BOWEN ORBITAL SPACEPORT (BOS) DEVELOPMENT

EROSION AND SEDIMENT CONTROL MANAGEMENT PLAN

43076-1-ENV-REP_1

Prepared for	Gilmour Space		
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VALUE THROUGH INTEGRATION

Proprietary Information Statement

Document Information

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1 INTRODUCTION

The Bowen Orbital Spaceport, as is the case with all development, has the potential to increase the risk in some areas of the access track and launch facility of erosion and the transport of sediment to land and waters during rainfall events. This potential exists throughout the lifecycle of the facility including during the construction, regular operations, and decommissioning phases. The highest risk of erosion potential and exists during the construction phase when land disturbance and exposed areas are greatest.

The Bowen Orbital Spaceport is subject to legal obligations to protect environmental values by preventing releases of contaminants and sediments to the adjacent land and waters. Gilmour Space will implement erosion and sedimentation management approaches to manage potential for impacts cognisant of environmental risk and costs.

1.1 Purpose

The purpose of this Erosion and Sediment Management Plan (ESCMP) is to demonstrate the framework and strategies Gilmour Space intends to implement to demonstrate compliance with regulatory, development approval and community expectation requirements.

1.2 Scope

This ESCMP identifies erosion and sediment risk within Bowen Orbital Spaceport (BOS) launch area and provides an erosion and sediment control strategy cognisant of these risks. The ESCMP is to be implemented by all Gilmour Space personnel including contractors and visitors conducting activities throughout the construction and operational phases.

This plan has been developed in accordance with the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline (IECA, 2008).

It is assumed that there may be differences as construction progresses between assumed conditions and construction processes that are outlined in this report, which has been prepared as part of the pre-construction approval process, and those that occur on the ground. As such, this plan should be treated as a live document, with regular reviews completed and all modifications to the plan noted on the affronting revision table. This may require consultation with the author of this plan.

1.3 Objectives and Targets

This Erosion and Sediment Control Plan has been developed in accordance with the following guidelines and Technical Standards:

- *Best Practice Erosion and Sediment Control* (IECA, 2008);

The objective of this ESCP is to minimise erosion, sediment discharge and impacts upon the environmental values of the receiving waters throughout the construction and post-construction stages, and to address the soil physio-chemical properties that may limit the success of the rehabilitation of project disturbance footprint.

To achieve compliance with the project environmental approval, the following targets are required to be met through compliance with this ESCP:

Fine Sediment (<0.02mm)	Minimise mobilisation of fines from the site
Coarse Sediment (>0.02mm)	Retain all coarse sediment on site

1.4 Project Area

The Bowen Orbital Spaceport is a facility to support small class orbital launch vehicles with access to multiple Low Earth Orbit trajectories. It is located within the Abbot Point State Development Area (SDA), which falls within the Whitsunday Regional Council (WRC) area, approximately 15km north of the Bowen township.

The launch site is on Lot 10 Abbot Point Road which is accessed from the Bruce Highway via Abbot Point Road. The facility footprint will be approximately 3 ha within the 94 Hectare lot in a previously cleared new growth area.

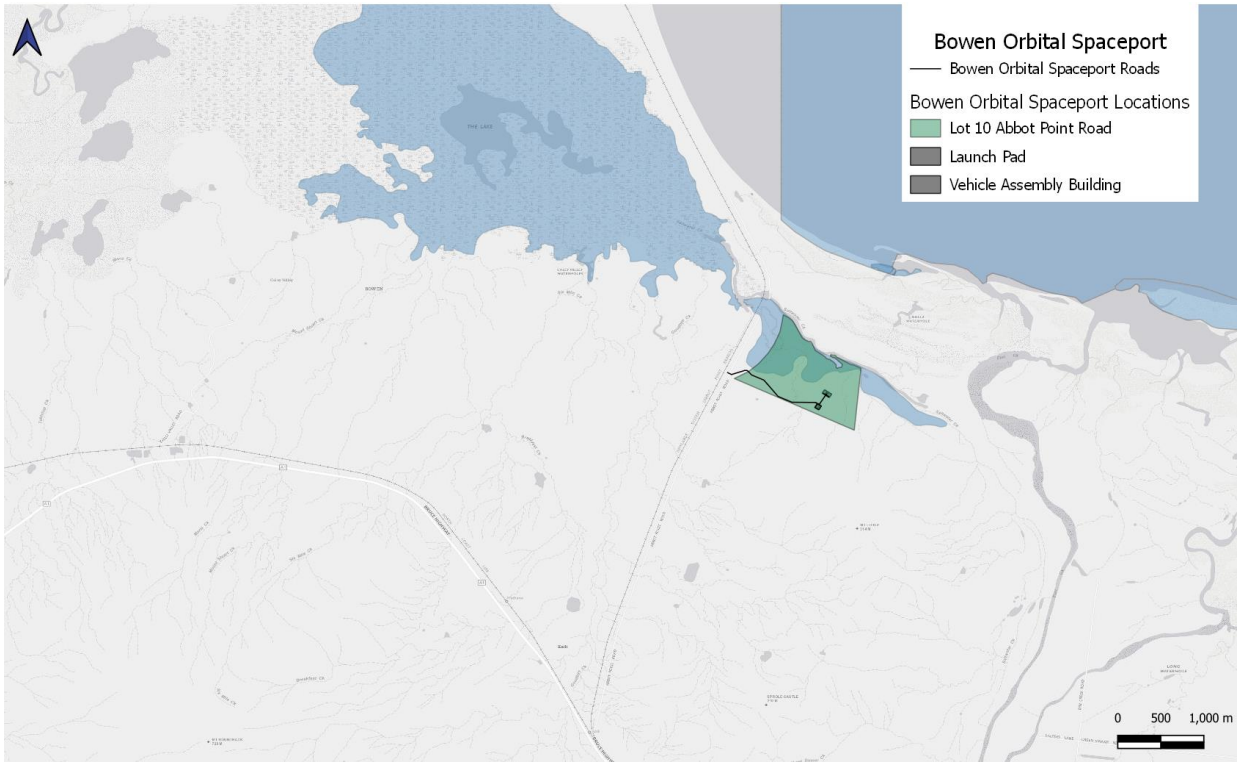

Figure 1 – Location of the Proposed Site.

2 LEGISLATION, CODES AND STANDARDS

An overview of the legislative requirements relevant to this ESCMP is provided in Table 1 below. The EP Act is the principal legislation governing Gilmour Space Technologies responsibilities in relation to erosion and sediment management.

- **Austroads**
  - Guide to Road Design Part 5: Drainage-General and Hydrology Considerations
- **Australian Government Department of Agriculture, Water and the Environment (DAWE)**
  - Environmental Protection & Biodiversity Conservation (EPBC) Act 1999
- **Queensland Department of Environment and Science**
  - Environmental Protection Act 1994
  - Environmental Protection Regulation 2019
  - Environmental Protection (Water and Wetland Biodiversity) Policy 2019
  - Planning Act 2016
  - Planning Regulation 2017
  - Soil Conservation Act 1986
  - Coastal Protection and Management Act 1995
- **International Erosion Control Association**
  - Best Practice in Erosion and Sediment Control Guidelines, International Erosion Control Association

2.1 Reference Documentation and Reports

Reference documentation and reports which have informed this plan include:

- **Queensland Government, 2018**
  - Geological Survey of Queensland, Abbot Point 1:100000 Geology Map Compilation 2018
- **BMT WBM, July 2015**
  - Abbot Point Growth Gateway Project – Technical Report for Wetland Flooding Component
- **Worley Parsons, 2015**
  - Soil Assessment and Management Plan – Abbot Point Growth Gateway Project ()
- **CDM Smith, 2014**
  - State Development Area Application – Planning Report – Abbot Point Terminal 0 Project
- **Connell Wagner Pty Ltd, September 2004**
  - Bowen Shire Storm Tide Study – Final Report prepared for the Bowen Shire Council
- **Maunsell, 2008**
  - Bowen Abbot Point Flood Modelling Study – Assessment of Flooding Constraints Report prepared for Minister of Industrial Development of Queensland

3 SITE CHARACTERISTICS

3.1 Climate

Average annual rainfall as recorded by the Bureau of Meteorology (BoM) station located at Proserpine Post Office (Station 033061) is 1433.7 mm. There is seasonality with the highest rainfall period between December and April.

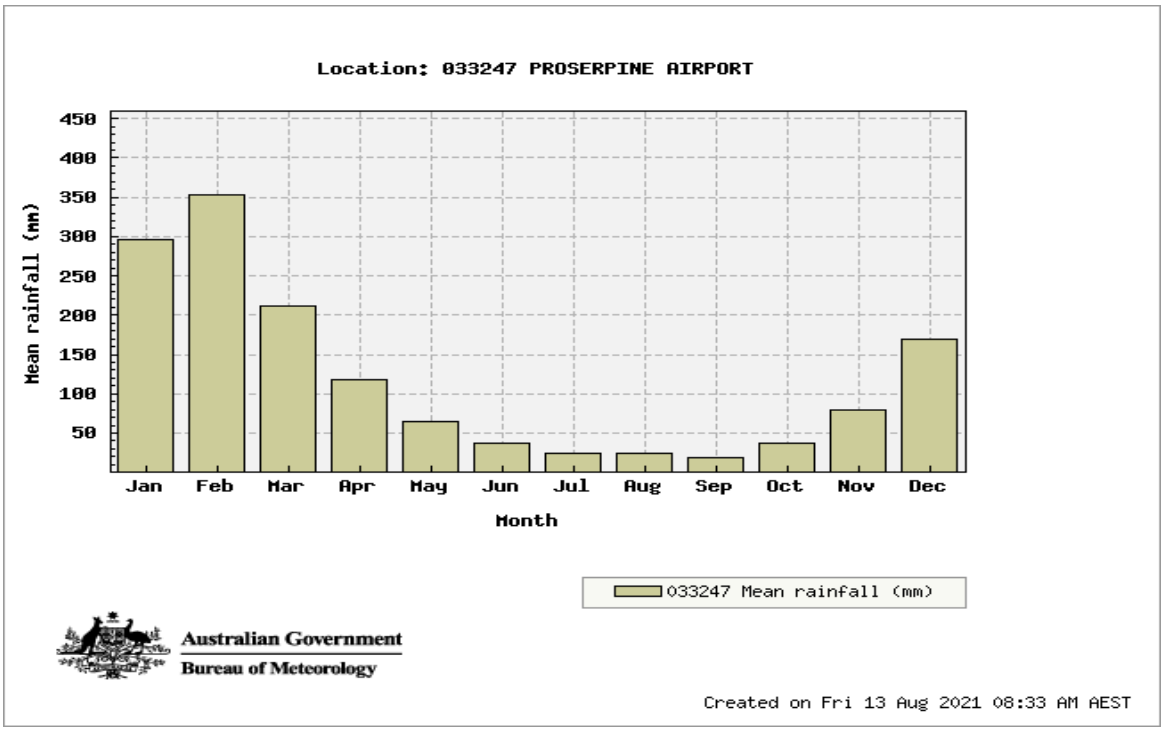

Figure 2 - Average Monthly Rainfall

The highest mean temperature occurs between November and February with maximum average temperature of 32.3° recorded in the month of December.

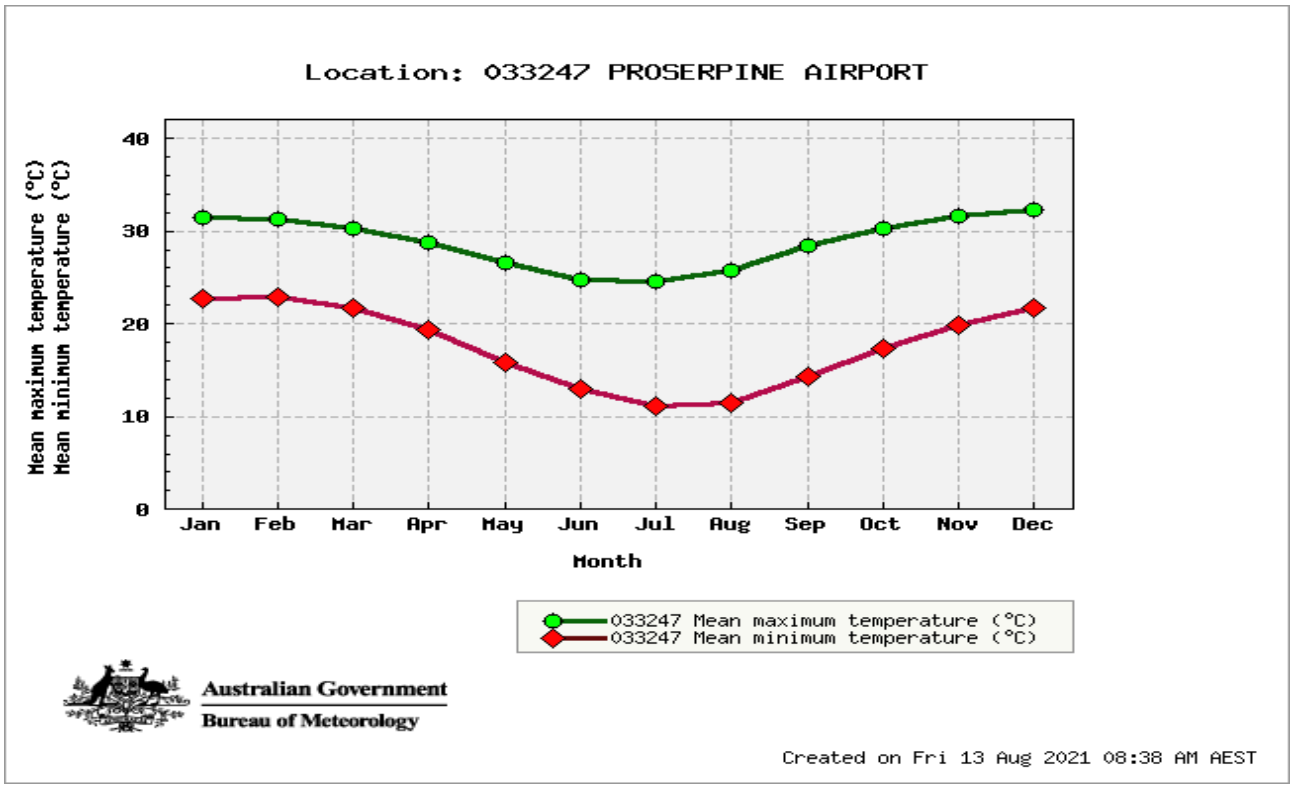

Figure 3 - Average Monthly Mean Maximum and Minimum Temperature

4 EROSION RISK IN THE PROJECT AREA

Soils of the Bowen Orbital Spaceport Project area show similar association to the geology of the broader Abbot Point SDA region. Much of the low lying areas in the northern part of the property is covered by clay, silt, and sand deposits (Qa). In the southeast corner of the property there is a pocket of colluvium (Qr\t) overlapping the proposed development location that is comprised of boulders and cobbles with interstitial sand and clays and intermittent talus deposits.

While erosion risk is anticipated to be low within the disturbance area due to the small footprint, low lying, low gradient and geology of the proposed site, it is expected that adequate drainage and controls can be designed and implemented across the development to mitigate associated erosion risks.

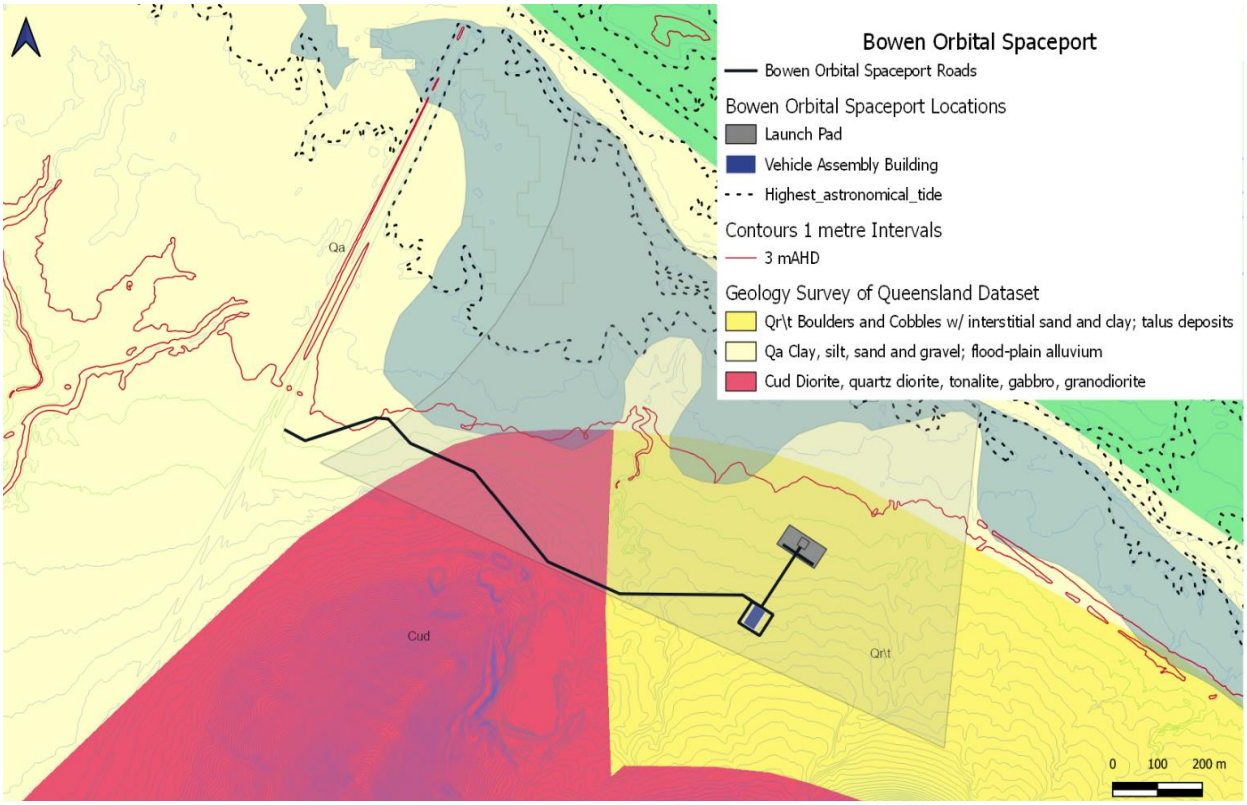

Figure 4 – Bowen Orbital Spaceport Disturbance Area and Geology

4.1 Methodology

Erosion risk assessment is utilised as a preliminary indicator assessment tool to determine the level and type of sediment and erosion controls that should be applied to a project. The effectiveness of these controls should be re-evaluated post installation and reviewed post any runoff producing rainfall event, with any changes to controls recorded in revisions of this plan.

4.1.1 Soil Erodibility (K)

The soil erodibility is a numeric representation of the ability of the soil to resist the erosive energy of rain. The subsoils are a Clay Loam (CL), and based upon Table E4 (IECA, 2008), with a K-factor of 0.035.

4.1.3 Rainfall Erosivity

The rainfall erosivity factor (R factor) is a measure of the ability of the rain to cause erosion. The annual R-factor as per Table E1 (IECA. 2008) is 4600. However, as construction is anticipated to take less than 6 months, an annual erosivity factor is unlikely to give an appropriate indication of the potential environmental hazard. Construction is recommended to be completed during the months of lower rainfall erosivity (i.e. May – November) to limit the impact.

4.1.4 Slope Length and Steepness

Slope length and slope gradient have substantial effects of soil erosion by water. The factor has been evaluated utilising Table E3 (IECA, 2008) based upon the slope gradient - slope length factor that represented the worst case scenario. Where this project is later discussed in terms of staging, separate calculations based upon each stage have been calculated to reflect the individual stages.

For the overall project a slope gradient of 6.1% over 200m slope length for the contributing sub-catchment has been considered within the design.

4.1.5 Site Management

The C & P factors represent 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. The worst case scenario of no cover (bare soil) has been adopted, i.e. C-factor = 1.0 for consideration of risk and determination of appropriate controls.

The P-factor measures the combined effect of all support practices and management variables. For construction sites it represents the roughening or smoothing of the soil surface by machinery. Therefore, to represent the construction period (prior to the soil getting a final treatment), a P-value of 1.3 has been considered when considering controls (to reflect a smooth, compacted surface).

4.1.6 Overall Erosion Risk Assessment

During the months of May – November the erosion risk assessment can be considered to be very low – medium. As such appropriate controls for sediment control, drainage and erosion management have been adopted ranging from:

- Diversion of clean water;
- Rock checks within correctly sized swales to manage water velocity; and
- Appropriate sediment controls ahead of vegetative cover to limit and inhibit sediment loss off site. These sediment controls are to be monitored for continued appropriateness and only removed once vegetation has become established.

This is further detailed within Section 6 of this report.

5 FLOODING AND DISCHARGE IN THE PROJECT AREA

Flooding and discharge for the Bowen Orbital Spaceport area has been studied for several other projects within the Abbot Point SDA region. These reports are listed in section 2.1 of this document.

5.1 Flooding

The most recent report by BMT WBM in 2015 identified that for the combined 100-year ARI Design Flood and 2100 Climate Change design flood event, the Caley Valley Wetland peak flood level is modelled at 2.6 mAHD. The report prepared for the minister of industrial Development of Queensland by Maunsell in 2008, also indicated a similar peak flood level for the 100-year ARI flood line with a 10-year storm surge.

Approximately 50% of the 94 Ha lot is below the 3 mAHD level and may then be forecast to experience flooding in in a peak flood event as has been previously extensively modelled. The highest astronomical tide line also encroaches into the northern portion of the Lot 10 from saltwater creek. The highest astronomical tide line, and the 3 mAHD contour are mapped in relation to the project siting in figure 1 above.

Due to the position of the Bowen Orbital Spaceport along the southern end of Lot 10, and with the facility being situated on an elevated position considerations for flooding are considered negligible. The proposed siting for the launch and utilities pads for temporary fluids storage during a launch activity are all above 4.5 mAHD, and inhabited buildings are above 7.5 mAHD.

5.2 Stormwater Drainage

The stormwater drainage across the site is designed generally in accordance with the requirements as set out in the Whitsunday Regional Council Development Manual and in accordance with the Queensland Urban Drainage Manual as required by the Abbot Point State Development Area Scheme.

5.3 Stormwater Quantity and Quality

The design discharge estimate for runoff created during rainfall events during a 1 in 100-year event attributable to the 3 ha Bowen Orbital Spaceport footprint which includes the Vehicle Assembly Building, the Launch and utilities pads and the new access track, is estimated using the rational method to be approximately 0.75 m^3/s of overland flow.
Risks associated with stormwater quality across the site locations are as follows:

- Excess water from drains containing nutrients, sediment, and other chemicals.
- Runoff from cleared, non-vegetated land, particularly that near to drain ways and access track.
- Effluent disposal, as well as spills and overflow from effluent treatment facilities and sewerage systems.
- Oils and other petroleum products from roads and sealed storage areas.
- General waste, debris or loose materials.

To ensure stormwater quality is maintained the use of Stormwater Quality Improvement Devices (SQIDs) may be necessary in certain locations such as prior to crossing the disturbance area boundary of the development to reduce the risk of pollutant concentrations. SQIDs such as gross pollutant trap and trash racks and stormwater pit baskets will be used to protect and improve stormwater quality where appropriate.

5.4 Stormwater Treatment

The proposed development intends to wherever possible leave the existing environment undisturbed. The planned disturbance area will result in a small increase to the impervious areas across the total footprint of the Lot 10 Area.
It is anticipated that there will be an increase to the quantity of stormwater run-off generated locally at the disturbance area, however, the installation of strategic culverts, channelling and dispersal drains is expected to attenuate the impacts to overland flows by providing well defined flow paths to suitable downstream areas.

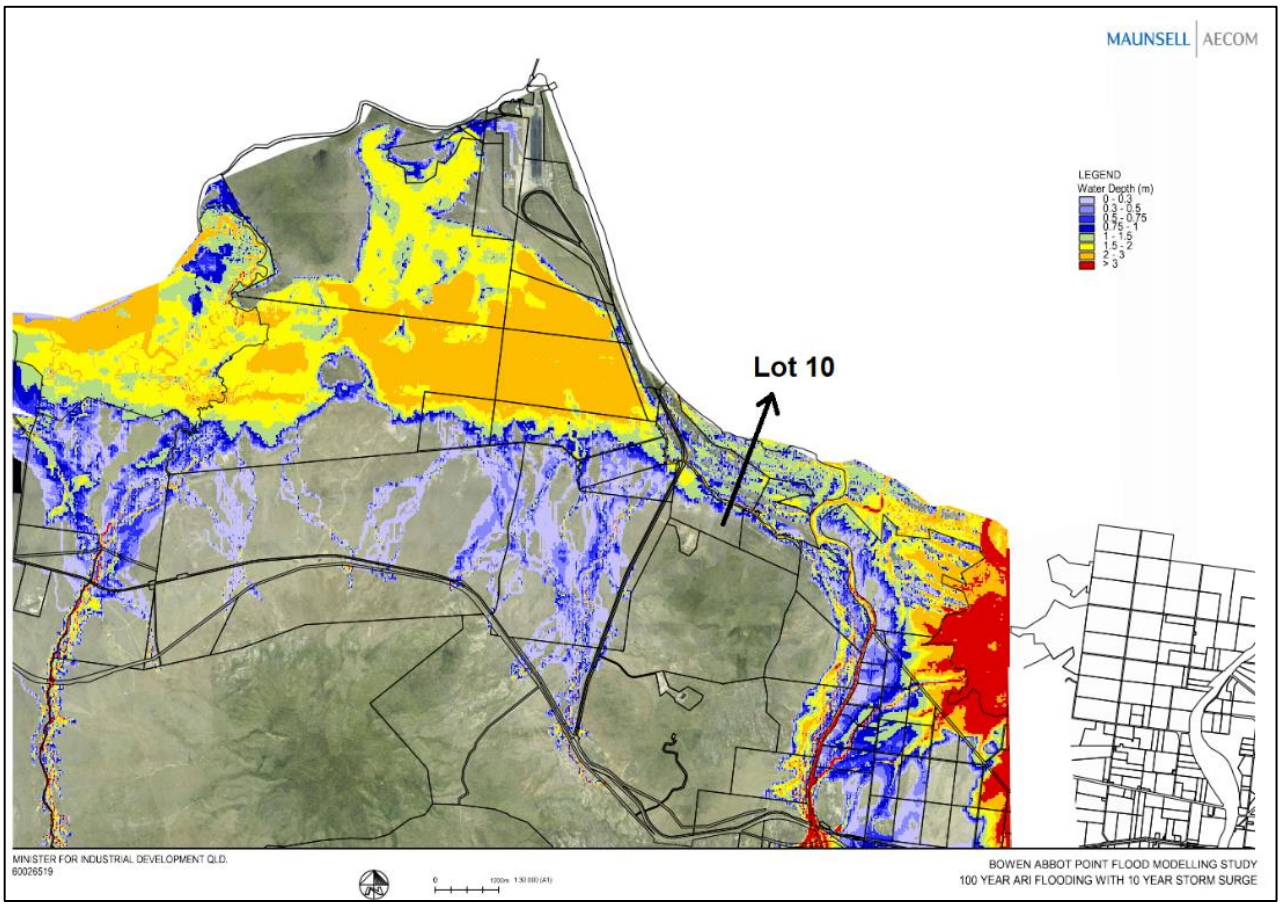

Figure 5 – 100 Year ARI Flooding With 10 Year Storm Surge (Maunsell, 2008)

6 EROSION AND SEDIMENT MANAGEMENT STRATEGY

The following erosion and sediment management strategy outlines how erosion and sediment will be managed at the BOS during construction and operation of the site.

6.1 Objectives

The key objectives of this strategy are:

- To minimise erosion and control the movement of sediments and other contaminants.
- To limit the impact of construction and operational activities on the aquatic environments adjacent to and downstream of the works.

This will be achieved by:

- Identification of activities that may contribute to erosion, sedimentation, and water quality impacts.
- Implementation of controls for the avoidance of erosion, sedimentation, and water quality impacts.
- Implementation of organised, integrated, and systematic processes to manage and review the implementation of controls for avoidance.

6.2 Performance Criteria

The performance of the implementation of this strategy will be measured by the below criteria:

- Erosion and sediment loss from work areas to adjacent non-work areas is controlled.
- Any potentially contaminated waters or soils are controlled and managed to ensure no offsite release.
- No lasting effects on water quality of adjacent waterways are experienced because of activities.
- No visible increase in the turbidity of marine and or surface waters due to construction or operational activities.

6.3 Activities Impacts and Management Actions

Table 1 – ESC Activities and Impacts Management Actions

Activities	Potential impacts	Gilmour Space Actions
Access track, Vehicle Assembly Building and Launch Pad Construction & Decommissioning		
Removal of Topsoil	Reduced plant productivity. Risk of Erosion and sediment transportation elevated.	Stock piling or removed soil to preserve nutrient rich topsoil. Appropriate sediment controls to capture any sediment runoff from exposed subsoils. Topsoil surface shall be left in a roughened condition to promote seed germination to facilitate establishment of permanent vegetation and reduce erosion.

Activities	Potential impacts	Gilmour Space Actions
Removal of Vegetation	Loss of topsoil, possible decrease in soil stability. Risk of Erosion and sediment transportation elevated.	Removal of vegetation will be avoided, when possible, to maintain integrity of the root network. Topsoil should be stockpiled separately clear of the work area and care taken to avoid contamination by other materials. Spreading mulch or retained native vegetation over disturbed areas. Use of erosion blankets. Use of sediment traps.
Heavy earthworks	Risk of splash erosion leading to soil displacement and runoff decreasing water quality if immediately prior to heavy downpours. Compaction of soil by equipment and vehicles leading to decreased soil infiltration, potential runoff. Decreased opportunity for root grown in soils.	Heavy earthworks construction activities to be conducted with consideration for weather. Use of sediment traps strategically during construction. Mulching of areas to improve cover. Use of diversion drains on high sides of sites and roads. Catch drains or Whoa-boys where appropriate
Establishment of work areas	Areas not stabilised leading to increased maintenance costs. Risk of Erosion and sediment transportation elevated. Potential decreased slope stability.	Planting native shrubs or grass to stabilize soil. Use of slaked lime. Use of soil cement if and where appropriate.
Excavation stockpiling	Loss of topsoil, possible decrease in soil stability. Risk of Erosion and sediment transportation elevated.	Stockpiles shall be located away from drainage paths and have dimensions 1V : 2H.
Implementation and Maintenance of erosion and sediment control measures	If ineffective, leads to increased site maintenance costs, and elevated risk of erosion and sediment transportation.	Sediment and erosion induction training. Regular toolbox meetings where verbal visual reports of degradation can be communicated. Weekly site inspections and reports by Site Supervision.
Bowen Orbital Spaceport Launch Facility Operation		
Implementation and Maintenance of erosion and sediment control measures	If ineffective, leads to increased site maintenance costs, and elevated risk of erosion and sediment transportation.	Sediment and erosion induction training. Regular toolbox meetings where verbal visual reports of degradation can be communicated. Weekly site inspections and reports by Site Supervision.

Activities	Potential impacts	Gilmour Space Actions
Vehicle Assembly	Direct activity of vehicle assembly has no direct impact to site. Transport and access along access track risks additional compaction by equipment and vehicles leading to degradation of road quality, or damage to drainage and increased potential runoff risk.	Sediment and erosion induction training. Regular toolbox meetings where verbal visual reports of degradation can be communicated to coordinate corrective maintenance. Weekly site inspections and reports by Site Supervision to coordinate corrective maintenance.
Delivery of Water, and launch fluids to site	Heavy vehicle transport and access along access track risks additional compaction by equipment and vehicles leading to degradation of road quality, or damage to drainage and increased potential runoff risk.	Regular toolbox meetings where verbal visual reports of degradation can be communicated to coordinate corrective maintenance. Weekly site inspections and reports by Site Supervision to coordinate corrective maintenance.
Rocket launches	Water deluge system on launch pad will deliver high quantities of water to pad bunding. Ineffective bund condition or maintenance could lead to overflow or leakage.	Weekly site inspections and reports by Site Supervision. Preventative inspection and maintenance for bunded areas and fluid systems. Use of diversion drains, planting of native shrubs or grass to stabilize soil and utilising Mulching of areas to improve cover around bunded areas.

7 MAINTENANCE SCHEDULE

7.1 Inspections

Best practice site management requires that all ESC measures are to be inspected by the project manager (or their nominated representative) by a frequency based upon risk; ie. at least daily when rain is occurring (where safe to traverse across the work site), within 24 hours prior to anticipated rainfall event (where predictions are >80% chance of >10mm rain) and within 18 hours of a rainfall event of sufficient intensity and duration to cause onsite runoff (IECA, 2008 Section 7.4). These inspections should include:

7.1.1 Daily Site Inspections

Daily Site Inspections (during periods of runoff producing rainfall) must check:

- all drainage, erosion and sediment control measures;
- occurrences of excessive sediment deposition (whether onsite or offsite);
- all site discharge points.

7.1.2 Weekly Site Inspections

Weekly Site Inspections must check (even when work is not occurring):

- all drainage, erosion and sediment control measures;
- occurrences of excessive sediment deposition (whether onsite or offsite);
- occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements;
- litter and waste receptors;
- oil, fuel and chemical storage facilities.

7.1.3 Pre-rainfall Inspections

Site Inspections immediately prior to predicted runoff producing rainfall event must check:

- all drainage, erosion and sediment control measures;
- all temporary flow diversion and drainage works.

7.1.4 Post-rainfall Inspections

Site inspections immediately following runoff producing rainfall must check:

- all drainage, erosion and sediment control measures;
- occurrences of excessive sediment deposition (whether onsite or offsite);
- occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements;
- occurrences of excessive erosion, sedimentation or mud generation around the site office, car park and/or material storage areas.

7.1.5 Post Construction – Rehabilitation Review

Rehabilitation Success (during both progressive rehabilitation and post final rehabilitation completion stages) must check:

- surface coverage of finished surfaces;
- health of recently established vegetation;
- effectiveness of long term drainage controls (prior to final acceptance and handover).

7.2 Audits

It is recommended that the project adopt the model Code of Practice (IECA, 2008 – Appendix G) and develop and maintain an audit schedule that:

- are completed on a monthly basis, commenced of not more than one month from the date on initial site disturbance until such time that all areas are suitably stabilised against erosion to the acceptance of the relevant regulatory authority;
- are undertaken by a person that is suitably qualified and experienced in erosion and sediment control (eg. CPESC, CPEng) that can be verified by an independent third party (this person must not be an employee or agent of the principal contractor).

8 ROLES AND RESPONSIBILITIES

All employees, contract staff and visitors are responsible for the environmental performance of their activities. This includes complying with relevant approval / permit requirements and for ensuring that all environmental objectives associated with the work are achieved and that all activities carried out do not cause or are not likely to cause environmental harm unless all reasonable and practical measures to prevent or minimise the harm are taken.

Project Manager - Construction

- Deliver the erosion and sediment control objectives outlined in this ESCMP.
- Assist with planning work activities to identify the required erosion and sediment control arrangements to facilitate the works.

Construction Supervisor - Construction

- Responsible for enforcing and monitoring erosion and sediment control management strategies throughout the project.
- Prepare, implement, monitor, and review all management strategies regarding the ESCMP.

Environment Health and Safety Coordinator – All phases

- Represent the project for environment, health and safety matters regarding erosion and sediment.
- Assist in the development and maintain the ESCMP.

Launch Site Supervisor – All phases

- Supports the delivery of the ESCMP objectives.
- Supports the principles and requirements of this ESCMP.

Stakeholder and Community Relations Officer

- Represent Gilmour Space for community and stakeholder issues raised regarding erosion and sediment control.

9 TRAINING

Training for the management of erosion and sediment control is crucial for the success in implementing the ESCMP as it raises awareness, improves knowledge, and increases motivation for personnel to perform to a high standard.

The key training methods that will be adopted to raise awareness, improve knowledge, and increase motivation for the control of erosion and sediment at the BOS are listed below

Table 2 – ESC Training and methods

Training Method	Frequency	Type
Site induction prior to accessing site	On induction.	Formal internal
Erosion and Sediment Control Training module	Annual	Formal internal
Conducting ESC site visual inspections	Weekly	On the Job
Conducting ESC site maintenance as required	Monthly / as required.	On the Job
Reporting and discussion of ESC concerns at toolbox meetings as identified.	Daily	On the Job

10 IMPLEMENTATION

This ESCMP at the Bowen Orbital Spaceport will be implemented using the tools and activities in the table below:

Table 3 – ESCMP Implementation tools and activities

Tools and Activities	Description
This Plan	This plan documents the strategy, and key data for use in implementing ESC controls at the Bowen Orbital Spaceport.
Construction Contractors Plan	During construction, a plan or strategy which a contractor may wish to implement may substitute the plan above where appropriate.
Checklists	Checklists are to be developed for site visual inspection, to ensure that activities managed by this plan have the appropriate control measures implemented.
Audits	Conduct internal audits to formally assess the level of compliance with both regulatory requirements and with this plan.
Incident Reporting	All ESC non-compliances shall be reported to site supervision as soon as they are identified, and an incident report created to be managed by site supervision.
Remediation	All ESC non-compliances, are required to be assessed and are to be remediated as soon as is reasonably practicable.

11 MANAGEMENT AND REVIEW

The Implementation of the Bowen Orbital Spaceport ESCMP will be regularly assessed and reviewed to ensure that:

- Gilmour Space is demonstrating compliance with legal and other obligations.
- The overall management strategy remains relevant and up to date.
- ESC is adequate to manage the environmental risks.

Table 4 – ESCMP Management and Review activities

Assessment Tool	Description
Checklists	The results of the checklists will be evaluated for trending issues and non-compliances that may be resolved through engineering or procedural change or by implementing another measure or process.
Audits	Results of internal audits to formally assess the level of compliance with both regulatory requirements and with this plan are to be used to develop corrective actions which may include changes to this plan.
Incident reviews	A review of reported ESC incident reports for trending issues and non-compliances that may be resolved through engineering or procedural change or by implementing another measure or process to address the recurring issue.
Review of Data	Analyse all relevant data collected for negative and/or undesirable trends that may be prevented by procedural changes or by implementing another measure or process.

The ESCMP will be reviewed at least every three years or sooner if required or if any of the following occur:

- Changes to legislative requirements.
- Changes to the Bowen Orbital Spaceport site area.
- Changes to Bowen Orbital Spaceport construction and operational activities as informed by contractors and Gilmour Space requirements.
- In response to offences to the legislative requirements described in Section 3.

Reviews and changes to the ESCMP will be communicated to relevant Gilmour Space personnel.

APPENDIX A - LIST OF RELEVANT DOCUMENTATION

Document Number	Description
BOS-GAR-0001	Bowen Orbital Spaceport – Site Access Roads Key Plan
BOS-GAR-0002	Bowen Orbital Spaceport – Access Track Detail 1
BOS-GAR-0003	Bowen Orbital Spaceport – Access Track Detail 2
BOS-GAR-0004	Bowen Orbital Spaceport – Access Track Detail 3
BOS-GAR-0005	Bowen Orbital Spaceport – Access Track Detail 4
BOS-GAR-0005	Bowen Orbital Spaceport – Vehicle Assembly Building and Launch Pad Cut & Fill – Plan & Environmental Sediment Control
BOS-LAY-0001	Bowen Orbital Spaceport – VAB and Launch Pad Key Plan
BOS-LAY-0002	Bowen Orbital Spaceport – Vehicle Assembly Building Site Layout
BOS-LAY-0003	Bowen Orbital Spaceport – Launch Pad Site Layout