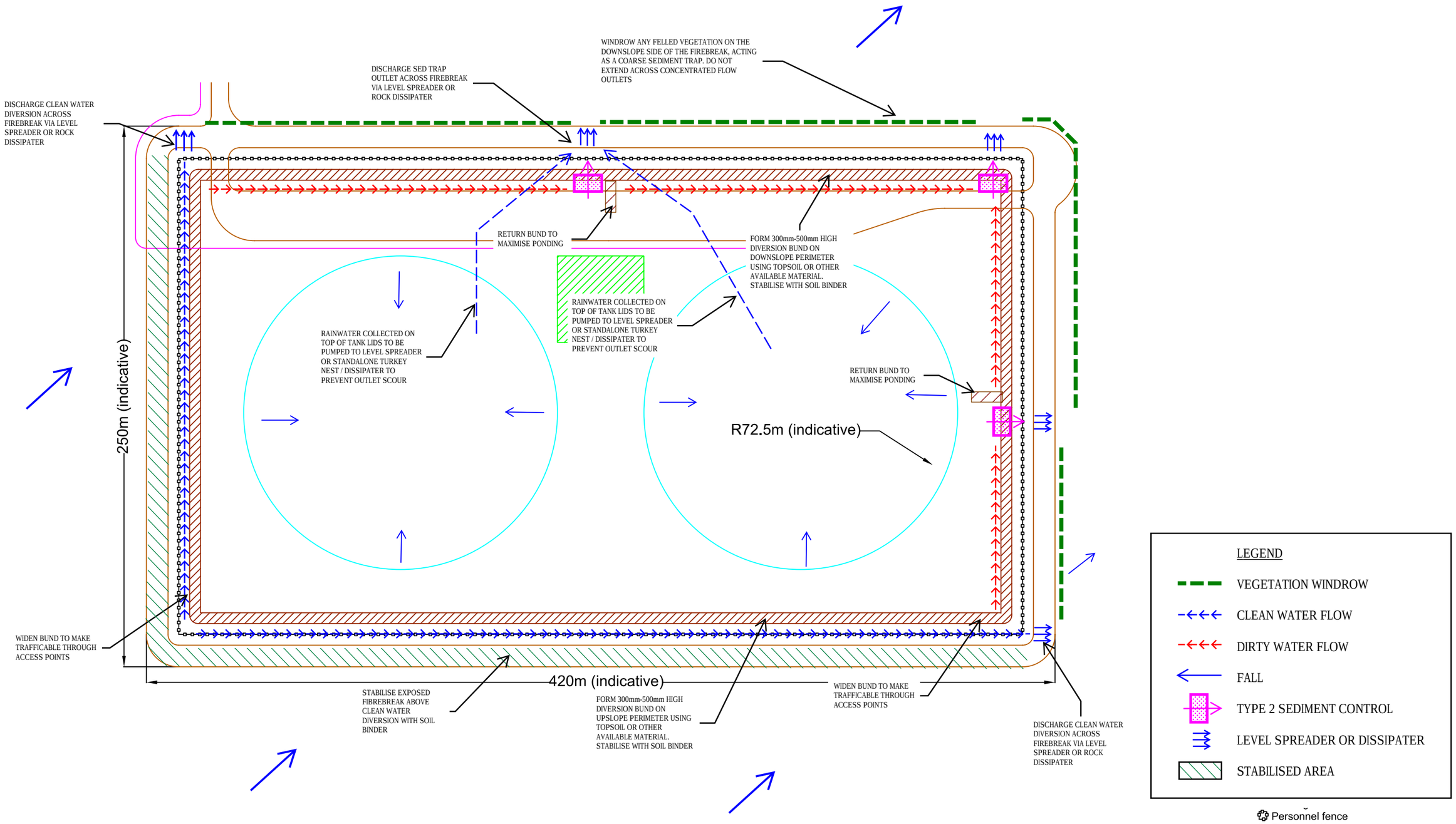
PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN
TYPICAL COMPRESSOR STATION CONSTRUCTION

PROJECT No	DRAWING No	REVISION
23-0254	D11	A



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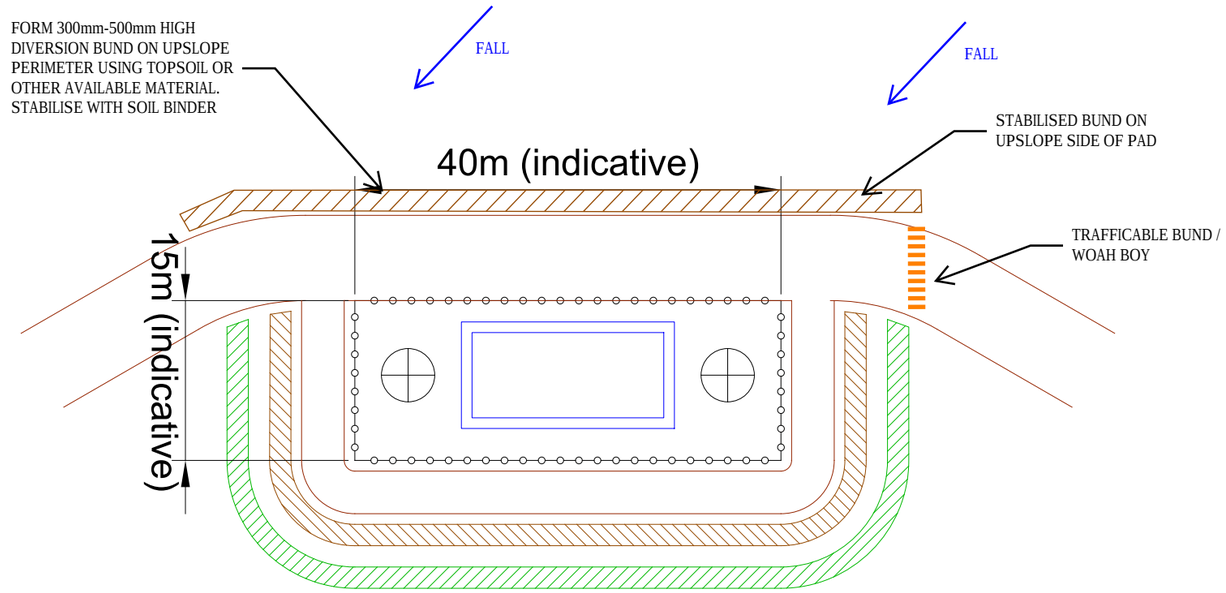
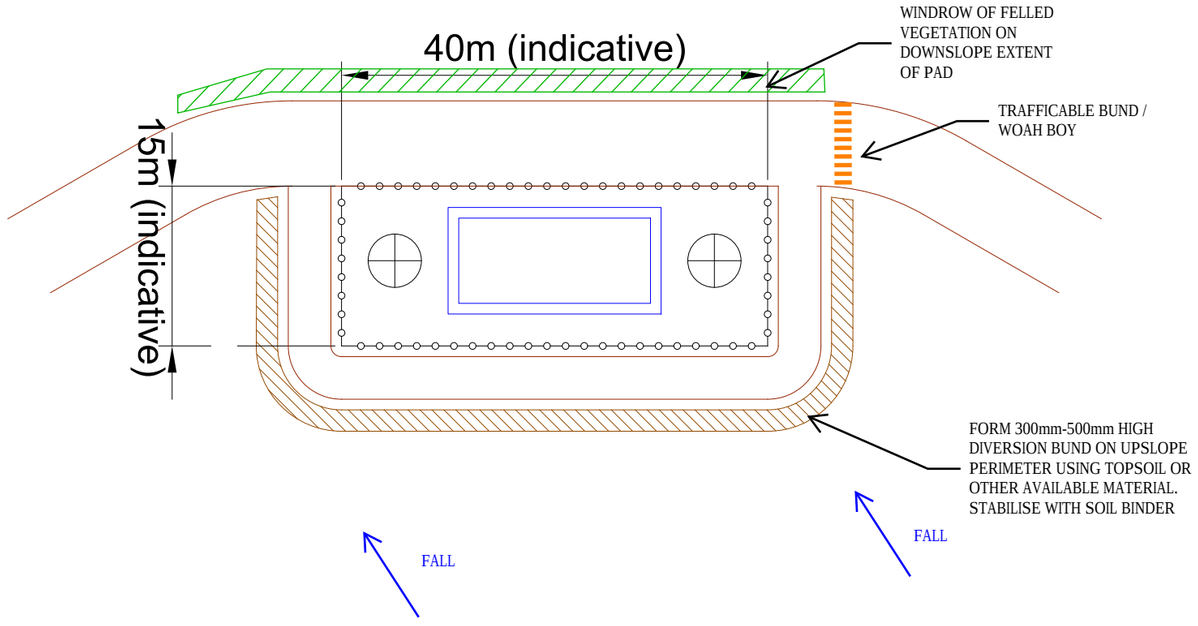
PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN TYPICAL WATER HANDLING STATION

PROJECT No	DRAWING No	REVISION
23-0254	D12	A





- Vegetation stockpile
- Topsoil stockpile/bund
- Access Track/Fire Break
- Freshwater pond
- Bore
- Fence (stock proof)

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN TYPICAL WATER BORE CONSTRUCTION

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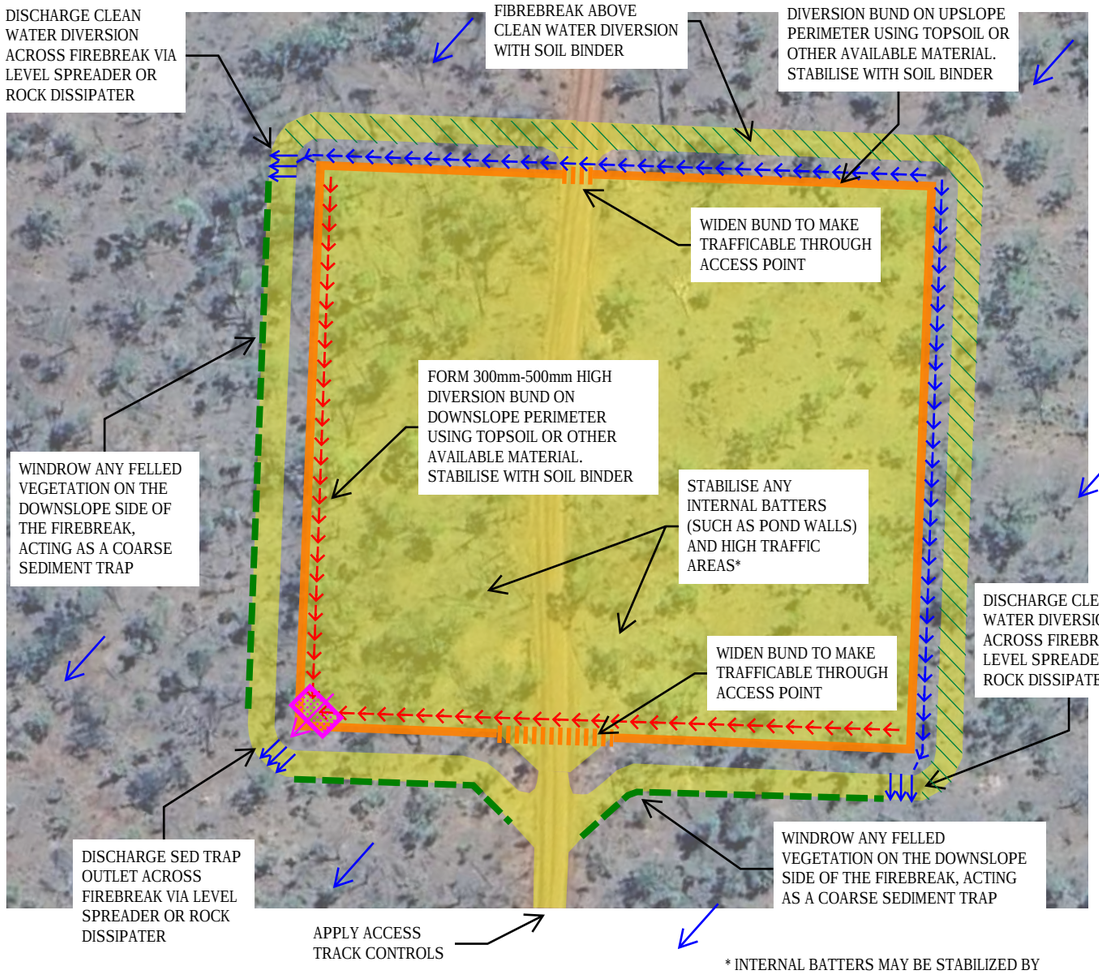
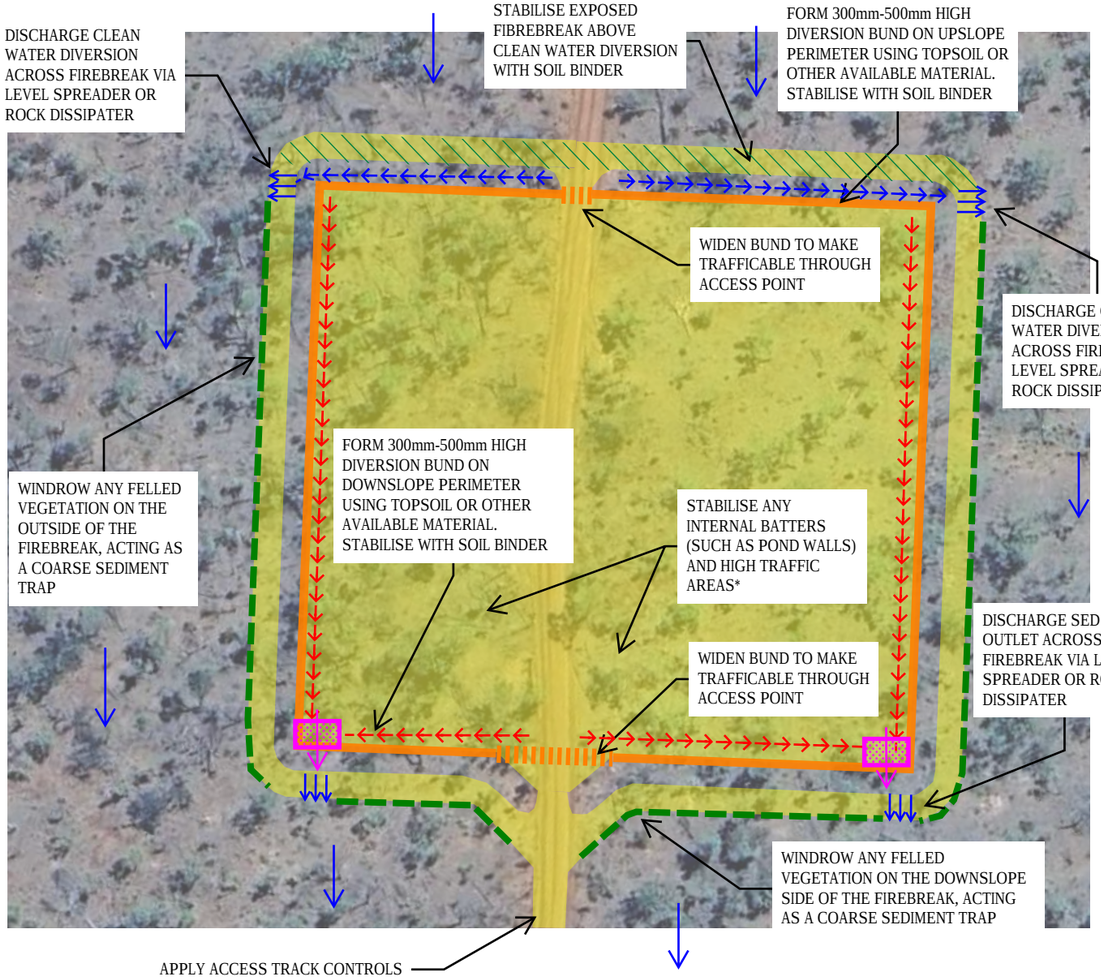


WELL PAD ON DIAGONAL SLOPE

* INTERNAL BATTERS MAY BE STABILIZED BY SEEDING NATIVE GRASS SPECIES TO REDUCE EROSION. SPECIES SELECTED WILL BE SUITED TO THE LOCAL BIOREGION.
COMBINE SEEDING WITH AN APPLICATION OF SOIL BINDER TO PROVIDE IMMEDIATE EROSION CONTROL UNTIL GRASS ESTABLISHMENT



WELL PAD ON SIDE SLOPE

LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- EXPOSED AREA
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

TOPO.

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN
TYPICAL WELL PAD CONSTRUCTION

PROJECT No	DRAWING No	REVISION
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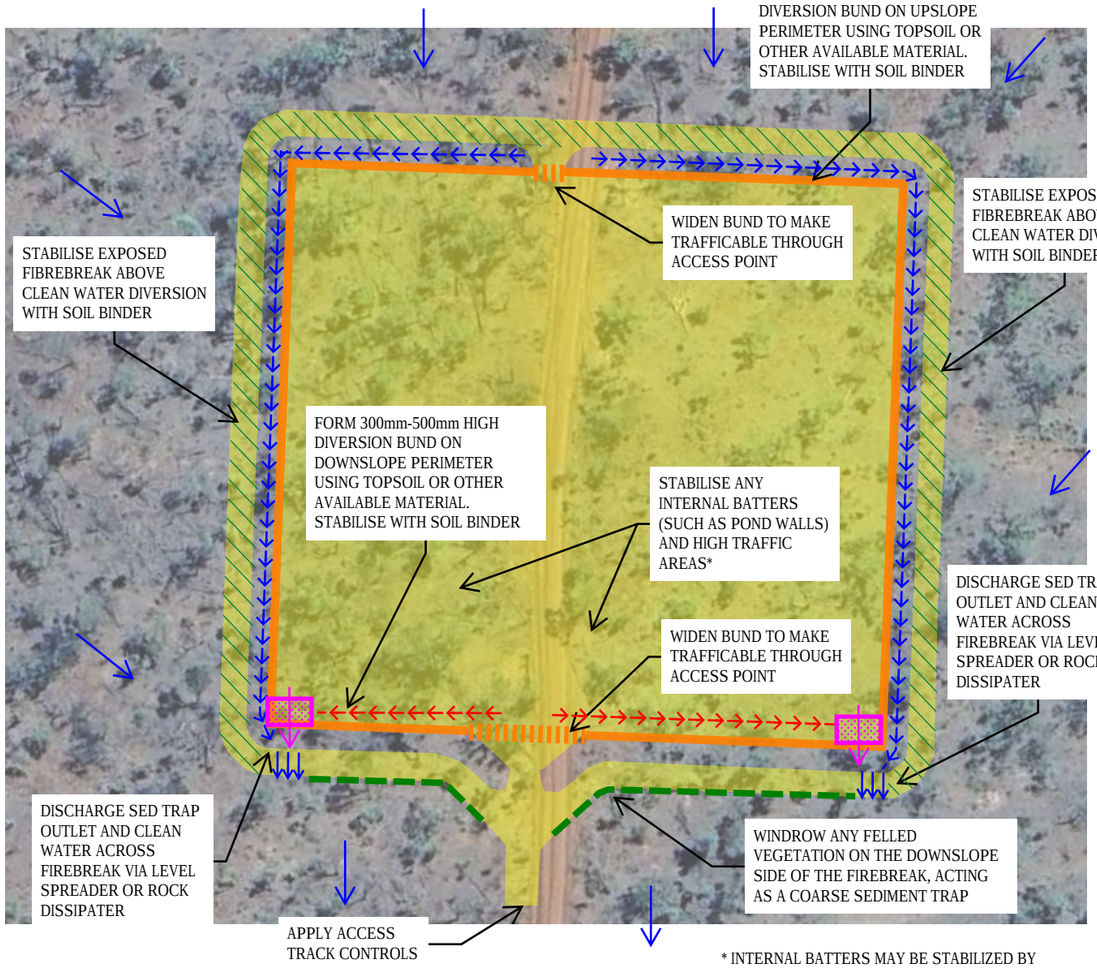
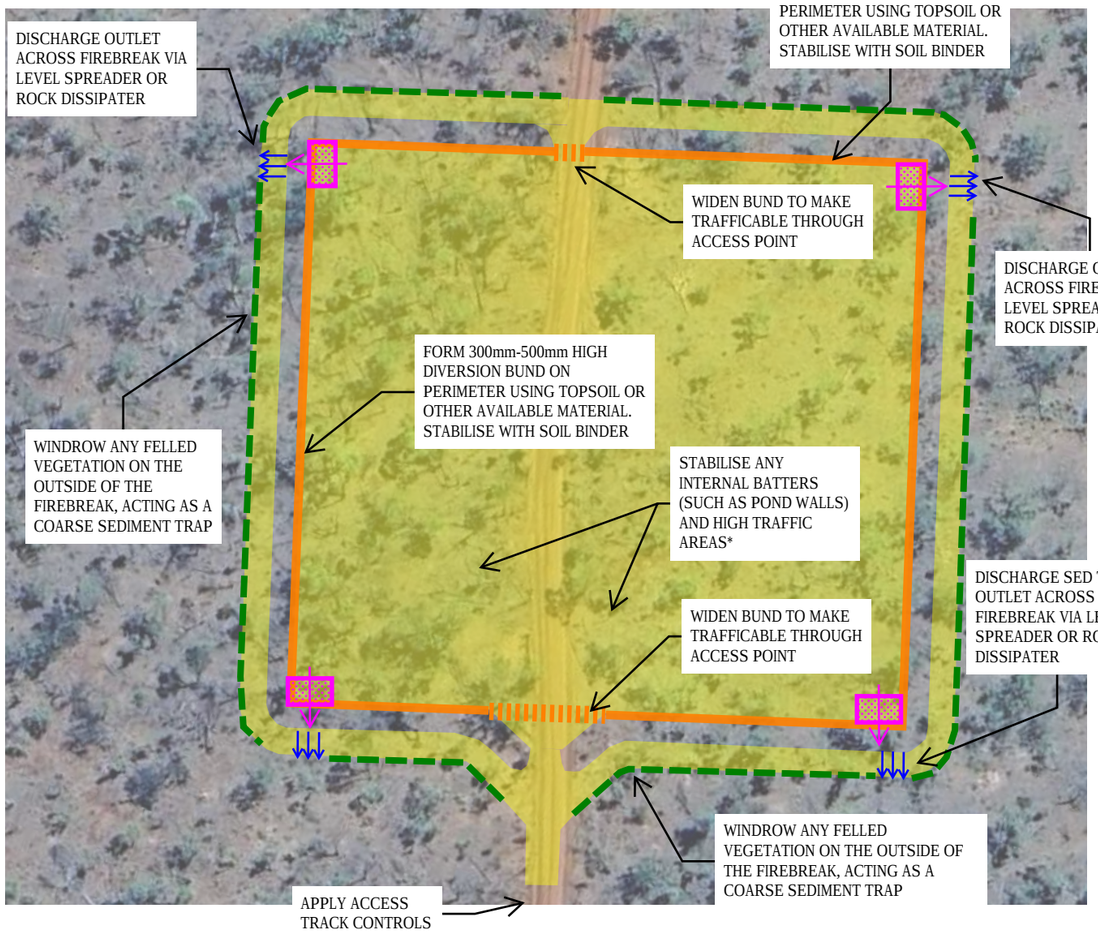


WELL PAD IN SAG

* INTERNAL BATTERS MAY BE STABILIZED BY SEEDING NATIVE GRASS SPECIES TO REDUCE EROSION. SPECIES SELECTED WILL BE SUITED TO THE LOCAL BIOREGION.
COMBINE SEEDING WITH AN APPLICATION OF SOIL BINDER TO PROVIDE IMMEDIATE EROSION CONTROL UNTIL GRASS ESTABLISHMENT



WELL PAD WITH NO APPRECIABLE FALL

LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- EXPOSED AREA
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

TOPO.

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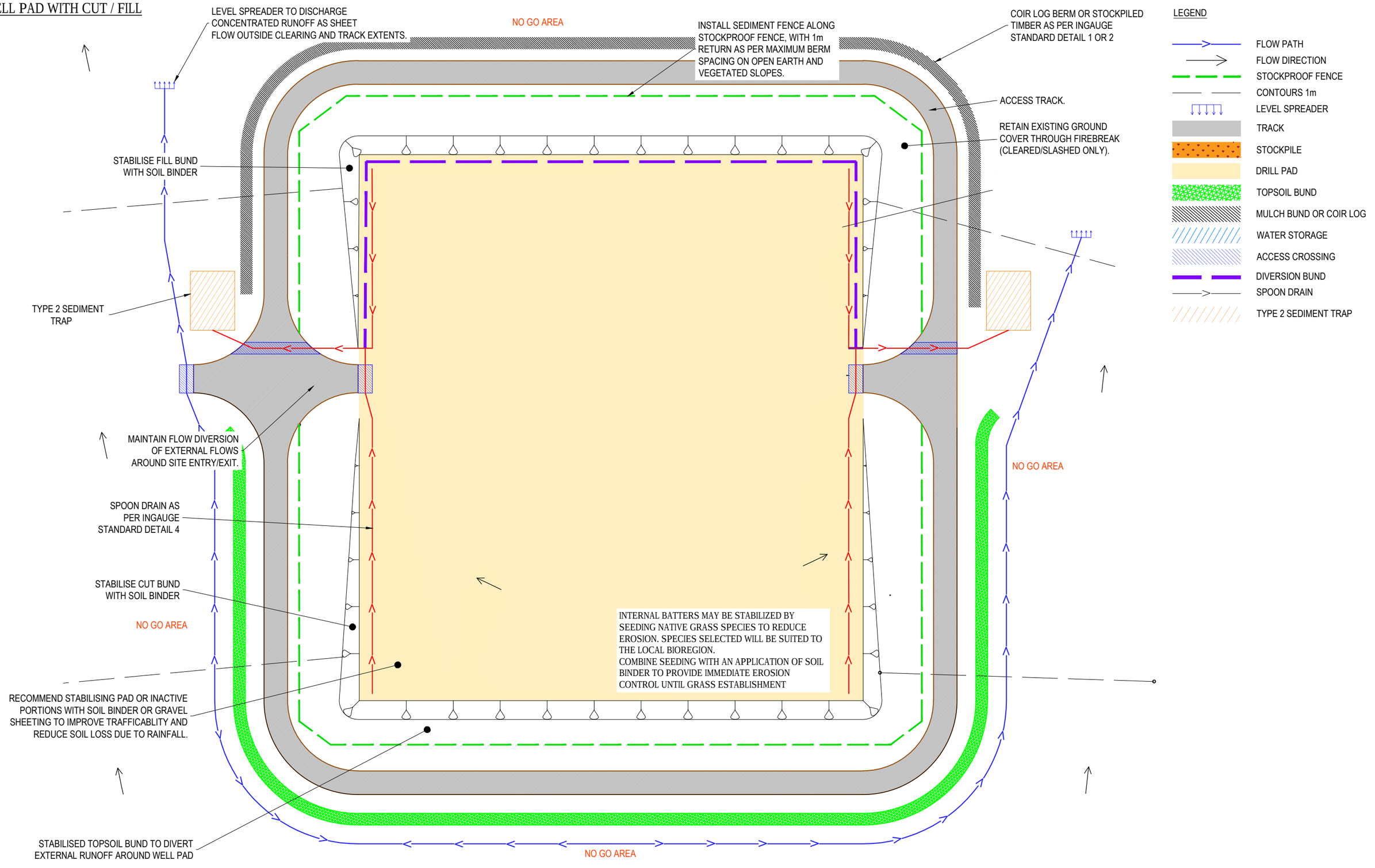
WELL PAD WITH CUT / FILL



TOPO.

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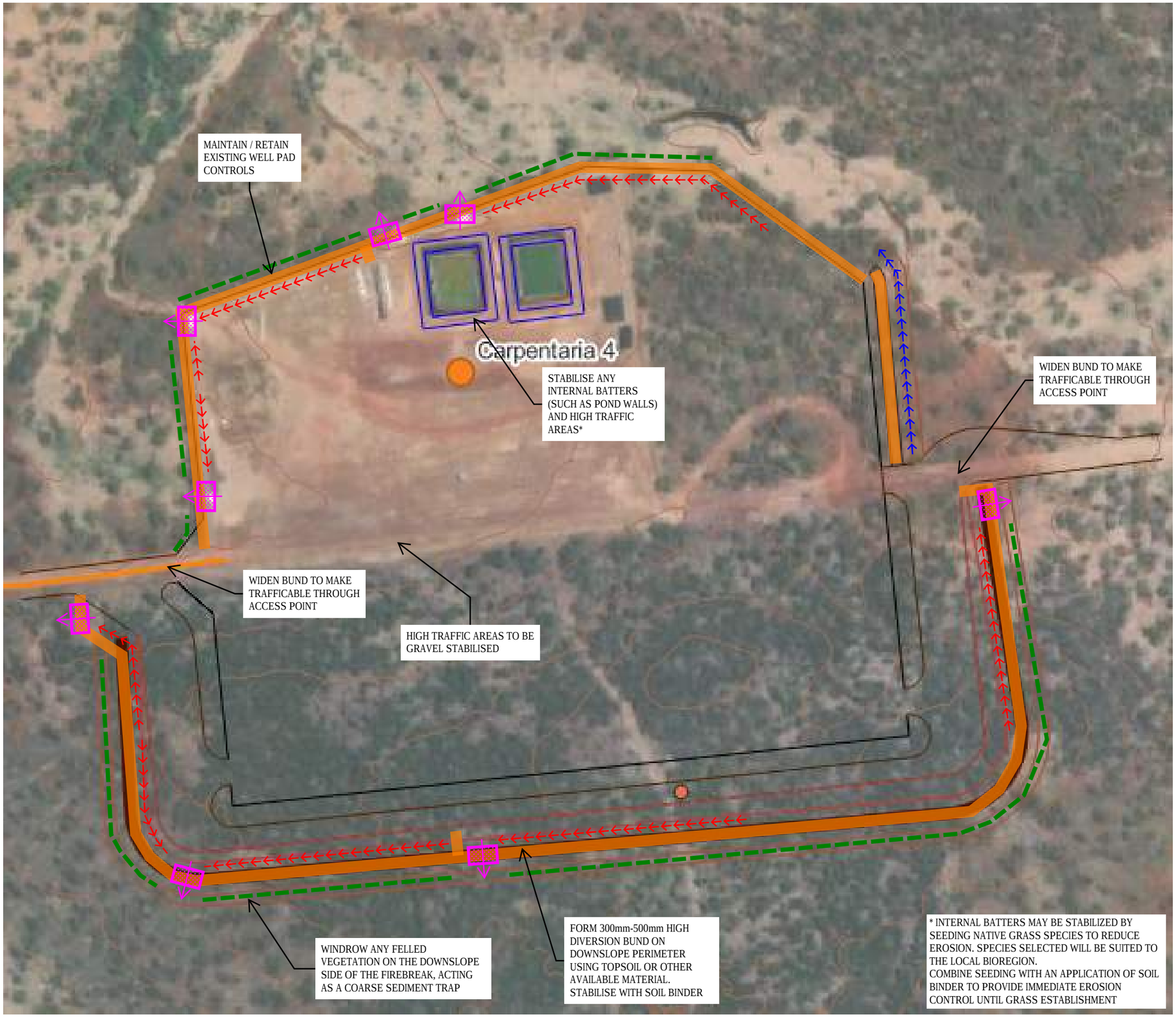
DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN TYPICAL WELL PAD CONSTRUCTION

PROJECT No	DRAWING No	REVISION
23-0254	D16	A



LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

TOPO.

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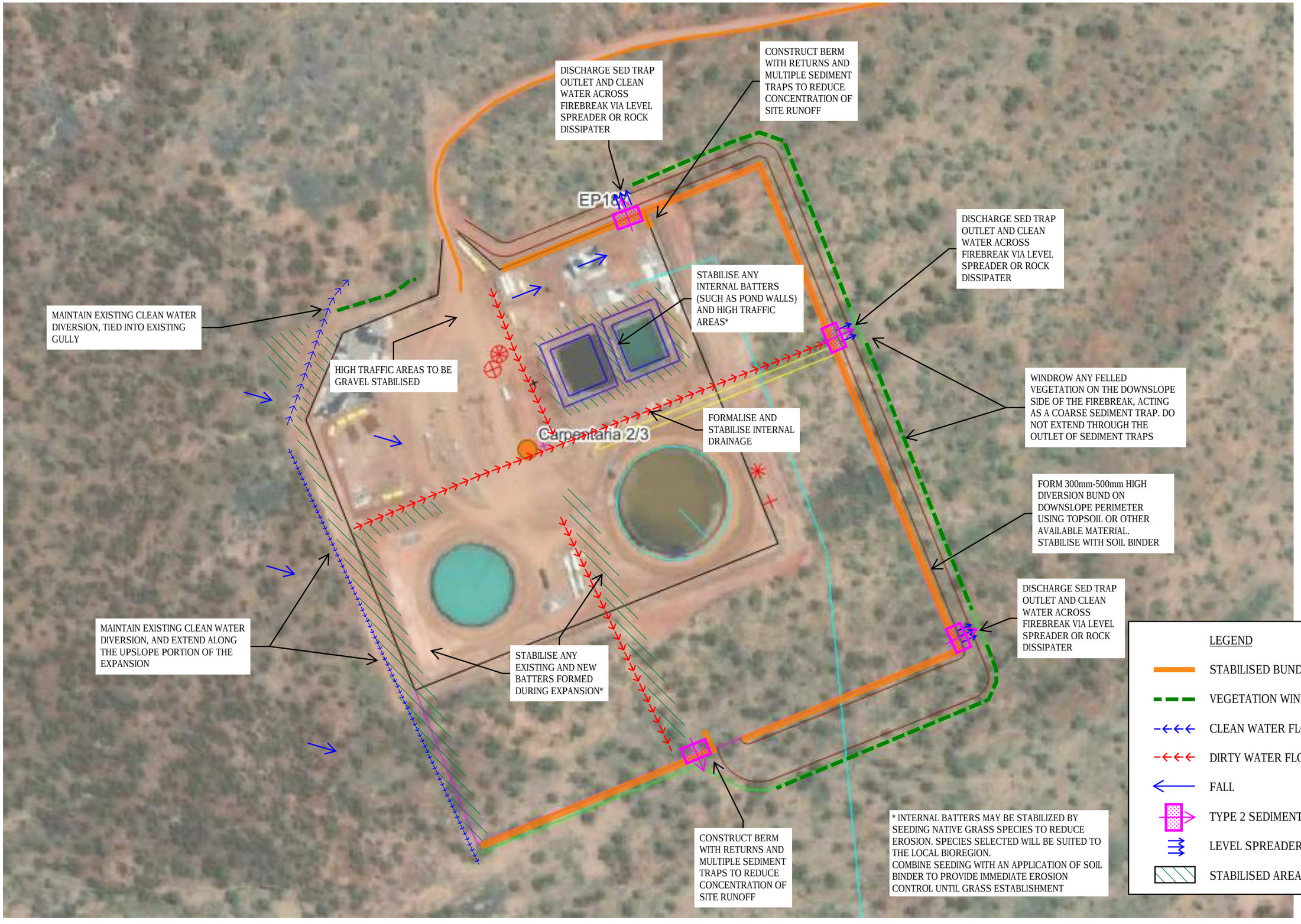
PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN CARPENTARIA 4 EXPANSION

PROJECT No	DRAWING No	REVISION
23-0254	D17	A



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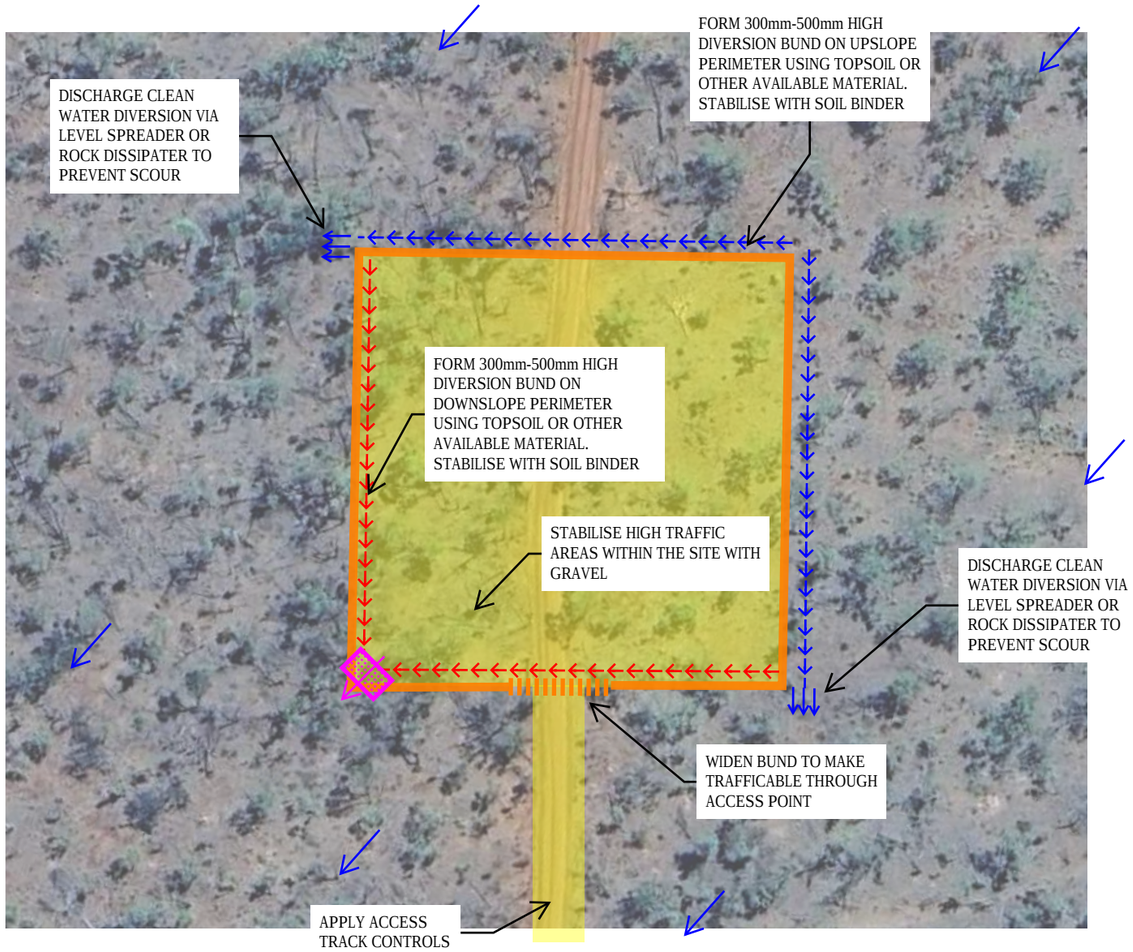
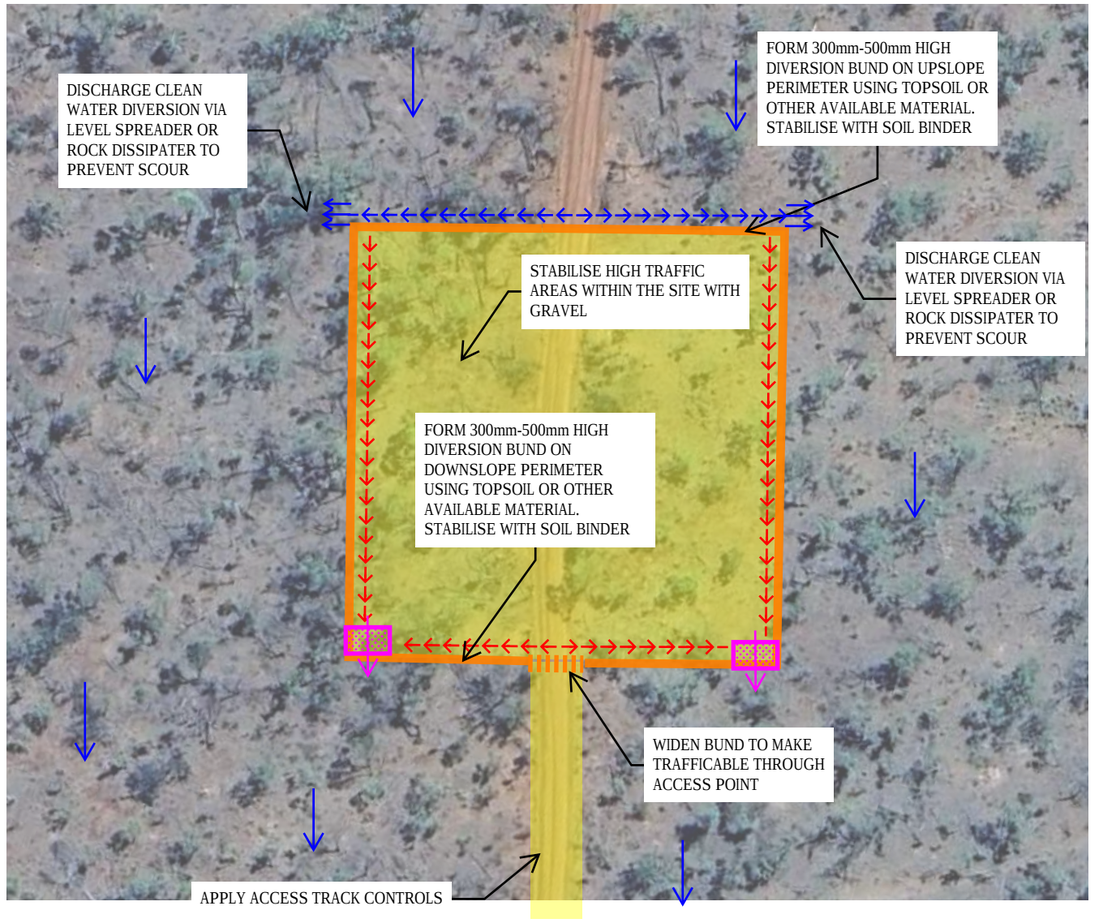
DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN CARPENTARIA 2/3 EXPANSION

PROJECT No	DRAWING No	REVISION
23-0254	D18	A



CAMP ON DIAGONAL SLOPE



CAMP ON SIDE SLOPE

LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- EXPOSED AREA
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

TOPO.

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PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN TYPICAL CAMP CONSTRUCTION

PROJECT No	DRAWING No	REVISION
23-0254	D19	A

LEGEND

- STABILISED BUND
- VEGETATION WINDROW
- CLEAN WATER FLOW
- DIRTY WATER FLOW
- FALL
- TYPE 2 SEDIMENT CONTROL
- LEVEL SPREADER OR DISSIPATER
- STABILISED AREA

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DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN TYPICAL GRAVEL PIT CONSTRUCTION

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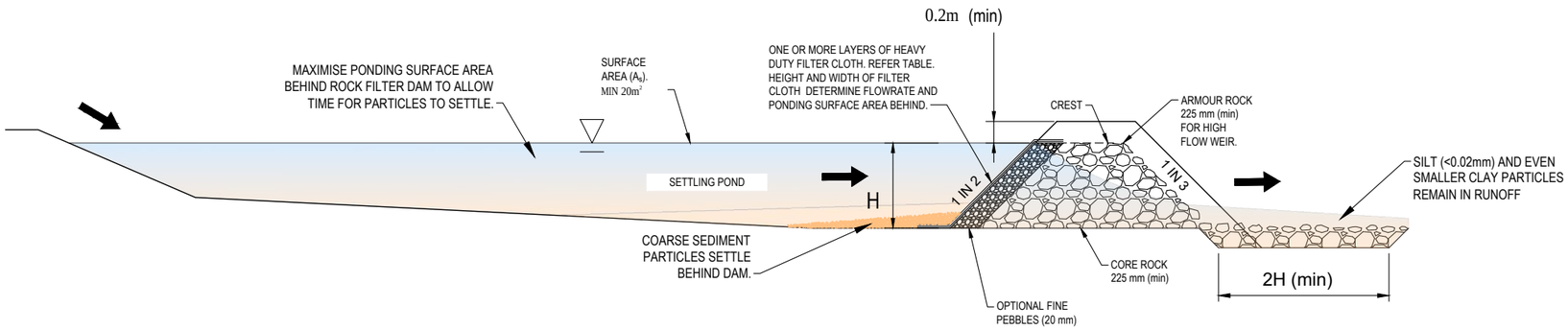
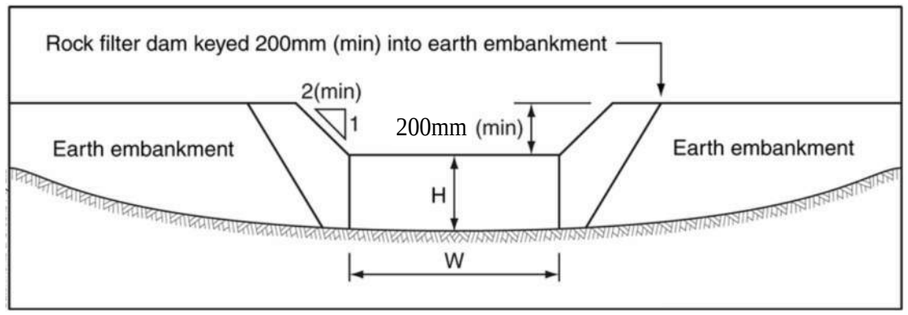


ROCK FILTER DAM



TIE IN TO TOPSOIL DIVERSION BUNDS

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PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN STANDARD DETAILS

PROJECT No	DRAWING No	REVISION
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MATERIALS

FIBRE ROLLS: TYPICALLY 200 TO 250mm JUTE, COIR OR STRAW ROLL TIED WITH SYNTHETIC OR BIODEGRADABLE MESH.

STAKES: MINIMUM 25 x 25mm TIMBER STAKES

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN PLACED ACROSS NON-VEGETATED OR NEWLY SEEDED SLOPES, THE ROLLS MUST BE PLACED ALONG THE CONTOUR.

3. IF PLACED ON OPEN OR LOOSE SOIL, ENSURE THE FIBRE ROLLS ARE TRENCHED 75 TO 125mm IN SANDY SOILS AND 50 TO 75mm IN CLAYEY SOILS.

4. ENSURE THE OUTER MOST ENDS OF THE FIBRE ROLLS ARE TURNED UP THE SLOPE TO ALLOW WATER TO ADEQUATELY POND UP-SLOPE OF THE ROLL, AND TO MINIMISE FLOW BYPASSING.

5. WHEN PLACED ACROSS THE INVERT OF MINOR DRAINS, ENSURE THE SOCKS ARE PLACES SUCH THAT:

(I) THE CREST OF THE DOWNSTREAM ROLL IS LEVEL WITH THE CHANNEL INVERT AT THE IMMEDIATE UPSTREAM SOCK (IF ANY);
(II) EACH ROLL EXTENDS UP THE CHANNEL BANKS SUCH THAT THE CREST OF THE FIBRE ROLL AT ITS LOWEST POINT IS LOWER THAN THE GROUND LEVEL AT EITHER END OF THE ROLL.

6. ENSURE THAT THE ANCHORING STAKES ARE DRIVEN INTO THE END OF EACH ROLL AND ALONG THE LENGTH OF EACH ROLL AT A SPACING NOT EXCEEDING 1.2m OR SIX TIMES THE ROLL DIAMETER, WHICHEVER IS THE LESSER. A MAXIMUM STAKE SPACING OF 0.3m APPLIES WHE USED TO FORM CHECK DAMS.
7. ADJOINING ROLL MUST BE OVERLAPPED AT LEAST 450mm, NOT ABUTTED.

MAINTENANCE

1. INSPECT ALL FIBRE ROLLS PRIOR TO FORECAST RAIN, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF PRODUCING STORMS OR OTHERWISE AT WEEKLY INTERVALS.
2. REPAIR OR REPLACE DAMAGED FIBRE ROLLS.
3. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. ALL EXCESSIVE SEDIMENT TRAPPED BY THE ROLLS MUST BE REMOVED FROM THE DRAIN OR SLOPE IF SUCH SEDIMENT IS LIKELY TO BE WASHED AWAY BY THE EXPECTED FLOWS.
2. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.
3. THE BIODEGRADABLE CONTENT OF THE STRAW ROLLS MAY NOT NECESSARILY NEED TO BE REMOVED FROM THE SITE.
4. ALL SYNTHETIC (PLASTIC) MESH OR OTHER NON READILY BIO-DEGRADABLE MATERIAL MUST BE REMOVED FROM THE SITE ONCE THE SLOPE IF DRAIN IS ESTABLISHED, OR THE ROLLS HAVE DETERIORATED TO A POINT WHERE THEY ARE NO LONGER PROVIDING THEIR INTENDED DRAINAGE OR SEDIMENT CONTROL FUNCTION.

Source: www.austieca.com.au/documents/item/124

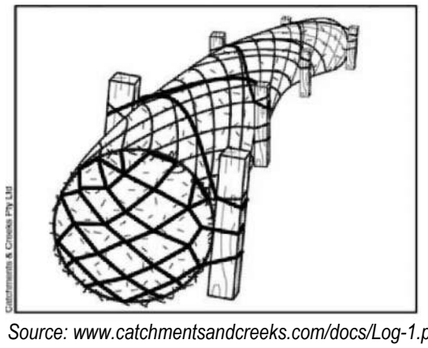
DRAINAGE CONTROL

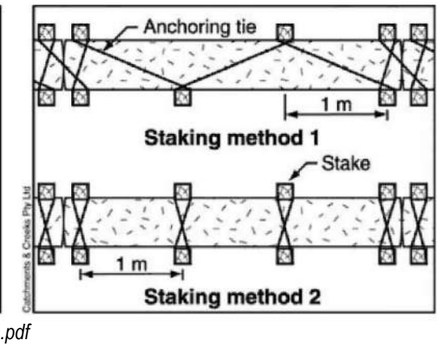
IN THIS CASE, COIR LOGS WILL ALSO BE USED AS DRAINAGE CONTROL. THIS HAS BEEN CONSIDERED A PREFFERED OPTION OVER CUTTING A DRAIN OR INSTALLING A BUND, BOTH OF WHICH REQUIRE SOIL DISTURBANCE. WHERE COIR LOGS ARE USED AS DRAINAGE CONTROL:

1. THE ENDS OF THE FIBRE ROLLS MUST BE STRAIGHT TO ALLOW WATER TO FLOW PAST THE ROLLS TO A LEVEL SPREADER.
2. ENSURE THE FIBRE ROLLS ARE TRENCHED 100mm INTO THE SOIL.
3. FIBRE ROLLS MUST BE OVERLAPPED AT LEAST 450mm IN THE DIRECTION OF THE FLOW AND NOT ABUTTED.
4. THE FLOWPATH ALONG THE ROLLS MUST BE CHECKED AFTER RAINFALL TO ENSURE EXTERNAL RUNOFF IS NOT ENTERING THE ACTIVE WORK SITE. AN ADDITIONAL ROW OF LOGS WILL NEED TO BE PLACED IF THIS IS THE CASE.

Source: www.westernexcelsior.com/products.html

Source: www.catchmentsandcreeks.com/docs/Log-1.pdf





Source: www.catchmentsandcreeks.com/docs/Log-1.pdf

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ISSUED FOR USE

CLIENT: IMPERIAL OIL AND GAS PTY LTD

DRAWN	DESIGNED	DATE
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RPEQ / SIGNATURE (IF REQUIRED)

PROJECT: EP187 CARPENTARIA PILOT PROJECT

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN STANDARD DETAILS

PROJECT No	DRAWING No	REVISION
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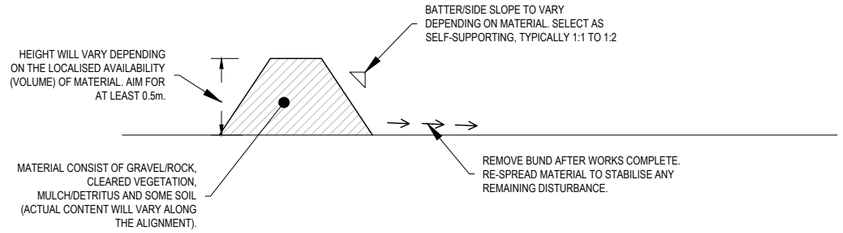
BUND/WINDROW

NOTE: BUND/WINDROW PRESCRIBED FOR USE AS BOTH DRAINAGE AND SEDIMENT CONTROL. REFER COVER REPORT R3188 FOR DETAIL.

INSTALLATION

1) FORM WINDROW/BUND OF CLEARED MATERIAL. CONSTRUCTION WILL VARY ALONG THE ALIGNMENT DEPENDING ON MATERIAL ENCOUNTERED WITHIN SPECIFIC REGION, CONSISTING OF GRAVEL/ROCK, CLEARED VEGETATION, MULCH/DETRITUS AND SOME SOIL.
2) HEIGHT WILL VARY DEPENDING ON THE LOCALISED AVAILABILITY (VOLUME) OF MATERIAL. AIM FOR AT LEAST 0.5m
3) BATTER/SIDE SLOPES WILL VARY DEPENDING ON THE SPECIFIC CONSTRUCT. FORM AS SELF-SUPPORTING SLOPE, TYPICALLY 1:1 TO 1:2.
4) DISCHARGE ANY BUNDS UNDER SHEET FLOW CONDITIONS, RETURNING IT UPSLOPE AS A LEVEL SPREADER
5) BUNDS ARE INSTALLED ON TOP OF EXISTING GROUND COVER WHERE LOCATED ON EXTENT OF CLEARING
6) REFER DETAILS PROVIDE FOR LOCATION AND LAYOUT OF BUNDS THROUGHOUT THE PROJECT



TYPICAL BUND/WINDROW SECTION
NOT TO SCALE

MAINTENANCE

1) INSPECT PRIOR TO RAINFALL TO ENSURE COMPLAINCE WITH ALL NOTE ABOVE, AND FOLOWING RAINFALL TO IDENTIFDY DETRIORATION.
2) CHECK FOR DAMAGE RESULTING FROM ACCESS OR TRAFFIC,OR HIGH FLOWS
3) REMEDIATE ANY SCOUR TO SOIL
4) REPLACE OR RE-FORM ANY DAMAGED SECTIONS
5) UNDERTAKE MAINTENANCE WITHIN 48HRS OR PRIOR TO IMMINENT RAINFALL

REMOVAL

1) AFTER ACCESS TO THE CLEARING AREA IS NO LONGER REQUIRED REINSTATE GROUND COVER USING THE BUND MATERIAL
2) RE-SPREAD MULCH, LEAF LITTER AND CLEARED VEGETATION TO STABILISED CLEARED AREA, SIMULTANEOUSLY REMOVING THE BUND/WINDROW
3) ENSURE NO PREFERENTIAL FLOW PATHS REMAIN AFTER REMOVAL

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GROUND COVER ASSESSMENT

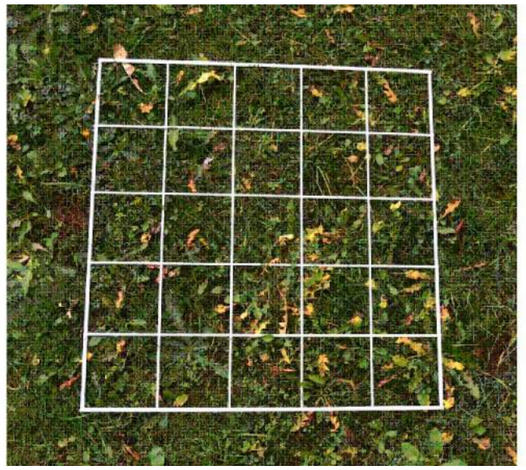
STEP POINT METHOD

1. PREPARE A FIELD SHEET ON WHICH TO RECORD OBSERVATIONS.
2. IDENTIFY AN AREA WITHIN THE SITE WHICH IS TYPICAL IN TERMS OF THE AMOUNT OF COVER AND PROPORTION OF NATIVE GROUNDCOVER.
3. WALK 100 STEPS IN A STRAIGHT LINE ACROSS THE SELECTED AREA.
4. AT EACH STEP, RECORD THE GROUNDCOVER AT THE TIP OF YOUR BOOT
5. REPEAT THIS IN AT LEAST FOUR OTHER AREAS ACROSS THE CLEARED SITE, COVERING VARIATIONS IN GROUNDCOVER WHERE POSSIBLE.
6. TO CALCULATE THE PERCENTAGE OF THE GROUNDCOVER DIVIDE THE AVERAGE BY THE OVERALL GROUNDCOVER PERCENTAGE FROM THE PREVIOUS STEP AND THEN MULTIPLY BY 100.
7. LOG PHOTOGRAPHS OF THE ASSESSMENT FOR PERFORMANCE TRACKING

QUADRAT METHOD

THIS METHOD USES A SQUARE FRAME (QUADRAT) OF AT LEAST 70cm x 70cm. SUCH A QUADRAT IS EASILY ASSEMBLED USING FOUR THIN PIECES OF PVC PIPE OR WIRE CUT TO EQUAL LENGTHS AND JOINED WITH TIGHT-FITTING ELBOW JOINTS.

1. PREPARE A FIELD SHEET ON WHICH TO RECORD OBSERVATIONS.
2. WITHIN THE SPECIFIC AREA SELECT AT LEAST FIVE AREAS OF GROUNDCOVER THAT ARE TYPICAL OF THE GROUNDCOVER ACROSS THAT AREA
3. FOR EACH REPRESENTATIVE AREA (SAMPLE AREA), PLACE THE QUADRAT RANDOMLY 10 TIMES.
4. FOR EACH QUADRAT PLACEMENT ESTIMATE THE PERCENTAGE OF THE QUADRAT THAT HAS VEGETATIVE GROUNDCOVER (NON-NATIVE AND NATIVE GROUNDCOVER), AND RECORD THIS IN THE FIELD SHEET
5. FOR THE WHOLE SITE ADD THE AVERAGES FROM ALL SAMPLE AREAS AND DIVIDE THESE TOTALS BY THE NUMBER OF SAMPLE AREAS TO YIELD THE AVERAGE PERCENTAGE OF GROUNDCOVER (NATIVE AND NON-NATIVE) ACROSS THE ENTIRE SITE
6. LOG PHOTOGRAPHS OF THE ASSESSMENT FOR PERFORMANCE TRACKING



QUADRAT METHOD

GROUND COVER - 20%

GROUND COVER - 40%

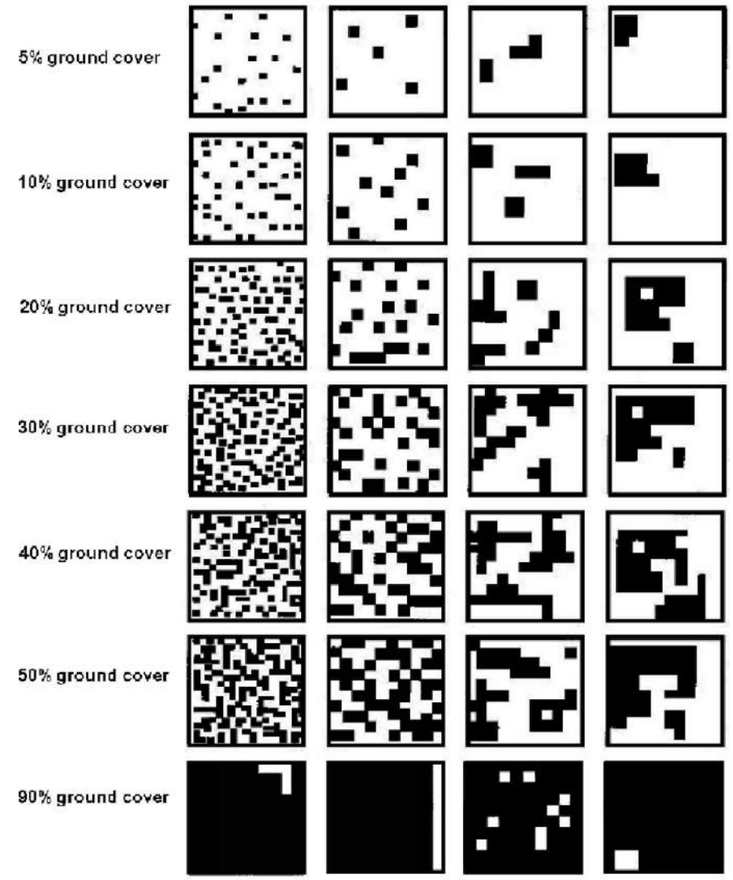
GROUND COVER - 70%

GROUND COVER - 90%

GROUND COVER ASSESSMENT OF VEGETATION

'GROUND COVER' APP

A USEFUL APPLICATION TO ASSESS GROUND COVER IS AVAILABLE FOR IOS DEVICES ON THE APP STORE. 'GROUND COVER' USES GEO-LOCATION TECHNOLOGY ALONG WITH A STANDARD STEP POINT MONITORING PROCESS AND IS SUPPORTED WITH PHOTOGRAPHIC BENCHMARK CAPABILITY. 'GROUND COVER' TAKES THE USER THROUGH THE STEP POINT METHOD IN A STRAIGHT FORWARD WAY TO GET YOU STARTED.



GROUND COVER ASSESSMENT FOR VEGETATION, ROCK, GRAVEL, SOIL BINDER, LEAF MATTER, MULCH OR SIMILAR

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