EQUATORIAL LAUNCH AUSTRALIA

Supplementary Environmental Report

ELA-000177

VERSION APPROVAL

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EXECUTIVE SUMMARY

Equatorial Launch Australia (ELA) proposes to increase the capacity of the Arnhem Space Centre (ASC) to launch commercial and research rockets into sub orbital and orbital trajectories. Expansion of the ASC will involve the clearance of ~ 91 ha of vegetation, primarily from within an existing mined area, the construction of up to fourteen (14) launch pads and supporting infrastructure, the increase in launching of multi-stage rockets each year, and the retrieval of some first stage launch vehicles (LV) from land in the Northern Territory (as well as Queensland and Commonwealth waters).

ELA made a referral to the Northern Territory Environmental Protection Agency (NT EPA) under section 48 of the *Environment Protection Act 2019* (EP Act) and the Environment Protection Regulations 2020 (EP Regulations) for the expansion of the ASC and its activities. The responding Determination made by the NT EPA was that the method of environmental impact assessment would be by Supplementary Environmental Report (SER). The matters for consideration in the SER are:

- The potential impacts of vegetation clearing within the ASC
- The potential impact of rocket launches on air quality
- Mitigation of risks and impacts of falling debris in the expanded recovery zone
- Mitigation of risks and impacts to Aboriginal sacred sites in the expanded recovery zone
- Community (Aboriginal) engagement within the vicinity of the project area and expanded recovery zone
- Community (Aboriginal) access to knowledge and information about the project and possible impacts on their values and interests

These matters for consideration are summarised in the following sections.

Potential impact of vegetation clearing

The vegetation in the project area is primarily *Eucalyptus tetrodonta* open woodland, which is typical of the region. Small pockets of monsoon vine forest occur on the southern plateau side slopes. Frequent fires and windstorms have led to large areas of early succession and sparse vegetation within the project area. Twenty-seven trees with a diameter at breast height (dbh) >40 cm (with 9 >50 cm dbh) occur within the ~91 ha to be cleared. This is significantly less than the threshold of 30 stems per ha with a dbh >40 cm or 5 stems per ha >50 cm dbh to be considered significant for biodiversity in the NT land clearing guidelines.

Assessment of sixty-five (65) listed threatened species that may occur in the wider region determined that only five (5) species had a medium likelihood of occurrence in the project area and the majority had a very low or non-likelihood of occurrence. Habitat assessment for seven (7) species, including the species identified as having medium likelihood of occurrence and those identified as being of concern in the NT EPA Direction (Ref EP2023/031), determined that the vegetation condition and lack of permanent water provided low quality to non-existent habitat for these species. Further, there are no recent regional or local records of occurrence of Black-footed tree-rat (*Mesembriomys gouldii gouldii*), Partridge pigeon (*Geophaps smithii smithii*), Northern brushtail possum (*Trichosurus vulpecula arnhemensis*), Northern brush-tailed Phascogale (*Phascogale pirata*), and Fawn antechinus (*Antechinus bellus*), with the three of these likely to be locally extinct in east Arnhem Land.

The monsoon vine forest patches may provide habitat for the Black-footed tree-rat, Northern brushtail possum, and Northern blue-tongued skink (*Tiliqua scinoides intermedia*) if they occur locally. This vegetation community will not be affected by vegetation clearance.

The vegetation of the project site does not contain significant, important, or quality habitat for any listed migratory species, the majority of which are coastal species.

Clearance of ~91 ha of Eucalyptus tetrodonta open woodland at the project site will not have an adverse effect on listed threatened fauna or flora as this does not provide quality, important or significant habitat. Consequently, monitoring, inspection, or reporting of impacts on threatened species will not be required.

ELA proposes the following control measures to protect ecological values while allowing for vegetation clearance:

- Laying of large diameter trees that have been felled within uncleared vegetation or rehabilitated vegetation to provide habitat for ground nesting species
- Applying a non-clearing buffer of at least 50 m to the majority of the outer edge of the monsoon vine forest community, however there may be a small area which goes no closer than 20m
- Applying a 20 m non-clearing buffer around the plateau edge to minimise erosion risk, except in specific instances where hard engineering will also achieve the same function
- Undertake vegetation clearance and site stabilisation during the dry season
- Revegetate exposed soils with appropriate native grass and/or shrub species where possible
- Develop an erosion and sediment control plan for the life of the project

Other environmental management controls are:

- Launch planning and trajectory control to avoid known areas of significant environmental value, including Matters of Territory and National Environmental Significance
- Weed management and control practices include pressure washing of non-local construction vehicles before entry to site, use of local fill only, and application of weed surveillance and control measures
- Water extraction licence obtained if groundwater is required to supplement surface water collection for launch deluge system
- Spill containment infrastructure and systems implemented at fuelling and storage sites

Potential impact on air quality

Rocket launches can cause short-term elevated levels of exhaust emissions. The primary polluting emissions from liquid and gas fuelled LV are carbon monoxide (CO) and nitrogen dioxide (NOx) and the primary polluting emissions from solid fuelled LV are hydrochloric acid (HCl) and aluminium oxide (Al_2O_3).

Dispersion modelling of the exhaust from the largest possible liquid fuelled LV that could be launched from the ASC and of the exhaust of a typical solid fuelled sounding rocket was conducted with AERMOD. The models assumed that one of each LV would be launched every hour over a period of one year (i.e., 8,760 launches per year) and that meteorological conditions, e.g. wind strength and direction, were typical for each hour of the day or year. The mass of these pollutants per launch modelled is provided in the table below.

LV type	Average fuel burn rate (kg/s)	Mass of emissions per launch (kg)			
		CO	HCl	NO_X	Al_2O_3
Liquid fuelled	403.5	44,726.7	nil	1,129.8	nil
Solid fuelled	61.0	50.8	166.7	2.4	301.7

The modelling process significantly overestimates the possible ground level concentrations of pollutants relative to regulatory or published air quality standards given what the spaceport could achieve at full capacity and the LV will be of varying sizes.

The 1-hour and 8-hour average ground-level concentrations of CO per launch are predicted to comply with the respective air quality standard at the nearest sensitive receptor, the Garma Cultural Knowledge Centre. The 15-minute, 1-hour, and 24-hour average ground-level concentration of HCl are predicted to comply with the respective air quality standards at the Garma Cultural Knowledge Centre. The 1-hour average ground level concentration of NO_2 is predicted to comply with the air quality standard. The average ground-level concentration of Al_2O_3 as PM_{10} is predicted to comply with the air quality standard.

Consequently, there is unlikely to be a significant impact on air quality at sensitive receptors adjacent to the ASC, on environmental or heritage values adjacent to the ASC, or at locally or regionally important sites.

Small amounts of the greenhouse gas nitrous oxide (N2O) are produced in the combustion of fuel. This gas is not regarded as a pollutant under Australian standards; however, ELA will be required to report the production of this gas if the facility exceeds the 25,000 tonnes of carbon dioxide equivalent in a year (t CO2-e/y) from fuel combustion. This threshold is unlikely to be exceeded.

Mitigation of environmental risks and impacts of falling debris

Each launch will have a defined trajectory and known area where a LV or associated debris will land. While the original Referral provided a mapping that showed objects could descend anywhere in the NT, this is incorrect and has been re clarified on Figure 2.

ELA collaborated with 5 Traditional Owner groups to develop an agreed protocol for land and water down range access and retrieval. This was used successfully for NASA with the Northern Land Council, Aboriginal Areas Protection Agency and impacted local Traditional Owner groups. This protocol is additional and complimentary to completing the required application for an AAPA Certificate for Sacred Site investigation of the down range recovery area. ELA is seeking to extend this protocol with the Central Land Council and other relevant stakeholders in this area of the Northern Territory (as well as be used in other States). The protocol includes requirements for consultation, information sharing, launch planning, and communication (including in language) prior to and during a launch and retrieval, and remediation of any site damage.

ELA will assess the potential for significant impact on environmental values during launch planning and will refer these to the Northern Territory and/or Australian Government, if necessary, for regulatory and conditional approval.

It is anticipated that LV dropped in the Northern Territory will be smaller than the largest LV first stage booster motor (i.e., 10 m x 2 m) and consequently the total area of physical impact to land will be relatively small and easily remediated.

Mitigation of risks to Aboriginal sacred sites

ELA has conducted a Heritage Register check for the proposed ASC expansion area and applied for an Authority Certificate from the AAPA covering the site and activities.

Inspections undertaken for the original mine development in the ASC area with senior Traditional Owners and elders determined that there were no sacred sites, objects, or other areas of heritage significance within the ASC area. ELA maintains a close relationship with the Gumatj Traditional Owners as well as the Northern Land Council regarding the ASC and proposed activities.

As part of ELA's down range recovery planning and access protocol, ELA will assess the potential for significant impact on cultural or heritage values in consultation with AAPA and the relevant Land Council during launch planning and will refer these to the Northern Territory Government if necessary for regulatory and conditional approval.

Community (Aboriginal) engagement within the vicinity of the project area and expanded recovery zone

ELA has adopted the International Association for Public Participation framework for community engagement (IAP2) recognising the need for a process that incorporates the interests and concerns of all affected stakeholders and meets ELAs commercial and operational needs. ELAs Stakeholder Engagement Plan defines the approach undertaken to identify, consult, and engage with stakeholders including Traditional Owners and their representative bodies during the expansion and future launch operations.

The plan's objectives are:

1. To determine the specific communication needs of impacted and potentially affected communities, and identifying culturally appropriate methods of communication

2. To provide direction on approach for community awareness and potential involvement during site expansion activities and launch operations activities as appropriate for the stakeholders impacts
3. To recognise the role that Aboriginal people have as stewards of their country and the importance of participation of Aboriginal people and communities in environmental and recovery decision making processes
4. To enable building relationships with key stakeholders, gaining local support and maximising positive benefits
5. To meet legislative requirements to engage with stakeholders for land access, agreements, and approvals

ELA has an established Safety and Retrieval Committee (SRC) forum that includes a core set of local Traditional Owner Groups and the Northern Land Council and as each launch is planned, expanded to incorporate impacted down range Traditional Owner Groups and Land Councils. These groups are engaged and invited >9months out from each launch.

Community (Aboriginal) access to knowledge and information about the project and possible impacts on their values and interests

ELA is committed to ensuring that the Aboriginal community who own the ASC site or are Traditional Owners and custodians of Country where LV may land and be recovered from are communicated to, engaged and consulted, both in the establishment of protocols for consultation and actual consultation during launch planning where the trajectory will land LV on Country.

ELA has an established Safety and Retrieval Committee (SRC) forum that includes a core set of local Traditional Owner Groups and the Northern Land Council and as each launch is planned, expanded to incorporate impacted down range Traditional Owner Groups and Land Councils. These groups are engaged and invited >9months out from each launch.

ELA recognises the role that the ASC and its operations will have in providing social and economic opportunities in the region, particularly as bauxite mining reduces in scale by the end of the decade. ELA has agreed to pay the Yolngu people royalties associated with each launch and will also provide:

- Jobs and commercial contracts in the local community
- Jobs and commercial contracts to support site operations support and launch recover
- Engagement with local educational institutions to promote STEM/STEAM1 and space as career options, including trainee and apprenticeship opportunities
- Permanent paid staff residing in Nhulunbuy
- Tourism and cultural opportunities through visiting professionals and space companies

The following table shows the projected staff and contractor roles required for the ASC over the next five (5) years. This includes dedicated Yolngu and indigenous positions, recognising the role for upskilling where possible and sourcing necessary skills outside of the region if needed.

Direct Jobs to NT over 5 years					
	2023/2024	**2024/2025**	**2025/2026**	**2026/2027**	**2027/2028**
Contractors					
Earthmoving in Nhulunbuy	1	2	1	1	1
Construction Services in NT	10	12	12	8	8
Construction in Nhulunbuy	5	10	10	5	5
ASC Support services	1	5	7	10	10

Direct Jobs to NT over 5 years					
Permanent Local ASC Staff					
Nhulunbuy	2*	5*	15	25	30
Yolngu positions (10%)	10%*	10%*	2	3	3
Indigenous positions (10%)	10%*	10%*	2	3	3

**Crucially dependent on talent required for key roles to scale ELA quickly to profitability and regular operational launch cadence*

Summary

The clearance of *Eucalyptus tetrodonta* open woodland for the proposed expansion of the Arnhem Space Centre will not have an adverse environmental impact on threatened species and communities, due to its low habitat quality and the low likelihood of occurrence of these species in the project area. Management controls are proposed to protect remaining ecological values inside and outside of the project area.

The emissions to air from rockets launched from the site will not adversely affect human or environmental health or features of indigenous or heritage significance. The predominant fuel used is likely to be RP-1, a more refined version of the Jet A-1 or Jet B combusted by aeroplanes at the nearby Gove airport. Any individual launch is unlikely to trigger air quality standards and the emissions of carbon monoxide (CO), nitrogen dioxide (NO_2), hydrochloric acid (HCl), or aluminium oxide (Al_2O_3) will not accumulate in the environment regardless of fuel type.

The trajectory for each launch will be determined by commercial requirements and the area where the first stage launch vehicle (LV) will be recovered (land or water) will be known during launch planning. Assessment of potential impact on environmental values will be undertaken during planning and pre-existing protocols for LV retrieval and site rehabilitation will be implemented. The point of impact will be relatively small, with the largest possible LV being 10 m x 2 m in size.

Protocols for LV that are launched from the ASC and that land on land and are recovered from Arnhem Land have been agreed with the Traditional Owners through the ELA SRC forum. This includes obtaining required AAPA Certificates for the recovery area for protection of cultural, heritage, and environmental values. ELA is seeking to extend this protocol with the Central Land Council and other relevant stakeholders in this area of the Northern Territory (as well as be used in other States). ELA is committed to ensuring that relevant Aboriginal communities and stakeholders have access to knowledge and information about the project and possible impacts on their values and interests.

ELA is committed to ensuring that the Traditional Owners of the ASC site and east Arnhem Land community can benefit from the economic and educational opportunities that an expanded and operating space port will bring to the region.

1 INTRODUCTION

1.1 SUPPLEMENTARY ENVIRONMENTAL REPORT

Equatorial Launch Australia (ELA) made a referral for the Phase 2 expansion of the Arnhem Space Centre (ASC) to the Northern Territory Environment Protection Agency (NT EPA) under section 48 of the *Environment Protection Act 2019* (EP Act) and the Environment Protection Regulations 2020 (EP Regulations). ELA sought a decision from the NT EPA on whether an environmental impact assessment is required for the proposal and, if so, which assessment method applies.

The NT EPA responded on 6 February 2024 that the method of environmental impact assessment would be by supplementary environmental report (SER). ELA were directed to:

- Prepare an SER to address the submissions received in relation to the referral information (Table 1)
- Include additional information in the SER as detailed in Table 1

Sections 2 through to 11 (including appendices) provide the response to Table 1. This document meets the requirements for the SER.

1.2 CONCURRENT REFERRAL – ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

ELA has made a concurrent referral to the Commonwealth Department of Climate Change, Energy, the Environment, and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The referral is not covered under the bilateral agreement for environmental assessments because activities may occur outside of the Northern Territory in Commonwealth jurisdictions.

This concurrent referral addresses the potential impact of the recovery of launch vehicle (LV) hardware (i.e., first stage booster motors and payload fairings) on Matters of National Environmental Significance (MNES) including areas that are MNES, e.g., the Gulf of Carpentaria and the Coral Sea Marine Park.

Table 1: Matters Raised for Inclusion in SER

Theme	Environment	EPA SER Resubmission Requirements	Addressed
Proposed Action	Description	Provide further information about the proposed construction and operation workforce including: • number of personnel, • timeframes, • source (e.g. local, FIFO of Darwin or interstate) • composition (mix of skills needed) • service and infrastructure needs from the region and NT (accommodation, car hire, food capacity) • peak period(s) for launches (individual and / or consecutive)	Section 2.1.1
	Consultation	Demonstrate that consultation with stakeholders (including the identification of relevant stakeholders within affected areas, including those within payload landing and hardware recovery zones within NT land and coastal waters) is appropriate and has been undertaken IAW NT EPA's EIA guidance for proponents: Stakeholder Engagement and Consultation and General duty of proponents under s43(a) to (d) of the Environment Protection Act 2019 (EP Act)	Section 7.4.1
		Describe how concerns and issues raised during community and stakeholder consultation and engagement processes have been considered and resolved	Section 4
Land	Terrestrial Ecosystems	Provide the area of previously disturbed (e.g. regrowth) and undisturbed (e.g. intact) native vegetation that will be cleared	Section 7.1
		Provide an updated assessment of the terrestrial ecosystem values that would be potentially affected by the proposed action.	Section 7.1
		Assess the potential impact of the proposed action on threatened species, their habitats, significant and sensitive vegetation, and landscape features. Identify measures that will be implemented to avoid or mitigate these impacts.	Section 7.1
		Demonstrate that clearing is consistent with the NT Land Clearing Guidelines, or justify any alternative	Section 7.1
		Describe ongoing monitoring, inspection, and reporting of impacts on ecosystem values to ensure their protection	Section 7.1
		Provide updated payload landing and hardware recovery plan that outlines the procedures for identifying biodiversity values of recovery activity sites and assessing risks of significant impacts. Identify measures to avoid or mitigate significant impacts during payload landing and hardware recovery activity.	Section 7.1 Appendix 1
Air	Air Quality	Describe all potentially affected sensitive receptors for impacts from reduced air quality, including • Gulkula ceremonial site, • any permanently or temporarily occupied homelands, • culturally significant sites (including but not limited to hunting and fishing sites, vegetation and/or rock features), • sacred sites / restricted works areas (as identified by the Aboriginal Areas Protection Authority (AAPA) and	Section 7.3.1.2

Theme	Environment	EPA SER Resubmission Requirements	Addressed
		• any areas of high biodiversity and environmental value.	
		Confirm, or advise otherwise, whether nitrous oxide (N2O) is a pollutant of concern	Section 7.3.2
		Define the area of potential air quality impacts resulting from rocket exhaust at each of the proposed launch pads, supported by an air pollutant emission inventory (ensuring all potential pollutants are considered, including nitrous oxide (N2O), if relevant) and air dispersion modelling, ensuring that modelling accounts for seasonal variations in prevailing wind conditions (this may further assist in identifying unfavourable launch / test conditions based on potential impacts to sensitive receptors).	Section 7.3.1.1
		Provide the predicted volumes of emissions and impacts from emissions on local air quality and sensitive receptors (as described … above), including cumulative impacts, and incremental impacts on culturally significant sites and other areas of cultural value from accumulation (including bioaccumulation and biomagnification, if relevant) over the life of the proposed action, including potential limitation on future land use.	Section 7.3.1.3
		Outline proposed avoidance, mitigation, and management measures to be implemented. Describe monitoring and reporting activities.	Section 7.3.1.3
		Provide maps and figures to support descriptions	Figures Figure 9 to Figure 13 Appendix 6
People	Community and Economy	Provide further information that demonstrates affected communities and individuals have been consulted on: • potential social and economic impacts on: o local infrastructure such as the Central Arnhem Road and Gove Peninsula access, services such as medical, other logistical services to the region from increased demand / use o users of the Gulkula ceremonial site (which includes the Garma Institute and Garma Cultural Knowledge Centre) o Individuals o other businesses particularly during peak visitor periods o community cohesion and o recreational and cultural activities. o the broader potential positive and negative impacts of the project, including details of the process used to identify these perspectives o public health and safety.	Section 7.4.1 and 7.4.2 Appendix 3

Theme	Environment	EPA SER Resubmission Requirements	Addressed
		Provide further information regarding local training, employment, and procurement opportunities in order to assess potential benefits of the proposed action.	Section 7.4.2 (Procurement Opportunities)
	Cultural and Heritage	Provide further information that demonstrates stakeholder engagement and consultation, consistent with the NT EPA Guidance, and the general duty of proponents under section 43(a) to (d) of the EP Act, with potentially affected Aboriginal communities and individuals (or their representatives, including the relevant land council) likely to be directly and indirectly affected by the proposed action (including but not limited to land clearing, rocket launches, static testing, hardware landing and recovery activities).	Section 7.4.1 Section 2.1 Appendix 3
		Ensure that the payload landing and hardware recovery plan (see … above) includes procedures, developed in consultation with relevant stakeholders including native title holders, traditional Aboriginal owners whose lands are within the potentially affected area and their representative land councils, and statutory bodies (e.g. AAPA, Heritage Branch of the Department of Territory Families, Housing and Communities) to identify: • the presence or likelihood of heritage places or objects • the presence or likelihood of sacred sites • the presence or likelihood of underwater cultural heritage • custodian protocols to access sacred sites or restricted work areas • how payload and hardware recovery activities will avoid significant impacts on identified culture and heritage values • timeframes for planning and execution of hardware recovery activities, ensuring that sufficient time is allocated for adequate consultation with affected Aboriginal communities/ individuals.	Section 7.4.1 Appendix 1 Appendix 9
		Provide an unexpected finds protocol for cultural, heritage or archaeological materials.	Section 2.3.1 Section 2.3.2 Appendix 9 (s2.3 within appendix)
Response to Referral Public Submissions			
Department or Territory Families, Housing and Communities			Section 5
Aboriginal Areas Protection Authority (AAPA)			Section 5.2
Department of Chief Minister and Cabinet, Strategic Policy			Section 5.3
Department of Environment, Parks and Water Security			Section 5.4
Environment Centre NT			Section 5.5
Tony Ryan MP			Section 5.6

2 PROPOSAL DESCRIPTION

2.1 PROPOSED ACTION DESCRIPTION

2.1.1 WORKFORCE AND ASSOCIATED ACTIVITIES

Construction of the expanded ASC is projected to require 80 jobs, with 15 staff employed directly by ELA and 65 contractors (Table 2, Table 3). ELA intends to preferentially contract local and Northern Territory service providers for earthworks and construction where feasible. It may be necessary, however, to employ or contract specialist staff for highly technical engineering activities, e.g. telecommunications, fuel storage, etc, from outside of the region or the Northern Territory.

The majority of Phase 2 construction of the ASC is expected to take an initial 12 months once all development approvals have been obtained. Subsequent individual launch complex construction will occur as each launch new client signs a contract to become a tenant at ASC. Operations of Phase 2 will commence 31/03/2025. Launch services (dates and times of launch) will occur all year due to the favourable weather (with exception to key events in the area such as Garma Festival at end July / early August).

Table 2: Estimated job creation as a direct result of proposed ASC Expansion 2023 - 2025

	ELA Full Time Employees (FTE)	Contractors	Total Jobs
Construction Phase	15	65	80
Post Construction – Initial Operational Phase	40	10	50
Total	**55**	**75**	**130**

Forty (40) staff are projected to be employed by ELA initially for Phase 2 operation of the ASC ramping up to ~100 FTE when mature in 2027/2028. The number of permanent staff residing locally is likely to increase as launch capacity increases. Table 3 shows the estimated growth of local NT jobs over 5 years split between contractors and permanent staff. The remaining staff will FIFO from interstate.

Table 3 - Direct jobs to NT over 5-year plan

Direct Jobs to NT over 5 years					
	2023/2024	2024/2025	2025/2026	2026/2027	2027/2028
Contractors					
Earthmoving in Nhulunbuy	1	2	1	1	1
Construction Services in NT	10	12	12	8	8
Construction in Nhulunbuy	5	10	10	5	5
ASC Support services	1	5	7	10	10
Permanent Local ASC Staff					
Nhulunbuy	2*	5*	15	25	30
Yolngu positions (10%)	10%*	10%*	2	3	3
Indigenous positions (10%)	10%*	10%*	2	3	3

**Crucially dependent on talent required for key roles to scale ELA quickly to profitability and regular operational launch cadence*

ELA is committed to sourcing materials and services from local suppliers where economic and feasible. This includes the supply of food and catering during operations.

ELA has held and will continue to hold supplier briefings ("open days") to explain what services are required and how ELA procurement processes will be run. Certain procurement tenders will have selection criteria that will be shared upfront and equally assessed, and feedback provided to those unsuccessful.

ELA will work with local business able to provide the following skills and services during construction and operational phases:

- Engineering (Civil, Mechanical, Aerospace, Mechatronic, Electrical)

- Construction (Concrete, Carpentry, Mechanical, Electrical, Earthmoving)
- Transport (Road and Sea)
- Accommodation
- Security
- Light vehicle workshop and mechanical services
- Housing stock to retain staff

International commercial clients and visiting professionals engaged in the space and aeronautics industry will reside onsite or in Nhulunbuy during launch periods and these numbers are expected to grow as the ASC reaches full capacity. This will provide opportunities to support ELAs engagement with local educational institutions to promote STEM/STEAM and space as career options. ELA is in discussions with both Charles Darwin University (CDU) and Gumatj Corporation to support training and employment of local people where possible.

Non-residential staff and clients will travel to East Arnhem Land via the Gove airport, and heavy equipment, fuels, and rockets may be transported by road from Darwin or through the Gove Port and then by road to the ASC.

Critical service and infrastructure needs in the area include:

- Maintenance of Gove airport for larger aircraft to be able to land (in place)
- Maintenance of Port for shipping requirements (in place)
- Paving and maintenance of East Arnhem Hwy from ASC to Nhulunbuy for smoother road for sensitive equipment transport (in work)
- Accommodation options for permanent staff to reside in Nhulunbuy (in work)
- Access to car hire, accommodation, and food capacity for overflow of tourists and clients during launch campaigns (in work)

2.1.2 Effect of ASC Operation on Infrastructure and Services

It is expected that Bawaka Road to the East of the ASC may be closed for periods of 15 – 30 minutes for security reasons during some few launches. There will be adequate warning for motorists and transport companies and provision will be made for the passage of emergency services.

Launches will occur when meteorological conditions are suitable, within a planned launch window. All consultations, notifications, and safety provisions will start 9 months in advance and updated with stakeholders as necessary to the point of launch.

2.1.3 Decommissioning

The ASC is projected to operate for at least 40 years and for an indefinite period. For reference Cape Kennedy has been in constant use for over 65 years. On closure, ELA commits to:

- Decommissioning and removing all infrastructure unless requested by the landowners that some or all infrastructure be retained for their purposes. This will be determined through consultation and agreement
- Remediation of any soil contamination at fuel or chemical storage areas if necessary
- Revegetation of exposed soils to reduce dust production, including with local native species where appropriate. Note: the ASC will have very little, if any exposed soil, and our intention is to have a mainly green site for visual, temperature and dust management process. Any rehabilitation, vegetation processes will be determined through consultation and agreement with landlord.

2.2 Regulatory Approvals

2.2.1 Corrigenda

The following corrigenda to Table 2 in the original referral to the NT EPA are provided in response to feedback from the Department of Territory Families, Housing and Communities (TFHC) and from the Aboriginal Areas Protection Authority (AAPA).

Table 4: Corrigenda to Table 2 in original referral to NT EPA

Approval	Legislation	Agency	Status
Northern Territory Approvals			
Works Approval	*Heritage Act 2011*	TFHC	The *Heritage Act 2011* provides for the identification, declaration, conservation and protection of places and objects of cultural and natural heritage. All sites on the NT Heritage Register and archaeological sites are protected under this Act. Aboriginal or Macassan archaeological sites and objects are automatically protected under this Act. This includes places and objects not previously recorded.
Authority Certificate	*Northern Territory Aboriginal Sacred Sites Act 1989*	AAPA	The *Northern Territory Aboriginal Sacred Sites Act 1989* provides for the protection and registration of sacred sites by the Traditional Owners or the custodians of land.

2.3 Approvals and Permits

2.3.1 ASC Site – Heritage and Sacred Sites

ELA has conducted a Heritage Register check for the proposed expansion of the ASC site. No matters protected under the *Heritage Act* 2011 have been identified. The nearest registered site is Wurrwurrwuy (stone pictures) within the area known as Manydjarraarrna-Nanydjaka. Wurrwurrwuy is approximately 13 km to the east northeast of the ASC.

ELA has applied for an Authority Certificate from AAPA under the *Northern Territory Aboriginal Sacred Sites Act* 1989 covering the ASC site and activities. Inspections undertaken for the Gulkula mine development with senior Traditional Owners (including Gumatj elders) determined that there were no Sacred Sites, objects, or other items of heritage significance within the site area. There is an Aboriginal Areas Protection Authority (AAPA) Restricted Work Area (RWA) to the east of the mining area and west of Bawaka Rd in the southeast corner of the ASC Phase 2 expansion area. This RWA is currently being reassessed for inclusion as part of the ASC lease expansion area (and included in an updated Authority Certificate) as there are no sacred sites in that location.

ELA will follow required procedures (ASC Principles for Land and Sea Access and Vehicle Recovery at Appendix 9 and Appendix 12) if unexpected objects or artefacts are found during vegetation clearance or construction. This will be informed by consultation with Traditional Owners, the AAPA, and TFHC. A suitably qualified archaeologist will be consulted to advise on mitigation strategies if necessary.

2.3.2 ASC Operations

ELA will seek, obtain and commit to adhering to all required permits and conditional approvals during the launch planning process once a specific trajectory has been defined by client requirements and the likely recovery area is calculated. The process will include consultation with appropriate authorities and undertaking searches of the following:

- Heritage Register (NT)
- Protected Matters Search Tool (Commonwealth)

Permits and conditional approvals may include:

- Authority Certificate (Aboriginal Areas Protection Authority)
- Land Clearing (Department of Land Resource Management)
- Environmental Approval (Department of Climate Change, Energy, the Environment, and Water)

ELA anticipates that approvals may have conditions requiring, for example:

- Avoidance of sacred sites
- Avoidance of vulnerable or otherwise significant sites
- Process for unexpected finds
- Reporting of incidents

- Remediation of damage

2.3.3 ASC Launch Trajectories and Recovery Areas

The different directions of launches and their recovery areas that may occur from ASC are show in Figure 1, Figure 2, and Figure 3. Figure 3 depicts the launch trajectories in Figure 1 and Figure 2 as an angled view (represented here by green lines), highlighting height of orbital rockets (~100 km alt at ~50 km distance down range).

The original Referral referred to recovery occurring on land in the NT but did not provide enough specificity to this. Recovery in the NT will only occur the areas indicated on Figure 2.

Figure 1: Key orbital trajectories (flight paths) requested from ASC

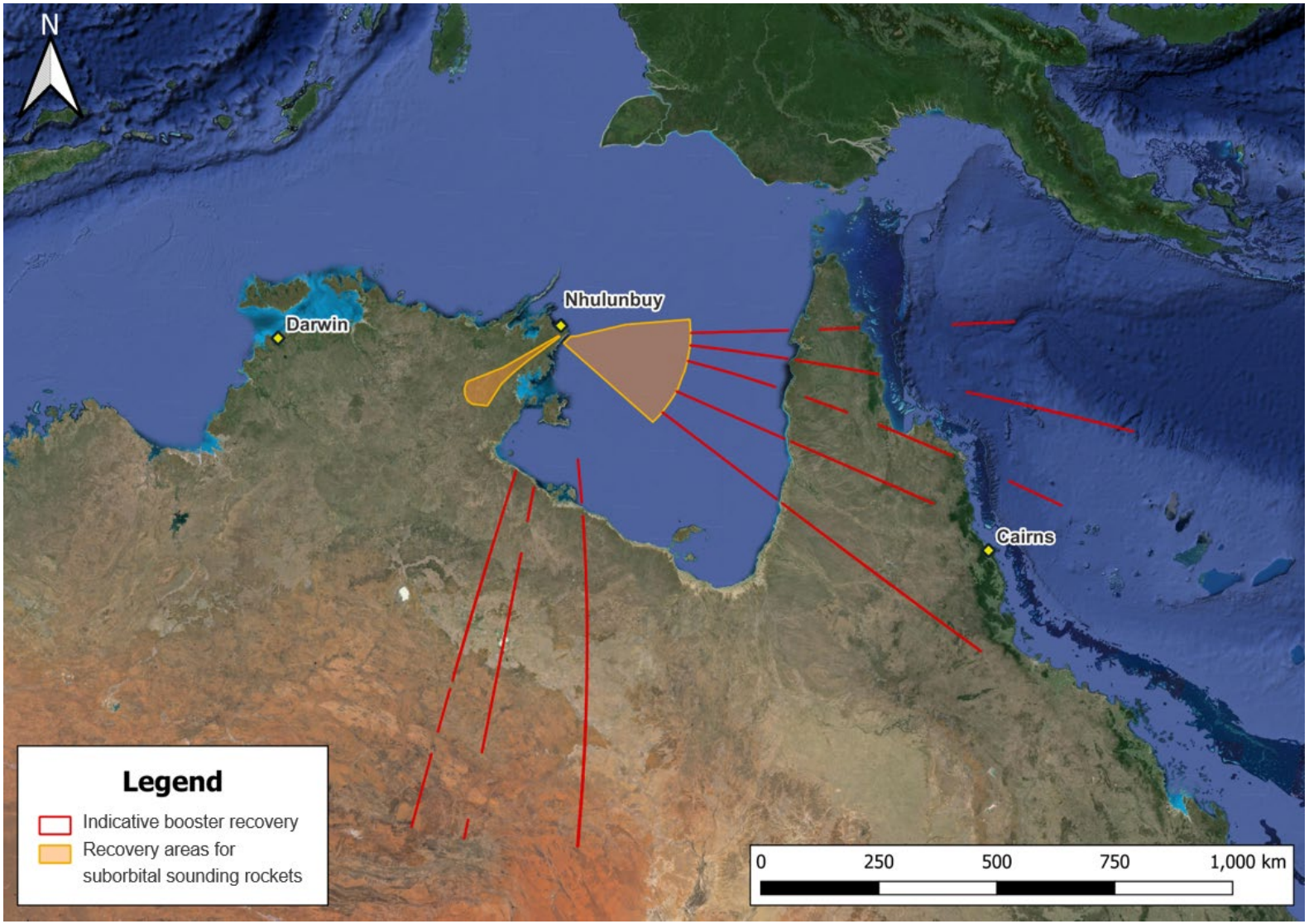

Figure 2: Indicative suborbital and orbital LV recovery areas for small research sounding rockets and orbital booster motors.

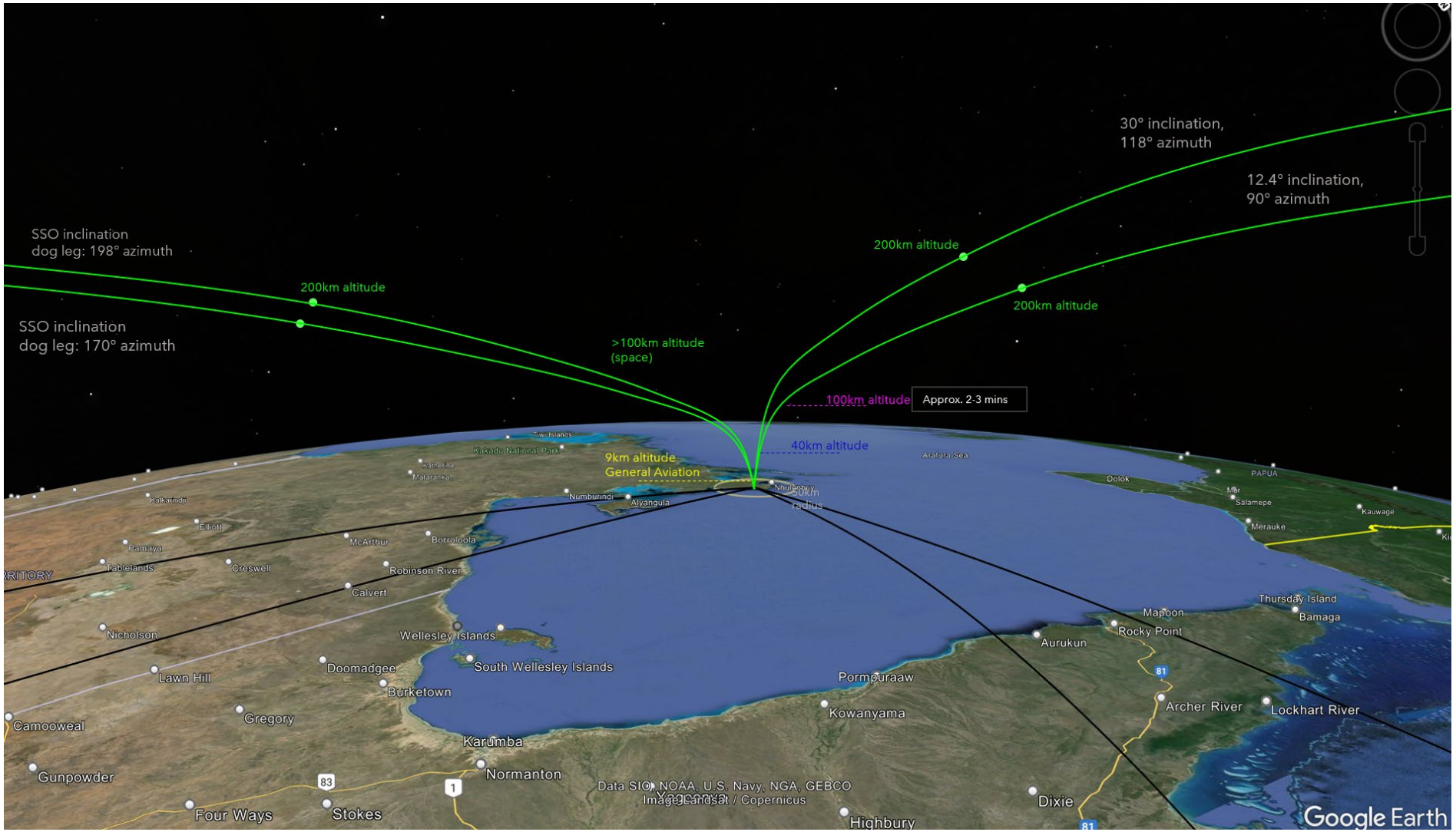

Figure 3: Angle view of trajectories shown in Figure 1 (represented here by green lines), highlighting height of orbital rockets (~100 km alt at ~50 km distance down range)

3 ALTERNATIVES

There have been no matters raised in public submissions or in direction to provide additional information by the NT EPA regarding alternatives.

4 STAKEHOLDER ENGAGEMENT

As the proponent of an action or strategic proposal ELA has duties under s43 of the Environment Protection Act 2019 (NT) for stakeholder engagement and consultation.

ELA's Stakeholder Engagement Plan (Appendix 3) defines the approach undertaken to consult and engage with stakeholders during the Phase 2 expansion and for future launch operations. The plan seeks to deliver to both State and Federal requirements (EPA Act and Space Act). The plan's objectives are:

1. To determine the specific communication needs of impacted and potentially affected communities, and identifying culturally appropriate methods of communication
2. To provide direction on approach for community awareness and potential involvement during site expansion activities and launch operations activities as appropriate for the stakeholders impacts
3. To recognise the role that Aboriginal people have as stewards of their country and the importance of participation of Aboriginal people and communities in environmental and recovery decision making processes
4. To enable building relationships with key stakeholders, gaining local support and maximising positive benefits
5. To meet legislative requirements to engage with stakeholders for land access, agreements, and approvals

The process for stakeholder engagement for this proposed action is discussed in more detail in Section 7.4.1

ELA has continued to engage with Gumatj Corporation and the Northern Land Council regarding the lease expansion and development of the ASC site since the original referral was made to the NT EPA.

ELA has written to the Central Land Council (CLC) to begin the process of engagement and consultation about general principles. ELA will consult with the Central Land Council on the process to be followed if LV booster is proposed to be recovered on Country in the future. The Central Land Council will be included as a member of the SRC in the bimonthly-to-weekly meetings for launches that have a southern trajectory and will require recovery on land. This process of consultation and engagement will be followed as part of launch planning (Section 7.4.1.3).

ELA has written to the Anindilyakwa Land Council (Groote Eylandt) as a matter of courtesy. Launches and retrievals will not affect or interact with Country or waters of importance to the Land Council. Short-term interference with scheduled and private flights from the Groote Eylandt airport may occur during a launch and this will be addressed through the Civil Aviation Safety Authority (CASA) procedures.

ELA, in collaboration with Gumatj (Appendix 11), will continue to support engagement of the East Arnhem stakeholders through a discovery education process and NLC facilitated consultations in support of the ASC lease expansion process. As part of this, the SER Executive Summary is forming part of the information to be translated into local language and communicated in this process.

Concerns and issues raised from ongoing consultations with Gumatj continue to be captured and maintained in Annex C of the ASC Stakeholder and Engagement Plan at Appendix 3.

5 RESPONDING TO SUBMISSIONS

All submissions received in response to the original submission have been considered and where appropriate the proposal has been adapted, performance criteria or mitigation measures included to address the issues raised.

A summary table is provided for each stakeholder addressing

- the issues raised in their submission
- the response to the issue raised including actions taken to address those issues
- why no action was taken or required/taken (where applicable).

5.1 DEPARTMENT OR TERRITORY FAMILIES, HOUSING AND COMMUNITIES

Theme	Environment	Submission Comment	Addressed
Regulatory Approvals	Heritage Act 2011	Please include the red text in Table 2 Regulatory Approvals: • The Heritage Act 2011 provides for the identification, declaration, conservation and protection of places and objects of cultural and natural heritage. All sites on the NT Heritage Register are protected under this Act. Aboriginal or Macassan archaeological sites and objects are automatically protected under this Act. This includes places and objects not previously recorded.	Table 4
People	Culture and Heritage	Table 12 Environmental Factors and Objectives: • Please confirm you have conducted a Heritage Register check with the Heritage Branch. • The presence or likelihood of archaeological material should be addressed under this factor.	Section 2.3.1
	Culture and Heritage	• A stop work policy/ unexpected finds protocol should be in place for potential cultural heritage materials on site. The guidance of an Archaeologist to provide recommendations on mitigation strategies may assist this requirement	Section 2.3.1

5.2 ABORIGINAL AREAS PROTECTION AUTHORITY (AAPA)

Theme	Environment	Submission Comment	Addressed
Regulatory Approvals	Certification	Main Report Table 2: • Note that Authority Certificates are issued under the Northern Territory Aboriginal Sacred Sites Act 1989.	Table 4
	Stakeholder Engagement	An application for an Authority Certificate has been received for the Arnhem Space Centre (ASC) site and activities. The recovery areas are not included in the application area. • Note AAPA is the "Aboriginal Areas Protection Authority"	Section 2.3.3

Theme	Environment	Submission Comment	Addressed
Land	Drop Zone A	Main Report Table 9: • Zone A covers the entire Northern Territory. • The proponent should be required to define more discrete drop zones and investigate potential environmental and cultural impacts in those locations. • Discrete recovery areas should then form an activity and subject land in an Authority Certificate. Custodians may require specific protocols to enter a sacred site for recovery of rocket components.	Figure 2 Section 7.4.1 Section 7.5.1 Appendix 1
Water	Groundwater Extraction and Impact	Main report s6.4.4 Pg 3: The proponent intends to top up the dam with groundwater during the dry season as necessary. • Volumes are not provided, and an assessment of groundwater flow, drawdown, and discharge area has not been made. Reference 3 s1.2 Pg 1 and s4.1.3 Pg 18: Identifies soaks, seepages, swamps and springs but • potential impact to water flow and ecology from groundwater extraction has not been assessed, and states further work is required. Reference 7 s4.3.3 Pg 7 and s4.4.1 Pg 8: • Currently it is not known whether groundwater dependent sacred sites are present in parts of the site area.	Section 7.2.1
	Water Quality and Aquatic Ecosystems	Main report s6.5 Pg 38 and s6.6 Pg 39: Direct and cumulative impacts are described, • but not indirect impacts. Section 6.2 determined that soils are thin to non-existent and have low carbon content and biological activity. Therefore • chemical spills to land may leach to groundwater with little retardation or degradation, and discharge to creeks affecting water quality and aquatic life. • Currently it is not known whether sacred sites are present along the creeks in parts of the site area.	Section 7.2.2
People	Cultural Impact	Main report s6.13 Pg 44: States that the ASC will have no direct or cumulative impacts on culture and heritage but • does not explain how this conclusion was determined. The information required for demonstrating avoidance / minimisation of impacts on Aboriginal sacred sites is: 1) evidence of an Authority Certificate that covers the proposed works and use of land and sea, in accordance with the Northern Territory Aboriginal Sacred Sites Act 1989; and 2) a commitment to comply with the conditions of the Authority Certificate. • Obtaining and adhering to an Authority Certificate is the appropriate mechanism to avoid and mitigate impacts to Aboriginal sacred sites.	Section 2.3.2 Section 7.5.1

5.3 Department of Chief Minister and Cabinet, Strategic Policy

Theme	Environment	Submission Comment	Addressed
People	Community and Economy	Impacts Identification and Engagement: Referral Report p22, p27-28 Table 11, and p34 Table 12: The Referral indicates the project will have a positive impact on the local community and economy, however, • does not include sufficient detail to allow for the significance of any potential positive and/or negative social, cultural and economic impacts to be assessed. • Stakeholder perspectives listed in the Referral focus on operations rather than on potential social, cultural or economic impacts. • Proponent processes to assess operational impacts and stakeholder processes to identify potential impacts need to be concurrent and to inform each other. Recommendation: It is recommended the Referral include information on potential social, cultural and economic impacts, for example on local infrastructure and services, other businesses, community cohesion, traffic, noise, dust, vibration, and recreational and cultural activities. The Referral should also include information on stakeholder perspectives (unsolicited and solicited) of the broader potential positive and negative impacts of the project, and of the process used to identify these perspectives	Section 2.1 Section 7.4.2 Appendix 3
	Culture and Heritage	Authority Certificate: Referral Report p34: • The Referral does not confirm if a heritage assessment has been undertaken or an Authority Certificate obtained for the Phase 2 site. Recommendation: To inform project planning and engagement activities it is strongly recommended the proponent obtain an Authority Certificate from Aboriginal Areas Protection Authority as a priority	Section 2.3.1
	Community and Economy	Workforce: Referral Report p12: The Referral describes site accommodation, however, • does not include workforce numbers or any potential impacts. Recommendation: To identify potential impacts, it is recommended the Referral includes information about the proposed construction and operation workforce, including numbers, timeframes, source (e.g. local, fly in fly out of Darwin or interstate), composition (e.g. mix of skills needed) and accommodation needs.	Section 2.1.1
		Local employment and Procurement: Referral Report p44: Although the Referral indicates the proponent will work with the Gumatj Corporation to provide training and education to support job creation and provide sustainable economic development opportunities in the region, • no detail as to how this is intended to be achieved is included. Recommendation: It is recommended that the Referral includes specific information regarding local training, employment and procurement opportunities in order to assess positive project impacts	Section 2.1
		Legacy Planning: Referral Report p24: Although the Referral indicates the proponent will re-vegetate areas that are not needed, it • does not include any information regarding the decommissioning of infrastructure such as fuel storages and water storages at the end of the project. Recommendation: To address any potential impacts or residual risks that may be identified at the conclusion of the project, it is recommended that the Referral includes specific information on how project infrastructure will be managed or decommissioned at the conclusion of the project	Section 2.1.3

5.4 Department of Environment, Parks and Water Security

Theme	Environment	Submission Comment	Addressed
Flora and Fauna	DEPWS Flora and Fauna Division	Surveys were undertaken in 2015 for the Gulkula Mine but were focused on previously cleared areas within the European Launcher Development Organisation site. • It is unclear if the adjoining vegetation is suitable for these species and whether those species are present. Recommendation: That the proponent provide further detail about the new areas proposed to be cleared and a significant impact assessment for the threatened species that could occur there. This assessment may require targeted surveys for threatened species. Recommendation: It is recommended that the NT EPA seek additional information from the proponent to clarify the extent of regrown and intact native vegetation being impacted by the works. This will allow assessment of the potential impact of the proposal on a number of threatened species that potentially occur in intact vegetation types that occur in the broader project area.	Section 7.1.1
	Weed Management Branch	• The proponent must ensure that all vehicles and machinery are free of weeds, weed seeds, soil and vegetative material prior to entering or exiting the site. Vehicles must avoid driving through weeds already present on-site to prevent further spread. Vehicles and machinery exhibiting such material must be thoroughly washed down before entering/departing. • Any works that cause disturbance to vegetation and soils will create conditions favourable for the growth of weed species, and weed control will be required following disturbance caused by exploration and/or extraction. Weed control prior to seed set should be carried out in all areas affected by these works.	Section 7.1.3

5.5 Environment Centre NT

Theme	Environment	Submission Comment	Addressed
Public Consultation Feedback	Lack of Information	ECNT notes that this Project comprises a complex industrial rocket launching operation, with a large range of environmental impacts spanning multiple jurisdictions, on a scale unprecedented in Australia.	Noted
		Potential militarisation of a remote and precious part of Australia and could increase the risk of the area becoming a military target.	Not applicable Section 7.4.1.3
		ECNT disagrees with ELA's alarming self-assessment that the potential impacts of the Project are low and can be managed through compliance with regulatory approvals and an approved Environmental Management Plan. • It is unclear under what legal framework ELA proposes the Environmental Management Plan would be approved and monitored. • It is manifestly inadequate for ELA's operations to be managed via a section 19 lease under the Aboriginal Land Rights (Northern Territory) Act, which appears to have been the primary approval and regulatory process to date. • In ECNT's view, the referral represents a slipshod effort to identify and address environmental impacts of this proposed industry, which could be very significant and far reaching, potentially impacting precious places like the Great Barrier Reef.	Section 1.1 Section 1.2 Section 2.2 (including original list in Referral Table 2)

Theme	Environment	Submission Comment	Addressed
		ECNT sought a number of documents via freedom of information on 23 October 2019, including: • The notice of intent provided by ELA to the NTEPA, including the proposed environmental management plan; • The advice provided by the NTEPA to ELA to ensure that potential impacts and risks to the environment are minimized; and • Comments from NT Government advisory bodies. The documents have never been released to ECNT. ECNT was advised that ELA lodged a complaint about the NT Government's decision to release information in March 2021, but has heard nothing since that date, including about the outcome of that complaint to the Information Commissioner. • It appears that the release of basic information about the facility to the public was resisted by ELA, for reasons which remain unclear. Such secrecy impacts ELA's social licence to operate.	Not applicable
	Summary of Project	There would be a rocket launch more than once a week on average, an extraordinary increase from current operations with probable significant impacts. Research undertaken by the New Zealand Government identified seven possible threats from rocket debris, including (1) direct strike causing mortality (2) noise disturbance (3) toxic contaminants (4) ingestion of debris (5) smothering of seafloor organisms, preventing normal feeding and/or respiration (6) Provision of biota attachment site and (7) floating debris. While they assessed the risk to be low in the case of 10 repeated launches, the authors stated that at 100 launches the risks could be moderate, and with 1000 could become high. • There is little analysis of, or even acknowledgement of, these risks in the referral report.	Section 1.2
	Summary of Project	• The possible trajectories for the launched missiles are alarmingly expansive, and span multiple jurisdictions (NT, Qld, Papua New Guinea, South Australia) and areas of high ecological significance, including the Great Barrier Reef. While assertions are made in the referral that national parks and marine parks will be avoided, it is unclear how this will be achieved.	Figure 2 Section 7.1.4
	Risks Associated with the Project	• There has been inadequate stakeholder engagement, with selective engagement with corporate entities including Gumatj Aboriginal Corporation, Dhimurru Aboriginal Corporation, Laynhapuy Aboriginal Corporation and the Northern Land Council. • There does not appear to have been any wider consultation with First Nations and other communities on the Gove Peninsula. While there are a number of organisations listed at Table 11, it is not clear that ELA has discussed the actual Project and its environmental impacts with them. The stakeholder engagement appears to breach the NTEPA's stakeholder engagement guidance; • There is no information provided about the purpose of the rockets which will be launched from the site, their capacities, connections to defence and/or weaponry, and associated risks; • There is no information about noise and light pollution from weekly rocket launches, and the potential impacts on human and animal life, and the environmental and cultural values of the area; • There is inadequate information provided about the risks to climate and the Earth's protective ozone layer from the cumulative impacts of increased rocket launches, which the US National Oceanic and Atmospheric Administration found could be considerable due to the increase in the amount of soot injected into the stratosphere. This could lead to an annual temperature increase in that layer of 1 to 4 degrees Fahrenheit, slow down tropical jet streams, and degrade the protective ozone layer. • There is no information about national security risks that could be posed by the potential militarization of this area of Arnhem Land, including the risk of this area becoming a military target;	Appendix 3 Section 1.1 Section 1.2 Section 6 Section 7.1 Section 7.1.4 Section 7.3.2 Section 7.4.1 Section 7.1.1

Theme	Environment	Submission Comment	Addressed
		• There is no information about the potential environmental, cultural and social impacts of the Project on Yirrkala, Nhulunbuy, outstations and other areas of residence on the Gove Peninsula; • Scant information is provided about the risk of explosion of rocket fuel or other hazard materials at the site, apart from brief dot points (see page 15 of referral); • Inadequate information is provided about the potential risks to human, animal and plant life in the case of launch failure, and management systems designed to mitigate these risks. While ELA characterizes launch failure as uncommon, they note that BBIX rockets have a launch failure rate of approximately 2%, which in ECNT's view represents a moderate to high risk; • Inadequate information is provided about the trajectory of launched missiles, or the risks of fallen debris across multiple jurisdictions and how these will be mitigated (e.g. (1) direct strike causing mortality (2) noise disturbance (3) toxic contaminants (4) ingestion of debris (5) smothering of seafloor organisms, preventing normal feeding and/or respiration (6) Provision of biota attachment site and (7) floating debris) • No information about impacts on threatened species including green turtles, flatback, hawksbill and olive ridley turtles; • No biodiversity surveys appear to have been undertaken, with ELA relying on out of date ecological studies prepared for a mine on the site that are not fit for assessing the risks of the Project (e.g. see reliance on vegetation study by Mitchell 2015); • No information has been given regarding the potential impacts of vegetation clearing at the site, with the information requirements falling far short of the NT Planning Guidelines.	

5.6 TONY RYAN MP

Theme	Environment	Submission Comment	Addressed
	Air and Land Pollution	• Dry season rocket / missile launches would spread chlorine gas across Gove Peninsula at a high altitude damaging ozone layer • Wet season lift-offs would toxify southern regions • There is no environmental oversight.	Section 7.3 Appendix 6 Section 1.2 Section 2.2 (including original list in Referral Table 2)
	Risks Associated with the Project	Militarisation of the NT: • The facility is also a US military missile site, inviting reprisal nuclear strikes in response to the planned American war with China. Land Rights and Homelands • Implications for land rights and homelands	Section 7.4.1.3 Section 1.2 Section 2.2 (including original list in Referral Table 2)

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Following consultation with the Department of Climate Change, Energy, the Environment, and Water, ELA has submitted a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) for the purpose of recovery of LV hardware from areas that are Matters of National Environmental Significance (MNES), e.g., the Gulf of Carpentaria and the Coral Sea Marine Park.

ELA has conducted a self-assessment for vegetation clearance at the ASC site as per the EPBC Act, based on a vegetation and habitat quality assessment (section 7.1.1, Appendix 2). Clearance of ~91 ha of *Eucalyptus tetrodonta* open woodland will not significantly impact any MNES and a referral is not required.

7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 LAND – TERRESTRIAL ECOSYSTEMS

7.1.1 VEGETATION CLEARANCE FOR ASC PHASE 2

Additional information required for SER:

- Provide an updated assessment of the terrestrial ecosystem values that would be potentially affected by the proposed action.
- Assess the potential impact of the proposed action on threatened species, their habitats, significant and sensitive vegetation, and landscape features.
  - Identify measures that will be implemented to avoid or mitigate these impacts.
- Demonstrate that clearing is consistent with the NT Land Clearing Guidelines or justify any alternative.
- Describe any ongoing monitoring, inspection, and reporting of impacts on ecosystem values to ensure their protection.

The NT allows for native vegetation to be cleared on unzoned freehold land under the *Planning Act 1999*, with a permit required if proposed clearance exceeds 1 ha. It also considers that a Eucalypt forest with more than 30 eucalypt stems >40 cm diameter at breast height (dbh) or 5 stems >50 cm dbh per hectare to be of high value for biodiversity. Referral under the EP Act is required prior to lodgement of a clearing application if there is the possibility that a proposal may have a significant impact on the environment.

Approximately 91 ha of native vegetation will be required to be cleared for expansion of the ASC (Figure 4). A vegetation and habitat assessment survey conducted for ELA (Appendix 2) determined that the intact vegetation on the plateau is primarily *Eucalyptus tetrodonta* open woodland, which is typical of the region. The surveyed vegetation is subject to regular late season fires, particularly from the south, and strong winds and cyclones, leading to large areas of early succession and sparse vegetation.

ELA is finalising master planning work and the final lease is still expected to be in place with Gumatj and the Northern Land Council in Q3 2024. The figures/areas in Figure 4 and Appendix 7 are supported by Gumatj and will be confirmed on final survey expected Jun/Jul 2024. Any changes to lease area and/or final area for vegetation clearance are not expected to be material and would be confirmed before seeking vegetation clearance permit.

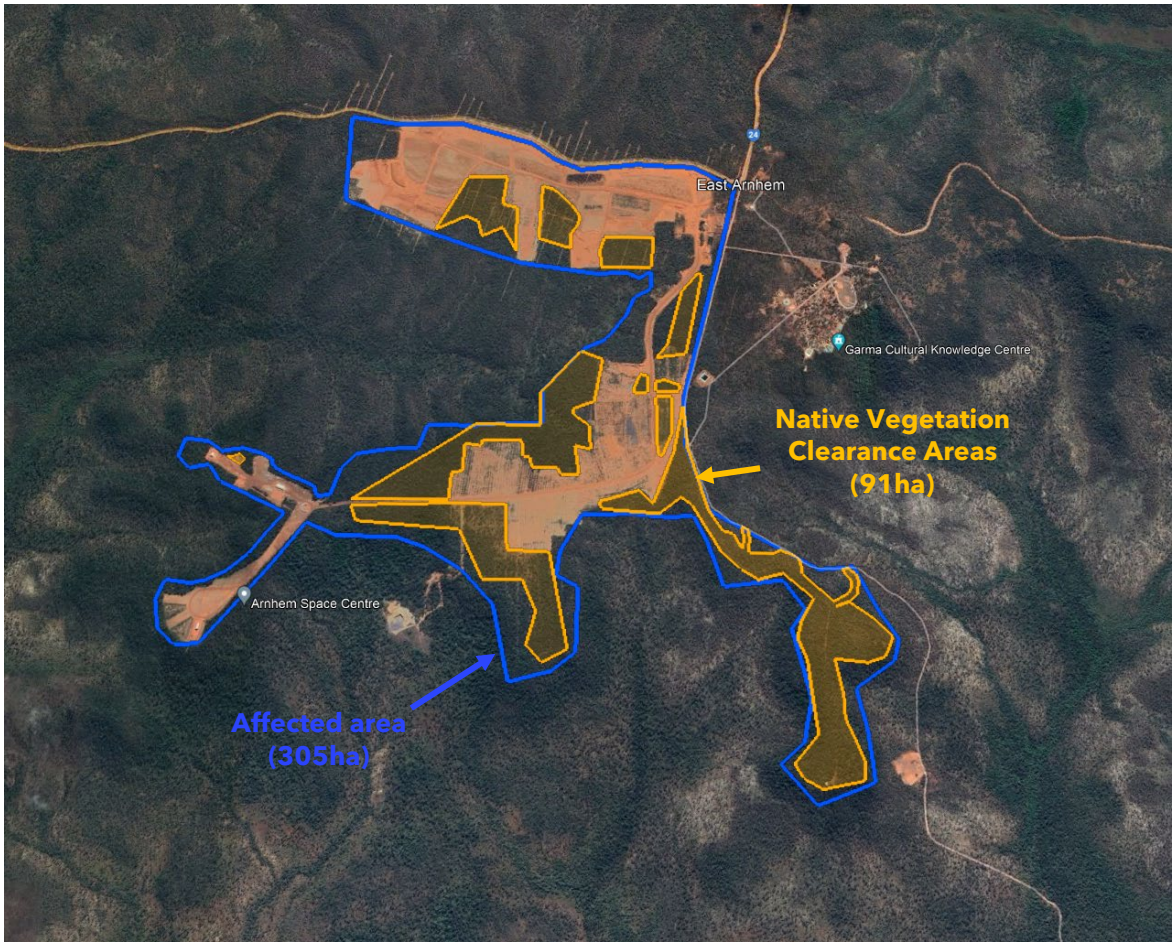

Figure 4: ASC operational area (dark blue polygon - ~305 ha) and areas for vegetation clearance (orange polygons – ~91 ha)

Twenty-seven (27) trees with a dbh > 40 cm (9 >50 cm dbh) were identified in the proposed clearance area. This is below the land clearing guideline's threshold of 30 by >40 cm dbh and 5 by >50 cm dbh stems per hectare for classification as significant.

Small pockets of monsoon vine forest (totalling ~ 6 ha) dominated by *Diospyros maritima*, *Canarium australianum*, and *Terminalia macrocarpa* occur on the southern plateau side slopes. Approximately 0.1 ha lies within the currently proposed clearing footprint. There was no evidence of the Vulnerable *Pternandra coerulescens* and *Hernandia nymphaeifolia* occurring in these patches.

An assessment of all threatened flora and fauna records for the Arnhem Coast bioregion contained in the latest NT Flora and Fauna Atlas database, and nationally significant fauna and flora found through the Protected Matters Search Tool, identified 65 (sixty-five) threatened species that may occur in the project area and wider region. Fifteen (15) species required marine or freshwater habitat and were discounted from further assessment. Five (5) of these species had a medium likelihood of occurrence although there are no proximate records for four of these species. Nineteen (19) species had a low likelihood of occurrence, other than as vagrants, and the remainder were highly unlikely to occur in the project area (Appendix 2).

A habitat assessment is provided for seven threatened fauna species that have historically been found proximate to the project area, including five (5) species identified as being of concern in the NT EPA Direction (Ref EP2023/031). The assessment (Appendix 2) determined that the habitat value of the vegetation proposed to be cleared for the ASC expansion is of low quality for these species for the following reasons:

- Black-footed tree-rat (*Mesembriomys gouldii gouldii*) – frequent fires and cyclones, and the shallow soils of the plateau, limit the number of large trees available for nesting and limit lower mid-storey species diversity for foraging. Patches of monsoon forest outside the project area

may provide some habitat, however of the ~15 records in east Arnhem Land in the last decade, none occur within 5 km of the project area.

- Partridge pigeon (*Geophaps smithii smithii*) – frequent fires limit availability of structurally patchy understorey. Key forage species *Alloteropsis semialata* and *Chrysopogon* do not occur in the project area. There are no recent records of this subspecies in east Arnhem Land, and it is likely to be locally extinct.
- Northern brushtail possum (*Trichosurus vulpecula arnhemensis*) – the plateau surface has a low density of large trees with hollows for nesting (> 40 cm diameter at breast height (dbh)) and a low density of mid-storey fruiting trees, making it poor foraging habitat. The monsoon forest patches outside the project area may support this species, although there are no recent records of this species in the area.
- Northern brush-tailed Phascogale (*Phascogale pirata*) - the plateau surface has a low density of large trees with hollows for nesting (> 40 cm diameter at breast height (dbh)). There are no recent records of this species on the mainland in the last two decades and it is likely to be extinct.
- Fawn antechinus (*Antechinus bellus*) – frequent fires limit habitat value. There are no recent records for this subspecies in east Arnhem Land and it is likely to be locally extinct.
- Floodplain monitor (*Varanus panoptes*) – shallow soils and the lack of permanent water limit the habitat value of the project area for this species.
- Northern blue-tongued skink (*Tiliqua scinoides intermedia*) – the lack of permanent water and frequent fires limit the habitat value of the project area for this species. The monsoon forest patches outside the project area may support this species.

The vegetation of the project site does not contain significant or important habitat for any listed migratory species, the majority of which are coastal species (Appendix 2).

Clearance of ~91 ha of Eucalyptus tetrodonta open woodland at the project site will not have an adverse effect on listed threatened fauna or flora as this does not provide quality, important or significant habitat, and these species do not currently inhabit the site. Consequently, monitoring, inspection, or reporting of impacts on threatened species will not be required.

7.1.2 Site Management – Biodiversity

ELA proposes the following measures to protect ecological values while allowing for vegetation clearance:

- Laying of large diameter trees that have been felled within uncleared vegetation or rehabilitated vegetation to provide habitat for ground nesting species
- Applying a non-clearing buffer of at least 50 m to the majority of the outer edge of the monsoon vine forest community, however there may be a small area which goes no closer than 20m
- Applying a 20 m non-clearing buffer around the plateau edge to minimise erosion risk, except in specific instances where hard engineering will also achieve the same function
- Undertake vegetation clearance and site stabilisation during the dry season
- Revegetate exposed soils with appropriate native species where possible
- Develop a comprehensive erosion and sediment control plan for the life of the project
- Develop a comprehensive fire control plan

7.1.3 Site Management - Weeds

Two class B weeds, i.e., Perennial mission grass (*Cenchrus pedicellatus*) and Hyptis (*Mesopharum suaveolens*), and five environmental weeds, i.e., Yellow oleander (*Casablanca thevetia*), Gambia pea (*Crotalaria goreensis*), Indian goosegrass (*Eleusine indica*), Milkweed (*Euphorbia heterophylla*), and White teak (*Gmelina arborea*), are found within the project area.

Perennial mission grass is a priority weed for strategic control, including eradication of outliers, and Hyptis is a hygiene and biosecurity weed (of concern to agriculture) with control required to prevent its spread.

ELA recognises the low weed status of the region and will ensure that:

- All non-local construction vehicles will be required to be pressure washed before coming onto site
- Local fill will be aimed to be used at the site for construction and will not be imported from offsite unless needed for specific civil structural foundation requirements
- Disturbed areas will be revegetated where not required for operational or infrastructure purposes
- Ongoing site management will include procedures for weed surveillance and control

7.1.4 Assessing and Mitigating Impact on Recovery Area Biodiversity Values

ELA is required to obtain all required environmental permits, approvals, and/or licences during the 13-month launch planning process before a new launch vehicle's Australian Launch Permit (ALP) will be issued by the ASA.

The required trajectory and technical specifications of a LV and its payload will be known by ELA approximately 9 months out from the launch. LV trajectory is controlled by sensors, the internal computer guidance system, and gimballed engines. The burn time and distance travelled for each stage is known from the mass of the LV/payload and fuel and the rate of fuel burn.

The potential recovery area is then able to be calculated with a 3-sigma certainty and mapped.

Once the area has been identified and optimised to avoid population centres and environmental no go areas (e.g., Great Barrier Reef), ELA is able to identify the Traditional Owners, landowners, land managers, and/or relevant Government authorities within the area and commence engagement and consultation as previously agreed with them (e.g., Section 7.4.1).

The Protected Matters Search Tool[1] and State/Territory databases will be consulted to identify Matters of National Environmental Significance (MNES) and/or State/Territory significance.

Self-assessment of potential impact against the defined criteria will be made as allowed by the EPBC Act and EP Act and as per any pre-existing conditions of approval made following current referrals under both Acts.

Impact site rehabilitation and remediation of any damage will be done as per agreement with the relevant landowners, land managers, or relevant authorities. Figure 5 - Figure 8 show the impact point of the NASA Black Brant IX (BBIX) sounding rocket (launch vehicle (LV)) and payload in East Arnhem Land and remediation of the impact point in collaboration with Traditional Owners.

The updated ASC Flight Hardware Recovery Plan is provided in Appendix 1.

[1] https://pmst.awe.gov.au

Figure 5: Stage 1 LV (BBIX rocket) recovered on land in East Arnhem Land

Figure 6: Payload debris from LV (BBIX rocket) recovered on land in East Arnhem Land

Figure 7: Site remediation with Traditional Owner representative

Figure 8: Remediated site following recovery of LV (BBIX rocket) and payload in East Arnhem Land

7.2 WATER – HYDROLOGICAL PROCESSES, WATER QUALITY, AND AQUATIC ECOSYSTEMS

7.2.1 GROUNDWATER EXTRACTION AND IMPACT

ELA indicated in the referral that groundwater may be required to top up a dam supplied by surface water flow during dry conditions. This activity will not occur within the first years of ASC operation and would only be a contingency when the ASC reaches full operational capacity by 2027-2030 and if surface water recharge was significantly lower than normal.

ELA would seek a water extraction licence at this time, and this would be a Tier 2 significant application for extraction of less than 500 ML per year in an intermediate or regional scale aquifer outside of a plan area. ELA would be required to provide the following information as part of its application for a water extraction licence[2]:

- Stakeholder engagement report showing how stakeholders, i.e. Aboriginal landholders and licenced water users have been engaged
- 10 km radius hydrocensus (bore stocktake)
- Report on pump tests and gamma log results
- Identification of specific yield and transmissivity of the groundwater resource
- Analysis of potential radius and cone of depression
- Ground truthed assessments of groundwater dependent ecosystems (GDE) or sensitive receptors in 5 – 10 km radius

There are no perennially flowing streams or water courses within the ASC lease or expansion area or the Dhupuma Plateau generally, and there are no GDE within the ASC lease or expansion area. Similarly, there are no sacred sites located along ephemeral drainage areas within the ASC lease area.

7.2.2 Water Quality and Aquatic Ecosystems

ELA will design and construct all liquid fuel storage and transfer areas to have a compacted base and bund to ensure that inadvertent spills do not flow into waterways, or leach into groundwater.

ELA's environmental management plan will have procedures for spill containment and site remediation in the event of accidental fuel or chemical spills elsewhere on site, and staff will be trained to undertake these actions in a timely manner.

There are no creeks or sacred sites associated with creeks (or otherwise) within the ASC lease or expansion area.

7.3 Air – Air Quality

7.3.1 Air Quality Impacts

7.3.1.1 Exhaust Emissions

Rocket launches can cause short-term elevated levels of exhaust emissions. A buoyant cloud of exhaust (and steam from the deluge system) is produced on ignition and the first few seconds of lift off. This very hot cloud rises quickly and stabilises at an altitude of fifty to several hundred metres above the launch pad before dissipating and mixing in the atmosphere. A contrail is formed along the trajectory of the rocket due to the presence of water in the exhaust. The contrail will gradually disperse and dissipate in the atmosphere.

The primary polluting emissions from the liquid and gas fuelled LV are the gases carbon monoxide (CO) and nitrogen dioxide (NO_2), with soot as particulate matter. Other gases produced will include water (H_2O), carbon dioxide (CO_2), hydrogen (H_2), oxygen (O_2), and small amounts of sulphur compounds, e.g. SO_2. While CO is initially produced due to incomplete combustion, a significant fraction of this will be further oxidised to CO_2 due to the very hot temperatures in the exhaust plume.

- Carbon monoxide affects human health by decreasing the amount of oxygen that can be taken up by the lungs and may affect environmental health through combining with other pollutants to form lower-atmosphere ozone and photochemical smog. Emissions from combustion of fossil fuels and burning of biomass are the largest contributor of carbon monoxide to the atmosphere. CO has a lifetime of ~ 2 months and is removed from the atmosphere through geochemical oxidation by atmospheric hydroxyl radicals or through biological oxidation by soil microorganisms
- Nitrogen dioxide can affect human health through lung irritation and increased susceptibility to respiratory infections and affect environmental health through the production of photochemical

[2] https://nt.gov.au/environment/water/licensing/water-extraction-licence/tiers

smog and lower-atmosphere ozone. Emissions from transport and electricity generation from fossil fuels are the largest contributor of nitrogen dioxide to the atmosphere. It has a short residence time in the atmosphere, photo-dissociating in sunlight to form nitric oxide (NO) and ozone (O_3) and deposited to soil where it is processed by soil microorganisms.

Solid fuelled LV will also produce hydrochloric acid (HCl) as a gas, and aluminium oxide (Al_2O_3) as particulate matter (National Research Council (US) Subcommittee on Rocket-Emission Toxicants 1998).

- HCl gas poses a human health risk when inhaled or through exposure to skin[3]. Safe Work Australia has established workplace exposure standards for airborne HCl (Table 6, Safe Work Australia 2021). HCl gas released to the atmosphere has a residence time of ~ 36 hours. It can be deposited to land in wet and dry form. In high concentrations it can react with atmospheric water to form hydrochloric acid, forming a component of acid rain and photochemical smog. Globally, emissions of HCl are mostly from open waste burning (38%), open biomass burning (19%), coal, oil, and gas combustion for energy (19%) and residential combustion (13%) (Zhang et al. 2022). HCl is rapidly neutralised by contact with alkaline soil.
- Al_2O_3 is a white odourless crystalline powder that can also be used to make abrasive and refractory materials, ceramics, paper, and indigestion tablets. It can irritate the skin and eyes on contact, and inhalation can lead to nose, throat, and lung irritation. Repeated exposure under industrial conditions can lead to physical lung damage. Al_2O_3 and iron oxide (Fe_2O_3) are the primary minerals of most soils in the Northern Territory and are a component of airborne dust in the region. The residence time of particulate matter in the atmosphere depends on a range of factors including meteorological conditions and particle size.

7.3.1.2 SENSITIVE RECEPTORS

Sensitive receptors are locations which have the potential to be impacted by air emissions from a project. They are defined with respect to:

- Potential impact on human health
- Potential impact on cultural structures or artefacts
- Potential impact on environmental health

The Garma Cultural Knowledge Centre (~ 800 m east of the closest proposed launch pad) and an uninhabited house (~ 870 m southeast of the closest proposed launch pad) are the nearest sensitive receptors to the ASC with respect to human health (Figure 9). Note, with support of Gumatj, the area around this house is now in final review with Gumatj and NLC as part of the new lease area.

Other areas of permanent or temporary human habitation in the region of the ASC, not mentioned in the original referral (Figure 9), are:

- Bawaka (homeland) (~ 15 km south)
- Dhalinybuy (homeland) (~ 36 km west)
- Garahan - Macassan Beach (homeland) (~14 km east northeast)
- Ganami (Wonga Creek) Camping Ground (~ 12 km southwest)
- Giddy River Campground (Guwatjurumurru) (~ 14 km west)
- Goanna Lagoon (tourist) (~ 8 km north northwest)
- Memorial Park (Gapuru) (~ 24 km south)
- Oyster Beach (Lurrupukurru) (tourist) (~8 km east)

Areas of cultural or heritage significance (Figure 9) are:

- Wurrwurrwuy Macassan Stone Pictures (~ 13 km north northeast)
- Other archaeological sites (~ 16 km north northwest)

[3] https://www.dcceew.gov.au/environment/protection/npi/substances/fact-sheets/hydrochloric-acid

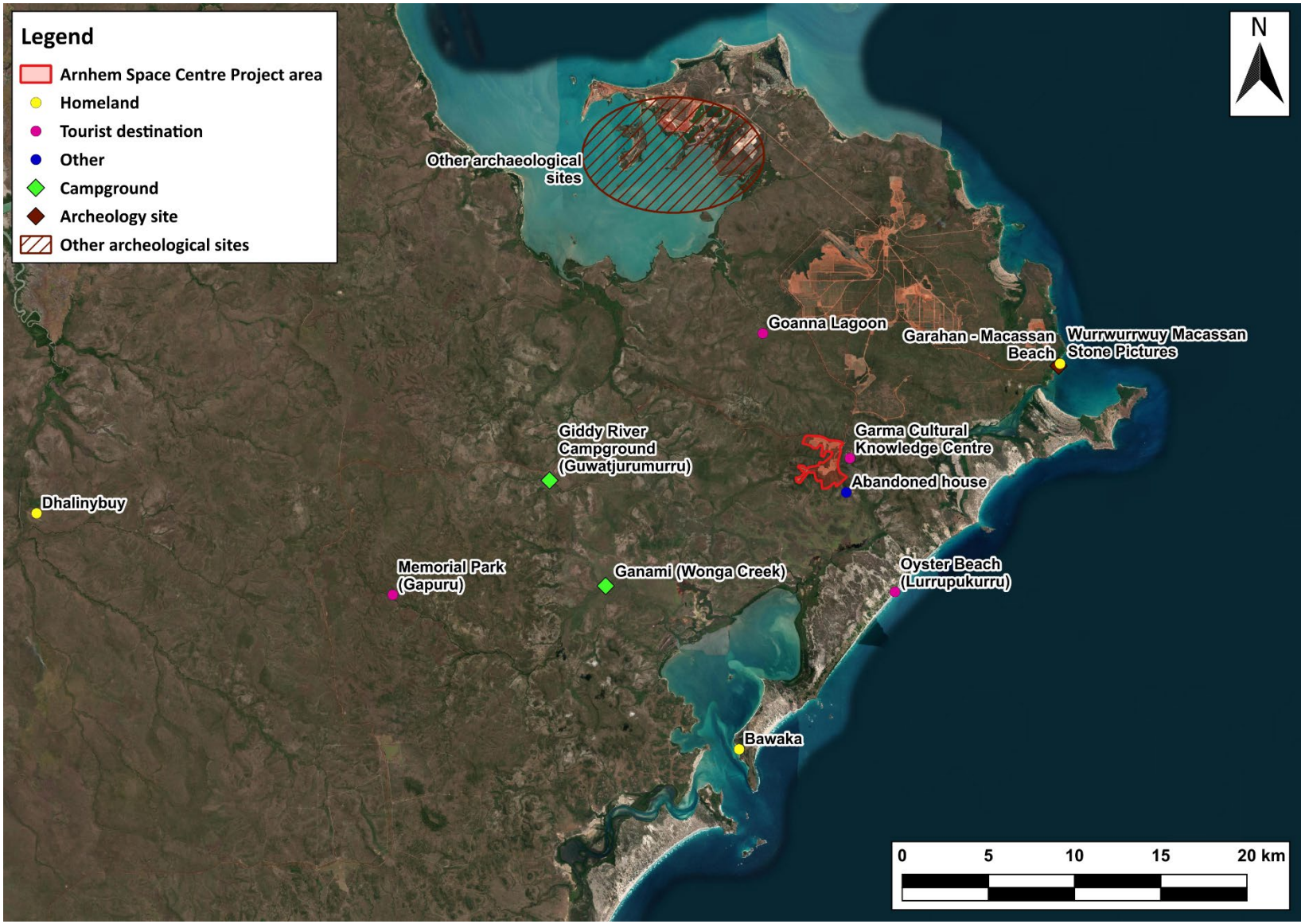

Figure 9: Location of potential sensitive receptors relative to the ASC

7.3.1.3 POLLUTANT DISPERSION MODELLING

Dispersion modelling of the exhaust from the largest possible liquid fuelled LV that could be launched from the ASC and of the exhaust of a typical solid fuelled sounding rocket was conducted with AERMOD. The models assumed that one of each LV would be launched every hour over a period of one year (i.e., 8,760 launches per year) and that meteorological conditions, e.g. wind strength and direction, were typical for each hour of the day or year. The mass of these pollutants per launch modelled is provided in the table below.

The AERMOD model has been adopted because a key concern in regard to the proposed operation is the potential for impacts in the near-field (close proximity to ASC). It is expected that, in the near-field, the model will provide a conservative estimate of ground-level concentrations of air pollutants. That is, the model will result in overestimates of ground-level concentrations associated with the proposed operation.

Additionally, in the far-field, ground-level concentrations of air pollutants will be substantially lower than in the near-field and, consequently, the model results showing compliance with air quality standards in the near-field also demonstrate compliance will be achieved in the far-field.

The Project site's proximity to the coastline (8-10 km) is captured in the meteorological data used in the dispersion modelling. There are no complex terrain, or other features, in the surrounding area that would result in the AERMOD dispersion model underestimating ground-level concentrations of air pollutants.

Exhaust emission rates for CO, HCl, NO_2, and Al_2O_3 (as PM_{10}) have been calculated for a typical sounding rocket, e.g. the BBIX, which uses solid fuel, and the largest liquid fuelled rocket, that may be launched from the ASC (Table 5), applying emissions factors from Ryan *et al*. (2022) for HCl, NO_X, and Al_2O_3.

The amount of CO is likely to be overestimated as an unknown proportion of this will be further oxidised to CO_2 due to the heat of the exhaust plume.

Table 5: Mass (kg) of main pollutants in exhaust emissions for two representative LV types

LV type	Average fuel burn rate (kg/s)	Mass of emissions per launch (kg)			
		CO	HCl	NO_X	Al_2O_3
Liquid fuelled	403.5	44,726.7	nil	1,129.8	nil
Solid fuelled	61.0	50.8	166.7	2.4	301.7

Dispersion modelling of the primary pollutants emitted by rocket fuel combustion, has been undertaken using annual meteorological data in 15-minute increments from the Bureau of Meteorology, the prognostic meteorological model TAPM, and the Gaussian plume model AERMOD (Hurley *et al*. 2005; Johnson 2022). This provides predictions of ground-level concentration of air pollutants, conservatively assuming constant production of the pollutants across all hours and all wind conditions of a year. Short-term concentrations (15-minute and 1-hour averages) are presented as 99.9th percentiles. Longer-term concentrations (8-hour and 24-hour averages) are presented as the maximums. Predictions have been made with reference to gridded receptors and the nearest possible sensitive receptor at the Garma Cultural Knowledge Centre.

The predictions have been made conservatively assuming a launch occurs during every hour of a year for assessment against the short-term air quality standards. Consequently, the contour plots and quoted results do not represent every launch but are the aggregation of the highest predicted results if a launch occurred in every hour of the year. Therefore, the results presented below will over-estimate likely ground-level concentrations of air pollutants under most circumstances. The purpose of this conservatism is to evaluate the potential impacts, regardless of when a launch occurs and in conjunction with the range of meteorological conditions that are likely to occur in one year.

The following standards are applied in the assessment of air quality impacts (Table 6):

- Air NEPM

- Approved methods for the sampling and analysis of air pollutants in NSW (NSW EPA 2022)
- Exposure Standards as defined in the Hazardous Chemical Information System, Safe Work Australia (Safe Work Australia 2021)
- Integrated Risk Information System, United States Environmental Protection Agency (US EPA 1995)

Table 6: Air quality standards applied for the SER

Pollutant	Averaging period	Guideline	Units	Source
Carbon monoxide	1-hour	30,000	$\mu g/m^3$	NSW EPA
		25	ppm	
	8-hour	11,000	$\mu g/m^3$	
		9	ppm	
Hydrogen chloride	15-minute	7,500	$\mu g/m^3$	Safe Work Australia
		5	ppm	
	1-hour	140	$\mu g/m^3$	NSW EPA
		0.09	ppm	
	24-hour	20	$\mu g/m^3$	US EPA
		0.012	ppm	
Nitrogen dioxide	1-hour	164	$\mu g/m^3$	Air NEPM
		0.08	ppm	
Aluminium oxide (as PM_{10})	24-hour	50	$\mu g/m^3$	Air NEPM

Figure 10 - Figure 13 present the predicted ground-level concentrations of the four pollutants emitted from the launch pad closest to the Garma Cultural Knowledge centre (designated Magenta by ELA). Figure 10 presents the 99.9th percentile 1-hour average concentration of CO and Figure 11 presents the 99.9th percentile 1-hour average concentration of NO_2 from the largest liquid fuelled LV that would be launched from the ASC. Figure 12 presents the 99.9th percentile 1-hour concentration of HCl and Figure 13 presents the maximum 24-hour concentration of Al_2O_3 (assuming a maximum of 1 launch per day) from a typical solid-fuelled sounding rocket launched from the same pad. Emissions of CO and NO_2 are not presented for solid-fuelled rockets as these are insignificant.

The contour plots show the area where ground-level concentrations due to exhaust emissions as a result of a launch in any hour of a year may be:

- ≥ the relevant air quality standard (dark blue)
- between 50% and 100% of the air quality standard (medium blue)
- between 25% and 50% of the air quality standard (light blue), and
- < 25% of the air quality standard (no colour)

For each individual rocket launch at any launch pad ASC is predicted to comply with air quality standards at all receptors:

- **1-hour and 8-hour average ground-level concentrations of CO are predicted to comply with the air quality standard at the Garma Cultural Knowledge Centre**
- **15-minute, 1-hour, and 24-hour average ground-level concentrations of HCl are predicted to comply with the air quality standard at the Garma Cultural Knowledge Centre**
- **1-hour average ground-level concentrations of NO_2 are predicted to comply with the air quality standard at the Garma Cultural Knowledge Centre**
- **24-hour average ground-level concentrations of Al_2O_3 as PM_{10} are predicted to comply with the air quality standard at the Garma Cultural Knowledge Centre**

Appendix 6 presents the predicted ground-level concentrations of the four pollutants emitted from three other proposed launch pads around the expanded ASC site.

The majority of sites identified in Section 7.3.1.2 that may have been considered sensitive receptors (Figure 9) are significantly beyond the area that will receive exhaust emissions at a level that would exceed 25% of the air quality standards in Table 6. Emissions will have dissipated or been deposited well before reaching these sites.

7.3.2 NITROUS OXIDE (AND GREENHOUSE GASES)

Nitrous oxide (N_2O) is produced in small quantities by the combustion of fuel. It is not regarded as an air pollutant in Australia's National Environment Protection Measure for Ambient Air (Air NEPM)[4] or in legislated air quality standards for New South Wales (NSW EPA 2022), Victoria (EPA Victoria 2022), or Queensland (Queensland Government 2019). The Northern Territory does not have any legislated air quality standards and may refer to the standards for these authorities when setting conditions for developments in the Northern Territory.

Nitrous oxide is a greenhouse gas (GHG) with a 100-year global warming potential of 265, i.e. the warming due to one molecule of N_2O is equivalent to 265 molecules of CO_2 over a 100-year period. Globally, 60% of N_2O emissions come from natural biological processes (predominantly through nitrogen cycling in forest soils) while 40% is due to human activities. N_2O is produced by agriculture (the primary source of human-derived emissions), wastewater management, industrial processes, and fuel combustion. Approximately 80% of Australia's N_2O emissions come from agriculture.

Nitrous oxide production is reported under the National Greenhouse and Energy Reporting scheme (NGERs)[5] by facilities that produce 25,000 tonnes of CO_2 equivalent (tCO_2-e) per annum. ELA may have to report its GHG emissions if, for example, more than 94 tonnes of N_2O, i.e., 25,000 tCO_2-e, are produced in a single year and where these emissions are defined to be Scope 1 and not Scope 3 emissions.

Rocket emissions may also include soot. This is not a GHG but in aggregate has a short-term climate forcing effect through absorbing sunlight, warming the surrounding air, and reducing albedo in areas of snow and ice, thereby increasing melting. The largest global sources of soot in the atmosphere are the burning of biomass and unfiltered diesel exhaust. Soot does not accumulate in the atmosphere like GHGs.

The actual mass of GHG emissions will depend on the mass of fuel combusted within the atmosphere in a calendar year. This will vary from year to year and will depend on the number and type of launch vehicles launched from the ASC. ELA is required to report these annually if Scope 1 and Scope 2 emissions exceed the legislated threshold of 25,000 tCO_2-e per annum and progressively reduce emissions if they trigger the Safeguards threshold of 100,000 tCO_2-e per annum. Annual operations at the ASC are unlikely to reach these thresholds.

[4] https://www.legislation.gov.au/F2007B01142/latest/text

[5] https://cleanenergyregulator.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme

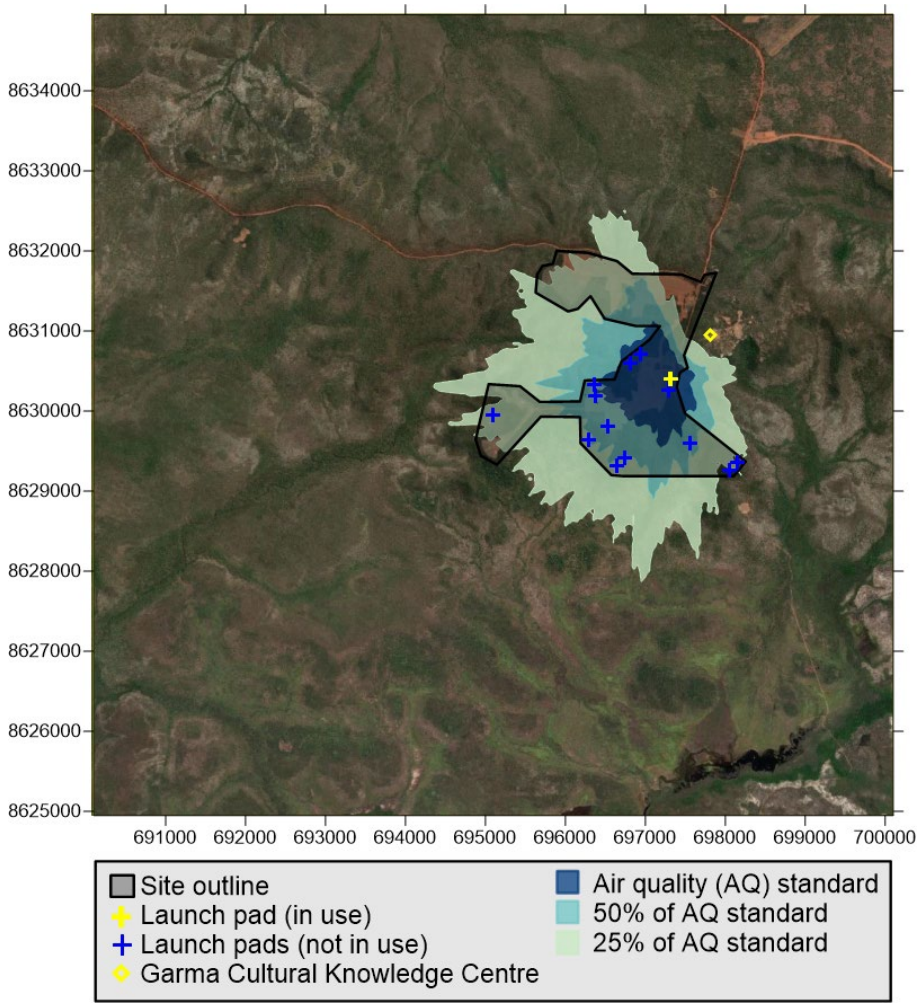

Figure 10: Predicted 1-hour ground concentration of CO from launch of liquid fuelled LV from pad closest to Garma Cultural Knowledge Centre

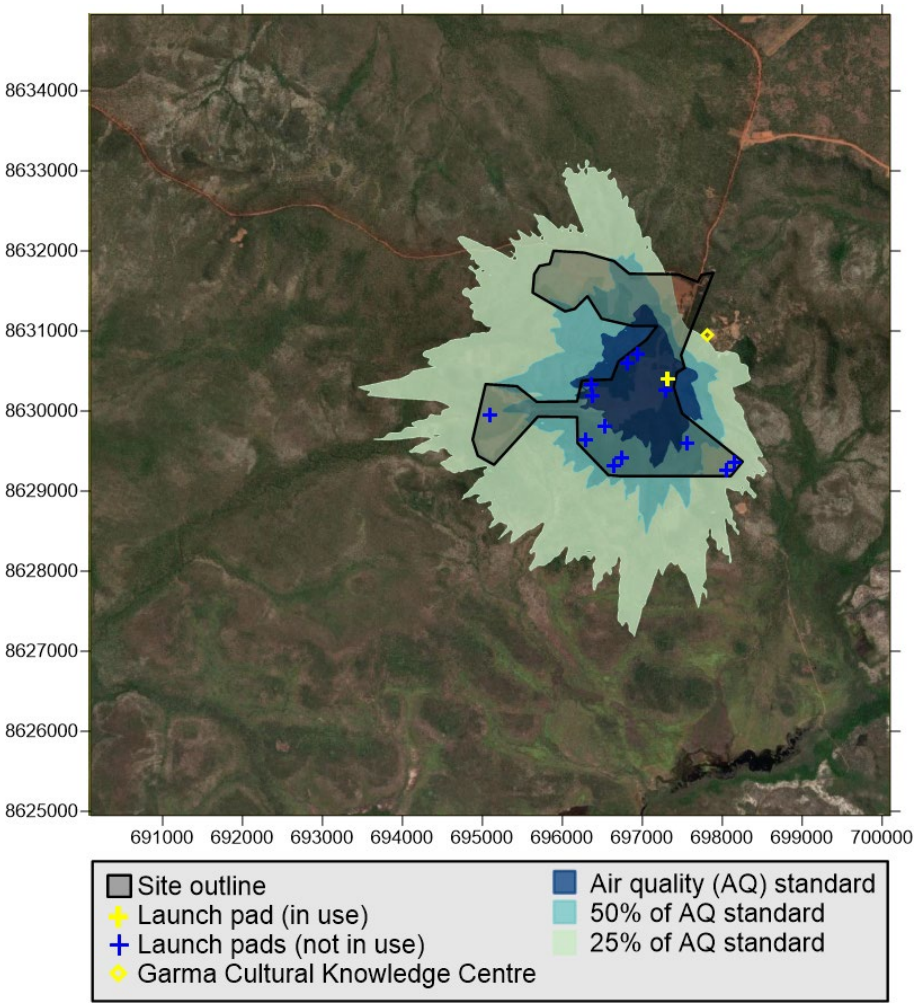

Figure 11: Predicted 1-hour ground concentration of NO_2 from launch of liquid fuelled LV from pad closest to Garma Cultural Knowledge Centre

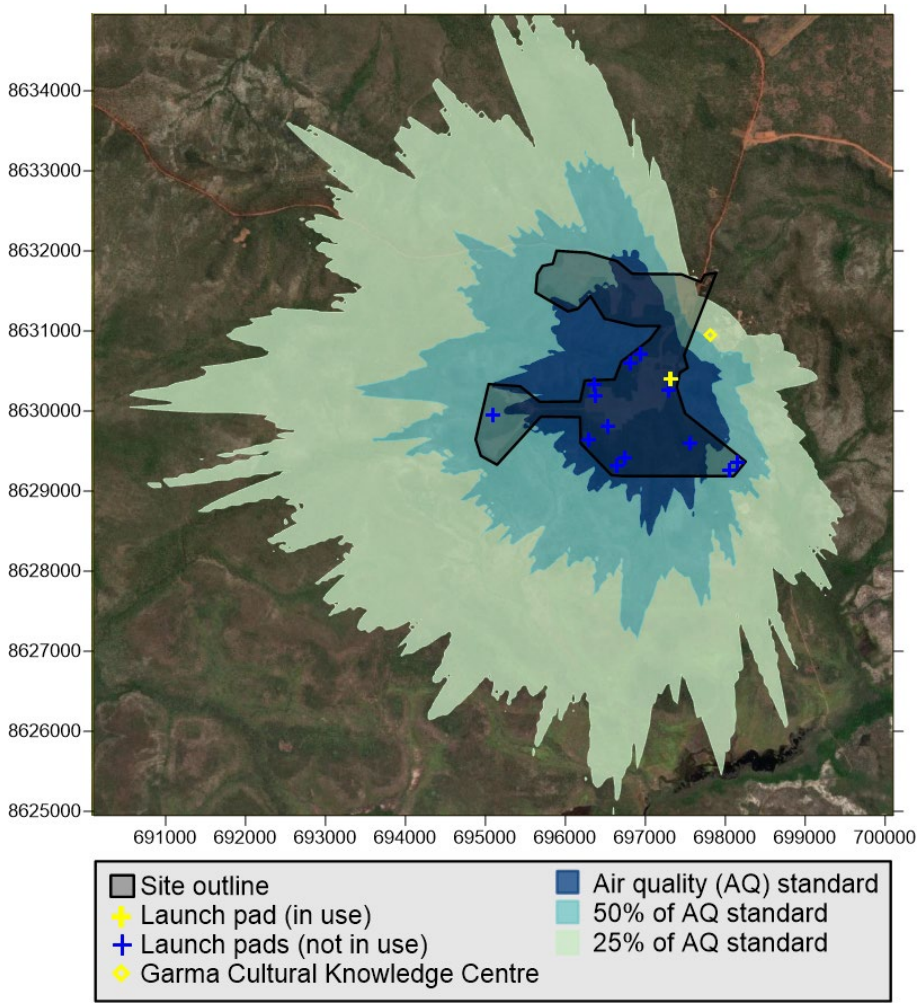

Figure 12: Predicted 1-hour ground concentration of HCl from launch of solid fuelled LV from pad closest to Garma Cultural Knowledge Centre

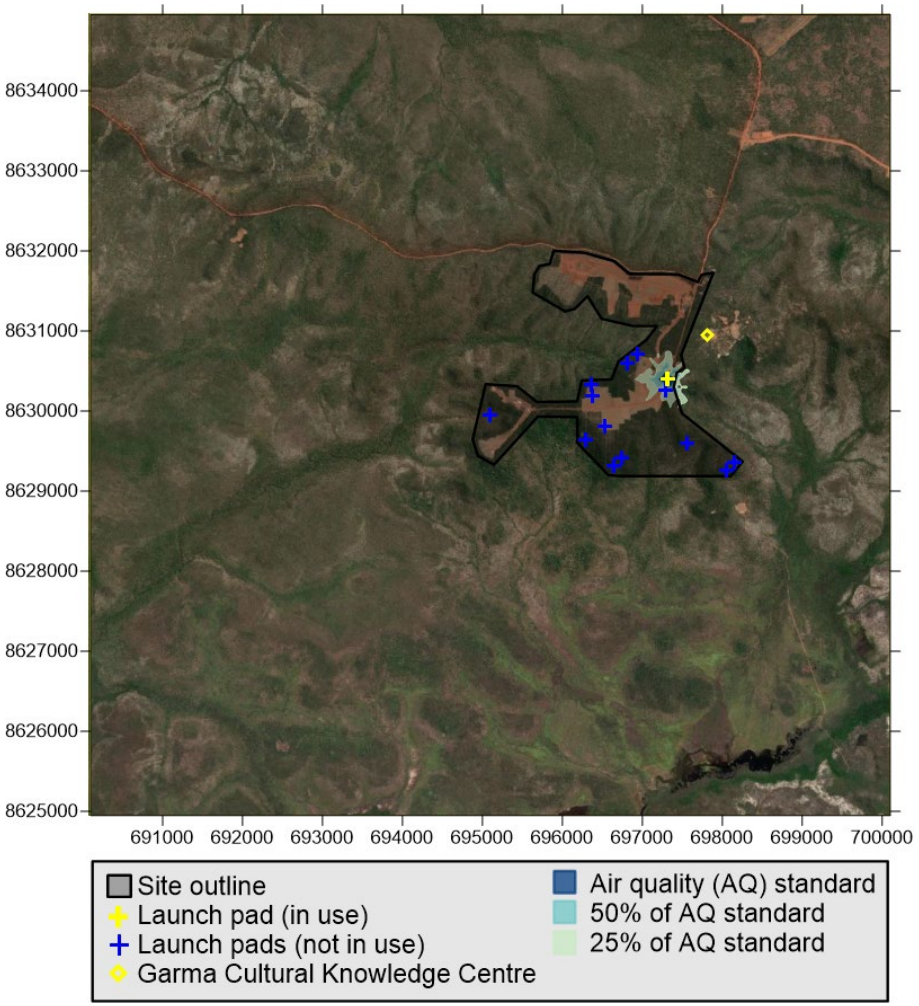

Figure 13: Predicted 1-hour ground concentration of Al_2O_3 from launch of solid fuelled LV from pad closest to Garma Cultural Knowledge Centre

The Launch Hazard Area (LHA) and Safety Clear Zone (SCZ) for personnel access to a launch pad is generally 30 minutes following a launch. This allows for dissipation of exhaust fumes and personnel awareness of any issues that may have arisen during the launch.

The actual emissions and their dispersal from any one LV can be calculated during launch planning when the technical specifications for the LV are known. A proportion of the initial ignition exhaust pollutants will be captured in the deluge water. The actual mixing in the atmosphere will depend on the height of the boundary layer at that point in time and the direction of dispersion will depend on the wind direction at that time.

Emissions from LV exhaust will not accumulate in the atmosphere, in biological material or ecosystems, and will not degrade items or areas of heritage value at or nearby the ASC. There will be no future limitation on land use associated with this exhaust.

Comparative analyses of emissions from the launch of very large solid-fuelled LV from USA intended for the 2020 Mars mission have determined that there are no short-term or long-term adverse impacts on air quality. NASA identified that the effects of launching these very large rockets would include short-term effects on air quality from the LV exhaust cloud, including short term acidic deposition on vegetation and water bodies at and near the launch complex, however the effects of this deposition would be transient and there would be no long-term or cumulative impacts on the environment (USAF 2000; NASA 2011, 2014). Those rockets are many times larger than any solid rocket motor to be launched at ASC.

ELA will establish a monitoring station at the Garma Cultural Knowledge Centre with the permission of the Traditional Owners to measure CO and HCl levels prior to, during, and following the launch of liquid-fuelled and solid-fuelled LV. These two air pollutants are most likely to be of concern for acute human health and/or effect on cultural materials.

7.4 People – Community and Economy

7.4.1 Stakeholder consultation

7.4.1.1 ASC Site Development and Intentions

The ASC is located on freehold Aboriginal land and the site is leased from the Gumatj Corporation and the Northern Land Council. ELA has an ongoing leaseholder and stakeholder relationship with the landowner representatives on which the ASC and its proposed expansion occur. The partnership has included agreement on land use, protocols for notification of specific launch operations, and ongoing engagement in business, social, and educational opportunities provided by the ASC and its operations.

7.4.1.2 Previous operations

An ALP was granted to ELA in May 2022 by the Commonwealth Minister of Industry, Science, and Resources (the Minister), and the ASA for the launching of three NASA Black Brant IX (BBIX) research sounding rockets. The BBIX were launched from the ASC and the LV, and their scientific payloads were recovered from freehold Aboriginal land to the southwest of the ASC (Figure 5 - Figure 8).

The Launch Permit was granted after a period of planning which included consultation and agreement with the Traditional Owners of both the ASC site and the recovery area.

Leading into the NASA campaign, ELA re-initiated the Safety and Retrieval Committee (SRC) at Appendix 4 to inform, consult, and work with Traditional Owners and other direct stakeholders on ASC operations. This collaborative approach led to the development of a protocol (ASC Principles for Land and Sea Access and Vehicle Recovery at Appendix 9) for down range land and water access and recovery planning and operations within Country (orange area south-west of the ASC, Figure 2).

7.4.1.3 Future operations

ELA is a world first commercial space port for launching orbital and sounding launch vehicles to a wide variety of orbit inclinations. ELA's target Clients are domestic and international new-space commercial launch vehicle companies as well as defence companies who are supporting payload customers seeking to send up to Low-Medium Earth Orbit (as well as Lunar transfer orbits) or sub-

orbital scientific tests for: telecommunication, climate, earth observation, security, scientific and other similar payloads. ASC is not a military base.

Client demand and requirements will determine the trajectory followed by each launch and the number of launches in any one year. It is projected that launch campaigns will overlap and be about three to five weeks' duration each, with one (1) to three (3) launches per campaign. The trajectory followed by each launch (Figure 1, Figure 2, Figure 3) will also be determined by client mission requirements and subsequent optimisation for safety and environmental constraints by ELA. It is planned that 98% of launches will be orbital (payload remains in space, booster motor returns to Earth) and 2% will be sub-orbital (all vehicle hardware returns to Earth).

Each proposed launch will have a tailored launch, flight, and recovery plan and will require permitting by the ASA. The ASA and their sub-contracted technical assessor (minister approved engineering company), will review each proposed launch, assessing LV type, flight or testing history of LV, payload, trajectory, flightpath, launch management plan, risk assessment, flight safety plan, environmental controls and permits, space safety (review for impacting orbiting satellites - Collision On Launch Assessment (COLA)), and technology security, before any permit and conditions of approval are issued for the launch. This also only occurs after reviewing that consultation with all stakeholders is adequate and that informed consent has been obtained where required.

Launch planning involves the identification of the specific trajectory that the LV will follow (Figure 1, Figure 2, Figure 3) and calculation of the actual recovery area based on the LV size/weight, fuel load, payload, and meteorology. Launch planning occurs approximately 9 months out from a prospective launch. ELA can then communicate to and engage with the appropriate stakeholders including Traditional Owners regarding specific operational parameters and obtain consent for the recovery of LV hardware such as first stage booster motor and payload fairings.

Recovery is carefully planned (ELA Mission Optimisation Process at Appendix 5). Launch parameters will ensure that recovery areas will avoid inhabited areas, the coastal areas of the Gulf of Carpentaria, the Great Barrier Reef, and spatially definable areas of high ecological value including those in the Coral Sea. Other areas may also be spatially defined and excluded as ELA becomes aware of them during each launch planning process. The outcome of this optimisation process, which includes 3rd party environmental input when required, is approved in the following order:

1. Manager, Orbital Trajectory and Risk Analysis
2. General Manager, Regulatory Compliance and Legal
3. General Manager, Launch Operations
4. If required, relevant Environmental agency (NT EPA or EPBC)
5. Australian Space Agency Launch Permit Application process

ELA's Environment Policy (Appendix 10) details the intent and commitment ELA plans to take in relation to Environmental management and in complying with our Environmental obligations. As part of ELA's obligation to the relevant State and Federal legislation, and in accordance with this policy (Appendix 10), ELA undertakes environmental planning and review as part of the Launch Facility License as well for each and every Australian Launch Permit - both of which maintain inclusion and engagement of our key stakeholders. The result of which will inform the development of ELA's Environmental Management Plan and the operational procedures in which ELA conducts environmental activities. A key process within planning for each Launch Permit is ELA's mission optimisation process (Appendix 5) in which every launch is reviewed for safety and environmental risk and then mitigated. These risk mitigation actions then inform specific actions to be taken within operations (e.g. recovery plans).

ELA's Stakeholder Engagement Plan for the ASC is provided in Appendix 3. ELA has adopted the International Association for Public Participation framework for community engagement (IAP2)[6],

[6] https://iap2.org.au/

recognising the need for a process that incorporates the interests and concerns of all affected stakeholders and that meets ELA's commercial and operational needs.

The Stakeholder Engagement Plan (Appendix 3) includes mapping of stakeholders for all aspects of ASC operations and consideration of the type of engagement required, based on the IAP2 framework. The Stakeholder Engagement plan (summarised in Table 7 below) demonstrates consultation with stakeholders (including and as specifically required for each launch, the identification of relevant stakeholders within affected areas, including those within payload landing and hardware recovery zones within NT land and coastal waters) is appropriate and has been undertaken in accordance with the NT EPA's EIA guidance for proponents: Stakeholder Engagement and Consultation and the general duty of proponents under section 43 (a) to (d) of the Environment Protection Act 2019 (EP Act).

The positive outcome of this is evidenced and reflected in continued positive feedback by local and down range Traditional Owner stakeholders.

Table 7 - Summary of Engagement

Stakeholder	Possible Impacts (direct/indirect)	Identified parties per Stakeholder plan	Engagement / Consultation Method	Timing
1. People residing within local proximity of the ASC	• Increased demand on local infrastructure such as the Central Arnhem Road and Gove Peninsula access, services such as medical, other logistical services to the region • Users of the Gulkula ceremonial site (which includes the Garma Institute and Garma Cultural Knowledge Centre) • Individuals • Other businesses particularly during peak visitor periods • Community cohesion and recreational and cultural activities. • The broader potential positive and negative impacts of the project, including details of the process used to identify these perspectives • Public health and safety.	• Gumatj Aboriginal Corporation (landlord) • Northern Land Council • Dhimurru Aboriginal Corporation • Laynhapuy Homelands Aboriginal Corporation • Rirratjingu Aboriginal Corporation • Mimal Aboriginal Corporation • Afura Swamp Rangers • Southern East Arnhem Limited (SEAL) IPA Aboriginal Corporation • Nhulunbuy Town Board • Nhulunbuy Construction Suppliers and Service Providers • East Arnhem Schools • East Arnhem Land Tourism Association • East Arnhem Regional Council – local authorities in Yirrkala and Gunyangara	**Consult**	
			SRC engagement	2023 and ongoing
			Direct meetings	2022-2024
			New Ards materials developed	Q1-Q2 2024
			Gumatj discovery education and NLC consultations (supported by ELA)	Q3 2024
			Business & community info sessions	2023 and ongoing into each launch
			Manage feedback	Ongoing
			Inform	
			Website	Ongoing
			EDM	Ongoing
			Printed SER on display	During enviro assessment
			Open day sessions	Annual – Ongoing last open day on Q4 2023
			School visits	Annual - Ongoing last visit on Q4 2023
			Launch coordination meetings	As required

Stakeholder	Possible Impacts (direct/indirect)	Identified parties per Stakeholder plan	Engagement / Consultation Method	Timing
		• Regional Economic Development Committee • NT Government • Gove Airport • Gulkula Mine • Developing East Arnhem Land (DEAL) • Nhulunbuy EMS (Fire, Police, Emergency)		
2. Key communities under potential flight path	No direct impacts under flight path	• Aboriginal Land Councils • Regional Councils and local authorities	**Inform**	
			Not Applicable	
3. Communities near proposed landing and recovery sites	To be identified 6-9 months before launch • Component will land in identified area • Sacred Sites review • Access permissions to recover landed component	• Central Land Council (CLC) • Recovery area EMS (Fire, Police, Emergency) • Aboriginal Authority Protection Agency (AAPA)	**Consult**	
			Meetings with and letter sent to AAPA	Nov 2022 and Q2 2024
			AAPA certificate (NT Only)	12 mths prior to launch
			Community info sessions and radio communications	3-6 mths prior
			Inclusion to SRC	As required
			Australian launch permit notifications	As per space act

As launch specifics become clearer, ELA will continue the process of engaging with stakeholder and government agency representatives in regions identified as potential recovery area(s) for spent rocket stages, e.g., the Central Land Council and Parks Australia (for Marine Parks, excluding the Great Barrier Reef Marine Park).

The actual trajectory and potential recovery area of first stage rockets launched from the ASC are known about 9 months before a launch. Trajectories are based on the client's commercial requirements, e.g., specific satellite orbit required, and the specific characteristics of the launch vehicle, e.g., motor and payload size, and fuel load.

ELA established the SRC to inform, consult, and work with Traditional Owners and other direct stakeholders leading into the 2022 NASA launch campaign. Establishing the SRC led to the development of a protocol (Appendix 9) for down range recovery planning and operations within Country (orange area south-west of the ASC, Figure 2). The SRC forum acts to address general awareness as well as public health and safety of the community.

An ALP for each launch will only be issued once the ASA is satisfied that all relevant stakeholder engagement has been undertaken and its effectiveness is reviewed.

Concerns and issues raised during community and stakeholder consultation and engagement processes are always considered, logged and either incorporated or resolved. These are captured in the ASC Stakeholder Engagement Plan (Appendix 3).

7.4.2 Economic Development

ELA recognises that the ASC and operations will play an important role in the ongoing economic development of the East Arnhem Region, particularly as bauxite mining ceases at the end of the decade (DEAL 2020, NT Government 2022). ELA has agreed to pay the Yolngu people royalties based on launch revenue, meaning that Yolngu will share in the success of the planned growth of the ASC and as the number of launches increases. ELA frequently welcomed to and attends the

local regional economic forum to provide and update on business progress and to hear feedback from this group, particularly going into launch campaigns with large numbers of ELA and client staff staying in town for extended periods.

Over the life of the ASC further economic benefits will be provided through

- salaries and wages,
- employee spending,
- launch companies spending,
- tourism to stay in Nhulunbuy and watch launches,
- contractor engagement,
- operational expenditure, and
- investments in and donations to the local community including royalties.

Short term, ELA will aim to fill roles using local NT talent, but the business is in a critical growth phase and recruitment of initial key technical roles with appropriate experience will need to prioritise candidates sourced with best qualifications in Australia.

Short term economic benefits will be seen through:

- jobs in the local community,
- earthworks and construction contracts to local NT companies
- engagement of local educational institutions to promote STEM/STEAM1 and space as career options, as well as
- economic support in the local community and hire/use of local services companies to support launches.
- launch companies spending,
- tourism to stay in Nhulunbuy and watch launches,

Medium term economic benefits will be derived from:

- launch companies spending,
- tourism to stay in Nhulunbuy and watch launches,
- permanent paid staff in Nhulunbuy (including increase percentage of technical and administrative jobs) (Table 3),
- construction contracts to local and NT companies,
- jobs in the local community to support large numbers ELA and visiting staff and
- professionals boosting the local tourism industry, plus
- trainee and apprenticeship opportunities.

Long term economic benefits will occur on completion of the ASC when an increased demand for services to sustain planned launch activity, includes

- launch companies spending,
- tourism to stay in Nhulunbuy and watch launches,
- maintenance construction,
- facilities management and support contracts to local and NT companies,
- permanent paid staff in Nhulunbuy,
- visiting professionals boosting the local tourism industry,
- trainee and apprenticeship opportunities and
- co-location / stimulation of relocated and emerging space industries (high tech manufacturing).

Per Table 3 ELA will strive to build the local Nhulunbuy workforce maximising local employment opportunities both at the ASC or as service providers:

- the ASC will eventually require permanent staff on site to service launch and site requirements and staff will be composed of Nhulunbuy local and ELA staff.

- during the planned ASC construction and operation phases, the workforce will need to increase, and the local Nhulunbuy community will see an increased demand for the following services:
  - accommodation provision,
  - hospitality and sustenance, and
  - recreational services (tourism and recreational permits).

7.5 PEOPLE – CULTURAL AND HERITAGE

7.5.1 AUTHORITY CERTIFICATE

ELA is in the process of obtaining an updated Authority Certificate from the AAPA for work within the updated operational ASC boundary of the wider Phase 2 leasehold area (Figure 4) and is committed to comply with the conditions of approval. There will be no works conducted outside of this operational boundary.

ELA will apply for an Authority Certificate from the AAPA if consultation and planning for a specific launch operation (Section 2.3.2, Section 7.4.1) identifies that there is the possibility that a spent rocket stage will need to be recovered on land within the NT.

ELA would comply with the conditions of approval.

8 OTHER ENVIRONMENTAL FACTORS

There have been no matters raised in public submissions or in direction to provide additional information by the NT EPA regarding other environmental factors.

9 WHOLE OF ENVIRONMENT CONSIDERATIONS

The original referral and this Supplementary Environmental Report address the potential environmental, social, and economic impacts of the proposed expansion of the Arnhem Space Centre (ASC) and the launching and retrieval of rockets in the Northern Territory by Equatorial Launch Australia (ELA).

The ASC is a commercial spaceport for the launching of small and medium sized rockets (launch vehicles (LV)) and their payloads into equatorial low earth orbit, geosynchronous equatorial orbit, lunar orbit, and/or deep space. The ASC site is on freehold Aboriginal land held by the Arnhem Land Aboriginal Land Trust and leased by ELA through Gumatj and the Northern Land Council.

This information detailed in this SER underpins the following key statements:

- The majority of the site for the proposed expansion has been cleared of vegetation and mined for bauxite under Northern Territory and Commonwealth legislation. ELA propose to clear a further ~91 ha of *E. tetrodonta* open woodland for site development with some revegetation of exposed areas not required for the development. The existing woodland does not provide important or significant habitat for any listed threatened species and clearance will not have an impact on Matters of Territory or National Environmental Significance.
- Vegetation clearance and the construction of hard infrastructure will affect overland flow of water and groundwater recharge during the wet season, however the volume of water potentially intercepted or redistributed is small relative to the total volume of water over the Dhupuma Plateau. There are no waterbodies or groundwater dependent ecosystems within or immediately adjacent to the ASC and the waterways during the wet season are ephemeral
- Bunding, reticulation, treatment of site water, if required, adherence to industrial storage and distribution standards, and spill remediation procedures, will ensure that no fuels or other chemical pollutants enter waterways or groundwater.
- The launching of LVs from the ASC will produce exhaust emissions that are regarded as air pollutants or greenhouse gases. Carbon monoxide (CO) from liquid or gas fuelled LV and Hydrogen chloride gas (HCl) from solid-fuelled LV are likely to be the pollutants of concern for acute human or environmental health.
- Dispersion modelling has demonstrated that air quality standards for these gases are unlikely to be exceeded at the nearest sensitive receptor, which is the Garma Cultural Knowledge

Centre, and will not affect more distant sensitive receptors. The relatively low number of launches per year will mean that the gases dissipate and decompose in the atmosphere or on the ground and will not accumulate or bioaccumulate.

- LV hardware recovery in the Northern Territory will have a small physical impact area and are unlikely to significantly impact matters of environmental or cultural importance. Known areas of importance / significance will be avoided through launch planning and LV controls, and protocols will be developed in advance with, for example, Traditional Owners for LV retrieval and site remediation.
- ELA intentionally intends that the development and operation of the ASC is socially and economically positive for the local Yolngu people and the wider Northern Territory community.

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11 APPENDICES (Separate volume)

1 ASC Flight Hardware Plan
2 Vegetation and Habitat Assessment – Arnhem Space Centre
3 Stakeholder Engagement Plan
4 Safety and Retrieval Committee (SRC) Charter
5 ELA Mission Optimisation Process
6 Pollutant Dispersion Modelling
7 Spatial Coordinates – Proposed Footprint
8 Preparation of Report and Studies Declaration
9 ASC Principles for Land and Sea Access and Vehicle Recovery
10 ELA Environment Policy
11 Gumatj Letter: Arnhem Space Centre: Approach to Ongoing stakeholder engagement and consultation
12 Unexpected Finds Process