Feature Activity Sensitivity Tool (FeAST) Guidelines

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VICTORIA State Government | Energy, Environment and Climate Action

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Photo credit

Front cover: Victorian weedy seadragon (*Phyllopteryx taeniolatus*), Wilson's Prom

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it.

We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

DEECA is committed to genuinely partnering with Victorian Traditional Owners and Victoria's Aboriginal community to progress their aspirations.

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Glossary

Term	How it's used in the context of FeAST
Activity	This is a standardised list of human use, development or works that may be undertaken in the marine or coastal environment and associated with set pressure intensities.
Biotope	The hierarchical classification unit under the Combine Biotope Classification Scheme (CBiCS). Biotopes at level 3 (habitat complex) are used in the FeAST assessment. This term is used interchangeably with habitat in this context.
Biounit	Set biogeographical units used to divide regions into discrete areas, determined by distinct oceanographic, geomorphic and ecosystem processes, as well as biotope distributions.
Environment	Used to define the area where activities may occur in the defined marine and coastal area. Used in the context of risk to specifically consider biotic natural components of the defined marine and coastal area.
Environmental Risk Assessment	The assessment to produce a FeAST score is described as a first pass environmental risk assessment. It is specifically considering habitat, and involves screening of pressures, assessment of mapped habitats sensitivity to the screened pressures, and an assessment of exposure.
Exposure	The extent and intensity of a pressure impacting a habitat within a biounit. Doesn't include the planned duration of a lasting pressure.
Feature	The term used to describe the assets and values or activities in the marine environment that have been spatially represented in CoastKit. This includes species, communities, geology, landforms, protected areas, and existing infrastructure.
Habitat	An area of benthic substratum that supports a site of recurrent species that are adapted to living in specific environmental conditions of that area. Habitats assessed in FeAST use the CBiCS classification for biotopes at level 3 (habitat complex).
Intensity	The potential effect the pressure is likely to have on the ecosystem as induced by the activity. Standard intensity ratings for activities are used for pressure screening.
Impact	Is a term to describe the concept of a change, effect or influence an activity may have on a habitat. Used inter-changeably with effect.
Pressure	This is how the activities may influence or affect habitats. In FeAST this is a standardised list of mechanisms with associated benchmarks and is considered in the context of impacts to habitats, although, the identified pressures can be considered in other contexts.
Precautionary approach	An approach with emphasis on caution and consideration of possible harm where conclusive evidence isn't available. A precautionary approach is used to produce scores and was used to develop the foundational information used in FeAST.

Resilience	The ability of a habitat to recover from disturbance or stress. Holling (1973).
Resistance	Resistance characteristics indicate whether a habitat can absorb disturbance or stress without changing character. Holling (1973).
Risk	Risk is defined as the effect of uncertainty on objectives (ISO 31000 and DEECA risk management framework). In practice risk considers the likelihood of an event occurring, and the consequence or impact of that event. For the FeAST score, risk is considered specifically as the possibility of irrecoverable impact to a habitat posed by a project's activities.
Sensitivity	The likelihood of change when a pressure is applied to a habitat. This is expressed the ability of the habitat to tolerate or resist change (resistance) and ability to recover from impact (resilience). Tillin et al. (2010), Tillin & Tyler-Walters (2014).

These guidelines introduce the Feature Activity Sensitivity Tool (FeAST), outlining the key users, applications, and limitations of the tool. The FeAST assessment process is explained, with further details and technical information provided.

A step-by-step practical user guide is presented to guide users on how to access the tool and use it to undertake a FeAST assessment. Possible future enhancements for FeAST are described, as well as a references list and additional supporting information.

1. Introduction to FeAST

This chapter provides an overview of the Feature Activity Sensitivity Tool. Outlining the purpose, context for development, applications, main users, capabilities, and limitations.

1.1 Purpose

FeAST has been developed to support better decision-making in the marine and coastal environment of Victoria. The purpose of FeAST is to allow users to undertake a desktop-based first pass risk assessment to evaluate environmental features that could be impacted by a proposed project.

FeAST is applicable for all proposed uses, works, or developments set to occur in the marine environment. The marine environment, as defined in the *Marine and Coastal Act 2018,* extends offshore from the high-water mark for three nautical miles (5.5km), the edge of the state's jurisdiction. It includes all bays, inlets, estuaries, and the Gippsland Lakes. FeAST aligns with the mapped coastline of Victoria based on the zero-metre contour dataset derived from a digital elevation model.

FeAST is a first pass risk assessment and does not replace the need for more detailed assessment. FeAST should be undertaken in consideration of any local information and all relevant legislation, policy (including the Marine and Coastal Policy), and advice. Details on limitations are in section 1.6 and more information on how to interpret and use the FeAST outputs can be found in chapter 4.

CoastKit is a publicly available and interactive web-mapping portal to display marine and coastal information in Victoria. The portal is regularly updated and provides access to mapped data, resources, and tools to support evidence-based decision making.

The portal is organised by themes and hosts datasets on biodiversity, habitats, management zones, infrastructure, features of significance and Victorian Coastal Monitoring Program sites. FeAST is fully integrated in CoastKit and uses the information available to generate the assessments.

CoastKit has been created to assist with many different applications such as environmental impact assessments, coastal hazard assessments, marine spatial planning, reporting, research, and restoration needs.

FeAST integrates the spatial information available on CoastKit to assess the potential impact to habitats posed by the project. FeAST analyses the proposed activities and the project location and size, to provide a final FeAST score. The tool also conducts a Proximity analysis which lists key marine and coastal features likely to be impacted by the direct footprint of the project or within a 2km radius of the defined project area.

FeAST incorporates recent work mapping Victorian marine and coastal habitats using the Combined Biotope Classification Scheme (CBiCS).

CBiCS is a habitat classification system that provides a means of describing, mapping, and monitoring biological communities, abiotic structural habitat components and ecosystem types. At the core of CBiCs is the concept of a biotope. The term biotope describes a community of species in a defined abiotic habitat.

FeAST is a structured tool for users to generate a rapid first-pass environmental risk assessment report. The assessment will inform processes including consents under the *Marine and Coastal Act 2018* and referrals and scoping of Environment Effects Statements and other environmental assessments under the *Environment Effects Act 1978.* FeAST also supports the identification of further investigation needs, analysis of options, and development of mitigation measures to avoid, minimise or mitigate potential impacts.

1.2 Overview

FeAST provides a standardised assessment based on best-available information and is streamlined and cost-effective. The FeAST risk assessment outputs are the FeAST assessment report (presenting the FeAST score results and Proximity analysis) and the FeAST score layer (Figure 1).

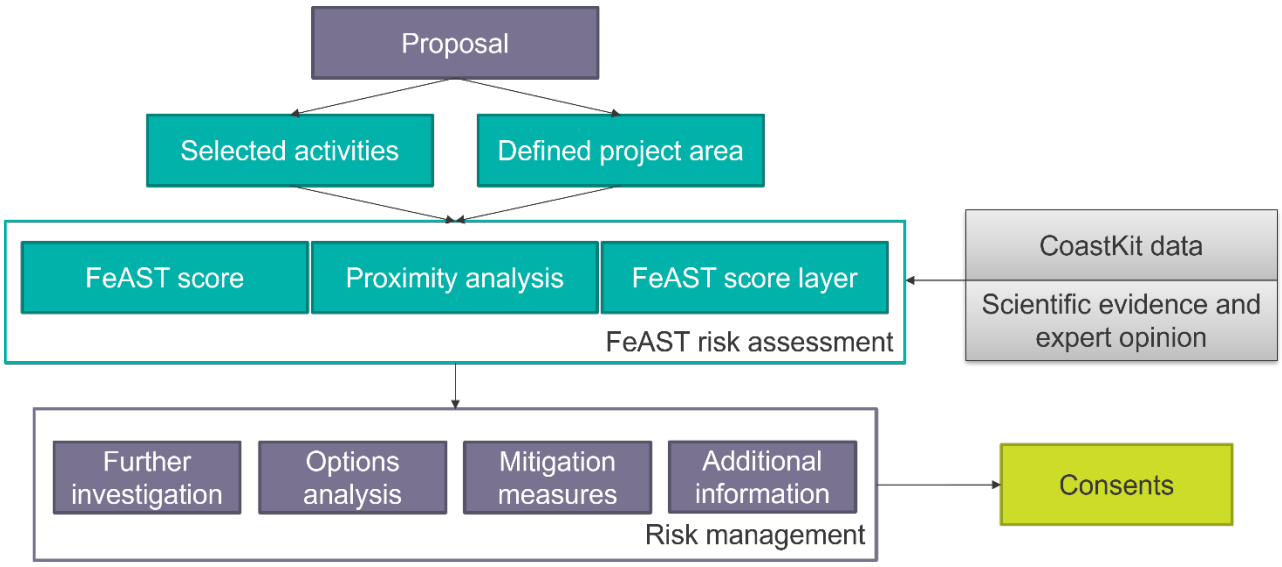


Figure 1: Diagram of the FeAST risk assessment process with inputs and outputs

The FeAST score provides an assessment of risk to habitats, this:

- supports project planning to minimise environmental risks
- presents a standardised risk assessment to support decision making
- supports identification of further investigation needs based on the assessed risk level
- assists identification of where mitigation measures may need to be developed to avoid, minimise, and mitigate potential impacts.

The Proximity analysis generates a list of key environmental and social features extracted from CoastKit (excluding habitats) which are located either directly within the defined project area or within 2km of the defined project area, this:

- informs the need for further investigation or information by identifying key features
- assists identification of where mitigation measures may need to be developed to avoid, minimise, and mitigate potential impacts.

1.3 Context

FeAST has been developed for the state of Victoria and considers relevant state and national legislation, policies, and strategies. Development of the tool has been guided by research and expert opinion.

The tool, in conjunction with the Marine and Coastal Policy, supports the *Marine and Coastal Act 2018* and *Environment Effects Act 1978*. FeAST supports area planning, pre-application planning, applications, options analysis, and assessing applications. FeAST collates the best-available marine and coastal environmental data and provides a transparent standardised process to ensure that all consent applications are uniformly assessed.

FeAST has been developed within the Marine and Coastal Knowledge Framework (MACKF). MACKF aims to promote improved data collection, management, and analysis to reduce uncertainty to better protect Victoria's marine and coastal environments.

FeAST development has been led by scientific experts in partnering organisations responsible for compiling the foundational information in the FeAST data inventory. These partnering organisations also created a prototype original software application that FeAST has been modelled on.

The FeAST data inventory is a cloud-based relational database that stores all the data required for the operation of FeAST. This is part of a broader project to improve Victoria's data holdings including classified data records, georeferenced literature and open-access imagery, video footage and other raw data.

FeAST has been inspired by, and builds on, international applied research, tools, web-based applications, and frameworks. These include Marine Scotland's Feature Activity Sensitivity Tool, The Marine Life Information Network's Marine Evidence-based Sensitivity Assessment, Joint Nature Conservation Committee's work on Marine Sensitivity Assessments, and the Integrated Biodiversity Assessment Tool.

1.4 Applications and users

FeAST has been developed to support:

- Planning permit applications under the *Planning and Environment Act 1987* in the marine and coastal environment.
- *Marine and Coastal Act 2018* consent applications to develop, use or conduct works on marine and coastal Crown land.
- Collating and interrogating spatial data during a marine spatial planning process.
- Scoping and preparation of Environment Effects Statements and other environmental assessments for project proposals as required by the Minister of Planning under the *Environment Effects Act 1978*.
- Considering impacts to Matters of National Environmental Significance, including migratory species, as required under the *Environment Protection and Biodiversity Conservation Act 1999*.
- Considering impacts to species and communities listed under the *Flora and Fauna Guarantee Act 1988*.
- Other approvals and project planning in the marine and coastal environment.

Figure 2: FeAST main user groups and example applications of the tool

FeAST has been designed to support multiple stages of project planning and approvals as a first-pass environmental risk assessment tool. Figure 2 provides an overview of the FeAST users, and Table 1 provides examples of how FeAST can be used to inform the various stages of the planning application process.

Table 1: FeAST applications and user groups

Stage	User groups	FeAST application
Pre-application	• Land managers • Businesses • Public and private developers • Architects and design consultants	FeAST provides information for: • Project scoping • Site selection • Options analysis • Pre-application documentation • Consulting stakeholders • Engagement planning
Application submission	• Land managers • Businesses • Public and private developers • Architects and design consultants • Environmental and risk consultants • Engineers	FeAST provides information for: • Assessment of project impact during construction, operation, and decommissioning phases • Environmental reports • Technical services • Environmental Impact Assessments • Environmental Management Plans • Supporting design of measures to avoid, minimise or mitigate potential impacts • Application requirements and documentation • *Marine and Coastal Act 2018* consents • Marine Spatial Planning
Assessing application	Assessment by decision-makers, such as: • Land managers • Local government • State government and agencies • Federal government and agencies • Registered Aboriginal Parties Assessment by interested stakeholders, such as:	

	• Traditional owners • Community groups • Universities and academics • Campaign groups • Non-governmental environmental organisations • Not-for-profit groups	• *Environment Protection and Biodiversity Conservation Act 1999* referrals • Environment Effect Statement referrals

In addition to supporting local, site and project specific assessments and planning, FeAST can also support strategic planning in the marine environment delivered through marine spatial planning. The Department of Energy, Environment and Climate Action is progressing implementation of Victoria's Marine Spatial Planning Framework (part of the Marine and Coastal Policy 2020), and guidelines to support marine spatial planning have been developed.

The Marine Spatial Planning Guidelines provide detailed step-by-step instructions, building on the direction in the Marine Spatial Planning Framework, on how to undertake a marine spatial planning process (Figure 3). As detailed in the guidelines, a key aspect of conducting a marine spatial planning process is utilising marine and coastal data and information using portals, such as CoastKit, and tools, such as FeAST. FeAST can support the steps in the marine spatial planning process by assisting in assessing and analysing the physical and biological characteristics in a marine planning area.

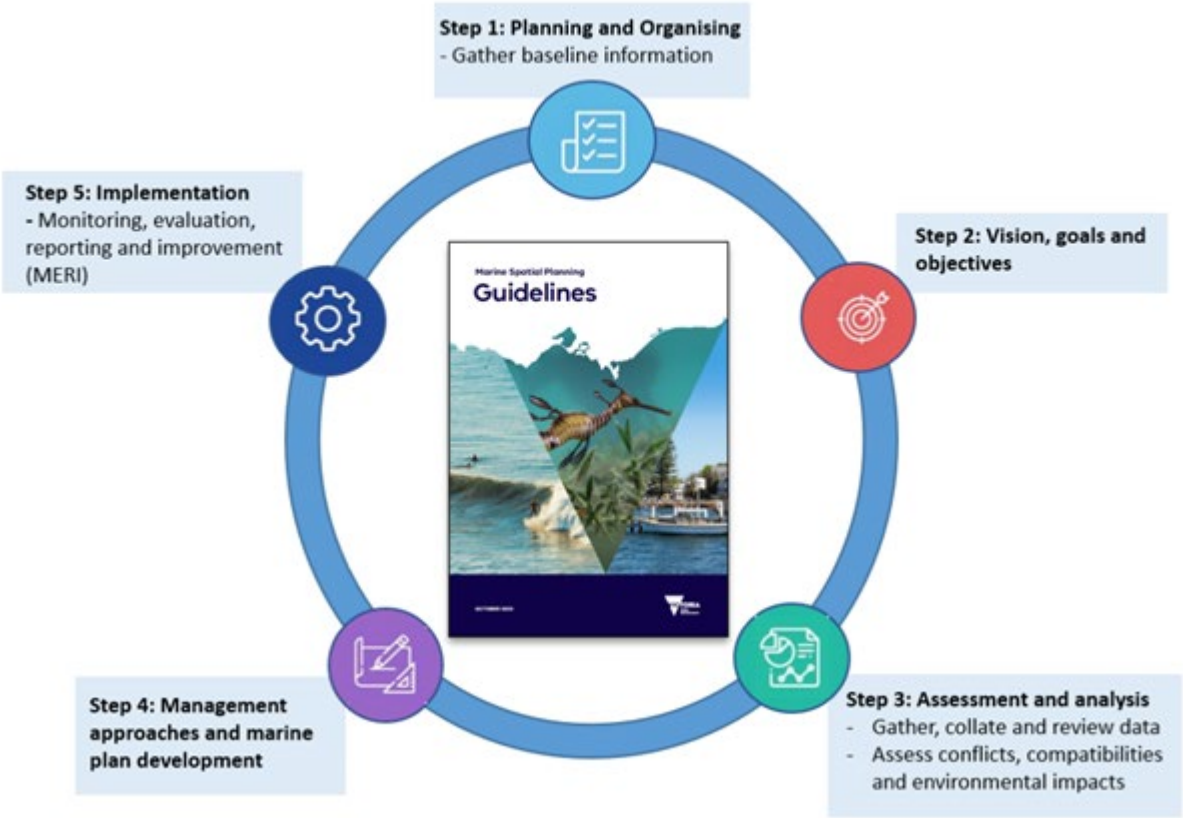


Figure 3: Diagram showing the marine spatial planning process steps

1.5 FeAST outputs

The FeAST assessment report provides the FeAST score and Proximity analysis**.** The FeAST score illustrates the potential risk to habitats based on the sensitivity to disturbance, recovery potential and the activity footprint. The distribution of habitats assessed by FeAST have been modelled to the level of habitat complex (CBiCs level 3) based on field survey records in the Biotope Atlas (see Table 2).

Table 2: CBiCs hierarchy, description and examples

Level	Category	Description	Example names
1	Environment	Major environmental type	Marine
2	Broad habitat	Environmental types segregated into habitat zones and substratum type	Sublittoral sediment
3	Habitat complex	Broad habitat factoring in energy regimes and grain size	Sublittoral seagrass beds
4	Biotope complex	Habitats grouped into similar physical and biological characteristics	Zostera - Ruppia
5	Biotope	Biotope complexes segregated by community composition and/or diagnostic species	*Zostera nigricaulis*
6	Sub-biotope	Defined by subtle differences in species assemblage, structure and geographical, temporal, or environmental variants.	*Z. nigricaulis* - dense

The Proximity analysis acts as a search tool to provide an indication of the key marine and coastal features such as potentially sensitive ecological values and existing activities that may occur within the vicinity of the proposal. The tool utilises spatial information from CoastKit's Marine and Coastal Feature Atlas to produce a series of summarised tables organised into the following themes:

- **Conservation and protection areas**: This table lists protected and management areas that must be considered in compliance with relevant acts and regulations. These include areas listed under the *National Parks Act* 1975 (marine national parks, marine sanctuaries, and marine and coastal parks), UNESCO Ramsar wetlands of national importance, declared shipwreck protection zones, animal protection areas and special management areas. Additionally marine asset areas are included but do not have specific legislative requirements but are of high conservation value.
- **Natural environment and biodiversity:** This table lists geological sites and areas of high biodiversity including significant habitats, *Flora and Fauna Guarantee Act 1988* listed marine communities and some important species sightings, and distributions (limited data available). It is recommended that NatureKit and the Protected Matters Search Tool should be used to extract the lists for threatened species observations, *Environment Protection and Biodiversity Conservation Act 1999* protected values and migratory species.
- **Defence and national security:** This table lists designated areas for military and naval activity occurring on the coast and offshore. Specific activities may be prohibited, and relevant permits may be required.
- **Energy generation and resource extraction:** The table lists existing areas for oil and gas infrastructure, saltworks and any sand extraction sites. Potential cumulative effects or interactions should be considered.
- **Fishing and aquaculture:** This table lists any aquaculture and fishery operations, reserves, and licenses with a commercial and recreational importance. Potential cumulative effects or interactions should be considered.
- **Marine transport:** This table lists major shipping lanes, designated anchorage areas for vessels, dredging areas and marine disposal grounds. Potential cumulative effects or interactions should be considered.
- **Recreation, tourism and leisure:** This table lists sites of recreational value such as boating, diving, and sailing areas. Potential cumulative effects or interactions should be considered.
- **Scientific and heritage areas:** This table lists important areas for research and monitoring purposes, as well as recorded non-Aboriginal historic sites in Port Phillip Bay and shipwreck sites across Victoria. Aboriginal cultural values have not been included, please refer to the *Aboriginal Heritage Act 2006* and consult with the nearest Registered Aboriginal Party to meet your obligations.

1.6 Limitations

FeAST has been designed to provide a rapid, cost-effective, and standardised assessment process that synthesises the best-available data to conduct a preliminary screening of risk. The outputs of the FeAST assessment are equivalent to undertaking a desktop-based study to identify likely concerns and issues of the project, which can be used to guide additional environmental assessments and filling of data gaps.

FeAST is a first pass risk assessment and does not replace the need for more detailed environmental or ecological assessment. The FeAST outputs should be interpreted with consideration of relevant legislation, policy, and advice. In particular, the Marine and Coastal Policy, developed under the *Marine and Coastal Act 2018*, provides statewide policy and direction to guide planning and decision making in the marine and coastal environment. For more information on using the FeAST report and interpreting the results generated by the tool see chapter 4 .

A semi-qualitative assessment method has been employed by FeAST to analyse risk. Experts have assigned numeric values to score specific components of interest across the state. This method provides a regional-scale perspective, where local characteristics or atypical behaviours of stressors may be overlooked. FeAST may not include all current and locally relevant information with regards to the activities undertaken, intensity of pressures, local habitat features and condition, current extent of habitats, or degree of habitat fragmentation.

FeAST only uses data available in CoastKit, currently this does not include information from other key data sources, tools, and portals. The user should use FeAST in conjunction with other state and commonwealth tools. Such as:

- *Flora and Fauna Guarantee Act 1988* (FFG) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) listed species records in the Victorian Biotope Atlas (VBA) accessed via NatureKit.
- Ecological Vegetation Classes (EVCs) and Terrestrial Bioregions from NatureKit.
- Matters of National and Environmental Significance (MNES), Migratory species and EPBC act species and communities from the Protected Matters Search Tool.

Separate assessments, permits and approvals of the impacts to FFG Act listed species and communities, EPBC Act listed matters and native vegetation impacts may be required.

Chapter 4 provides more information on how to consider what hasn't been accounted for in FeAST. There are several specific limitations that must be considered in Table 3.

Table 3: Key considerations and limitations of FeAST

Key consideration	Limitation description
Assessed under normal conditions	The intensities used to determine the Pressure score are precautionary and represent 'typical' stressor profiles or scenarios according to experts. They do not consider the location, extent, seasonality, duration, or frequency that the pressure may be applied for. These details should be considered and investigated further by the user.
Direct footprint analysis	The FeAST score only evaluates the risk to habitats within the direct footprint of the defined project area and does not conduct any form of environmental modelling. Activities and pressures have the potential to have zones of influence extending beyond the footprint, which may result in additional impacts not accounted for. The onus is on the user to select the most appropriate activities and define the full area likely to be impacted by the project with accuracy.
Environmental-based assessment	FeAST does not currently assess the safety, human health, societal, cultural heritage, technical or economic implications associated with the use, activity, or project development.

	The FeAST assessment is primarily focussed on understanding the risks of impacts to biodiversity, habitats, and ecosystems, and is not intended to assess risks posed by coastal hazards and processes. The Victorian Resilient Coast program has developed a framework to support local government, land managers and communities with implementing place based, best practice and long-term coastal hazard risk management and adaption.
FeAST assessment extent	The tool does not assess habitats outside of Victorian State waters and the boundaries of the Victorian Marine Biogeographical Units (biounits) (Edmunds & Flynn, 2018). Coastal and inland freshwater habitats are currently not assessed. However, the Proximity analysis may identify coastal features within 2km of the project area.
Habitat classification scheme	FeAST adopts CBICs as the standard classification system for mapping habitats, which aligns with but will not be completely consistent with other classification schemes such as CATAMI (Collaborative and Annotation Tools for Analysis of Marine Imagery and video).
Project-specific assessment	The tool does not assess cumulative impacts or combined effects of multiple current, past, or emerging activities, uses or developments in an area. Additionally the tool does not consider the cumulative impact of the combination of activities of a single proposal.
Scale of decision-making	While FeAST and CoastKit are frequently updated with the data and available literature, the accuracy and confidence of information varies depending on the survey effort, quality of studies, and the dynamic nature of the marine and coastal environment. The scale of decision making is constrained by the accuracy of data available, and the resolution of the statewide habitat map.
Static assessment	FeAST currently uses a fixed baseline and does not account for variability such as temporal variation in species distributions and migration, hydrodynamics, weather patterns, climate change or intensity of activity pressures. In addition, the frequency, seasonal timings, and duration at which activities are planned or may occur has also not been accounted for in FeAST.

2. FeAST assessment process

The FeAST risk assessment adopts a uniform process for assessing the level of risk across all habitat and activity types. This chapter provides an overview of the process, key components, and methods for calculating the FeAST score and the Proximity analysis.

More technical details on the methodology can be found in chapter 5.

2.1 Overview

The FeAST risk assessment adopts a uniform process for evaluating a proposal's potential environmental impact on marine and coastal habitats. The results from the assessment are presented in a standardised report, which is available for download after the tool has been run. The two key outputs in FeAST assessment report can be divided into the:

- **FeAST score**: this presents the final results of the FeAST risk assessment and provides an indication of the level of risk (either low, medium or high) as posed to the habitat by the proposal's activities.

- **Proximity analysis**: this provides tables of the key marine and coastal features for further investigation which are located directly within the defined project area or within a 2km buffer from the project boundary.

The FeAST score is calculated by the tool in three automated steps, these include:

1. **Pressure score:** This first step identifies all the pressures likely to arise from the selected activities and evaluates the intensity. The Pressure score indicates the potential effect that each activity may have on the ecosystem under normal conditions.
2. **Habitat score:** This is the second step in calculating the overall FeAST score. This score provides a total sensitivity value for each habitat type within the defined project area for pressures with a medium or high Pressure score. The sensitivity is a measure of the habitat's response to the activities in terms of its ability to resist or recover from impact.
3. **FeAST score:** This final score provides an overall risk level for the proposal, evaluating the Habitat scores and Pressure scores against the estimated exposure level. The exposure level is determined by calculating the spatial overlap of the defined project area with the habitat's known distribution across each of the 26 distinct Victorian biounits.

2.2 Key components

The design of FeAST follows an ecosystem-based management approach attempting to systematically capture the complex interactions and impacts of activities on the marine environment. To achieve this, the Driver-Pressure-State-Impact-Response (DPSIR) cause-and-effect framework has been employed (Maxim et al, 2009).

Currently FeAST includes the 'D', 'P' and 'I' of the framework, with work underway to determine the 'State' of habitats i.e. the condition, health, or quality. The 'Response' is the management actions to control the risk or impact, and this can relate back to regulations, action plans and mitigation measures. Response is outside the scope of FeAST.

There are four key components in the FeAST data inventory that are used to generate the FeAST score: Activity, Pressure, Habitat and Biounit (Figure 4).

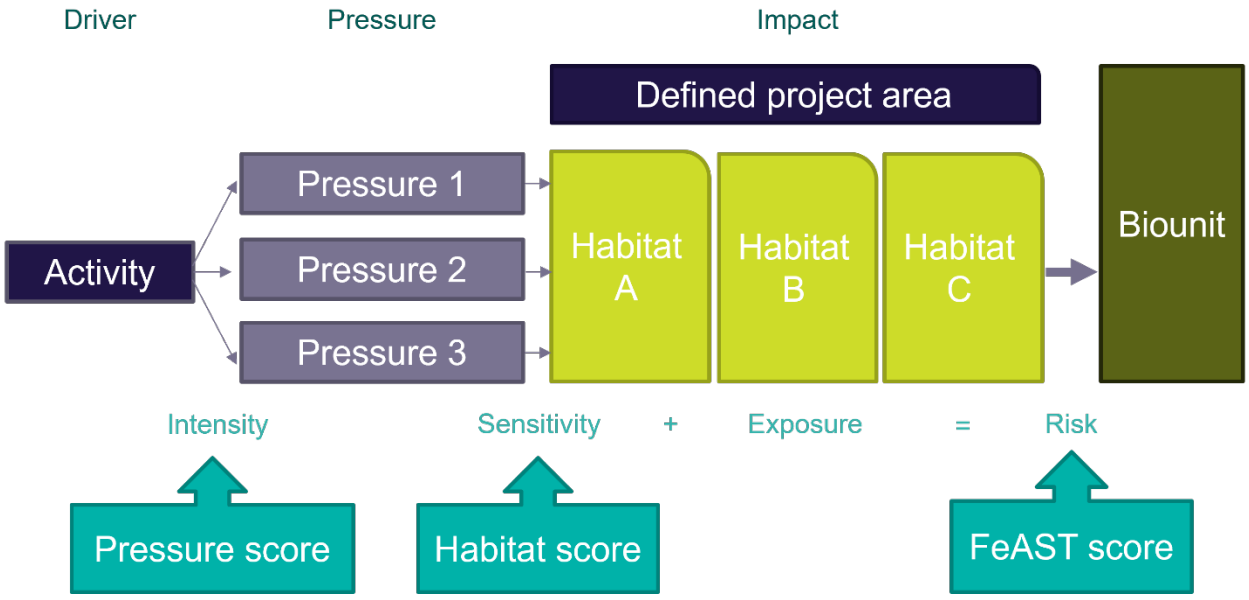


Figure 4: Key components of the FeAST assessment process showing the three scores generated

Activities represent the 'Driver' and are selected by the user. Multiple activities can be selected from a standardised list of over 130 different uses, works or developments likely to occur in the marine and coastal

environment. These human-influenced activities are grouped into twelve activity categories in Table 4. A full list of activities and their descriptions can be found in section 8.1.

Table 4: FeAST activity categories details and colour codes used for the activities list in the tool on CoastKit

Activity category	Category description	Number of activities	Colour code
Coastal infrastructure	The development and maintenance of coastal infrastructure such as ports, marinas and harbour developments.	18	
Coastal management activities	Activities related to management of coastal sites. This does not include the development or maintenance of infrastructure, such as sand scraping.	10	
Defence and national security	Activities conducted by the military within the marine environment such as aerial military activities.	4	
Energy generation	Activities related to the development, operation, maintenance and decommissioning of structures and wider developments which generate energy or are related to energy generation.	19	
Extraction of non-living resources	Activities which include the extraction and disposal on non-living marine resources such as aggregate dredging.	10	
Extraction of living resources	Activities relating to the extraction of living marine resources such as fishing activities.	22	
Other man-made structures	Man-made structures in the marine environment which are not covered elsewhere.	9	
Production of living resources	Activities relating to the production of living marine resources such as aquaculture.	7	
Recreation and leisure	Activities relating to recreational pursuits such as swimming and the use of light aircraft.	15	
Research	Activities relating to the investigation and study of the marine environment for both scientific and exploratory purposes; includes activities such as sonar, and exploratory drilling.	6	
Transport	Activities directly involving transport such as vessel movements or relating to the support of transport activities such as vessel moorings.	9	
Waste management activities	Activities which include the disposal or discharge of liquid waste into the marine environment.	2	

Activities can exert a range of impacts, hazards or threats on the environment resulting in physical, biological, or chemical changes. These are referred to as pressures in FeAST. Each activity in the FeAST data inventory has specific pressures assigned from a standardised list of 40 possible combinations. The pressures are classified into five pressure categories based on the type of effect on the ecosystem (Table 5).

More information on the development of the FeAST data inventory and the pressures and their descriptions can be found in sections 5.1 and 8.2.

Table 5: FeAST pressure categories and descriptions

Pressure category	Category description	Number of pressures
Biological Pressures	Includes pressures relating to the translocation of native species, escape of farmed or genetically modified species, introduction of pathogens and invasive species, removal of target and non-target species and visual disturbance.	7
Hydrological changes (inshore/local)	Includes pressures relating to changes in temperature, salinity, water movement, water levels and wave exposure.	7
Physical damage	Includes pressures relating to temporary changes such as the disturbance of the seabed surface and sub-surface, changes to habitat structure and water clarity as well as heavy and light siltation and smothering effects.	6
Physical loss	Includes pressures relating to permanent changes such as the removal of habitats and the change of sediment or habitat type.	3
Other physical pressures	Includes pressure relating to above water and underwater noise, vibration, electromagnetic changes, underwater noise changes, introduction of light and litter and the mortality of biota from collision above and below the water.	9
Pollution	Includes pressure relating to hydrocarbon, synthetic compound, radionuclide, transition elements and organo-metal contamination, in addition to nutrient and organic enrichment, deoxygenation and the introduction of liquids, solids or gases.	8

The pressures are analysed for expected impact on each habitat mapped within the defined project area. There are 23 habitats in Victoria used in the FeAST data inventory, covering four marine and coastal zones: littoral, sublittoral, infralittoral and circalittoral zones (Table 6). The habitats are mapped to the scale of CBiCS level 3 (habitat complex) and have a biotic code as displayed in the Biotope Atlas on CoastKit. More information on habitat description and type can be found in section 8.3.

Table 6: Habitat types assessed by FeAST

Biotic code	Habitat complex	Substrate	Marine and coastal zone	FeAST assessment report legend
ba1.1	High energy littoral rock	Rock	Littoral	
ba1.2	Moderate energy littoral rock	Rock	Littoral	
ba1.3	Low energy littoral rock	Rock	Littoral	
ba2.1	Littoral coarse sediment	Sediment	Littoral	
ba2.2	Littoral sand	Sediment	Littoral	
ba2.3	Littoral mud	Sediment	Littoral	
ba2.5	Saltmarsh and reedbeds	Sediment	Littoral	
ba2.6	Mangrove	Sediment	Littoral	
ba2.7	Littoral sediment seagrass	Sediment	Littoral	
ba3.1	High energy infralittoral rock	Rock	Infralittoral	

ba3.2	Moderate energy infralittoral rock	Rock	Infralittoral	
ba3.3	Low energy infralittoral rock	Rock	Infralittoral	
ba4.1	High energy open coast circalittoral rock	Rock	Circalittoral	
ba4.2	Tide-swept channels of circalittoral rock	Rock	Circalittoral	
ba5.1	Sublittoral coarse sediment	Sediment	Sublittoral	
ba5.2	Sublittoral sand and muddy sand	Sediment	Sublittoral	
ba5.3	Sublittoral mud	Sediment	Sublittoral	
ba5.4	Sublittoral mixed sediments	Sediment	Sublittoral	
ba5.5	Sublittoral rhodolith beds	Sediment	Sublittoral	
ba5.6	Sublittoral biogenic reefs	Sediment	Sublittoral	
ba5.7	Sublittoral seaweed on sediment	Sediment	Sublittoral	
ba5.8	Sublittoral seagrass beds	Sediment	Sublittoral	
ba5.b	Non-reef sediment epibenthos	Sediment	Sublittoral	

To understand the severity of the possible impact of a pressure on a habitat, the distinctiveness of each habitat within the local biounit is calculated. This determines the exposure level, a component of the FeAST score. In Victoria there are 26 biounits which vary in size, and are categorised by their unique physiographic settings, habitats (Figure 5). For more information see section 8.4.

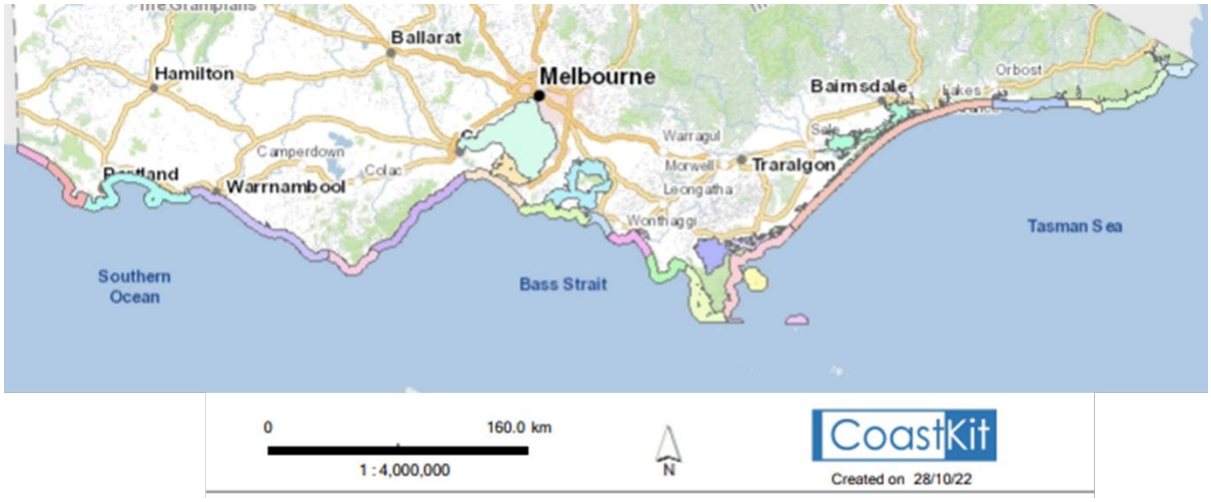


Figure 5: Map of biounits in Victoria as displayed on CoastKit

2.3 Calculating the FeAST score

The FeAST score represents the overall risk of the proposal to each habitat found in the defined project area. The FeAST score uses the Pressure score and Habitat score to calculate risk as one of four levels: no risk, low, medium, and high (Figure 6).

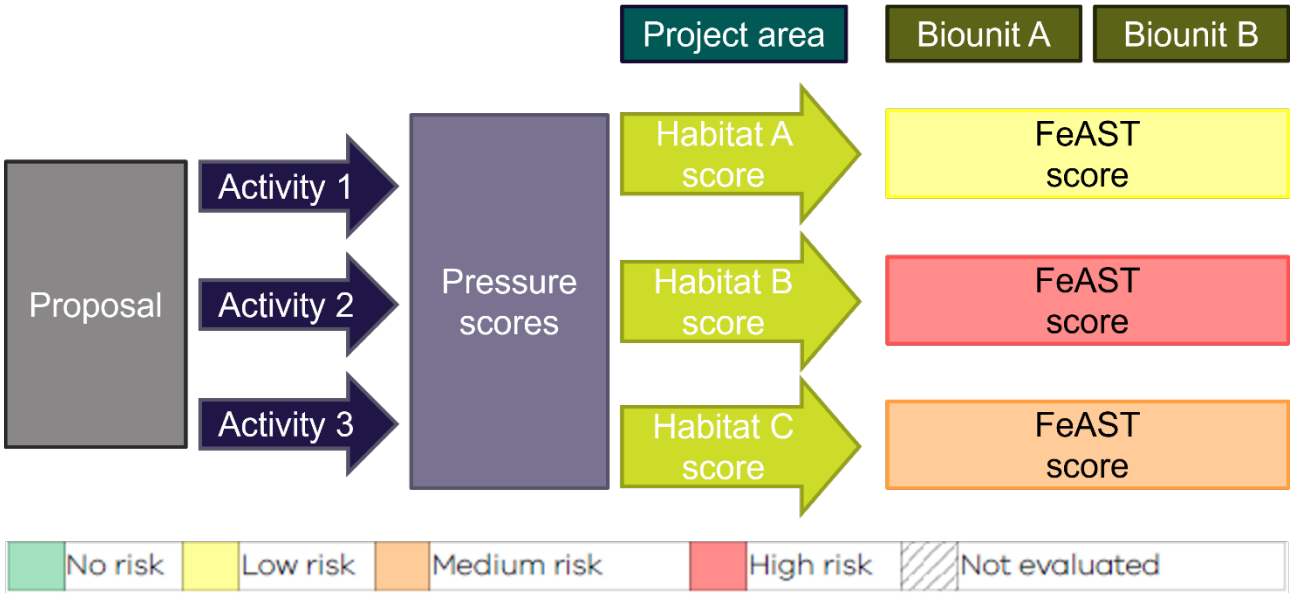


Figure 6: Process to calculate the FeAST scores for a proposal and the possible levels of risk

There are several instances when the tool may return the score 'not evaluated', these include:

- If the defined project area is in commonwealth waters (>3nm offshore).
- If the defined project area is in the terrestrial environment (limited coastal information).
- If the defined project area is in a gap in the habitat mapping due to limited bathymetry data (southwest coast of Victoria between Port Fairy and South Australian border).

Pressure score

The Pressure score is the first step to calculate the FeAST score. Proposed activities can exert multiple impacts, hazards or threats on the environment resulting in physical, biological, or chemical changes, these are referred to as pressures in FeAST.

In this step, each of the identified likely pressures to occur have been profiled for intensity. The Pressure score acts as a screening process to remove pressures of least concern from the FeAST assessment, where only medium and high scores are considered further.

How is each activity-induce pressure profiled for intensity?

These have been assigned based on a series of predefined benchmarks for each pressure e.g. a temperature increase of 2°C for one year, as set by scientific studies and expert opinion.

The scoring for intensity has been conducted independently of the habitat sensitivity and does not consider the spatial location or area of the proposal.

More information can be found in Section 8.

The intensity scoring is based on the potential effect from low to high, where applicable (Table 7).

Table 7: Pressure score intensity definitions and consideration in the FeAST assessment

Intensity	Potential effect	Assessment in FeAST
High	Ecosystem functional change	Included in the FeAST assessment, with the highest score across all the activities used as the Pressure score
Medium	Populations and communities will shift a distinct level	

Low	Some noticeable change	Excluded from the FeAST assessment
NA	Not applicable	

When multiple activities have been selected, the Pressure score analysis adopts a precautionary approach and takes the worst or highest intensity score across the activities as the Pressure score.

Figure 7 shows the Pressure score results from an example FeAST report demonstrating the process when multiple activities have been selected, and low or NA scores are excluded.

More information on determining the Pressure score can be found in section 5.2.

	Activity		
Pressures	**Dredging - Capital**	**Tidal lagoon - Construction**	**Pressure score**
Above water noise	High	Medium	High
Abrasion to seabed	High	High	High
Barrier to species movement	High	High	High
Change of seabed type	High	High	High
Change of sediment type	High	High	High
Heavy siltation or smothering	High	High	High
Introduction of light	High	Medium	High
Invasive species	High	Medium	High
Light siltation or smothering	High	High	High
Penetration to seabed substrates	High	High	High
Physical loss of habitat	Medium	High	High
Removal of non-target species	High	Low or NA	High
Removal of substratum	High	High	High
Underwater noise	High	Medium	High
Vibration	High	Medium	High
Visual disturbance	High	High	High
Water clarity changes	High	High	High
Water flow changes	High	High	High
Water level changes	Low or NA	High	High
Wave energy changes	Low or NA	High	High
Collision above water	Low or NA	Medium	Medium
Collision below water	Low or NA	Medium	Medium
Hydrocarbon contamination	Medium	Medium	Medium
Litter	Low or NA	Medium	Medium
Nutrient enrichment	Medium	Low or NA	Medium
Organic enrichment	Medium	Low or NA	Medium
Transition & organo-metal contamination	Medium	Low or NA	Medium

Figure 7: Table extract from an example FeAST report showing the Pressure score results for multiple activities

Habitat score

The Habitat score is the second step in calculating the FeAST score. This step evaluates the sensitivity of specific habitats, which occur within the defined project area, to each of the relevant and screened activity-induced pressures.

How is the sensitivity of a habitat calculated?

Sensitivity is calculated by determining the resistance, which measures the likelihood of the habitat to tolerate change, versus the resilience of the habitat to adapt and recover once the pressure has ceased.

Sensitivity is calculated by determining the resistance, which measures the likelihood of the habitat to tolerate change, versus the resilience of the habitat to adapt and recover once the pressure has ceased.

The Habitat score provides an indication of the overall sensitivity of each habitat type to the proposal, this incorporates the combined effect of the screened pressures across all selected activities. Each habitat is assigned a value from low to high, and none when a pressure poses no threat. The Habitat scores are calculated as a percentage, where a 100% score would indicate that a habitat type is has a high sensitivity to the proposal (Figure 8).

Habitat Score	Very Low	Low	Medium	High
Percentage	<55%	55- 70%	70- 85%	85-100%

Figure 8: Habitat scoring percentages and ratings

The Habitat score is displayed in tables in the FeAST assessment report (as seen in Figure 9). More information about the calculating the Habitat score can be found in section 5.3

Legend				
Pressure	**Littoral Sand**	**Sublittoral Sand And Muddy Sand**	**Sublittoral Mixed Sediments**	**Sublittoral Seagrass Beds**
Invasive species	High	High	High	High
Removal of substratum	Medium	Medium	Medium	High
Wave energy changes	Medium	Medium	Low	High
Change of seabed type	Medium	Medium	Medium	High
Physical loss of habitat	Medium	Medium	Medium	High
Change of sediment type	Medium	Medium	Medium	High
Water flow changes	Medium	Medium	Low	High
Water level changes	Medium	Low	Very Low	None
Removal of non-target species	Medium	Medium	Low	Medium
Water clarity changes	Low	Low	Very Low	High
Abrasion to seabed	Low	Low	Very Low	High
Heavy siltation or smothering	Low	Low	Low	High
Penetration to seabed substrates	Low	Low	Low	High
Light siltation or smothering	None	None	None	Low
Nutrient enrichment	None	Medium	Low	High
Organic enrichment	None	Medium	Medium	High
Habitat score	Medium (75%)	Medium (75%)	Low (65%)	High (96%)

Figure 9: Table extract from an example FeAST report showing the Habitat score results

FeAST score

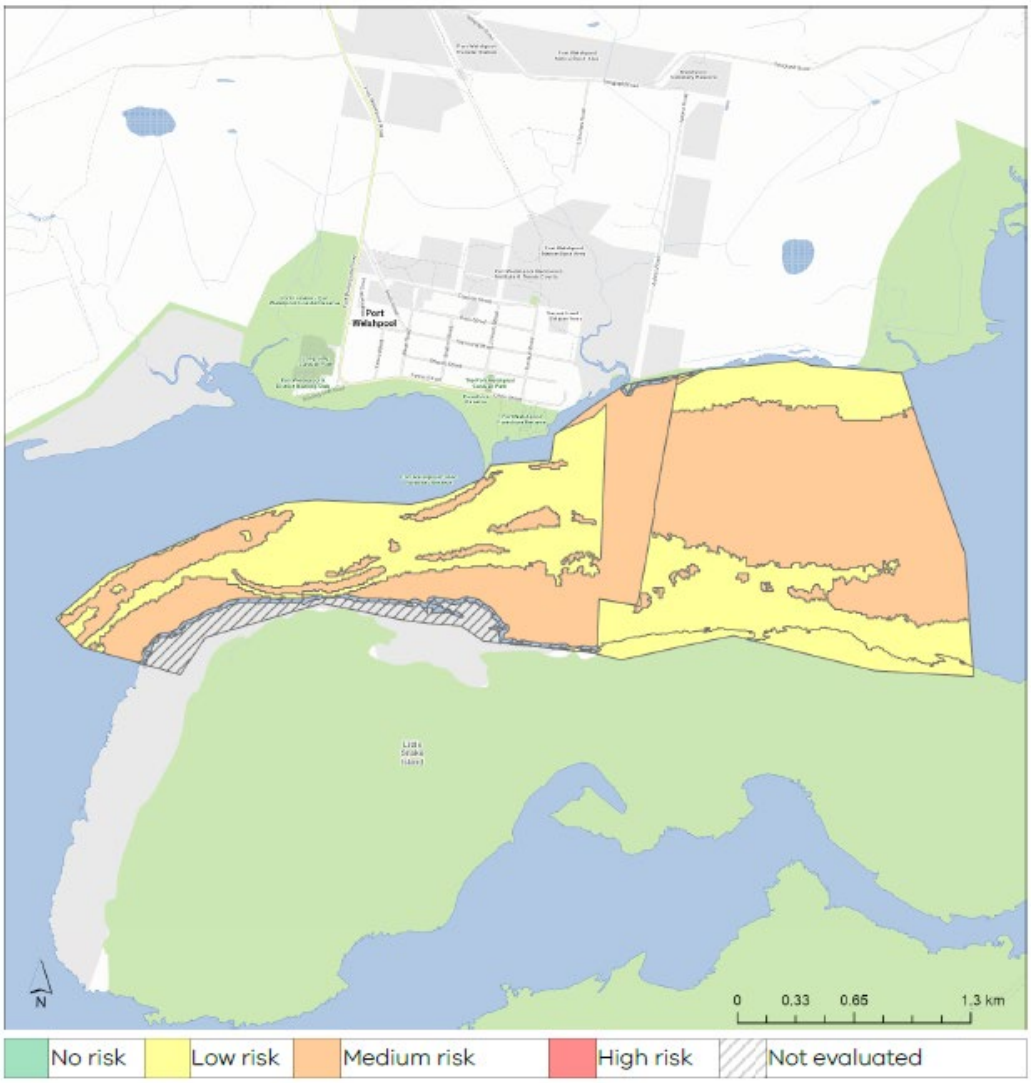
The FeAST score is the final step in the FeAST assessment and provides an indication of the overall risk posed by a proposal to habitats within the defined project area. The FeAST score evaluates the level of exposure against the Habitat score.

The exposure level assesses the distribution and distinctiveness of each habitat to determine the proportional impact of the proposal, which is considered in the context of the 26 Victorian biounits.

How is the exposure level calculated?

The exposure level is determined by calculating the percentage habitat area impacted by the defined project area against the total habitat area across the relevant biounit to produce a percentage. In cases where the proposal may cross two biounit boundaries, a precautionary approach is taken, and the highest FeAST score is used.

Figure 10 shows an example from the FeAST assessment report demonstrating the FeAST score results and corresponding may showing the mapped habitat risk. More information can be found in section 5.4.



FeAST Assessment	Littoral sand	Sublittoral sand and muddy sand	Sublittoral mixed sediments	Sublittoral seagrass beds
Habitat Score	Medium	Medium	Low	High
Exposure Level for biounit: Corner Inlet	Low	Low	Low	Low
Exposure Level for biounit: Nooramunga	Low		Low	Low
Feast score for biounit: Corner Inlet	Low risk	Low risk	Low risk	Medium risk
Feast score for biounit: Nooramunga	Low risk		Low risk	Medium risk
FeAST score	Low risk	Low risk	Low risk	Medium risk

Figure 10: Table extract and map from an example FeAST report showing the FeAST scores and mapped risk

2.4 Proximity analysis

The Proximity analysis acts as a search tool to provide an indication of the key marine and coastal features that may occur or can sometimes occur within or nearby (up to 2km) the defined project area.

In addition to the FeAST score, it is critical for proposals to consider any impacts or negative interactions to existing marine and coastal activities, the natural environment and biodiversity, as well as designated conservation management and protection areas.

The tool generates a series of summarised tables from the Feature Atlas on CoastKit. Tables are organised into eight themes:

1. Conservation and protected areas.
2. Natural environment and biodiversity.
3. Defence and national security.
4. Energy generation and resource extraction.
5. Fishing and aquaculture.
6. Marine transport.
7. Recreation, tourism, and leisure.
8. Scientific and heritage areas.

Each table in the FeAST assessment report provides the feature category, feature name, description, and proximity. Feature records are ordered from largest overlap to furthest distance away. The proximity value is displayed as either:

- **Percentage overlap (%):** provides an indication of how much of the total defined project area is covered by the feature.
- **Distance in metres (m):** provides an indication of how far the feature is from the boundary of the defined project area to a maximum buffer of 2km.

The diagram below shows the two ways proximity can be displayed in the FeAST report (Figure 11). In this example 25m^2 of the total defined project area (100m^2) is covered by the feature's extent which is equal to 25% overlap. Additionally another feature record has been identified 900m away from the boundary of the defined project area within a 2km buffer zone.

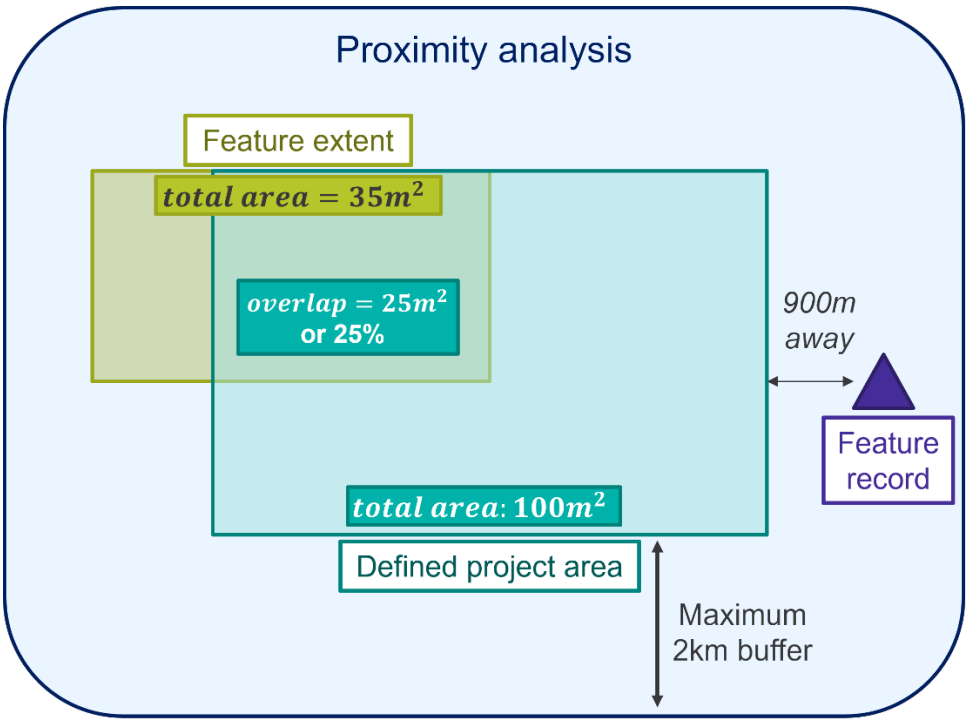


Figure 11: Diagram showing an example of how the Proximity analysis in the FeAST report is calculated

The number of tables displayed in the report will vary. If no features from a theme have been identified within 2km of the defined project area boundary, the corresponding table will not be displayed in the report. Some key spatial datasets have not been included in the Proximity analysis, please refer to section 4.6 for recommended tools to use in conjunction with FeAST.

The Proximity analysis does not evaluate the potential risk posed to habitats, this is assessed under the FeAST score (see section 2.3).

The following images show examples of tables from the Proximity analysis in the FeAST assessment report including Conservation and protected areas (Figure 12), Natural environment and biodiversity (Figure 13), and Scientific and heritage areas (Figure 14).

Conservation and protected areas

This table lists protected and management areas that must be considered in compliance with relevant acts and regulations. Please note that marine asset areas do not have specific legislative requirements but are of high conservation value.

Feature name	Category	Description	Proximity
Ramsar - Corner Inlet	UNESCO Ramsar site	Ramsar wetland bird habitat in Victoria. 25k resolution.	100 %
Nooramunga Marine and Coastal Park	Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	51 %
Nooramunga and Corner Inlet sediment flats	Marine asset areas	Pied and sooty oystercatcher habitat. Thirty two recorded species of wading birds both resident and migratory. Supports 21.5% of total Victorian wader population. Sediment beds contain a high abundance of microalgae.	1131 m

Figure 12: Table extract from an example FeAST report listing conservation and protected areas

Natural environment and biodiversity

This table lists geological sites and areas of high biodiversity including significant habitats, FFG act listed marine communities and some important species sightings, and distributions (limited data available). It is recommended that the Protected Matters Search Tool and NatureKit should be used to extract the lists for threatened species observations, EPBC act protected values and migratory species.

Feature name	Category	Description	Proximity
Summerland Peninsula and Seal Rocks	Important bird areas	Colonies of penguins and shearwaters, supports large population of crested terns, Australian fur seal breeding colony on Seal Rocks.	585 m
Summerland Peninsula and Seal Rocks	Marine mammal areas	Colonies of penguins and shearwaters, supports large population of crested terns, Australian fur seal breeding colony on Seal Rocks.	585 m
FFG species - Apsolidium densum	FFG Act listed species and communities	Apsolidium densum - Sea cucumber - FFG Act listed - Museum record	608 m
Somers-Flinders Amphibolis beds	Significant seagrass habitat	Patchy reefs with Amphibolis beds; important seadragon habitat and may be important as breeding area for squid (significant for supporting fishery).	643 m

Figure 13: Table extract from an example FeAST report listing any natural environment and biodiversity features

Scientific and heritage areas

This table lists important areas for research and monitoring purposes, as well as recorded non-Aboriginal historic sites in Port Phillip Bay and shipwreck sites across Victoria. Aboriginal cultural values have not been included, please refer to the Aboriginal Heritage Act 2006 and consult with the nearest Registered Aboriginal Party to meet your obligations.

Feature name	Category	Description	Proximity
Wreck - CASCADE	Shipwreck sites	CASCADE. Sailing schooner. Built in Australia in 1841. Wrecked in Welshpool, Ninety Mile Beach in 1876.	654 m
Wreck - UNIDENTIFIED: PORT WELSHPOOL	Shipwreck sites	UNIDENTIFIED: PORT WELSHPOOL. Wrecked in East of Port Welshpool Jetty.	738 m
Wreck - AHO 6469 - UNKNOWN	Shipwreck sites	AHO 6469 - UNKNOWN. Wrecked in 2km south-west of Port Welshpool, Corner Inlet.	1935 m

Figure 14: Table extract from an example FeAST report listing scientific and heritage areas

The Proximity analysis provides users with important foundational data to use as a starting point for managing and mitigating any environmental risks that may arise from the proposal. This may consist of a user-driven risk appraisal to assess the likelihood of any negative or undesirable impacts and interactions.

The information provided in the Proximity analysis is indicative only and is based on available data that may be limited geographically, temporally, or otherwise incomplete. In cases where more accurate or up-to-date supplementary information exists, this should be used additionally to inform analysis beyond the FeAST assessment, see section 4.

3. FeAST user guide

This chapter provides a step-by-step practical user guide for accessing and interacting with the online tool. It includes information on how to use the tool, generate the report and what to do when a project has multiple stages, activities or sites.

The user guide will walk through an example case study for a fictional development proposal located in Corner Inlet. The case study will be used to demonstrate the applications of FeAST, featuring screenshots from the tool and FeAST assessment report. The example does not represent a real-life proposal, or the approval process undertaken.

3.1 Where to access FeAST

The tool is publicly available on CoastKit, Victoria's marine and coastal knowledge management system and online mapping portal. Use Google Chrome browser for best results. To find out more about CoastKit check out the how-to video series.

After launching CoastKit, a navigation menu along the top bar with different tabs will appear. FeAST is located under both the Main tab and the Tools tab. When you click the FeAST icon, the left-hand side panel will change from Layers to Run FeAST Assessment (Figure 15).

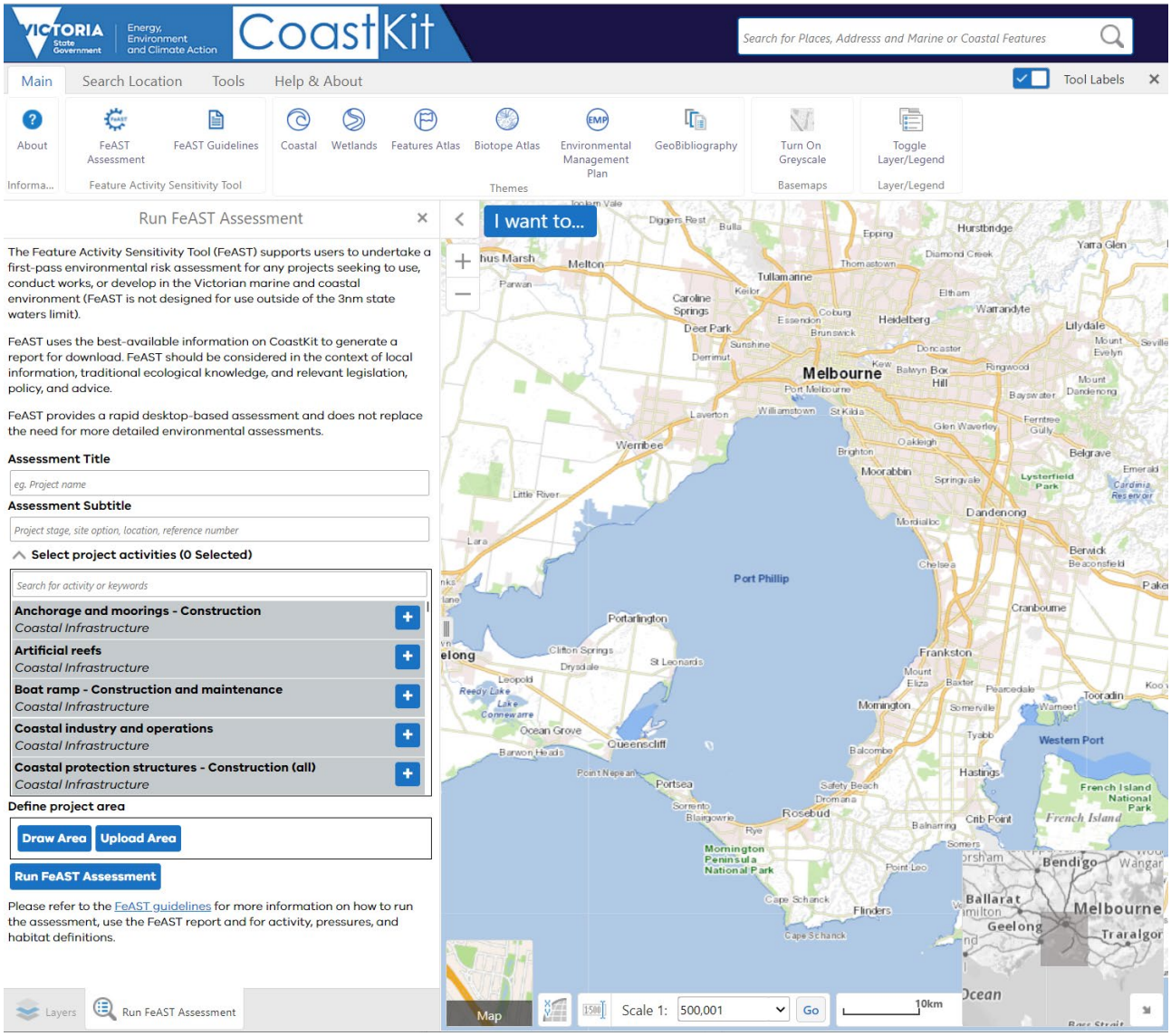


Figure 15: Screenshot showing the FeAST tool after launch in CoastKit

3.2 Background layers and base maps

FeAST can be used while viewing different base maps depending on user preference. Click the map square located on bottom left to open a slider bar of base map options.

Base maps serve as a background reference map and are shown underneath any layers turned on. Base maps can be used to provide spatial context and further information about the location, environment or any features that might be present (Figure 16).

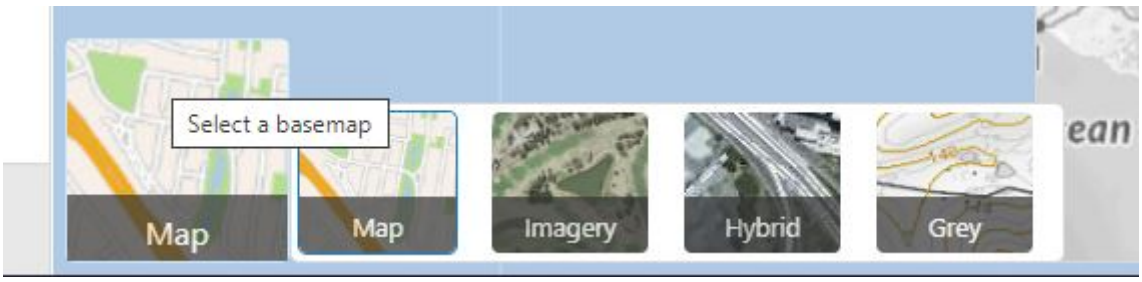


Figure 16: Screenshot from CoastKit showing the base maps available

Option 1: Map

Map is the default base map on CoastKit and is a simplified colour cartographic map. It provides information on the topography and depicts key local elements such as towns, roads, waterways, urban areas and national parks. Zooming in and out will change the resolution of the information displayed on the map.

Option 2: Imagery

Imagery shows a statewide mosaic of the latest available aerial and satellite photography which has been stitched together as one seamless layer. Please note the imagery is limited in offshore areas. No localities or roads are shown, use the Hybrid option.

Option 3: Hybrid

Hybrid is a simple-styled overlay map that combines the main localities and roads with the Imagery base map.

Option 4: Grey

Grey is a black and white cartographic map, with additional information on specific map elements such as points of interest, ferry crossing routes, walking tracks, vegetation, topographic contours and runways. The level of detail will change when zooming in and out.

Additionally you can click ‘Turn on Greyscale’ icon in the top ‘Main’ menu at any time to change the base map to black and white and declutter the display (Figure 17).

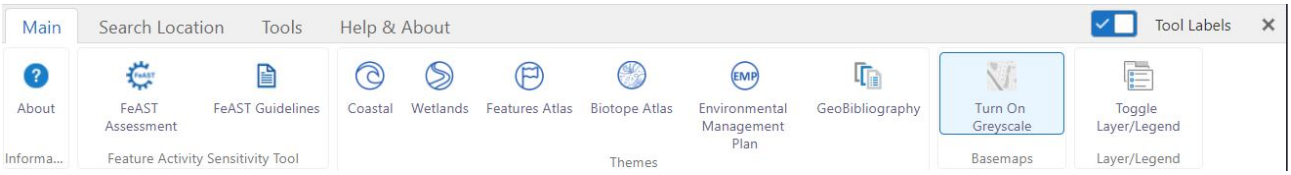


Figure 17: Screenshot from CoastKit showing the ‘Turn On Greyscale’ icon on the Main menu bar

FeAST can also be used while viewing other layers available on CoastKit. This functionality may be useful to inform the planning stages of a proposal to avoid key structures, habitats, or features, identify administration boundaries or understand local conditions.

To access the full suite of available layers, click the Layers tab at the bottom of the left-hand side panel, next to Run FeAST Assessment, and the panel will toggle back to the default display (Figure 18).

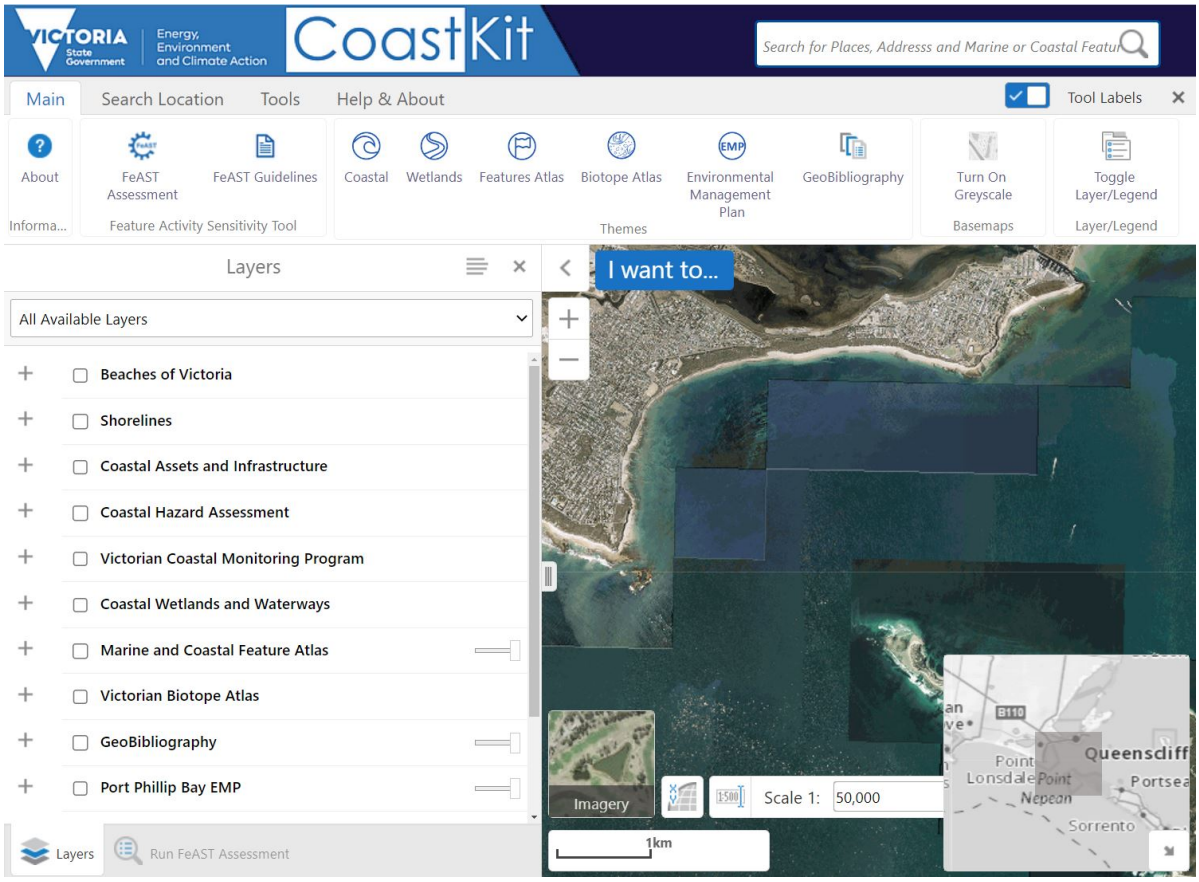


Figure 18: Screenshot from CoastKit showing the layers available for display

Individual layers on CoastKit have been organised into specific groupings or themes (as shown above). To turn on layers for display in CoastKit click the checkbox next to the layer name and use the plus (+) on the left-hand side panel to expand the layer group to see individual layers.

When a layer has been selected to be displayed using the checkbox, an icon will appear on the left of the layer name. Click on this icon to see the legend information or symbol key for the specific layer. Alternatively, the Toggle Layer/ Legend button on the main navigation bar at the top shows the layers selected, the legend and drawing order of the layers on CoastKit. Table 8 provides a list of buttons and their functions.

Table 8: CoastKit buttons and functions

CoastKit button	Button name	Function
+	Expand layer group	Use to show the list of layers underneath.
–	Collapse layer group	Use to hide the list of layers underneath.
	Toggle Legend	Use to show the legend or key for any layer selected.
	Transparency slider	Use to change the transparency of the layer displayed on the map. Only available for some layers.
	Panel actions menu	Use this to access the option to display the legend for visible layers and to change the order of the layers drawn on the map.

	Expand/collapse the data frame	Use this to show or hide the left hand-side panel.
	Zooms in or out a step	Use this to zoom in and out of the map.
	Map scale selector	Use this to change the scale of the map.
	Open and close coordinates widget	Use this to view or change the current coordinate of the map and see the latitude and longitude coordinates of the mouse pointer position.
	Open and close the overview map	Use this to open and close the view of the map of Victoria showing the current map view as a dark grey square.

When using FeAST there may be some layers available on CoastKit which might be of interest to display, these include:

1. Marine and Coastal Feature Atlas

The Feature Atlas includes the layers used and displayed in the Proximity analysis (Figure 19). The Feature Atlas holds conservation listed, natural environment and biodiversity distributions (limited data), conservation and protected areas such as the National Parks Act, UNESCO Ramsar sites, management areas and monitoring, dive sites.

It also displays information on the location of anthropogenic activities and structures such as fisheries, aquaculture, dredge areas, energy and resources. Some cultural and non-aboriginal heritage sites are also available for display.

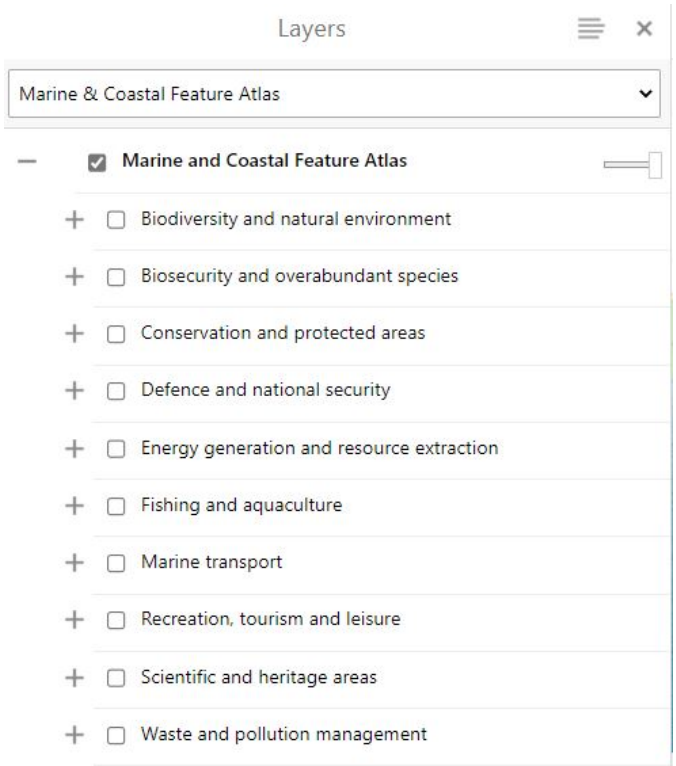


Figure 19: Screenshot from CoastKit showing the marine and coastal feature atlas layer list

2. Marine habitat mapping

The statewide marine habitat mapping can be found on CoastKit under the Victorian Biotope Atlas and Habitat Classification (Figure 20).

The habitat map represents 24 distinct habitats as classified to CBICS level 3, aligning with the habitats included in FeAST. The habitat map was constructed using 32,998 records of habitat observations, in combination with 28 environmental properties to model and predict the distribution of habitats across Victorian waters. For more information visit Victoria's marine habitat map.

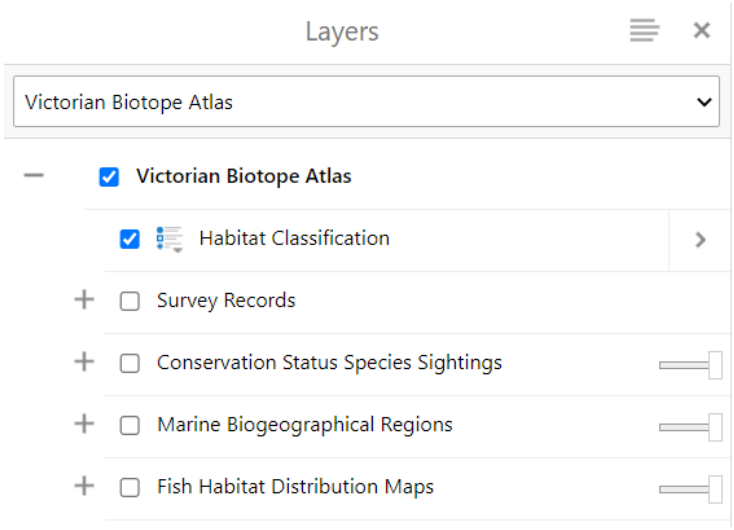


Figure 20: Screenshot from CoastKit showing the Victorian Biotope Atlas and habitat mapping

3. Traditional owners

The FeAST report identifies and lists the nearest Registered Aboriginal Parties to the defined project area. To find this layer on CoastKit click Planning and Administration then Traditional Owner (Figure 21).

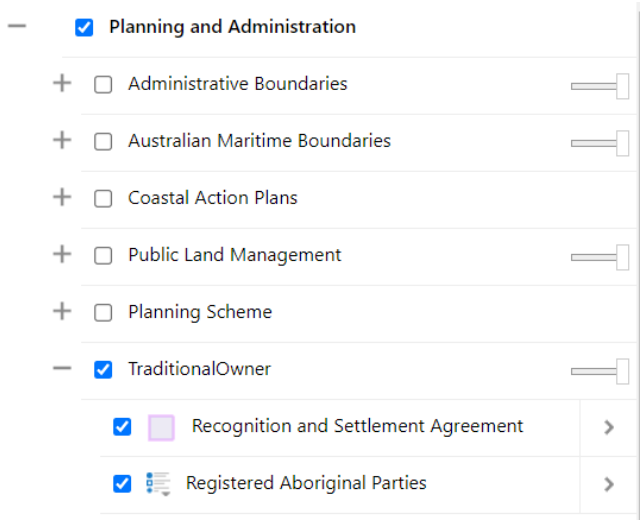


Figure 21: Screenshot from CoastKit showing the traditional owner layers

4. Public land management

The Public Land Management layers show a range of public land use areas including Marine National Parks and Marine Sanctuaries (Figure 22). To find this on CoastKit, click on Planning and Administration > Public Land Management > Public Land Management (PLM25).

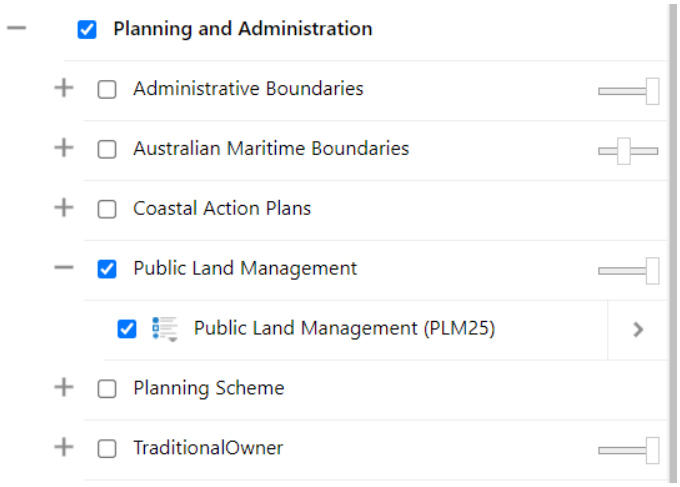


Figure 22: Screenshot from CoastKit showing the public land management layers

3.3 FeAST assessment titles

The ‘Assessment Title’ and ‘Assessment Subtitle’ are free text fields and will be displayed on the header of the generated FeAST assessment report. These titles should be relevant to your project and refer to the project name, project stage, site option or location. If you have reference numbers, make sure to include these in one of the titles.

Figure 23 shows the tool in action using the example case study. The assessment title is the project name, and the subtitle is the work involved, stages of the project and a unique application reference number.

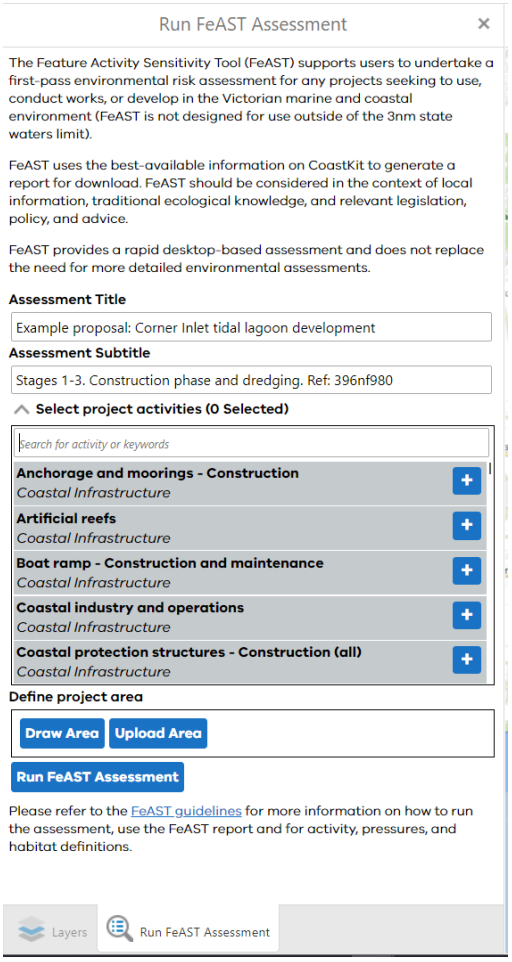


Figure 23: Screenshot from CoastKit showing assessment titles for the example case study

3.4 Selecting project activities

The user must choose all relevant activities associated with the proposal to generate an accurate FeAST score. The activities selected must all occur in the activity area chosen, if activities occur in different areas multiple FeAST assessment reports must be created (see section 3.9).

The activities are shown in coloured groups to assist selection from over 130 possible activities. More detailed information on activities can be found in section 8.1. To find the relevant activities for your project:

Use the search bar to type part of the activity name or activity category. This will filter and display all activities that include what you typed.

Use the scroll bar on the right-hand side of the activity selection menu or your mouse wheel to browse the list. To see the full list make sure to delete everything from the search box.

Use the plus button (+) to choose an activity, this will then be moved to the bottom box which displays all the chosen activities (see example in Figure 24). Activities can also be removed from this box using the minus button (-).

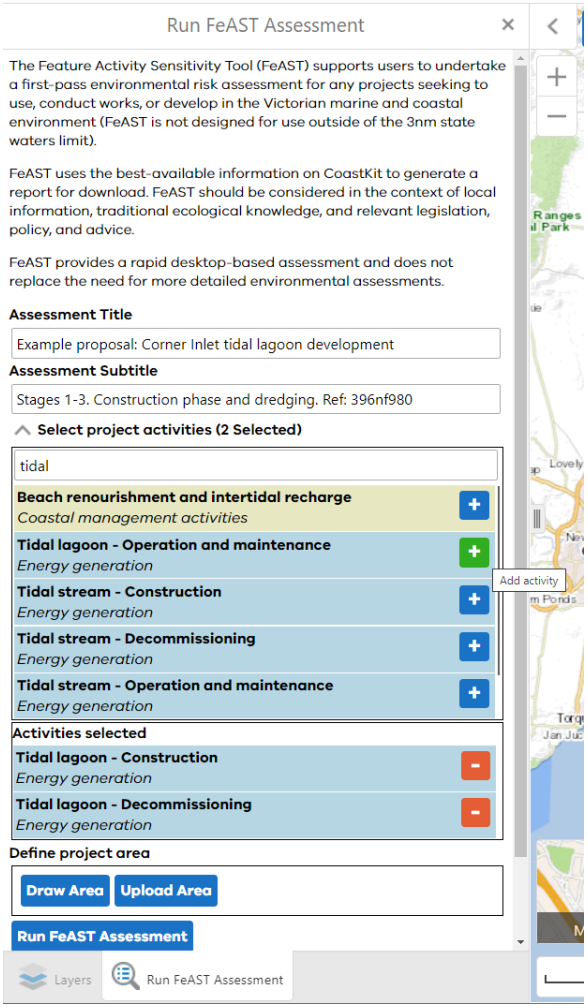


Figure 24: Screenshot from CoastKit showing how to select project activities for an example case study

There is no limit on the number of activities which can be selected for the FeAST risk assessment. The assessment will consider all these activities to calculate the FeAST score taking a precautionary approach, however it will not consider the cumulative impact of the combination of activities. More information on the limitations can be found in sections 1.6 and 4

The activities in the tool have been chosen based on existing uses, frequent works, or likely emerging sectors in Victoria. Despite this, there will be some cases when an activity associated with a proposal is not in the tool. Another activity may be suitable for substitution to run the FeAST assessment, this should be informed by activity description and pressure profile and agreed by the decision-maker (section 8.1).

3.5 Defining the project area

Before the FeAST risk assessment can be run, users must define their full project area. Within the ‘Define project area’ box, there are two options to do this: draw area or upload area.

1. Draw area

Click on the ‘Draw area’ blue button to manually draw the project area. Click the button to activate the drawing tool, start drawing the polygon by clicking on the map. A single-click adds a corner to the shape and a double-click finishes the polygon.

2. Upload area

Click on the ‘Upload area’ blue button to upload any pre-prepared GIS files to the map. The GIS files will need to be polygonised, as the tool does not support point or line datasets, and be of the following formats .shp, .gpx, or a zip containing a FileGBD or shapefiles.

Click the button to open a pop-up box saying ‘Add data to Map’ where users can choose files from their computer to add. You will be prompted to change the name and symbolize the polygon. Click ‘Proceed’ to finalise, the map will zoom to the location of the uploaded area. Click the cross (x) in the top right of the pop-up box at any time to leave this option.

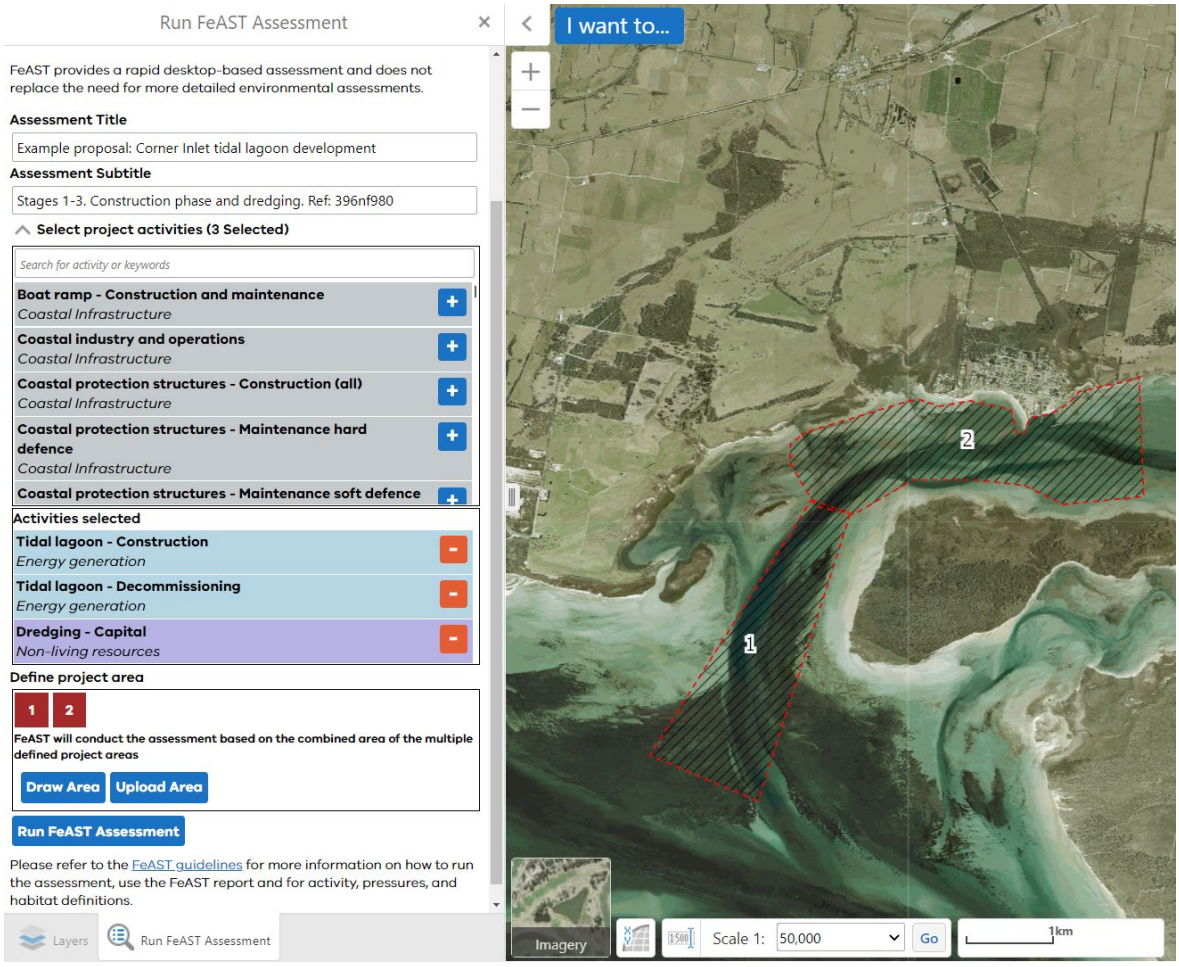


Figure 25: Screenshot from CoastKit showing the project area drawn for the example case study

Each polygon created and added to the map is assigned a number and displayed in the ‘Define project area’ box. Multiple areas can be added using one or both methods and these areas can overlap or be distinct from each other.

In Figure 25, the base-map has been changed to display the imagery basemap (see section 3.2) and the two project areas have been defined using the ‘Draw Area’ tool.

The user is responsible for ensuring all the areas associated with the proposal are included. In cases where multiple areas overlap, the tool will merge these areas to be assessed together without double counting. For more information on multiple project areas see sections 3.8 and 3.9.

How do you delete a project area?

To delete the drawn or uploaded project area, hover the cursor over the number of the polygon in the 'Define project area' box. This will highlight the polygon on the map with a blue outline and generate the message 'Delete _?'. Click again to remove the polygon permanently from the assessment and map.

The rolling numbering of each project area (i.e. 1, 2, 3) will continue from the last number deleted and does not refresh at 1 again (see section 3.7).

How do you save a project area?

If you want to save the project areas, use the CoastKit drawing tools to create a shape and export. Toggle to the 'Tools' tab along the top main bar, within 'Draw & Measure', change the 'Point' tool to 'Polygon' using the drop-down arrow. Follow the prompts to draw your shapes and use the 'Export Drawings' tool to download files which can be uploaded for a FeAST assessment.

3.6 Generating a FeAST assessment report

Once all the above steps are completed the tool can run the FeAST assessment by selecting the blue 'Run FeAST Assessment' button. If the user has not completed any of the steps an error message will be displayed (see Figure 26).

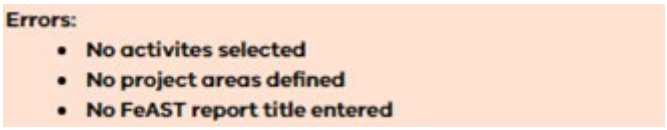


Figure 26: Screenshot from CoastKit showing FeAST error messages if the steps have not been completed

The assessment will take a less than a minute to complete. Once complete, the tool will display two new buttons on the left-hand side panel:

- **Download Report:** This will download a PDF version of the FeAST assessment report, detailing the results from the FeAST risk assessment and the final FeAST score.
- **Download FeAST score layer:** This will download a GIS file of the mapped habitat risk and FeAST score as displayed on CoastKit.

You will notice the project areas now look different on the map. The project areas are now split by habitat and coloured according to the FeAST scores generated from the assessment (see example in Figure 27). To interact with the project areas, click within the area to open a pop-up box that provides the Habitat type and the 'FeAST score'.

You can also print or save the current map shown on CoastKit. To do this use navigate to the 'Tools' tab in the top menu bar and select the option 'Map with Legend'. See section 3.2 for how to add additional layers.

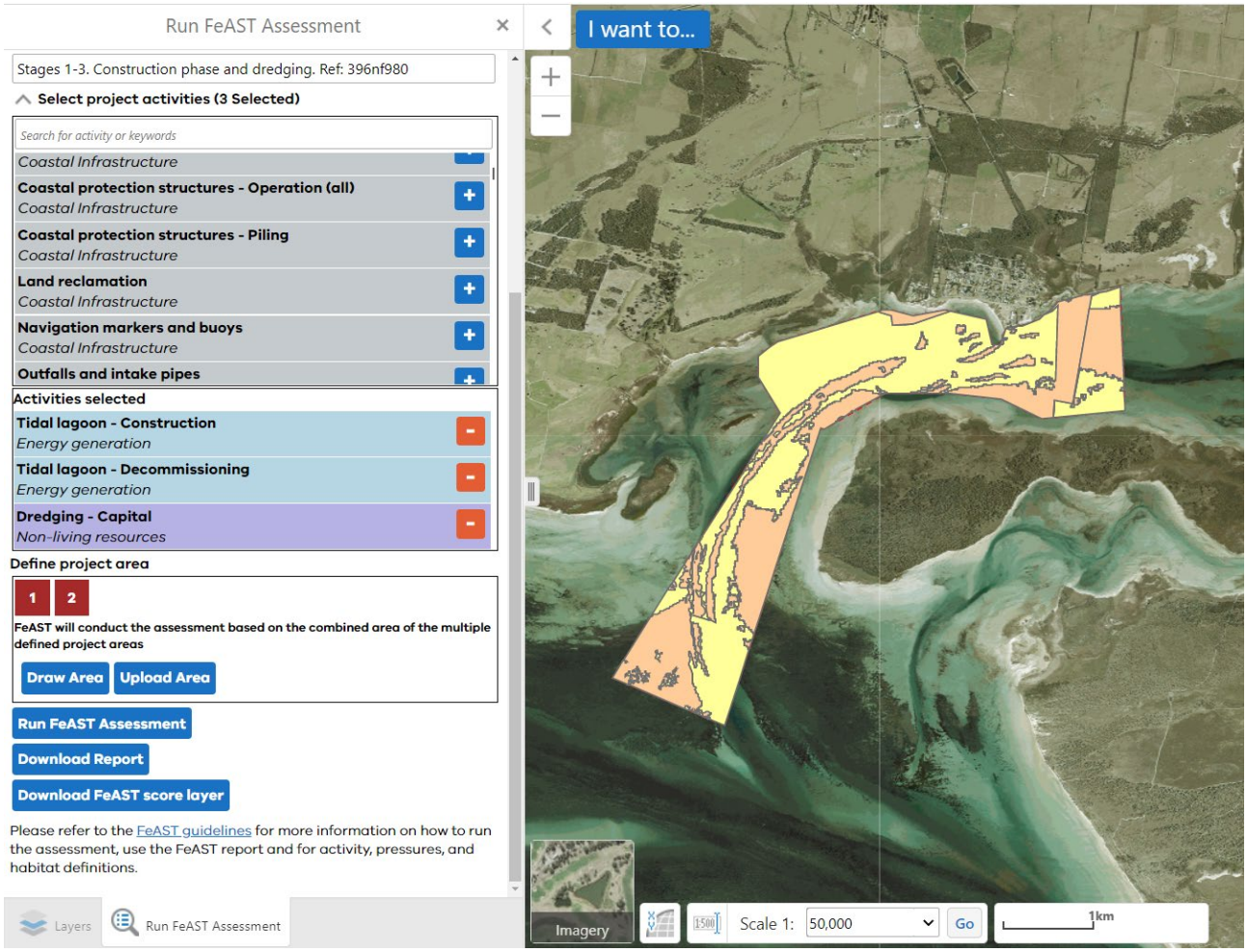


Figure 27: Screenshot from CoastKit showing the FeAST assessment results for the example case study

3.7 Re-running the FeAST assessment

Users may want or need to run several FeAST assessments in quick succession. When a new FeAST assessment is run, the previous FeAST assessment report is no longer available, and the new assessment will be based only on the information selected. However, the FeAST score layer is preserved and will stay displayed on the CoastKit map.

To amend or delete the FeAST score layer, toggle back to the ‘Layers’ tab on the bottom left-hand-side bar below the tool. At the top of the layer list is the ‘FeAST Score’ layer. Here you can view the legend, double click the name ‘FeAST score’ to rename the layer, you can use the slider bar to alter the transparency, hide the layer by unticking the checkbox, or use the arrow to the right to remove the layer permanently (Figure 28). The rolling numbering of each project area i.e. 1, 2, 3, will continue from the last number deleted and does not refresh at 1 again.

Alternatively, refreshing the CoastKit site will restart the tool and remove this pre-existing data.

Make sure to download and save the FeAST assessment report and FeAST score layer after running each assessment.

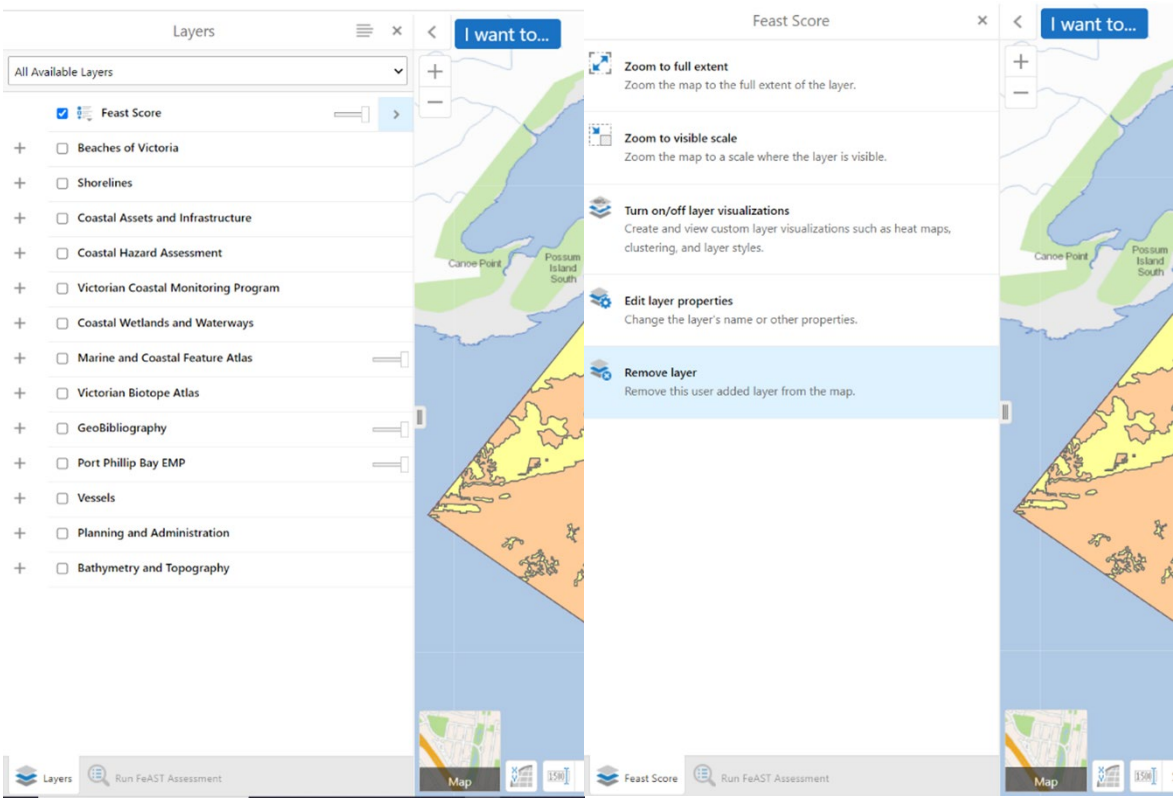


Figure 28: Screenshot from CoastKit showing how to remove the FeAST score layer

3.8 Options analysis: site selection

FeAST supports users to evaluate the most suitable sites for proposed activities. The tool assists users to assess options for the placement of activities to avoid most-at-risk habitats, marine and coastal features of importance and nearby activities. Additionally, the results can be used to refine the size of the project area.

To do this, the user is required to run separate FeAST assessments for each potential project area. The same set of activities must be selected to allow accurate comparison. When you have generated your first FeAST assessment report, make sure to download and save the report and FeAST score layer.

You can then delete the numbered project area and draw or upload another. Make sure to click ‘Run FeAST assessment’ and download the new report and layer when it has processed. You will see that both project areas you have run separate reports on are visible in the map. You can change which ones are shown by toggling back to the ‘Layers’ tab and checking and unchecking the new FeAST score layers at the top.

You should also compare the information in the FeAST assessment reports, particularly the Habitat scores, FeAST scores and Proximity analysis.

Figure 29 shows the FeAST score results of an options analysis for the example case study. The first project area avoids the seagrass (green) and mangrove (dark blue) habitats and was drawn using the habitat mapping on CoastKit, however the other two project areas cross multiple habitat types.

Three separate reports were generated for each area, showing one with a low FeAST score (yellow) and two with areas of both low (yellow) and medium (orange) FeAST scores.

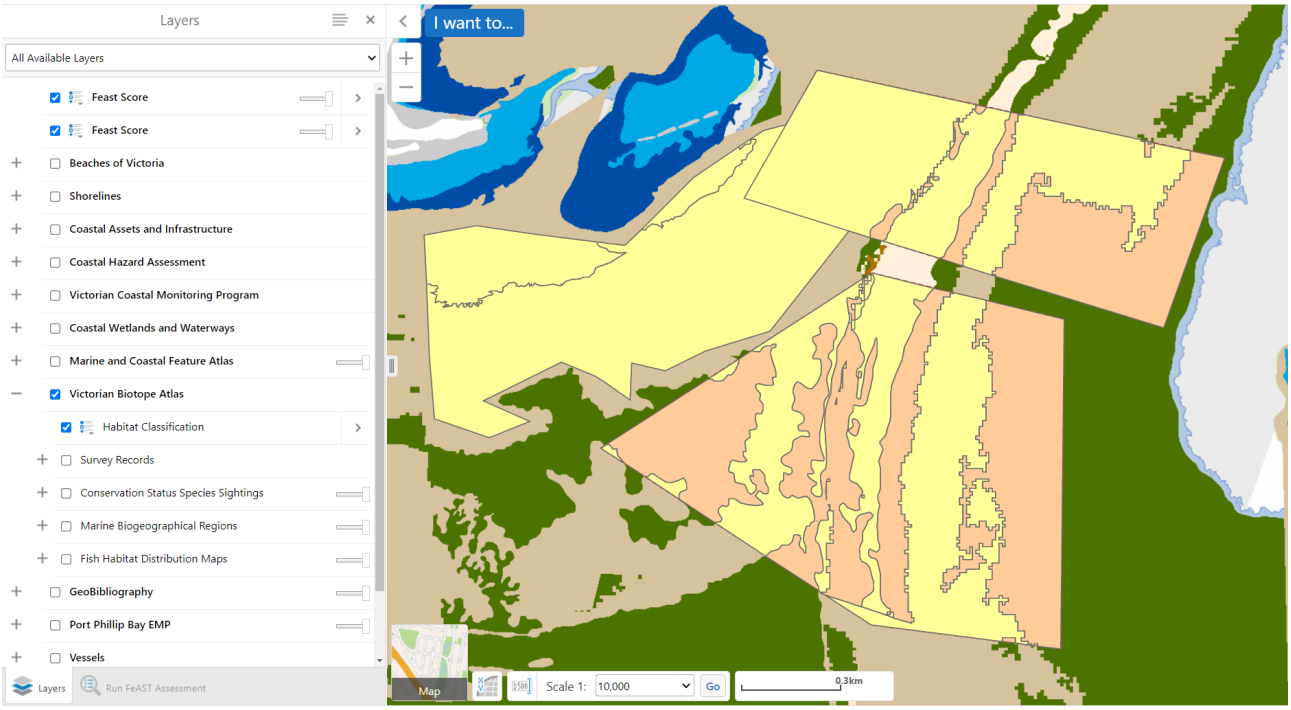


Figure 29: Screenshot from CoastKit showing three options analyses for the example case study

3.9 Complex projects: multiple activities

Only one FeAST assessment is required if all the selected activities are planned to occur in the same project area.

However, there may be cases when a project has different activities occurring across multiple locations or within different parts of the overall project area and this will require multiple FeAST assessments.

Complex projects may also involve primary and secondary activities, which all need to be considered. For example, a project's primary activity may be to construct a tidal lagoon, however, there are associated secondary activities that may be required, such as capital dredging, seismic surveying, installation of power cables, and the transportation of spoil materials by vessels. These activities may also occur in different project areas.

A project may also require an options analysis to evaluate which activities may be most suitable for an area (see section 3.8).

To run multiple FeAST risk assessments for multiple activities. Run the assessment as normal, making sure to use the titles and subtitles to differentiate between the different activities, and to download and save each report and FeAST score layer.

You will see that all the project areas you have run separate reports on are visible on the map. You can change which ones are shown by toggling back to the 'Layers' tab and checking and unchecking the new FeAST score layers at the top.

As you will be considering the different activities separately it will make it difficult to assess the risk to each habitat, see sections 1.6 and 4 for more information.

In Figure 30, three separate FeAST assessments that have been run using the example case study. Each of the areas has a different set of activities planned to occur as part of the wider development of the tidal lagoon. For demonstration purposes, each area has been labelled. Area 1 includes capital dredging, Area 2 and 3 construction of a coastal protection structure and tidal lagoon, and Area 4 installation of power cables

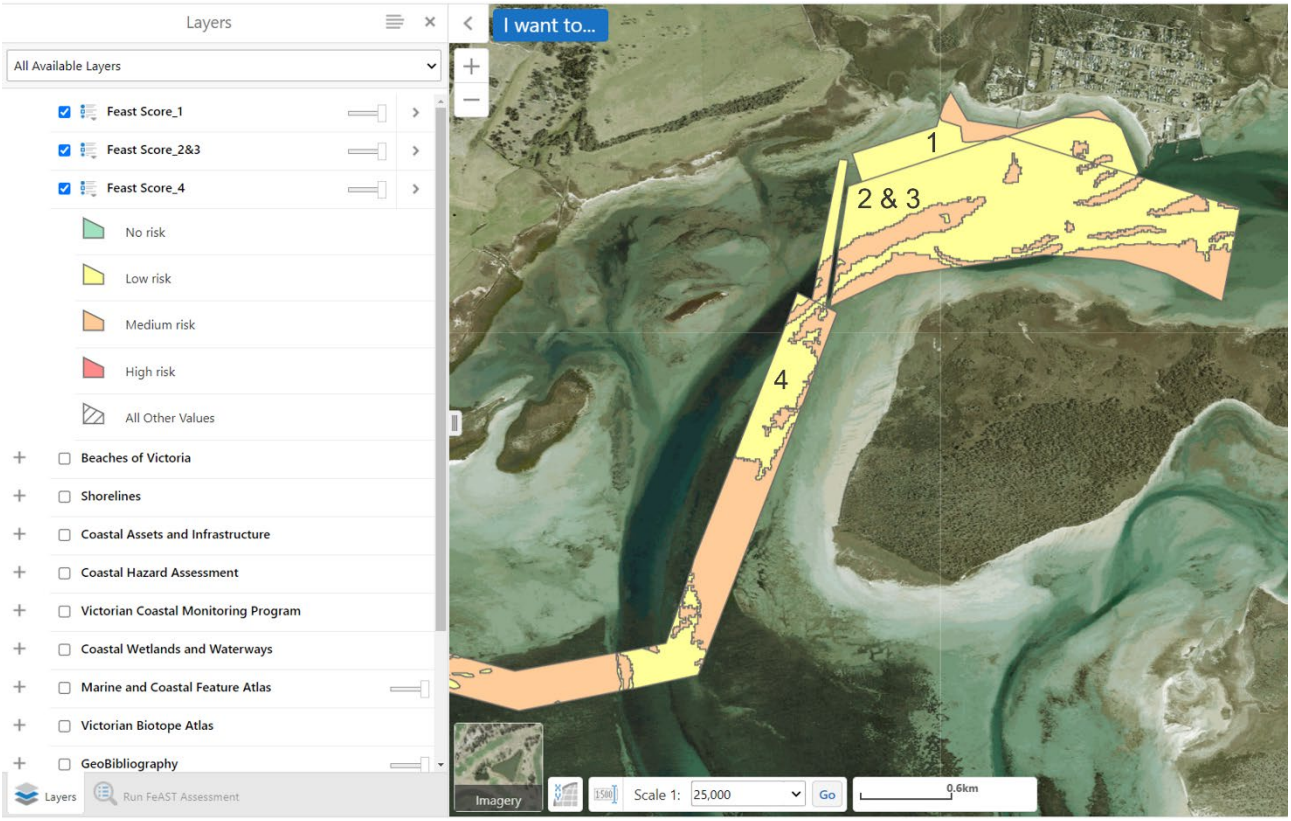


Figure 30: Screenshot from CoastKit showing the FeAST results for different activities across multiple areas.

3.10 Projects with multiple stages

Typically, large-scale, or major projects have multiple stages of development during the life of the project. The stages may involve anything from exploratory surveying and sampling to the operation and maintenance, and even end of life decommissioning and rehabilitation of structures.

Each of the stages involve activities which may pose risks to the habitats within the project area. A proposal must account for all activities that will be undertaken during the duration of the project.

If all of the stages occur within the same project area a single FeAST risk assessment should be undertaken. If the stages occur across different areas, for example pre-project surveying may occur over a much larger area than the development and operations stages. These two areas will require two separate FeAST reports for the relevant activities (see section 3.9).

Using the case study, we have identified three stages to use as examples:

- **Stage 1**: Surveying prior to construction, including sampling and seismic testing (Figure 31).
- **Stage 2**: Construction and associated dredging (Figure 32).
- **Stage 3**: Operation and maintenance (Figure 33).

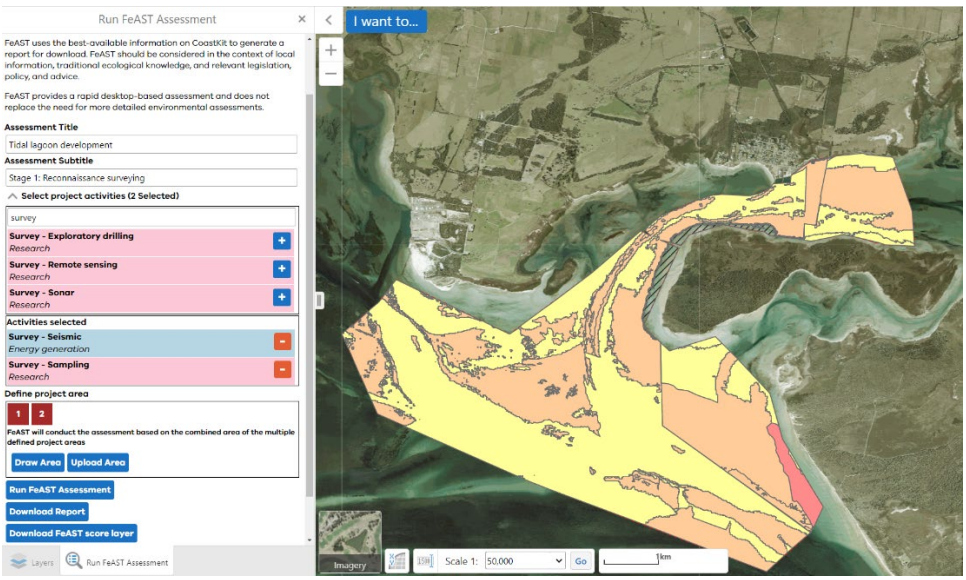


Figure 31: Screenshot from CoastKit showing results from stage 1 of the FeAST risk assessment

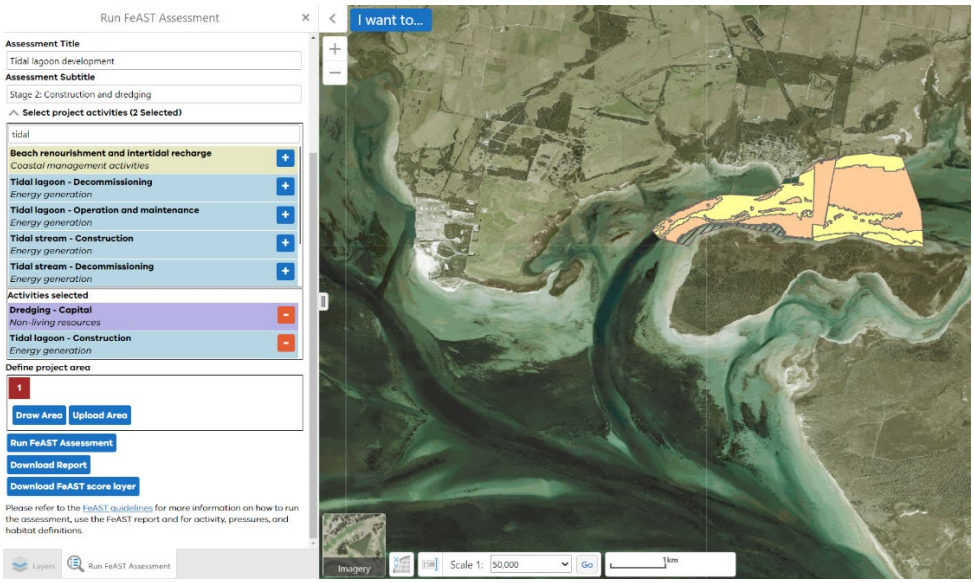


Figure 32: Screenshot from CoastKit showing results from stage 2 of the FeAST risk assessment

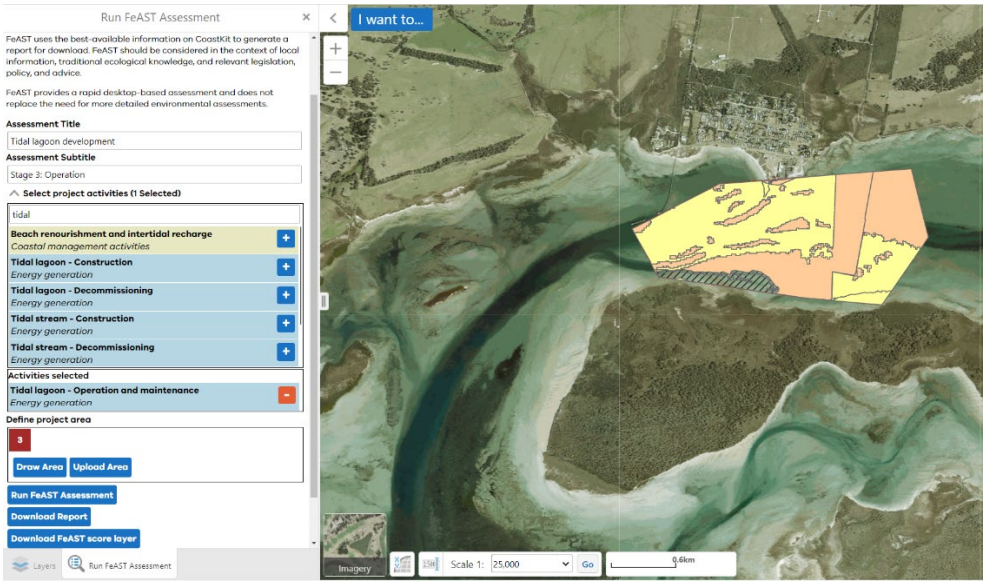


Figure 33: Screenshot from CoastKit showing results from stage 3 of the FeAST risk assessment

4. Using the FeAST report

This section will provide users with detailed guidance on using the key outputs and results from the FeAST report in decision making. This section has been written for all user groups engaged in the pre-application, application submission or application assessment stages of project planning and approvals. FeAST is a key tool in the referral stages of a project; however it does not replace the need for more detailed and bespoke assessments as required for an EES or no-EES with conditions assessment.

FeAST provides a first-pass environmental risk assessment that compiles existing and publicly available information in the form of a desk-based study to highlight the potentially significant impacts to habitats that could arise from a project. FeAST also identifies important features that need to be considered, that are either present or potentially present within a site or the surrounding area.

FeAST assessment should be used at the outset of the project in either the initial project design phase or preliminary screening stage and does not replace the need for a full environmental impact assessment, or environmental audit. FeAST provides a sub-set of the pre-existing and relevant background information that could be used to inform site and activity selection, and determine which species, ecosystems, habitats, or environmental features are likely to require a detailed assessment.

The results generated by FeAST are particularly applicable to the initial negotiation stages between a project proponent and planning authority, and can assist with discussion to:

- Evaluate the significance of ecological issues identified by FeAST in determining an application for planning consent.
- Establish requirements and conditions prior to approving planning consent applications.
- Define the appropriate scope and content of a subsequent detailed environmental impact assessment.
- Determine the proposed survey design and methods for survey, evaluation, and assessment.
- Decide on strategic plans of sustainable development to allow for various uses.

FeAST is a first pass risk assessment and does not replace the need for more detailed environmental or ecological assessment. The FeAST assessment report can also support requirements under the following legislative and policy framework objectives, with more detailed information in section 4.3:

- The *Environment Protection Act 2017*, support General Environmental Duty (GED): the responsibility of the user to reduce the risk of harm posed to the environment.
- The *Flora and Fauna Guarantee Act 1988*, which ensures the conservation of threatened species and communities, and for the management of potentially threatening processes. The project must consider the conservation objectives as outlined in Protecting Victoria's Environment - Biodiversity 2037. The plan aims to stop the decline of Victoria's biodiversity and achieve a net improvement in the outlook across all species over the next 20 years.
- The *Marine and Coastal Act 2018*, which provides objectives and guiding principles for planning to protect and enhance the marine and coastal environment.
- The *Environment Effects Act 1978* applies to projects with the potential to have a significant effect on the environment.

FeAST adopts the Australian Standards for Environmental Risk Management and can assist with the preliminary screening of risks. It can also be used to rank and prioritise which risks require further investigation and analysis due to unacceptable levels of change, harm, or impact, additionally FeAST can indicate where there is insufficient data available and uncertainties.

It is recommended that the Australian Standards for Environmental Risk Management framework should be applied by users after using FeAST to establish the context for the risk assessment process (Figure 34).

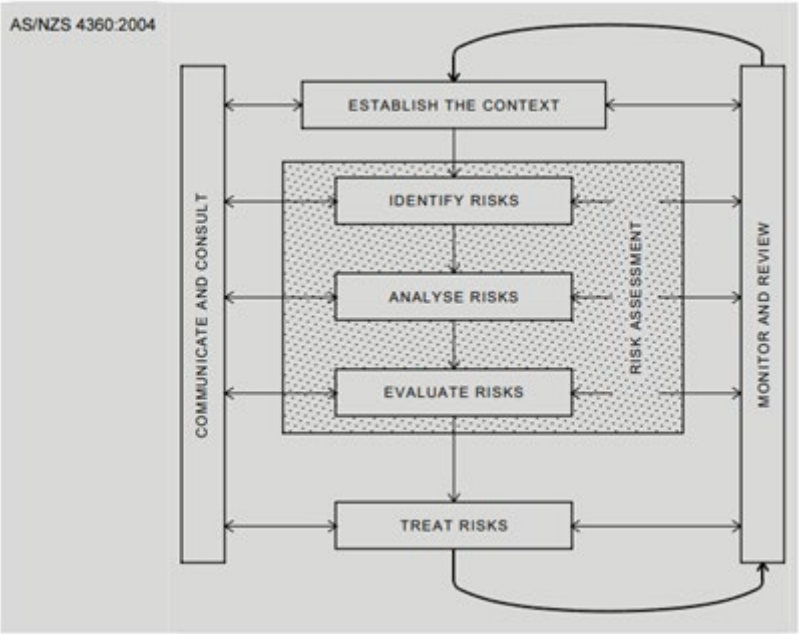


Figure 34: Risk Assessment process (AS/NZS 4360:2004)

Additionally the following risk management principles are recommended to guide the user with a sequential process if a high or medium FeAST score has been attained (CIEEM, 2018):

1. **Avoidance:** The proponent should evaluate multiple site options and explore the most-suitable timings for project activities to avoid harm to sensitive habitat at risk and environmental features within close vicinity.
2. **Mitigation:** The proponent must provide solutions for avoiding, minimising, or managing potentially negative impacts as highlighted in the Pressure Score section of the FeAST report. The pressures should be used to inform the design of the project or produce options for mitigation measures, in addition to best-practice guidelines.
3. **Compensation:** In cases where potentially negative impacts are unavoidable or residual ecological effects persist, it is a requirement for a compensatory offset as per planning conditions.
4. **Enhancement:** Depending on the significance of the impacts posed by the project, the proponent should demonstrate suitable measures to improve the health, condition or extent of habitats or at-risk environmental features identified within the vicinity of the project area.

FeAST can be applied to projects of varying scales, however the level of detail required by regulators and planners will be proportionate to the scale of the development and the complexity of potential impacts posed by the project. A checklist has been created to support using the FeAST report and to inform next steps (section 4.1).

4.1 User checklist

A checklist has been created to support using the FeAST report and to inform next steps. Use the list below to find more information and which section to navigate to on this chapter.

☐ Has the FeAST report been checked for accuracy? (Section 4.2)

☐ Have the results from the FeAST assessment been addressed? (Section 4.3)

☐ Have Traditional Owners' rights, aspirations and knowledge been considered appropriately? (Section 4.4)

☐ Have all relevant policy, plans and legislation been accounted for? (Section 4.5)

☐ Has all relevant information from other data sources been considered? (Section 4.6)

☐ Have alternative locations been considered? (Section 4.7)

☐ Have any surveys been undertaken, and information provided to decision makers? (Section 4.8)

☐ Has the user explored the most suitable time of year and day for project activities to occur? (Section 4.9)

☐ Has climate change or sea level rise been considered in context of the location and activities of the proposal? (Section 4.10)

☐ If applicable, has modelling been conducted to consider the zone of influence? (Section 4.11)

☐ Have integrated impacts and cumulative effects associated with the project activities and other nearby existing or emerging activities been considered? (Section 4.12)

☐ Have appropriate mitigation measures been developed and what is the anticipated risk level after implemented? (Section 4.13)

☐ Has the report and associated files been sent to the relevant decision maker? (Section 4.14)

4.2 Quality Assurance process

The FeAST report presents information in a way that is transparent and allows for rapid appraisal and review of information. The user must ensure that all the information provided in the report is accurate and not misleading. It is the responsibility of the user to undertake a quality assurance process to ensure all activities that will occur as part of the project have been accounted for and the defined project area is an accurate representation of where all the activities will occur.

The checklist below should be used as a process for ensuring the information in the report is correct:

☐ Is the defined project area (combined if multiple polygons) accurate and comprehensive, including all the activity footprints or ancillary works associated with the proposal?

☐ Do the activities selected best describe the project and all the activities planned to occur during the lifecycle or duration of the project (i.e. construction, operation, maintenance, or decommissioning)?

4.3 Interpreting the FeAST report and scores

The FeAST score provides the level of risk to each habitat identified using the project area and activities. The FeAST score represents the risk of irrecoverable impact to a habitat and indicates the need for further action.

The FeAST score addresses risk concepts of likelihood vs consequence, framed by FeAST as the level of exposure vs the sensitivity of the habitat (see section 5).

It is important to note FeAST is based on semi-qualitative information and provides only a preliminary prediction of risk, and several limitations apply (see section 1.6).

The Australian Standard for Environmental Risk Management places risk into three categories:

- Risks that are at an acceptable level, and do not need to be considered further.
- Risks that are currently too high to be acceptable, and for which risk treatment measures must be considered to bring them to an acceptable level. These risks are sometimes referred to as ‘tolerable’ because they are tolerated under specific circumstances or for a specified time.
- Risks that are unacceptable in any circumstances or at any level (intolerable).

The interpretation of the FeAST results is based on the concept of acceptability. Table 9 presents the potential ecological effect, the interpretation and user recommendations based on the FeAST score and acceptable level of risk criteria.

Table 9: Interpreting FeAST scores and suggested user actions

FeAST Score	Potential ecological effect	FeAST assessment interpretation	User actions
High risk	A permanent functional, structural, or ecological change in character of a habitat at an ecosystem scale is likely.	A high possibility that the project activities will pose irrecoverable harm to a habitat type. With the current information available this would be considered an unacceptable level of risk.	Further investigation is likely needed to understand the full extent of possible impacts to the habitat and broader environment. Based on the available data from the FeAST assessment consideration needs to be given to changing the location and/or activities. Decision-makers need to be satisfied the impacts have been avoided, minimised, mitigated, and sufficient evidence must be provided to support this and to show thorough consideration of local information, indirect or cumulative impacts, and relevant legislation.
Medium risk	Habitats may take a prolonged time to recover with significant mortality of keystone and characterising species leading to populations and communities shifting a distinct level.	A moderate possibility that the project activities will pose serious harm to a habitat type. With the current information available this would be considered an unacceptable level of risk.	
Low risk	Some noticeable changes in the physicochemical character of a habitat and mortality of species possible with a small reduction in the overall extent of the habitat.	A low, but existing possibility that project activities will pose serious harm to a habitat type. With the current information available this would be considered an unacceptable level of risk.	Additional information may be required based on the results of the Proximity analysis. Evidence should be provided to show consideration of local information, indirect or cumulative impacts, and relevant legislation.
No risk	No significant effects to habitats	A negligible possibility that the project activities will pose serious harm to a habitat type in this location. However local information, indirect or cumulative impacts, and relevant legislation may deem this level of risk unacceptable.	
Not evaluated	Significant data gap or uncertainty. FeAST has no mapped data for coastal and terrestrial environments, and Commonwealth Waters (> three nautical miles)	Insufficient data available to determine if project activities will pose serious harm to a habitat type.	Further investigation is required to identify potential risks to the habitat. Additional information may be required based on the results of the Proximity analysis. Evidence should be provided to show consideration of local information, indirect or cumulative impacts, and relevant legislation.

The FeAST score should only be adopted as first-pass or preliminary risk assessment due to the limitations, see section 1.6 with the potential for the level of risk to increase depending on project, location, project

impacts outside of the footprint, temporal specific factors, and other environmental values like migratory species. The habitat map accuracy and survey effort (i.e. number of ground-truthed biotope records) across the state and displayed on the biotope atlas, should be taken into consideration when interpreting the FeAST scores and deciding on further actions.

Figure 35 is from an example FeAST report showing a set of project activities that have triggered a low, medium, and high-risk FeAST score across the 8 identified habitats present in the project area and Cape Otway biounit. The spatial depiction of risk helps users look to avoid specific habitats and should be used to inform further actions.

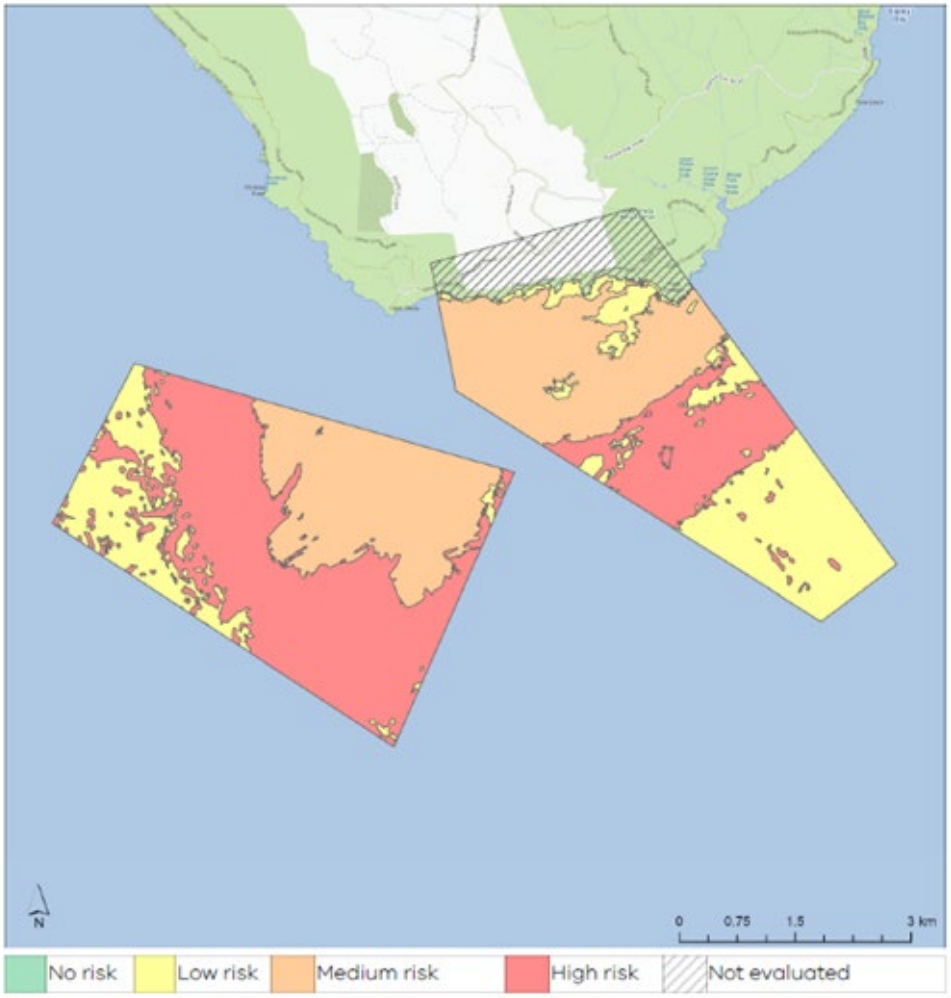


Figure 35: Image from the FeAST report showing the FeAST score results for an example test proposal

Using Habitat scores

Where high, medium or low FeAST scores have been attained, the user should also look at the Habitat score results and individual sensitivity scores. The Habitat score table shows the sensitivity of each habitat to all the pressures likely to occur during the duration of the project.

The Habitat scores can inform the selection of appropriate avoidance, minimising, and mitigation measures and whether proposed measures are appropriate. Figure 36 shows an example from a FeAST report where the user has started to circle those habitats with a high and medium sensitivity.

The Habitat score does not account for the location of the project or the proportional exposure as calculated within the biounit. The sensitivity relationship is always the same between each pressure and habitat. However the scale of the project and the location across the state is considered in the FeAST score (see Figure 37).

Legend								
Pressure	**High Energy Littoral Rock**	**Littoral Sand**	**High Energy Infralittoral Rock**	**High Energy Open-Coast Circalittoral Rock**	**Sublittoral Coarse Sediment**	**Sublittoral Sand And Muddy Sand**	**Sublittoral Seaweed On Sediment**	**Non-Reef Sediment Epibenthos**
Abrasion to seabed	High	Low	Medium	High	Very Low	Low	Medium	Medium
Removal of substratum	High	Medium	Medium	High	Medium	Medium	Medium	High
Change of seabed type	High	Medium	Medium	High	Medium	Medium	Medium	High
Invasive species	High	High	High	High	High	High	High	High
Penetration to seabed substrates	High	Low	Medium	High	None	Low	None	High
Hydrocarbon contamination	High	None	Medium	None	None	None	None	None
Water clarity changes	Medium	Low	Medium	High	Very Low	Low	None	Medium
Visual disturbance	Medium	None	None	None	None	None	None	None
Change of sediment type	None	Medium	None	None	Medium	Medium	Medium	High
Water flow changes	None	Medium	Medium	High	Low	Medium	Medium	High
Light siltation or smothering	Low	None	None	Low	None	None	None	None
Above water noise	Low	None	None	None	None	None	None	None
Heavy siltation or smothering	Medium	Low	Medium	High	Very Low	Low	Medium	Medium
Habitat score	Medium (82%)	Medium (73%)	Medium (82%)	High (88%)	Low (65%)	Medium (73%)	Medium (83%)	High (93%)

Figure 36: Table extract from the FeAST report showing the Habitat score results for an example proposal

FeAST Assessment	High energy littoral rock	Littoral sand	High energy infralittoral rock	High energy open-coast circalittoral rock	Sublittoral coarse sediment	Sublittoral sand and muddy sand	Sublittoral seaweed on sediment	Non-reef sediment epibenthos
Habitat Score	Medium	Medium	Medium	High	Low	Medium	Medium	High
Exposure Level for biounit: Cape Otway	Low	Low	Medium	Medium	Low	Low	High	High
Feast score for biounit: Cape Otway	Low risk	Low risk	Medium risk	High risk	Low risk	Low risk	High risk	High risk
FeAST score	Low risk	Low risk	Medium risk	High risk	Low risk	Low risk	High risk	High risk

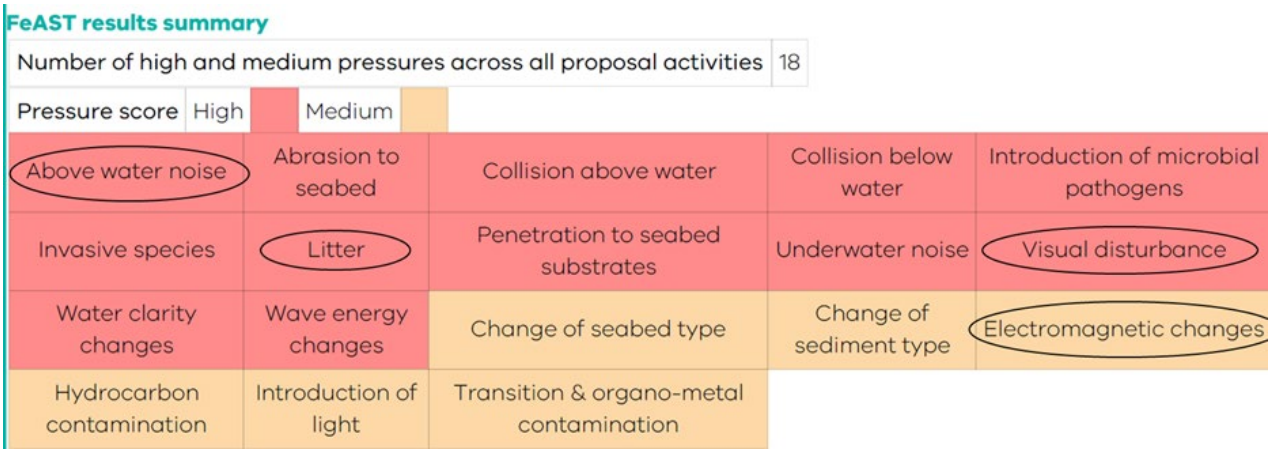
Figure 37: Table extract from the FeAST report showing the Habitat scores and FeAST scores

Using the pressure scores

Additionally, the user should analyse the results from the Pressure score even if the FeAST score has not presented a high or medium risk. The Pressure score synthesises all the pressures likely to be exerted by the activities regardless of habitat type. This provides an indication of impact to other environmental features, assets, or even humans.

Figure 38 shows 18 pressures with a high to medium likelihood to occur from all the proposal activities. Some of the pressures identified will pose minimal or no threat to habitats these include ‘electromagnetic

changes', 'visual disturbance', 'litter' and 'above water noise'. However, these pressures may still need to be avoided, minimised, or mitigated to avoid impact to fauna and people. This summary provides useful information for developing robust mitigation measures around each pressure. More information on mitigation measures in section 4.13.



FeAST results summary

Number of high and medium pressures across all proposal activities 18				
Pressure score High		Medium		
Above water noise	Abrasion to seabed	Collision above water	Collision below water	Introduction of microbial pathogens
Invasive species	Litter	Penetration to seabed substrates	Underwater noise	Visual disturbance
Water clarity changes	Wave energy changes	Change of seabed type	Change of sediment type	Electromagnetic changes
Hydrocarbon contamination	Introduction of light	Transition & organo-metal contamination		

Figure 38: Table extract from the FeAST report showing a summary of the high and medium Pressure scores

The Pressure score results can also be used to evaluate the potential pressure cause-effect pathways across different user-selected activities. This information can be used to explore and screen other activity alternatives or project options to minimise pressure-induced impact pathways.

The scoring is based on a standardised list of benchmarks for each pressure that assumes compliance to thresholds or objectives set by legislation or best-practice frameworks. The user is required to consult the supporting material in section 8.2 to ensure their project is aligned to nationally and state-wide adopted values. Additionally, the project should consider the context of local conditions refer to the section 1.6.

The Pressure score results should also be considered with information in the Proximity analysis tables.

Using the proximity analysis results

This can provide an indication of potential interactions with sensitive environmental assets, or other activities occurring in the vicinity from the project activities. The Proximity analysis is separate to the FeAST assessment and should be considered by user even if a low or no risk FeAST score has been attained.

The Proximity analysis can be used to identify ecological features and matters that may be subject to a more in-depth investigation or detailed environment assessment to avoid, minimise or reduce possible adverse effects. Additionally, the Proximity analysis could be used to consider the impact of cumulative effects by identifying other existing marine and coastal activities near the project area. More information can be found in section 4.12.

Figure 39 shows examples of the user circling nearby features in orange and red, and other features that might be impacted and require further investigation in green.

Conservation and protected areas

This table lists protected and management areas that must be considered in compliance with relevant acts and regulations. Please note that marine asset areas do not have specific legislative requirements but are of high conservation value.

Feature name	Category	Description	Proximity
Point Addis Marine National Park	Marine National Park	National Parks Act Schedule 4 park or reserve	55 %
Point Addis rhodolith beds	Marine asset areas	Unique for Rhodoliths patchy but dense beds distributed within this area	48 %
Surf Coast beaches	Marine asset areas	Hooded plover Habitat - Surf Coast	543 m
Point Addis seascape	Marine asset areas	Unique geology, Mulloway, salmon, gummy shark	1195 m

Scientific and heritage areas

This table lists important areas for research and monitoring purposes, as well as recorded non-Aboriginal historic sites in Port Phillip Bay and shipwreck sites across Victoria. Aboriginal cultural values have not been included, please refer to the Aboriginal Heritage Act 2006 and consult with the nearest Registered Aboriginal Party to meet your obligations.

Feature name	Category	Description	Proximity
Wreck - RAAF - Mitchell	Shipwreck sites	RAAF - Mitchell. Wrecked in 1944.	1220 m
Monitoring site - IRMP - 3901	Monitoring sites	Intertidal reef monitoring program. Long term, central Victorian monitoring program associated with MPAs, 2003-2014. Infralittoral reef using scientific diver UVC methods. Field and data methods quality controlled.	1226 m

Figure 39: Table extract from FeAST report showing Proximity analysis results and example highlighted features

4.4 Traditional Owners' rights, aspirations, and knowledge

It is critical in the early stages of any planning process to respect the rights, aspirations, and knowledge of Traditional Owners in Victoria. This includes acknowledging cultural and spiritual connections to land, biodiversity, and resources through a relationship with Country.

FeAST assists with identifying which Registered Aboriginal Parties (RAPs) the project area overlaps with or is nearest to within 2km of the defined project area boundary. The first page of the FeAST report presents a table that lists the one or multiple RAPs (Figure 40).

In cases when the report lists multiple RAPs, the defined project area either crosses both boundaries, or is equidistant away from the RAPs (within a 2km buffer). Additionally, if the table shows a blank result this indicates that there is no RAP within 2km of the project area boundary.

Location of proposal

Proposal Area	22.834 km^2
Biounit	Surf Coast
Nearest LGA	Surf Coast Shire
Nearest Locality	Lorne
Registered Aboriginal Party	Eastern Maar Aboriginal Corporation

Figure 40: Table extract from the FeAST report showing the details of the location of the proposal

Sites of cultural significance and value are not included in the FeAST assessment, it is the responsibility of the user to consult early with Traditional Owners about projects or matters that affect them, their country, and their communities. Some Traditional Owners have Country Plans, which should be considered as part of your application.

The *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2007* provide protection and management for Victoria's Aboriginal heritage with streamlined processes linked to the Victorian planning

system. If a proposed development is within an area of cultural heritage sensitivity, If a proposed development is within an area of cultural heritage sensitivity, the Aboriginal Heritage Planning Tool can help determine if it falls under the definition of 'high impact activity' and will need a Cultural Heritage Management Plan (CHMP). The First Peoples- State Relations Online Map (FPSR) can assist with this process.

4.5 Key legislation and policies

It is necessary to consider all relevant Victorian and Federal statutory mechanisms at an early stage of the decision-making process. The user is required to demonstrate the project's accordance and consistency with relevant legislation, acts, regulation, plans, standards, policies, and frameworks. Consulting these relevant mechanisms will assist with interpreting the FeAST report and determining next steps based on the significance of effects.

This section will advise users of the linkages between the FeAST assessment and legislative processes, and how FeAST can be used in these instances to provide useful information to inform these. The list of legislation and policies isn't exhaustive, and users should conduct their own review.

Marine and Coastal Act 2018

FeAST aligns with several objectives of the *Marine and Coastal Act 2018* (MACA), these principally include:

a. Protect and enhance the marine and coastal environment.

b. Promote the ecologically sustainable use and development of the marine and coastal environment and its resources in appropriate areas.

c. Engage with specified Aboriginal parties, the community, user groups and industry in marine and coastal planning, management, and protection.

d. Build scientific understanding of the marine and coastal environment.

FeAST has been developed in the context of the Marine and Coastal Policy. The Policy provides long-term policy guidance and adopts seven key principles for consideration in planning and decision making in the marine and coastal environment (Figure 41).

Figure 41: Diagram showing the Marine and Coastal Policy guiding principles

The Policy sets out how each of these guiding principles should be considered in the context of planning and decision making. The Policy also includes a Marine Spatial Planning Framework that provides guidance and a process for achieving integrated and coordinated planning and management of the marine environment.

FeAST provides key information for applications for MACA consent, and FeAST reports must be included when submitting applications for MACA consent.

Environment Effects Act 1978

The *Environment Effects Act 1978* requires: a project with potential adverse environmental effects that, individually or in combination, could be significant in a regional or state context should be referred. The Ministerial Guidelines for Assessing Environment Effects sets out the referral criteria for projects.

In cases where the project has the potential for a significant environmental impact based on the marine environment related referral criteria, the outputs from FeAST should be included in the submission of the referral package for determining the need for an Environment Effects Statement (EES). The user should refer to the guidelines for precise formatting and content requirements, and information.

FeAST provides useful information on the existing environment, presenting analysis on some of the relevant environmental assets listed in the guidelines for inclusion. Not all the required environmental assets are captured by FeAST, this should be explored by the user. Full list of layers in the Proximity analysis can be found in section 8.5.

The FeAST outputs should also be used to identify potential adverse environmental effects and should meet the format and content requirements for EES referrals as set out by the guidelines. These include:

- Brief description of potential changes or risks to environmental assets resulting from the project.
- Available information on the likelihood and significance of such changes.
- The sources and accuracy of this information, and associated uncertainties.

Potentially significant effects should be described in sufficient detail for a reasonable conclusion to be drawn as to whether the project could pose a significant risk to those assets.

Flora and Fauna Guarantee Act 1988

FeAST supports the *Flora and Fauna Guarantee Act 1988* (FFG Act), ensuring that decisions are made with proper consideration of the potential impact on biodiversity, aligning with the following objectives:

a. to guarantee that all taxa of Victoria's flora and fauna, other than taxa specified in the Excluded List, can persist, and improve in the wild and retain their capacity to adapt to environmental change; and

b. to prevent taxa and communities of flora and fauna from becoming threatened and to recover threatened taxa and communities so their conservation status improves; and

c. to protect, conserve, restore and enhance biodiversity, including— (i) flora and fauna and their habitats; and (ii) genetic diversity; and (iii) ecological communities; and (iv) ecological processes; and

d. to identify and mitigate the impacts of potentially threatening processes to address the important underlying causes of biodiversity decline; and

e. to ensure the use of biodiversity as a natural resource is ecologically sustainable; and

f. to identify and conserve areas of Victoria in respect of which critical habitat determinations are made.

A FeAST risk assessment provides information to reduce or avoid impacts to protected species and communities in the marine and coastal environment. The FeAST assessment does not replace the need for further work to identify if listed species may occur in the project area and considerations to ensure the project meets all obligations under the FFG Act.

Environment Protection and Biodiversity Conservation Act 1999

The commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined as Matters of National Environmental Significance (MNES).

The FeAST assessment does not replace the need for further work to identify if MNES may occur in the project area and considerations to ensure the project meets all obligations under the EPBC Act. A FeAST risk assessment provides information to reduce or avoid impacts to MNES. Outputs from the FeAST report should be used in conjunction with results from the Protected Matters Search Tool.

Environment Protection Act 2017

The Environment Protection Regulations 2021 and the Environment Reference Standard (ERS) are subordinate legislative tools that support the Environment Protection Act 2017. The legislation enhances the

protection of Victoria's environment and human health through a more proportionate, risk-based environment protection framework that includes:

- A preventative approach through a general environmental duty.
- A tiered system of EPA permissions to support risk based and proportionate regulatory oversight.
- Significant reforms to contaminated land and waste management.
- Increased maximum penalties.
- Requirements for more environmental information to be publicly available.
- Modernising and strengthening EPA's compliance and enforcement powers.

The EPA has produced a general guidance publication intended for businesses to assess and control risks, which follows four steps (Figure 42).

Table 1: Steps in controlling hazards and risks

Step	Action	Description
1	**Identify hazards**	What hazards are present that might cause harm
2	**Assess risks**	What is the level or severity of risk, based on likelihood and consequence
3	**Implement controls**	What measures are suitable and available to the business to eliminate or reduce a risk
4	**Check controls**	Review controls to ensure they are effective

Figure 42: Environmental Protection Agency (Victoria) steps for controlling hazards and risks

FeAST aligns with many of the principles listed under the principles of environment protection and is guided by duties relating to environment protection, principally the general environmental duty. The FeAST report supports identification of hazards, assessment of risk and identification of controls.

4.6 Supplementary information

Due to the current limitations and scope of FeAST, other decision-making tools should be used in conjunction with FeAST to supplement the information provided in the report. In particular, other government interactive mapping tools and other national tools to access the best-available information to provide to decision-makers.

All the information extracted from these tools (reports, spreadsheets, maps etc.) should be provided in addition to the FeAST report to the relevant decision maker to support an application.

NatureKit

Use the portal to query, extract and download a species list of threatened fauna and flora under the FFG and EPBC Acts on the Victorian Biodiversity Atlas (VBA) which details species sightings and observation records. To understand the coastal vegetation in the vicinity of the defined project area explore the Ecological Vegetation Classes (EVCs).

Native Vegetation Information Management system (NVIM)

The NVIM tool should be used if the proposal intends to remove, destroy, or lop any native vegetation. Removal of wetland vegetation (including saltmarsh and mangroves), and seagrasses is may require a planning permit application under Clause 52.16 and Clause 52.17 of Victoria's planning schemes.

Protected Matters Search Tool (PMST)

The PMST should be used to understand important EPBC act protected values. This includes information on migratory species, key ecological features, commonwealth marine areas, listed critical habitats and matters of national environmental significance for key consideration.

4.7 Avoiding locations

It is the responsibility of the project proponent to seek options to avoid harm to habitats and ecological features as presented in the FeAST report. The FeAST score provides an indication of the risk to the habitats within the defined project area, and it is possible that the risks to habitats may be lower in an alternative location. If there is the option to relocate the proposal to another location, an options analysis can be undertaken using FeAST as detailed in section 3.8.

In some cases, it will be a requirement to move the location of a proposed project due to the features identified in Proximity analysis tables. These may include, but are not limited to:

- Ramsar sites.
- Marine protected areas, marine sanctuaries.
- Protected shipwreck areas.
- Non-aboriginal cultural site.
- Important breeding, feeding or aggregation areas for listed species with a conservation or migratory status.
- Significant landscape or natural features.
- Existing infrastructure, activity conflict or emerging development area.

4.8 Undertaking field surveys

Irrespective of the FeAST assessment results, it may be important for the proponent to undertake their own field surveys and conduct a full impact assessment. The FeAST score and Proximity analysis can provide an indication of when and where field surveys may be useful to better understand the risk posed by the project.

FeAST is based on several limitations and assumptions as listed in section 1.6, the collection of new data would support better understanding of the level of risk and possible impacts of pressures.

Field surveys should be tailored to the local ecology and conditions and adopt a systematic and robust survey design for collecting data. It is recommended that survey design is informed by existing datasets, research, imagery, and studies. The habitat survey effort around Victoria is unevenly distributed and collecting information in data-deficient areas would inform the accuracy of classifying habitats.

For each field survey undertaken the proponent must ensure that the accompanying spatialised data is provided with the list below providing the minimum information to be included:

- Spatialised data in the form of mapped survey transects, study area or sampling points.

- Description of the methodology including rationale for the number of surveys.
- Description of the methods and equipment employed to undertake field surveys.
- Documented imagery (if appropriate) to be labelled with survey/sampling ID, aspect, field of view (degrees). Ensuring images are of high quality and resolution and are not blurry.
- Name and qualifications of surveyors.
- Date(s) of surveys or sampling.
- Objectives, findings, interpretations, and results from the field surveys (including the classification of the habitat type, recording flora and fauna present, environmental features, and condition of habitat).
- Weather conditions at the time of survey(s) and time of day.
- Reference to relevant guidance, technical manuals, OHS or best-practice documentation.
- Explanations of departures from guidance.
- Limitations associated with the survey design including seasonality and time of day.

4.9 Seasonal considerations

FeAST does not account for the seasonally important times of year for habitats and biodiversity or take into consideration seasonal changes in the distribution of other marine and coastal activities. The FeAST report can be used to guide and determine the most suitable time of year and day for specific activities to occur or the best times to avoid.

Look at the habitats in the FeAST assessment, the listed tables in the Proximity analysis and the pressures listed in the pressure score when considering the following:

- Biodiversity to minimise impacts and disturbance i.e. during important life-history events such as breeding, nursing, migrating, and nesting.
- Water quality to reduce the chance of poor water quality events i.e., postponing activities following significant rainfall or during months likely to see harmful algal bloom events.
- Impacts to people i.e. avoiding summer months and keeping works between social hours.
- Busy timings for other activities that could result in negative interactions i.e. seasonal shipping changes, fishing areas, anchorage areas.

4.10 Climate change and sea level rise

Proposed projects should be considered in the context of potential climate change impacts such as changing water temperature, sea level rise, changing coastlines, acidity and species distributions and movements.

The FeAST assessment is primarily focussed on understanding the risks of impacts to biodiversity, habitats, and ecosystems, and is not intended to assess risks posed by coastal hazards and processes. The Victorian Resilient Coast program has developed a framework to support local government, land managers and communities with implementing place based, best practice and long-term coastal hazard risk management and adaption. CoastKit also provides shoreline and wave buoy data generated from the Victorian Coastal Monitoring Program.

4.11 Zone of influence

FeAST provides a semi-qualitative screening of risks and does not incorporate any modelled data as listed in section 1.6. Each activity and associated pressures will have a diverging scale of impact proportional to the size, duration, location in the water column, and magnitude of the effect. In addition to the FeAST report, a user may be required to undertake a full-footprint analysis and develop models for estimating the zone of influence or aerial range induced by pressures.

Any calculations should consider the local hydrodynamic and wave setting, and dynamic modelling may consist of estimating, but is not limited to:

- sediment dispersal plumes
- temperature and contaminant concentration changes
- underwater noise and vibration profiles
- light duration and intensity

The level of risk and subsequent potential impact of activities on benthic habitats and environmental features can change depending on the time they are exposed to by a particular pressure and the varying strength of that pressure. FeAST does not account for changes in the duration or frequency of project activities, pressure events or does not consider changes in the concentration or power of a pressure.

The intensity of each pressure based on the activity has been expertly scored using a standardised list of benchmarks that assume a 'normal scenario' stressor profile. Any deviations away from these values will increase the risk factor of the pressure, this could affect the strength, concentration, or power of the pressure. This includes but is not limited to, changes in:

- the concentration of pollutants, chemicals, or surfactants
- the temperature discharges
- height of sedimentation
- depth of penetration or removal of sediment

Additionally, it is important to consider the number of pressure events or the activity frequency. HELCOM (Berg et al. 2018) have developed a scale for estimating the pressure frequency (Table 10).

Table 10: Frequency estimates for pressure events (adapted from HELCOM)

Descriptor	Frequency
Persistent	More than three times per year or permanent.
Frequent	Two to three times per year.
Regular	Once per year.
Occasional	Less than once per year.

The duration of time between which a pressure ceases and begins again should also be a key consideration. This may reduce the ability of the habitat to recover from an impact and have negative implications on specific environmental features. The Proximity analysis should be consulted in this instance.

☐ Could the project activities exceed the determined benchmarks for pressures in section 8.2. Has this been accounted for?

4.12 Cumulative effects

The FeAST assessment adopts a precautionary approach to take the most detrimental intensity level (high and medium) across each pressure to produce the Pressure score. The intensity of each pressure is not combined or aggregated in any way across the selected activities, it merely takes the worst-case scenario to produce a first-pass screening of risks.

FeAST also does not consider the potential cumulative impact of other activities nearby to the defined project area. Multiple activities can have complex interactions and can potentially have greater impacts together than when considered separately. The Proximity analysis can assist with this assessment of cumulative impact by identifying other marine and coastal activities occurring within a 2km buffer of the project area. It is important to note the Feature Atlas datasets are not exhaustive and may not include the most current information.

4.13 Developing mitigation measures

The FeAST report provides a starting point for developing a series a mitigation measures for the potential impacts and risks of activities.

All the identified pressures listed on the FeAST summary page of the report should be considered and may have mitigation measures developed. Consideration should be given to the likely success of measures and how they would function to reduce risk.

It is important for the proponent to consult best-practice guidelines for undertaking specific activities and developing mitigation measures to ensure that no further risks are posed. An environmental management plan and set of monitoring actions may be required to ensure mitigation measures are implemented effectively and the performance is reported on.

The robustness of measures should be evaluated to ensure that the mitigation proposed is not unachievable, experimental, unproven, or controversial, and to ensure adequate funding is available for the entire project.

4.14 Submitting the FeAST report

A copy of the downloaded FeAST report PDF and zipped FeAST score shapefile should be provided to the relevant decision-maker or approver. These outputs must be provided and presented in their original and unaltered state. Please consult formal planning approval processes for full details on the how to submit and attach information in the MACA consent and the EES referral forms.

FeAST provides a PDF with a unique report name i.e. coastkit-feast-3d4ea93f-c743-4f6b-8dfb-44c4eb47000e.pdf and zipped file i.e. Export (22).zip. In cases where multiple FeAST assessment have been generated, it is recommended that a systematic file naming structure is employed to ensure FeAST reports and shapefiles are stored and retrieved efficiently. For example, this could involve listing the project name, date and denoting a, b, c for each assessment:

- FeAST_report_projectname_date_a.pdf
- FeAST_score_projectname_date_b.zip

5. Technical summary

This section provides additional technical information to support users to understand the methodology behind the FeAST assessment process. Details are provided on the FeAST data inventory and the process to generate the Pressure, Habitat and FeAST scores.

5.1 FeAST data inventory

The FeAST data inventory has been prepared by Dr. Matt Edmunds (Australian Marine Ecology), Dr. Adrian Flynn (Fathom Pacific) and Adam Nordinson (Nordinson Studios) and underpins the functioning of FeAST. The FeAST data inventory is stored in a relational database in PostgreSQL and is displayed as views to retrieve data in the form of a query from multiple tables. Each activity, pressure, feature, and habitat has been assigned a code, id, and tier, and operates in a hierarchical way.

The structure of the database allows for multiple connections to be formed between these nodes, describing all possible impact pathways and the link strength or relationship as defined in terms of the sensitivity and intensity. This can be expressed as an ecosystem network model as referred to as EcoNet (Figure 43).

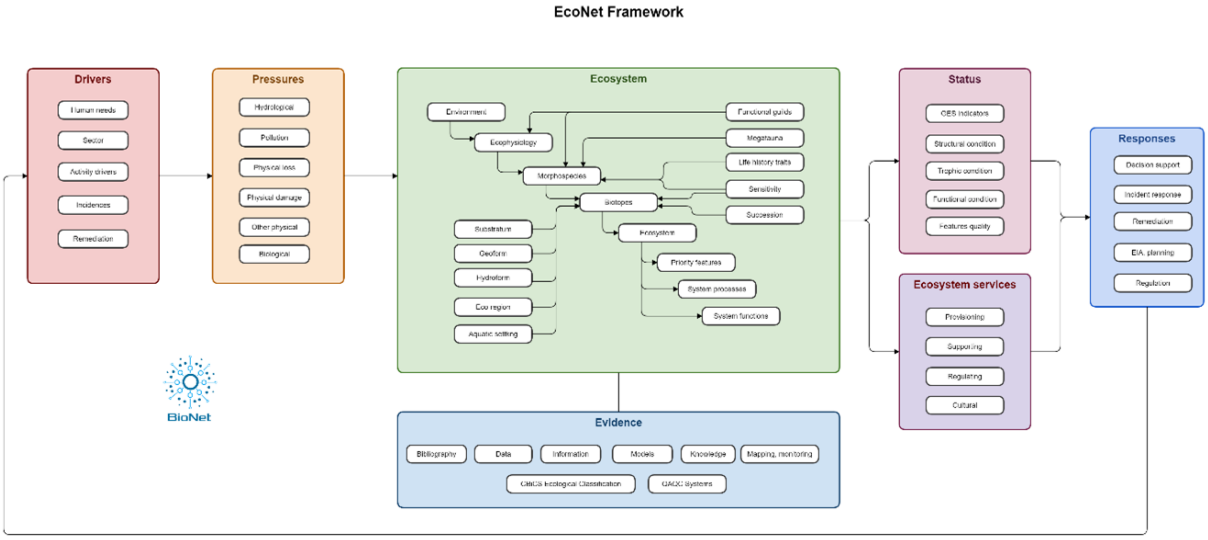


Figure 43: Schematic diagram of the structure of the EcoNet framework (Australian Marine Ecology 2022)

Scores for sensitivity and intensity are relative and have been assigned using a semi-quantitative approach, combining expert opinion with relevant literature. The confidence of scores and linkages have also been evaluated using a 3-tier system in the database, whereby the confidence is based on the weight of evidence available.

The EcoNet is fully spatialised for habitats and features, each node has been assigned a geometry in the database. This allows assessments to be site-specific using mapping available in CoastKit. The data in CoastKit is supported by a data management plan, ensuring data is frequently updated and reviewed under FAIR data principles.

5.2 Pressure score

The Pressure score is the initial step in the FeAST risk assessment process to understand the potential effect that different human activities can exert on the environment. This step primarily forms a screening process, where a user selects the activities relevant to the proposal and FeAST performs a pressure identification and prioritisation process. This involves the tool extracting only the pressures with a high and medium intensity, which then inform the next stages of the FeAST assessment.

What methods have guided the development of FeAST?

The Marine Evidence-based Sensitivity Assessment (MarESA) developed by Marine Life Information Network (MarLIN) (United Kingdom) (Tyler-Walters et al, 2018 & 2022) and the Joint Nature Conservation Committee's (JNCC) pressures-activities database (Robson et al, 2018) commissioned by Department for Environment, Food and Rural Affairs (United Kingdom) are methodologies that have principally guided the development of FeAST.

FeAST expands on the JNCC list of activities which incorporates all stages of a proposal from the pre-construction, construction, operation, to decommissioning. This aligns with efforts to adopt a life cycle assessment and encompass all possible ecological impact pathways. Each of the 12 activity categories broadly represent the human needs required by the various sectoral divisions. The FeAST data inventory captures 131 anthropogenic activities which are listed alphabetically in with summarised descriptions.

It is recommended that users consult the activity definition tables (section 8.1) to ensure the activities selected in the tool best describe the use, development or works proposed. It is common for one proposal to have multiple activities, for example to deploy, build, or demolish a structure. Therefore, it is important that all primary and secondary activities are selected to provide an accurate measure of risk to ecological values.

The list of activities represents those most frequently conducted in Victorian waters and other industries that may emerge in the future under the blue economy. However, the list is not exhaustive, and it is possible that some activities may be absent from the tool. The activities listed also range in scale, some activities may have a small impact and not require any form of planning consent.

Activities can have multiple negative, positive, and benign effects on ecological values and the environment which are captured by the pressures exerted. Each activity in the FeAST data inventory has been assigned all relevant pressures and an intensity profile (Table 11).

Table 11: Intensity profile for pressures in the FeAST data inventory

Intensity	Potential ecological effect	Considered in FeAST assessment
High	Ecosystem functional change	Included in the FeAST assessment, with the highest score across all activities used as the Pressure score
Medium	Populations and communities will shift a distinct level	
Low	Some noticeable change	Excluded from the FeAST assessment
NA	Not applicable	

The nature of the relationship between the activity and pressure is referred to as the intensity or intensity profile, which represents the potential effect to the ecosystem resulting in anything from an ecosystem functional change to a negligible effect. The Pressure scores are based on evidence derived from a suite of benchmarks and thresholds, which have been developed through expert consultation workshops.

A full list of pressures evaluated by FeAST with descriptions and benchmark values can be found in section 8.2.

What are the Pressure score benchmarks based on?

This analysis builds on the substantial work conducted in Europe initially by OSPAR Intercessional Correspondence Group on Cumulative Effects in 2011 to develop a standardised list of man-made marine pressures (Connor et al, 2011), which was

later updated by NatureScot in 2020 to provide clear definitions and impact benchmarks for use in Scotland's Marine Assessment in 2020. These benchmarks have subsequently been adapted for a Victorian context and adjusted using indicators and objective values obtained from state-wide documentation such as the Environment Reference Standards and other best-practice guidelines.

The pressures considered in FeAST only include anthropogenically direct pressures, therefore excluding indirect pressures such as the effects of greenhouse gas emissions, climate change and ocean acidification. The intensity of pressures is evaluated without considering the location of the defined project area, different locations may need to consider location specific values for environmental parameters such as pollutants or nutrient concentrations. The FeAST assessment has applied a precautionary approach to determining intensity baselines.

To calculate the Pressure score when multiple activities are selected, the assigned pressures are combined in a table and the highest (or worst) intensity level achieved across the activities is adopted as the Pressure score. Each pressure is assessed separately and does not account for the cumulative impact that multiple activities may have on the marine and coastal environment. Further assessment would be needed to establish the cumulative effect the interactions between different activities such as the additive, synergistic and antagonistic impacts.

The FeAST risk assessment has adopted a pressure-based approach to assist with identifying the key ecological impact pathways from activities for the basis developing mitigation and management measures. The relative scoring ensures that each activity is assessed in a standardised way, the ranking is comparable among activities and allows for applications such as an options analysis (sections 3.8 and 3.9).

5.3 Habitat score

The next step of the FeAST risk assessment involves assessing the sensitivity of each habitat within the defined project area to each of the screened pressures. The tool conducts a spatial analysis to identify which habitats are found within the defined project area using the most up-to-date habitat maps for Victoria. Sensitivity assessments are undertaken at biotope level 3 classifications (Habitat complex).

Sensitivity can be defined as the function of the habitat to withstand or tolerate change as exerted by a pressure referred to as resistance against the rate of recovery after impact or inherent adaptive capacity to return to its prior condition which is referred to as resilience (Tillin & Tyler-Walters, 2014). The development of the methodology for the Habitat score has been adapted from MarESA.

The likelihood of functional change due to a pressure is factored into the scoring of sensitivity. To calculate the sensitivity for each habitat against each itemised pressure, the resistance and resilience have been scored from high to very low based on a review of available scientific evidence and literature by Australian Marine Ecology (AME). The lower the score achieved across both categories means that the response is poorer and hence demonstrates that the severity of the impact to the habitat is greater.

The assessment scales for resistance and resilience are provided in Table 12 and Table 13.

Table 12: Descriptions for scoring the resistance of habitats (adapted from MarESA)

Resistance	Description
None	Key functional, structural, characterizing species severely decline and/or physicochemical parameters are also affected e.g. removal of habitats causing a change in habitats type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat component e.g. loss of 75% substratum (where this can be sensibly applied).
Low	Significant mortality of key and characterizing species with some effects on the physicochemical character of habitat. A significant decline/reduction relates to the loss of 25-75% of the extent, density, or abundance of the selected species or habitat component e.g. loss of 25-75% of the substratum.

Medium	Some mortality of species (can be significant where these are not keystone structural/functional and characterizing species) without change to habitats relates to the loss <25% of the species or habitat component.
High	No significant effects on the physicochemical character of habitat and no effect on population viability of key/characterising species but may affect feeding, respiration, and reproduction rates.

Table 13: Descriptions for scoring the resilience of habitats (adapted from MarESA)

Resilience	Description
Very low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function.
Low	Full recovery within 10-25 years.
Medium	Full recovery within 2-10 years.
High	Full recovery within 2 years.

The scores obtained for resistance and resilience per habitat to each pressure are combined to produce the sensitivity score using the matrix below (Figure 44). A linear relationship is expressed between resistance and recovery, where if low scores are achieved in both assessments, the sensitivity will be higher for that specific habitat type against the pressures (Figure 45).

Sensitivity intersection matrix		***Resistance*** Tolerance to the pressure			
		Very Low (>75% loss)	**Low** (25- 75% loss)	**Medium** (25% loss)	**High** (No significant effect)
Recovery Resilience after pressure has ceased	**Very Low** (>25 years)	High	High	Medium	Low
	Low (10- 25 years)	High	High	Medium	Low
	Medium (2-10 years)	Medium	Medium	Medium	Low
	High (<2 years)	Medium	Low	Low	Very Low

Figure 44: Sensitivity matrix showing the combination of resistance and recovery (adapted from MARLIN)

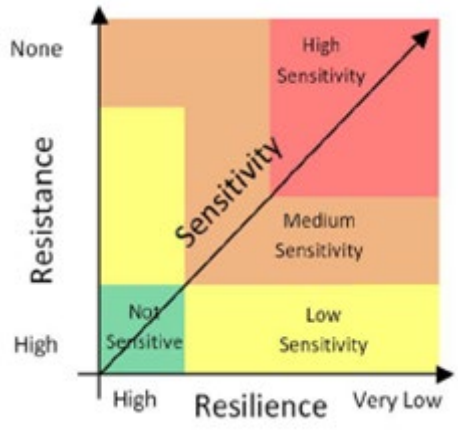


Figure 45: Graph showing the relationship between resistance and resilience to form sensitivity

To calculate the Habitat score, each sensitivity score is assigned a number from 1 – 5, this denotes the degree of sensitivity from very low to high. The Habitat score is calculated, for each habitat type, by adding together the sensitivity scores across all applicable pressures using a standardised normalisation process (Figure 46). This value is then converted to a percentage score which is categorised using pre-determined thresholds.

	Habitat A	Habitat B	Habitat C	MAX
Pressure 1	4	3	5	5
Pressure 2	3	3	5	5
Pressure 3	5	2	3	5
Pressure 4	2	3	NA	5
Pressure 5	4	4	4	5
Pressure 6	5	4	5	5
SUM / MAX	23 / 30	19 / 30	22 / 25	30
Percentage	77%	63%	88%	
Habitat score	Medium	Low	High	

Figure 46: Example table showing the calculation methodology for the Habitat score for Habitats A, B and C

To calculate the Habitat score, the sensitivity scores achieved for each habitat per applicable pressures are summed. To normalise these values, the maximum total sensitivity score attainable per pressure, which is always 5 (or high), is used. The sum is divided by the max and multiplied by 100 to form a percentage score.

The calculated percentage scores are categorised into four levels of Habitat scores (Figure 47). The Habitat score can be interpreted as the total sensitivity to all the activities selected or pressures identified in the FeAST assessment, without taking into account any cumulative effects.

Habitat Score	Very Low	Low	Medium	High
Percentage	<55%	55- 70%	70- 85%	85-100%

Figure 47: Habitat score criteria based on calculated percentage values

The Habitat score step in the FeAST assessment considers the general sensitivity of the habitat types and several limitations apply. In cases where the information exists or can be collected through surveys, it is the responsibility of the user to ensure that local properties of habitats are accounted for.

Limitations to the Habitat scoring methodology

This Habitat score does not consider the extent of the habitat area, level of exposure or location. Habitats in specific locations may have diverging life history traits or intrinsic properties from the typical habitat considered in the FeAST assessment. Differences in behaviour, structure, growth, morphology or habitat connectivity may result in changes in resilience and resistance to specific pressures.

5.4 FeAST score

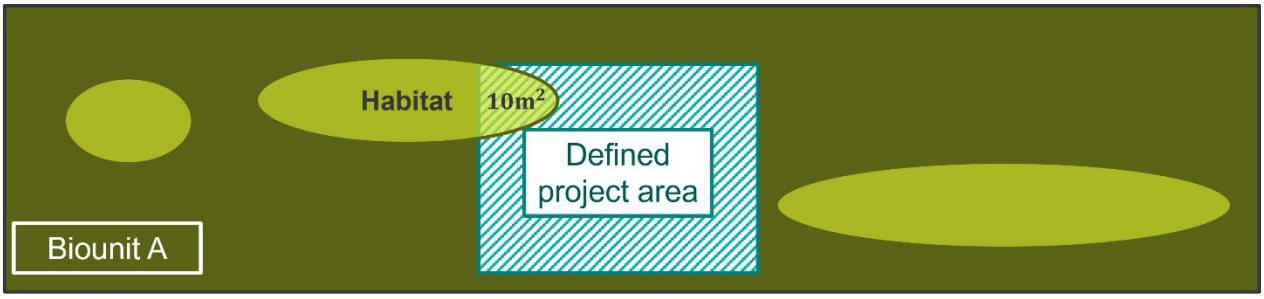
The FeAST score depicts the final risk score of the proposal to each of the identified habitats. This score establishes the level of risk by assessing the vulnerability of the habitat to determine the degree of exposure. To do this, the tool conducts a spatial analysis to estimate the overlap of the defined project area with each habitat. This analysis factors in an estimation of the distinctiveness or significance of each habitat which is considered in the context of the 26 marine biounits in Victoria.

The biounit boundaries have been employed as a metric for estimating the distinctiveness of habitats and hence the total habitat area per biounit. This relies on the principle that habitats are area-based and regionally distinct due to their surrounding environmental conditions. Where each discrete biounit is characterised by differing physiographic settings, ecosystem processes and biotope distributions.

This is referred to as the exposure level and is ranked into high, medium, low and none categories based on the proportional of habitat area impacted (Table 14). This is calculated by dividing the habitat area in the defined project area by the total habitat area in the biounit (Figure 48). This produces a percentage score for each habitat per biounit.

Table 14: Exposure level categories for each habitat (per biounit) using the proportion of overlap

	Exposure level: Proportion of areal overlap			
	None	**Low**	**Medium**	**High**
Habitat (per biounit)	0%	<0.25%	0.25-0.49%	>0.5%



$$\text{Exposure level} = \frac{\text{Habitat area in the defined project area}}{\text{Total habitat area in Biounit A}} \qquad 0.1\% = \frac{10\text{m}^2}{100\text{m}^2}$$

Figure 48: Schematic diagram and equation for calculating the exposure level for the habitat per biounit

The methodology for establishing the exposure level and the percentage threshold categories is based on research undertaken by Department of Environment Food and Rural Affairs UK (Griffiths et al, 2017). This is aligned with national and state policy targets to minimise the loss of habitats and declines of biodiversity under the Protecting Victoria's Environment - Biodiversity 2037 to protect Victoria's environment.

Following the calculation of exposure, the habitat score combined with the exposure level provides the overall risk level (FeAST score) for each habitat using the risk intersection matrix (Figure 49).

Risk intersection matrix		**Exposure level**			
		None	**Low**	**Medium**	**High**
Habitat score	**Very Low**	No risk	Low risk	Low risk	Low risk
	Low	No risk	Low risk	Low risk	Low risk
	Medium	No risk	Low risk	Medium risk	High risk
	High	No risk	Medium risk	High risk	High risk

Figure 49: Risk intersection matrix used to calculate the FeAST score combining Exposure level and Habitat score

The FeAST score does not factor in the condition, quality, or connectivity of habitats and undertakes the analysis in a data-limited scenario. The exposure level is based on purely two-dimensional spatial data and does not account for three dimensional encounterability in terms of interactions within the water column and the duration or frequency of activities. For more information on the limitations please refer to section 1.6.

Limitations of the FeAST scoring methodology

The FeAST score does not factor in the existing condition, quality, or connectivity of habitats.

The exposure level does not account for different three-dimensional interactions in the water column, i.e. where an activity may only occur in a benthic, pelagic, or surface setting. All activities will have the same areal overlap regardless of positioning.

Additionally the duration and frequency of activities is not incorporated into the analysis.

6. Future of FeAST

FeAST provides a transparent process for planning through a desktop-based environmental risk assessment. The concept of the tool has been adapted from international studies to an Australian context and is driven by evidence and spatial information, in an often data-limited domain. The software for FeAST has developed to allow for continuous amendments and updates, employing streamlined workflows and novel geoprocessing tools.

The limitations and caveats of the tool and FeAST scope (see section 1.6) form the basis for potential revisions to the tool and are detailed in the following enhancement sections. This is split into datasets and changes to the FeAST scope.

6.1 Enhancements: FeAST datasets

FeAST is currently limited to the datasets available on CoastKit. CoastKit will be updated with new data and layers, some of which will be useful for FeAST. The following list provides some additional data layers that have already been identified. The timing and feasibility to add these to CoastKit will be determined.

- **Level 4 & 5 Biotope distribution data**: The number of biotope records and the types of biotopes recorded in available ground-truthing data could be integrated into the Proximity analysis. This would provide greater detail on locally specific biotopes and support identifying critical habitats.
- **Biologically Important Areas**: Important life history regions for aggregations of species such as breeding, foraging, migrating or sanctuary zones are currently available on the Commonwealth Conservation Value Atlas and could be added and integrated into the Proximity analysis.
- **Occurrence records for listed coastal and marine flora and fauna**: Occurrence records from the Victorian Biodiversity Atlas, Melbourne Museum records and the Atlas of Living Australia for FFG and EPBC listed fauna and flora species sighted in coastal and marine areas could be added and integrated into the Proximity analysis.
- **Matters of National Environmental Significance (MNES):** could be added and integrated into the Proximity analysis.
- **Core bird areas**: Additional feeding and roosting sites critical for resident and migratory bird species could be added and incorporated into the Proximity analysis.

6.2 Enhancements: changes to FeAST scope

Including additional datasets in the FeAST assessment to expand the scope of the assessment would require additional work to the tool. The timing and feasibility of these changes still need to be determined. Expansion of scope could include:

- **Coastal habitats**: Currently FeAST is useful for primarily marine habitats. The tool could be expanded to include coastal habitats realm and aligning with the Marine and Coastal Act 2018 boundary of 5km inland. This would involve incorporating some of the logic behind the strategic management prospects tool and inclusion of the ecological vegetation classes (EVCS) and more coastal habitats such as estuaries and saltmarsh.
- **Cumulative risk and effects**: This could be incorporated using existing activity maps, seafloor integrity work and additional information from stakeholder consultation.
- **Seasonal and monthly timings**: By including life history traits, users could assess what time of year to undertake works to avoid breeding periods or sensitive periods.
- **Habitat condition and state**: The condition or state of habitat could be included to better understand the possible impacts of activities.
- **3D dimensionality:** This could be incorporated to better understand the impact of activities in the water column.

- **Automation of footprint:** Each activity depending on its nature has a different zone of influence and effect on environment, this could be automatically built into the tool.
- **Culturally significant features:** Sensitive cultural features important to Aboriginal custodians and Traditional Owner groups could be included, this addition in FeAST would require extensive consultation and likely buffering to ensure the exact location remains hidden.
- **Improving FeAST and sensitivity assessments for mobile marine species and marine birds:** A FeAST score could be calculated for mobile species in a similar way to how FeAST currently provides a FeAST score for habitats. Research undertaken by NatureScot will be used to inform this tranche of work: Development of Marine Bird Sensitivity Assessments for FeAST (Rogerson et al, 2021) and Developing FeAST for mobile marine species (Sinclair et al, 2020).

7. References

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8. Supporting information

This section provides users with specific information on the activity, pressure and habitat types, biounit descriptions and datasets used in the Proximity analysis.

8.1 Activity descriptions

The tables below (Tables 15 - 26) provide a summarised description for each activity grouped by the activity category, as selected in FeAST. The colour code and number of activities is presented on the heading bar of each table.

Table 15: Coastal infrastructure activity descriptions

Coastal infrastructure	18 activities
Activity	**Description**
Anchorage and moorings - Construction	Creation of new anchorage areas and laying of new moorings in the intertidal or subtidal zone by vessels, machinery, and vehicles.
Artificial reefs	Construction of reef structures for habitat restoration, rehabilitation or to provide more fishing opportunities. Resulting in habitat change, increased and concentrated fishing activity and marine pests. Key consideration should be extended to how many structures a proposal includes and the construction material.
Boat ramp - Construction and maintenance	The building and construction of boat ramps or slipways to launch vessels. Ongoing maintenance of washing down and clearing accumulated sediment.
Coastal industry and operations	Shoreside based industries on the coast including chemical works, oil refineries, factories, processing plants, and other maritime industry.
Coastal protection structures - Construction (all)	Construction of new coastal protection works to mitigate coastal hazards such as erosion and inundation. These include seawalls, revetments, groynes, breakwaters, levees/dykes, tidal gates and beach renourishment programs.
Coastal protection structures - Maintenance hard defence	Maintenance of coastal protection structures including sea walls, revetments, groynes, breakwaters, stabilisation structures, tidal gates, and sluices using vessels. Includes use of machinery, vehicles, and materials.
Coastal protection structures - Maintenance soft defence	Maintenance of coastal protection works including beach renourishment programs and coastal management activities such as dune and vegetation management, controlled access and drainage works.
Coastal protection structures - Offshore	Construction and operation of offshore or detached coastal defence structures (intertidal or subtidal) including wave-screens, breakwaters.
Coastal protection structures - Operation (all)	Operational effects of coastal protection works that alter natural coastal processes. This includes erosion, accretion, changes to the intertidal zone, changes to coastal habitats, and coastal squeeze. Operations may include sand-bypass/ nourishment systems, operation of tidal gates etc.
Coastal protection structures - Piling	Pile driving required for the construction of foundations for structures including coastal defences involving the use of machinery and vessels.
Land reclamation	Creation of new land from below the high-water mark by filling areas with sediment, rock, or cement to raise the elevation for coastal infrastructure.

Navigation markers and buoys	Operation, maintenance, and presence of navigation structures such as markers, Cardinals, lights, buoys, posts, towers, and transit markers.
Outfalls and intake pipes	The construction, maintenance, and ongoing use of an outfalls and intakes pipes. The outfalls pipe could discharge liquids at varying temperatures, salinities, oxygen, nutrient concentrations.
Port, marina, and harbour - Construction	Construction for an expansion, new or re-development of infrastructure associated with ports, marinas and harbours including facilities, mooring berths, and the accompanying machinery, vehicles and vessels required.
Port, marina, and harbour - Clearance	Periodic, regular, or discrete clearance of structures and waterways, or debris, sediment, algal growth by vessels, machinery, and vehicles.
Port, marina, and harbour - Operation	Day-to-day operational use of ports, marinas and harbours including use of estate, movement of vessels, navigation markers, lights, and supply of fuel.
Port, marina, and harbour - Maintenance	Maintenance of 'hard' coastal protection structures including sea walls, groynes, rock armours, wave screens and breakwaters using machinery.
Port, marina, and harbour - Piling	Pile driving of tubes, stakes, beams, or sheets into substrate to create foundations for structures including coastal protection.

Table 16: Coastal management activity descriptions

Coastal management activities	10 activities
Activity	**Description**
Agriculture - Grazing	Grazing of farm animals on coastal saltmarsh or wetland areas, involving the use of machinery to modify drainage systems or improve fertilisation.
Beach cleaning	Removal of marine litter and accumulated organic material such as seaweed and seagrass wrack that is decomposing or has an odour on the beach.
Beach raking	The use of sand rakes deployed from a vehicle or an individual to sweep and sift the beach for aesthetic reasons and to remove marine debris.
Beach renourishment and intertidal recharge	Process by which sediment is relocated and deposited onto beaches and intertidal mud and sandflats for erosion protection or for habitat creation.
Coastal habitat creation	Creation of new areas of intertidal, transitional, freshwater, or terrestrial habitat to protect species or as part of a biodiversity offsetting or mitigation, or coastal hazard adaptation.
Coastal weed control	Management activities involving the removal of invasive or non-native vegetation through clearance or herbicide spraying in the coastal zone.
Extracting - Beach sand	The physical removal of sand from the intertidal zone by mechanical extraction using tractors, dredgers, diggers, or trailers.
Land reclamation	Creation of new land from below the high-water mark by filling areas with sediment, rock, or cement to raise the elevation for coastal infrastructure.
Managed coastline retreat	Managed and planned retreat of the coastline or active breaches of defences to allow exposure to flooding by the sea or sea water intrusion.
Vegetation change	The removal of existing vegetation, or the planting of vegetation in areas once previously a different land-use, habitat or EVCs using machinery.

Table 17: Defence and national security activity descriptions

Defence and national security	4 activities

Activity	Description
Military - Air based	Military exercises involving aircraft flying, air to sea or ground firing with exploding shells.
Military - Seabed based	Military exercises that involve the use of the seabed e.g. installation and operation of seabed mounted equipment, seabed sampling and degaussing.
Military - Sea surface based	Military exercises on the sea surface e.g. boats, surface explosions and surface target towing.
Military - Submersed	Military exercises undertaken in the water column by submarines or divers.

Table 18: Energy generation activity descriptions

Energy generation	19 activities

Activity	Description
Gas storage and sequestration	The deposition, injection of natural gases or carbon into identified submarine storage sites, known as carbon capture and storage.
Heat abstraction infrastructure	The construction, maintenance and ongoing use of heat abstraction exchanger housing, outfalls, and intake pipes, and machinery involved.
Offshore wind - Construction	The seabed preparations prior to installation of turbine structures involving the removal of seabed material, creation of foundations and vessel transit. Excluding power cable laying.
Offshore wind - Decommissioning	Vessel movement, vessel discharges, use of jack up barges, removal of structures, scour protection and associated habitat, use of explosives, cutting, drilling, excavation of seabed close to foundations.
Offshore wind - Operation and maintenance	Regular vessel movement, vessel discharges, rotor sweep, lighting, presence of turbine and foundation structures. Excludes cabling.
Oil and gas infrastructure - Construction	The installation of permanent and temporary infrastructure as well as rock dump to stabilise jack up rigs, cementing, concrete mattresses, matting and gravel, pipelines, debris baskets, drilling wells and plugging.
Oil and gas infrastructure- Decommissioning	The plugging and abandonment of wells, removal of structures and associated habitat, use of explosives, cutting, drilling. Includes operation by supporting vessels, vessel discharges, use of Remote Operated Vehicles (ROVs), lifting and jack-up rigs.
Oil and gas infrastructure - Operation and maintenance	Production, operation, with routine supply, return of wastes to shore, power generation, chemical use, produced water, and re-injection of reservoirs.
Oil spills and response	Spills that can originate from terrestrial sources, sub-sea or on the surface and effect nearshore, inshore or within offshore waters. Response activities include the use of dispersants, in-situ burning, mechanical recovery and physical removal, the drilling of relief wells or plugging of wells.
Survey - Seismic	Any survey that uses airguns, including 2D, 3D, 4D and OBC (On Bottom Cabling) surveys and any similar techniques that use airguns.

Tidal lagoon - Construction	The preparation of the seabed for foundations to allow for installation of structures involving clearing, dredging, drilling, cutting by machinery.
Tidal lagoon - Operation and maintenance	Operation of tidal devices and structures, involving changes to water levels and tidal regimes and required servicing and repairs by vessels.
Tidal lagoon - Decommissioning	Removal of structures and cabling involving the use of specific machinery and vessels.
Tidal stream - Construction	Seabed preparation involving dredging, cutting, spoil disposal, piling, anchoring, mooring, scour protection by vessels.
Tidal stream - Operation and maintenance	Vessel movement, vessel discharges, rotor sweep or other device operation, lighting.
Tidal stream - Decommissioning	Machinery and vessels involved with removal of the impoundment and associated disruption to the seabed.
Wave power - Construction	Seabed preparation prior to installation involving dredging, cutting, mooring, spoil disposal, anchoring, piling, drilling and associated vessel movement.
Wave power - Decommissioning	Removal of structures and associated habitat using vessels and other machinery for cutting, drilling and use of explosives.
Wave power - Operation and maintenance	Continuous operation of devices and associated repairs and servicing required by vessels.

Table 19: Extraction of living resources activity descriptions

Extraction of living resources	22 activities

Activity	Description
Coastal harvesting by hand	The collection and removal of intertidal zone invertebrates and seaweed by hand or using digging implements for consumption or bait purposes.
Collecting - Aquarium	Collection of live fish and other biota for the aquarium trade.
Collecting - Souvenirs	Collection of biotic material for ornaments or collections or souvenirs, including shells, sponges, corals, sea stars. Also referred to as beachcombing.
Dive harvesting - Abalone	Collection of abalone by divers and snorkelers for recreational and commercial purposes.
Dive harvesting - Bivalves	Collection of scallops, mussels and bivalve species by divers, snorkelers. Includes recreational diving.
Dive harvesting - Pearls	Collection of pearls by divers and snorkelers for recreational and commercial purposes.
Dive harvesting - Sea urchins	Collection of sea urchin species by divers and snorkelers for recreational, management and commercial purposes.
Dive harvesting - Other	Removal of biota and other living resources from marine habitats by diving and direct handling for recreational or commercial purposes.
Extracting - Rhodolith	Removal of rhodolith beds and sediments from the seabed for aggregate use.
Fishing - Demersal seine netting	Fishing activity that includes demersal anchor, Danish seines, and Scottish seines, as well as beach seines that come into contact with the seabed.
Fishing - Demersal trawling	Fishing activity that includes beam trawls, demersal otter trawls, demersal pair trawls. Excludes electronic pulse fishing.

Fishing - Dredging for shellfish	Fishing activity using either vessels or tractors to tow non-hydraulic gear such as dredges along the seabed for scallops, oysters, and mussels or in the coastal zone to harvest clams and cockles.
Fishing - Electric pulse	Fishing activity that uses electrical currents to direct and drive fish and shellfish into nets and trawls towed by vessels.
Fishing - Hydraulic dredging	Fishing activities that include hydraulic or suction dredging to harvest clams, cockles, and razor shells.
Fishing - Pelagic	Fishing activity where gears do not interact with the seabed and no anchoring occurs, e.g. mid water trawls, drift nets, pelagic seines, and lines.
Fishing - Push net	Fishing activity includes handheld and small vessel driven push nets for fishing inshore shrimp and prawns.
Fishing - Purse seine netting	The targeted removal of fish species using pelagic purse seine nets towed by vessels.
Fishing - Rod and line	Rod and line fishing, including commercial live fish industry and recreational fishing.
Fishing - Long line	The targeted removal of fish species using static hooks and lines that are recovered after a period of time to retrieve caught fish.
Fishing - Static net	Fishing activity using permitted static nets to catch targeted fish species such as set, gillnets and boat operated lift nets.
Fishing - Traps	Fishing activity using only permitted gear including hoop nets, bait traps, bait nets, permitted pots, creels or rings and other similar gear.
Studies - Bioprospecting	Extraction of chemical and genetic material from biological resources for commercial, medical or research purposes.

Table 20: Extraction of non-living resources activity descriptions

Extraction of non-living resources	10 activities
Activity	**Description**
Coastal saltworks	Operation of coastal salt pans, lagoons, and channels. Includes influences on wetlands and littoral habitats and of hypersaline water.
Collecting - Salvage	Collection of salvage or cargo from wrecked vessels or infrastructure (e.g. from oil and gas) on the coast, or in the marine environment using boats.
Dredging - Aggregate	The excavation of offshore seabed sediments using trailing suction or static grab dredgers intended for use in building or for the construction industry.
Dredging - Capital	The removal of material from an area not previously dredged or has not been dredged for greater than 10 years using vessels, machinery, and vehicles.
Dredging - Maintenance	Periodic or regular removal of material from previously dredged areas e.g. berths, channels, marinas, can be every few weeks to 10 years apart.
Dredging - Spoil disposal	Disposal and relocation of dredged spoil materials originating from the seabed leading to dispersal, contamination, toxic algae, and habitat changes.
Extracting - Guano	Collection of accumulated excrement in coastal regions from seabirds (guano) for use as fertiliser due to high phosphate content.
Mining - Deep sea	Extraction of minerals such as polymetallic nodules using seafloor mining devices, riser and lifting systems and mining support vessels.

Mining - Shallow sea	Mining of phosphate, mineral sands, and other non-living resources from shallow and shelf seabed habitats.
Water extraction	The temporary or permanent removal of water from the marine environment for irrigation, cooling, desalination, or industrial processes.

Table 21: Other man-made structures activity descriptions

Other man-made structures	9 activities

Activity	Description
Cultural and heritage sites	Includes existing heritage and cultural sites such as wrecks, sculptures and foundations, negative impacts may include enhanced visitation pressures, site contamination and habitat change. Structures may also positively support biodiversity.
Pipelines	Installation, maintenance, and removal of pipeline including operations by supporting vessels.
Power cable - Decommissioning	The retrieval, repair or maintenance of cabling and the following reburial and protection by vessels anchored during this operation.
Power cable - Laying, burial, and protection	The laying of submarine power cables and associated seabed preparation activities. Cabling is either laid directly on the seabed, covered with rocks and mattressing for protection, or buried using by trench excavators.
Power cable - Operation and maintenance	The operation of power cables and maintenance where cables may become exposed and require reburial or need to be accessed for repairs.
Telecommunication cable - Decommissioning	Complete removal of cables through grabbing and raising on the seabed by vessels anchoring along the cable route.
Telecommunication cable - Laying, burial, and protection	Laying of telecommunications cables directly on the seabed, covered with material for protection or buried involving excavators and vessels.
Telecommunication cable - Operation and maintenance	Cables requiring retrieval, additional protection or to be accessed for repairs or maintenance and are then reburied or protected. Vessel movement and anchoring during the operation is considered.
Urban dwellings and infrastructure	Built environment activities leading to habitat removal, changes in drainage, enhanced runoff, introduction of coastal pests, noise, and light.

Table 22: Production of living resources activity descriptions

Production of living resources	7 activities

Activity	Description
Aquaculture - Finfish	Marine-based aquaculture facilities for growing finfish in either suspended, floating or seabed anchored cages and nets.
Aquaculture - Land based	Land based aquaculture including fish, prawns, abalone, and shellfish spat. Involving a seawater intake and outlet to natural environment.

Aquaculture - Predator control	The adoption of practices to deter, control and prevent predation at aquaculture facilities. These include noise deterrents or visual disturbance.
Aquaculture - Shellfish bottom culture	Farming and harvesting of shellfish (e.g. mussels, oysters, scallops) on suitable areas of intertidal and subtidal substrate off the seafloor.
Aquaculture - Shellfish suspended rope or net	Shellfish (e.g. mussels, oysters) grown on ropes, nets suspended from surface structures or lines. These structures may be anchored to the seabed.
Aquaculture - Shellfish trestle culture	Cultivation of shellfish (e.g. oysters) grown on racks or trestles in the intertidal zone.
Aquaculture - Seaweed	Seaweed grown on ropes and nets suspended from surface structures or lines. These structures may be anchored to the seabed.

Table 23: Research and leisure activity descriptions

Recreation and leisure	15 activities
Activity	**Description**
Boating - Powerboat anchor	Motorised boating and impacts from installed moorings and impacts from anchors and impacts of boat when at anchor or mooring.
Boating - Powerboat launch	Launching and recovery of motorised boats from the shore, boat ramps or beach including possible use of trailers. Includes powerboating races and events.
Boating - Sailing boat launch	Launching and recovery of sailing boats from the shore, boat ramps or beach including possible use of trailers. Includes sailing races and events.
Boating - Sailing boat anchor	Sailing without an engine and impacts from installed moorings and impacts from anchors and impacts of boat when at anchor or mooring.
Boating - Water sports	Includes non-motorised small craft-based water sports such as the kayaking, windsurfing, kite surfing, dinghies, canoes, row boats, paddle boards.
Camping, holiday, and resort	Includes all foreshore and shore leisure resulting in increased foot traffic, disruption to wildlife, litter, erosion, and fire risk. Also includes infrastructure components associated with urbanisation and drainage.
Outdoor activities - Beach sports	Beach-based sports involving small non-motorised craft such as sand yachting, kite surfing and buggies. Includes events and competitions.
Outdoor activities - Coastal nature-based	Coastal nature-based and sight-seeing activities including bushwalking, bike riding, beach walking, whale watching, bird watching, wildlife interaction, photography, and filming.
Outdoor activities - Duck hunting	The use of firearms such as shotguns on foot to shoot waterfowl and gamebirds. Hunting with gundogs and from a boat is excluded.
Outdoor activities - Firework displays	Shore-based only public and private firework displays. Excludes boat-based and pontoon fireworks.
Outdoor activities - Foreshore based	Public beach activity, surf lifesaving, swimming, surfing, promenading, social gathering, picnic and barbeque, rocky shore rambling.
Outdoor activities - Horse riding and dog walking	Beach based activities involving animals such as horse riding and dog walking.

Outdoor activities - Intertidal based	Includes surfing, swimming, rock-pooling and other water sports (excluding vessel based). Includes events such as beach cleans and large gatherings of people.
Outdoor activities - Light aircraft	Includes the use of manned aircraft for recreational purposes such as small planes, helicopters, hang gliding, skydiving, paragliding, and parachuting.
Outdoor activities - Marine nature-based	Marine nature-based and sight-seeing activities including boat tours, whale watching, bird watching, wildlife interaction, non-extractive diving, photography, and filming.

Table 24: Research activity descriptions

Research	6 activities
Activity	**Description**
Studies - Archaeology	Marine archaeological research, including the removal of artefacts, the use of vessels and the presence of people.
Studies - Palaeontology	Paleontological studies including digs resulting in geomorphological disturbance and changes.
Survey - Remote sensing	This includes methods of obtaining data or images from a distance from satellites, drones or aircraft and includes LIDAR.
Survey - Exploratory drilling	Offshore drilling tests to evaluate the presence of deposits, minerals or assess the commercial viability for energy, extractive, or research needs.
Survey - Sonar	The use of echo sounders underwater for research or exploratory purposes as well as military purposes.
Survey - Sampling	Physical sampling of the seabed, foreshore (intertidal) and, or water column in situ using a variety of marine survey techniques.

Table 25: Transport activity descriptions

Transport	9 activities
Activity	**Description**
Boating - Commercial hovercraft	Use and operation of commercial hovercraft over the intertidal and coastal zone.
Cargo operations and logistics	Includes the trans-shipment of cargo, loading and unloading of vessels, landside handling, logistics and on-ward transportation.
Outdoor activities - Hovercraft	Use and operation of personal hovercraft moving across the coastal zone including travel, launching and when stationary or beached.
Vessel - Anchorages	Operational use of designated areas where ships are permitted to anchor inside and outside of harbours, ports, and marinas.
Vessel - Berths	Operational use of berths including moorings, anchorages and the presence of these structures and vessels using them.
Vessel - Discharges and emissions	Includes operational, incidental, and accidental discharges and emissions from all types of vessels such as sewerage, oils, wastes and exhaust fumes.

Vessel - Maintenance	Vessel maintenance and repair on land and afloat, operation of ship, boatyards, lay-ups, dry docks, designated anchorages, and hull cleaning.
Vessel - Moorings	Use of temporary and permanent mooring structures by vessels such as swing mooring, trot, fore and aft mooring, pile mooring.
Vessel - Movements	Movement of commercial or non-recreation vessels of all scales, from container ships, tankers, cruise liners, pilot vessels, tugs, ferries, and trawlers.

Table 26: Waste management activity descriptions

Waste management activities	2 activities

Activity	Description
Effluent discharge - Sewage	The release of waste matter such as sewage effluent, faeces or contaminated water from sewage treatment facilities and outfalls.
Effluent discharge - Thermal or Nuclear	Thermal or nuclear effluent reaching the coast or sea from power stations.

8.2 Pressure descriptions

Table 27 below provides descriptions and benchmarks for each pressure in the FeAST data inventory.

Table 27: Pressure descriptions and benchmarks adopted by FeAST

Pressure	Description	Benchmark
Above water noise	Relates to any loud noise made onshore or offshore including by construction, vehicles (including aircraft), vessels, tourism, mining, and blasting that may disturb birds and reduce time spent in feeding or breeding area.	Anthropogenic sound sources that exceed levels that elicit a response from an individual, in terms of movement away, or cessation of feeding (for disturbance), for example, or exposure which leads to auditory injury.
Abrasion to seabed	Physical disturbance or abrasion at the substratum surface, affecting epiflora and epifauna. May result from recreational access (human or livestock), vehicular access, moorings, activities that increase scour and grounding of vessels, pots or creels, cables and chains, anchoring, objects placed on the seabed, and harvesting of marine species.	Damage to species or habitats living on the seabed. Damage to surface features (e.g. species and physical structures within the habitat).
Barrier to species movement	Physical obstruction of local (within and between roosting, breeding, feeding areas) and regional/global movements (migrations) of mostly birds, fish, and mammals. Can include up-river (tidal barrages or dams) and open waters movements (offshore wind farm, wave/tidal device arrays, mariculture, or fixed fishing gears.	Species movement restricted or changed via physical obstruction.

Change sediment type	The permanent change of one marine habitat type to another, through the change in substratum. Causes include installation of infrastructure, rock dumping, and any replacement or removal of substrate where the sediment typology changes. Excludes drastic change from soft sediment to hard rock.	The permanent change of in substratum from one sediment type to another including to artificial (e.g. concrete mattresses, rock dumping).
Change of seabed type	The permanent change of one marine habitat type to another marine habitat type, through the change in substratum. Specifically, change between soft sediment and hard rock. Causes include installation of infrastructure, rock dumping, cutting pile placement from oil and gas, and replacement or removal of existing substrate.	The permanent change in substratum, including to artificial (e.g. concrete mattresses, rock dumping). Specifically, change from soft sediment to hard rock/ surfaces or vice versa.
Collison above water	Injury or mortality from above-water collisions of biota with static and/or moving structures not naturally found in the marine environment like boats, machinery, structures, and wind turbine blades. Activities increasing number of vessels transiting areas will influence the scale and intensity of this pressure.	Death or injury by collision above water.
Collision below water	Injury or mortality from below-water collisions of biota with static and/or moving structures not naturally found in the marine environment like power station intake pipes, tidal devices, and shipping. Activities increasing number of vessels transiting areas will influence the scale and intensity of this pressure.	Death or injury by collision below water.
Deoxygenation	The lowering, temporarily or more permanently, of oxygen levels in the water or substrate due to anthropogenic in the absence of nutrient or organic enrichment. The release of ballast waters or stagnant waters may result in deoxygenation events.	Compliance with all average annual water quality guidelines or environment reference standards.
Electromagnetic changes	Localised electric and magnetic fields associated with operational power cables and telecommunication cables (if equipped with power relays). Such cables may generate electric and magnetic fields that could alter behaviour and migration patterns of sensitive species (e.g. sharks and rays).	Local electric field of 1 volt per meter, or Local magnetic field of 10 tesla (μT) due to anthropogenic means.
Genetic modification of species	Deliberate (introduction of farmed individuals to the wild, genetic modified (GM) food production or as a by-product of other activities (mutations associated with radionuclide contamination). Scale of pressure is compounded if GM species are translocated via ballast water, ships hulls, aquaculture or aquaria imports, live bait, live seafood, or natural migration.	Translocation of indigenous species and/or introduction of genetically modified or genetically different populations of indigenous species that may result in changes in genetic structure of local populations, hybridization, or change in community structure.
Heavy siltation or smothering	Deposition of layers of sediment on a seabed with similar physical characteristics. Although most species of marine biota are unable to adapt, such as sessile organisms unable to make their way to the surface, a similar biota could, with time, re-establish. Associated with disposal of dredged materials.	5 - 30cm of fine material added to the seabed in a single event or the deposition of fine material over the lifetime of the development.
Hydrocarbon contamination	The increase of hydrocarbon compounds above background concentrations. Categorised based on the	Compliance with all average annual water

	sources i) petroleum hydrocarbons from natural seeps, oil spills and surface water runoff. ii) pyrogenic hydrocarbons from combustion of coal, woods, and petroleum. And ii) biogenic hydrocarbons from plants and animals.	quality guidelines or environment reference standards.
Introduction of light	Direct inputs of light from anthropogenic activities, such as lighting related to construction, oil and gas facilities or new tourist facilities. Ecological effects may be the diversion of bird species from migration routes if they are disorientated by or attracted to the lights. Continuous lighting may also lead to increased algal growth.	Change in incident light via anthropogenic means.
Introduction of microbial pathogens	Sources include untreated or insufficiently treated effluent discharges and run-off from terrestrial sources and vessels, ballast water releases, imported seed stock for mussel or shellfisheries, accidental releases of effluvia, aquaculture escapees or release contaminated faecal matter.	The introduction or increase in levels of pathogens, disease vectors or parasites from anthropogenic activities.
Introduction of other substances	The systematic or intentional release of other substances liquids, gases and solids resulting in pollution. Solid debris can include shellfish shells and seaweed debris that may have detrimental effects on species and changes in habitat.	Compliance with all average annual water quality guidelines or environment reference standards.
Invasive species	Introduction or spread of invasive non-indigenous species. Ballast water, hull fouling, stepping stone effects (such as via offshore wind farms) may facilitate the spread of such species. This pressure could be associated with aquaculture, mussel, or shellfishery activities due to imported seed stock or from accidental releases.	A significant pathway exists for introduction of one or more invasive non-indigenous species.
Light siltation or smothering	Deposition of layers of sediment on a seabed with similar physical characteristics. Deposition of layers of sediment on a seabed where most species of marine biota are able to adapt, such as sessile organisms able to make their way to the surface. Associated with disposal of dredged materials, mariculture, land claim, marine mineral extraction, cable and pipeline laying and various construction activities.	< 5cm of fine material added to the seabed in a single event, or the deposition of fine material over the lifetime of the development.
Litter	Discarded, disposed, or abandoned manufactured or processed solid material from anthropogenic activities including plastics, metals, timber, rope, fishing gear, and microplastic particles. Ecological effects can be physical (smothering), biological (ingestion; entangling; physical damage) and/or chemical (leaching, contamination).	Introduction of man-made objects able to cause physical harm (surface, water column, sea floor and/or strandline).
Nutrient enrichment	Increased levels of the nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Enrichment can occur from natural processes such as the decomposition of detritus and riverine inputs or from anthropogenic sources such as wastewater runoff, terrestrial or agricultural runoff, sewage discharges, aquaculture, and atmospheric deposition.	Compliance with all average annual water quality guidelines or environment reference standards.
Organic enrichment	Resulting from the degraded remains of dead biota and microbiota, faecal matter from marine animals, flocculated colloidal organic matter and the degraded	A deposit of 100gC/m2/yr and Compliance with all average annual water

	remains of sewage material, domestic wastes, industrial wastes. Organic matter can enter marine waters from sewage discharges, aquaculture, or terrestrial and agricultural runoff.	quality guidelines or environment reference standards.
Penetration of seabed substrates	Abrasion and penetration of sub-surface layers where sediments are physically disturbed but there is limited or no loss of substratum. Associated activities include anchoring, taking of cores, cone penetration tests, cable burial, propeller wash, certain fishing activities, agitation dredging, and aquaculture.	Damage to species or habitats below the surface of the seabed.
Physical loss habitat	The permanent loss of marine habitats associated with land claim, new coastal defences that move the high-water mark seawards, the footprint infrastructure, and dredging if it alters the position of the halocline. This excludes changes from one marine habitat type to another.	Permanent loss of existing marine habitat (to land or coastal infrastructure).
Radionuclide contamination	Introduction of radionuclide material, raising levels above background concentrations. Such materials can come from nuclear installation discharges, and from land or sea-based operations such as oil platforms and medical sources.	An increase in 10µGy/h above background levels.
Removal of substratum	Temporary and/or reversible change, such as from marine mineral extraction where a remaining residual layer of seabed is similar to the pre-dredge structure; or navigation dredging where the substrate removed is replaced by non-anthropogenic mechanisms, so the sediment typology is not changed.	Extraction of sediment to 30cm.
Removal of non-target species	By-catch of non-target species associated with fishing, harvesting and extraction activities. Ecological consequences include decline in bycatch species population, food web dependencies and population dynamics of fish, marine mammals, turtles, and sea birds. Excludes physical impacts of fishing gear (see abrasion pressures).	Accidental or incidental removal of features through pursuit of a target fishery, or harvesting or other extractive activity (commercial, recreational, or artisanal scale), including through accidental entanglement with nets or ropes e.g. aquaculture nets, mooring lines).
Removal of target species	Direct removal / harvesting of biota through commercial exploitation of fish and shellfish stocks, including smaller scale harvesting, angling and scientific sampling. Ecological consequences include the sustainability and composition of stocks, and energy flows through food webs. Excludes physical impacts of fishing gear (see abrasion pressures).	Removal of target species that are features of conservation importance or sub-features of habitats of conservation importance at a commercial, artisanal, or recreational scale.
Salinity decrease	Events or activities decreasing local salinity such as dilution from freshwater discharges at pipelines, alteration of haloclines from dredging or erection of structures or barrages that alter freshwater and seawater exchange rates.	Decrease in salinity by 4-10 units for a year.
Salinity increase	Events or activities increasing local salinity such as brine discharges from salt cavern washing, coastal saltworks or alteration to haloclines.	Increase from 35 to 38 units for one year.

Synthetic compound contamination	Increases in the levels of these compounds compared with background concentrations. Synthesised compounds such as PCBs, DDT and TCDD occur from a variety of industrial processes and chemical applications. These include pesticide and medical use.	Compliance with all average annual water quality guidelines or environment reference standards.
Temperature decrease	Events or activities decreasing local water temperatures seen in a thermal plume from sources such as the discharge of cooling waters from power stations, or operation of sub-sea power cables. Excludes climate change.	A 5°C change in temperature for a one-month period, or 2°C for one year.
Temperature increase	Events or activities increasing local water temperatures seen in a thermal plume from sources such as discharge of cooling waters from power stations, or operation of sub-sea power cables. Excludes climate change.	
Transition elements and organo-metal contamination	The increase in transition elements levels compared with background concentrations, such as Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead and Zinc Organo-metallic compounds such as the butyl tins (Tri butyl tin and its derivatives) can be highly persistent and chronic exposure to low levels has adverse biological effects.	Compliance with all average annual water quality guidelines or environment reference standards.
Underwater noise	Increases above background noise levels (environmental and incidental anthropogenic noise). May cause temporary or permanent hearing loss, discomfort, injury, behaviour change or death in marine mammals and fish. High amplitude low and mid-frequency impulsive sounds and low frequency continuous sound are of greatest concern.	Anthropogenic sound sources that exceed levels that elicit a response from an individual, in terms of movement away, or cessation of feeding (for disturbance), for example, or exposure which leads to auditory injury.
Vibration	Aquatic animals are sensitive to particle motion therefore vibration alone will present a significant direct disturbance to some species. Sources include direct vibration from drilling, trawling, piling, etc. and sound waves generated from substrate vibrations entering the water column.	Anthropogenic vibration sources that exceed levels that elicit a response from an individual, in terms of movement away, or cessation of feeding (for disturbance), for example, or exposure which leads to auditory injury.
Visual disturbance	Disturbance of biota by anthropogenic activities, such as increased vessel movements during construction phases for new infrastructure (bridges, cranes, port buildings), increased personnel movements, tourism, or vehicular movements on shore disturbing ecologically important areas like bird roosting and seal haul outs.	The visual disturbance of biota by anthropogenic activities.
Water flow changes	Changes in water movement, flow direction and speed, tidal processes, and ocean currents, which may result in sediment transport and erosion changes.	Peak mean king tide flow change of greater than 0.1m/s over an area >1km2 or 50% of width of water body for > 1 year.
Water level changes	Localised changes in water levels or tidal cycles, that alter the time the intertidal zone is exposed or immersed by water effecting habitats.	A 1-hour change in the time covered or not covered by the sea for a period of 1 year.

Water clarity changes	Changes in clarity/turbidity and related effects of scour due to changes in sediment and organic particulate matter and chemical concentrations. Can result from natural run-off and riverine discharges or short-lived anthropogenic activities like dredging, disposal at sea, cable and pipeline burial and construction works.	A change in one step in mean suspended particulate (mg/l), where: clear = <10 intermediate = 1-10 medium turbidity = 100 – 300 very turbid = >300 (Based on the EU the WFD Water Framework Directive scale).
Wave energy changes	Local changes in wavelength, height, and frequency. Changes in wave action can result from structures, vessel movement or networks of wind turbines.	Change of nearshore wave height > 3% for 1 year.

8.3 Habitat descriptions

The following Tables 28 - 32 provide habitat descriptions for all Biotopes (habitat complexes) and CBiCS level 3 used in the FeAST assessment.

Table 28: Littoral rock habitat descriptions

Littoral rock			
Biotic code	**Habitat complex**	**Description**	**Key**
ba1.1	High energy littoral rock	Shores of bedrock, boulder, cobble, and artificial hard substrata, either extremely exposed or exposed to breaking swell waves. Occur in the intertidal zone and the splash zone from the top of the lichen, supralittoral zone and to the lowest astronomical tide (LAT), sublittoral fringe. Further distinguished at Levels 4 and higher by type of cover, which could include species or types of species, such as mussels and algae, or presence/absence of sediment.	
ba1.2	Moderate energy littoral rock	Moderately exposed shores (bedrock, boulders, and cobbles) and other hard substrata. Includes shores that are exposed to swell surge and low swell waves but not directly exposed to breaking swell waves. Occur in the intertidal zone and the splash zone from the top of the lichen, supralittoral zone and to the LAT, sublittoral fringe. May have strong tidal stream influence. Further distinguished at Levels 4 and higher by type of cover, which could include species or types of species, such as mussels and algae, or presence/absence of sediment.	
ba1.3	Low energy littoral rock	Sheltered to ultra-sheltered rocky shores with very weak to weak tidal streams. Includes bedrock, boulders, cobble, and other hard substrata. Occur in the intertidal zone and the splash zone from the top of the lichen, supralittoral zone and to the LAT, sublittoral fringe. Further distinguished at Levels 4 and higher by type of cover, which could include species or types of species, such as mussels and algae, or presence/absence of sediment.	

Table 29: Littoral sediment habitat descriptions

Littoral sediment			
Biotic code	**Habitat complex**	**Description**	**Key**
ba2.1	Littoral coarse sediment	Littoral coarse sediments include shores of mobile pebbles, cobbles, and gravel, with varying amounts of coarse sand. Sediment is highly mobile and subject to high degrees of drying between tides. As a result, few species can survive in this environment: beaches of mobile cobbles and pebbles tend to be devoid of macroinfauna, while gravelly shores may support limited numbers of crustaceans.	
ba2.2	Littoral sand	Littoral sand, in the intertidal zone and the splash zone from the top of the lichen, supralittoral zone and to the LAT, sublittoral fringe.	
ba2.3	Littoral mud	Littoral mud, in the intertidal zone and the splash zone from the top of the lichen, supralittoral zone and to the LAT, sublittoral fringe.	
ba2.5	Saltmarsh and reedbeds	Saltmarsh and reedbeds. Further distinguished at Levels 4 and higher by type (like grassland, shrubland, saltmarsh), dominant species, location (such as estuarine or coastal) and degree of inundation (such as wet or dry).	
ba2.6	Mangrove	Mangrove habitat, further distinguished at Levels 4 and higher by habitat type (such as wetland or shrubland), dominant species, location (such as estuarine or coastal) and degree of inundation (wet or dry).	
ba2.7	Littoral sediment seagrass	Sward-forming aquatic herbland of sheltered marine shallows, intertidal flats and lower estuarine habitats. Dominated by Grass-wracks or Sea-grasses (*Zostera muelleri* ssp. *muelleri* and *Z. muelleri* ssp. *capricornii* and/or *Zostera nigricaulis* and *Z. tasmanica* s.l.), often monospecific and sometimes in close extends into lower estuarine proximity to *Avicennia marina* (White Mangrove) stands. *Zostera muelleri* s.l. conspicuous on intertidal mudflats.	

Table 30: Infralittoral rock habitat descriptions

Infralittoral rock			
Biotic code	**Habitat complex**	**Description**	**Key**
ba3.1	High energy infralittoral rock	High energy rock and other hard substrata, including gravel, cobble and boulders found below the low tide mark extending to the lower limit of dense seaweed growth. Further distinguished at Levels 4 and higher by cover type or dominant algal species.	
ba3.2	Moderate energy infralittoral rock	Moderate energy rock and other hard substrata, including gravel, cobble and boulders found below the low tide mark extending to the lower limit of dense seaweed growth. Further distinguished at Levels 4 and higher by cover type or dominant algal species.	
ba3.3	Low energy infralittoral rock	Low energy rock and other hard substrata, including gravel, cobble and boulders found below the low tide mark extending to the lower limit of dense seaweed growth. Distinguished at Levels 4 and higher by cover type or dominant algal species.	

Table 31: Circalittoral rock habitat descriptions

Circalittoral rock			
Biotic code	**Habitat complex**	**Description**	**Key**

ba4.1	High energy open-coast circalittoral rock	High energy open-coast circalittoral rock found below the algal-dominated infralittoral, dominated by animal communities typically comprised of a mosaic of species. Distinguished at Level 4 by additional cover type, like sandy, or by dominant species, and at Level 5 by location.	
ba4.2	Tide-swept channels of circalittoral rock	Animal-dominated communities below the algal-dominated infralittoral, typically comprised of a mosaic of species, found within channels, and narrows areas. Subject to strong tidal flows with high to moderate current and wave energy. Distinguished at Level 4 by substrate or dominant species, and at Level 5 by location.	

Table 32: Sublittoral sediment habitat descriptions

Sublittoral sediment			
Biotic code	**Habitat complex**	**Description**	**Key**
ba5.1	Sublittoral coarse sediment	Coarse sediments in the near shore zone including coarse sand, gravel, pebbles, shingle, and cobbles which are often shingle, due to tidal currents and/or wave action. Generally found on the open coast or in tide-swept channels of marine inlets and having a low silt content. Typically lacking a significant seaweed component and characterised by a robust fauna including venerid bivalves. Distinguished at Level 4 and higher by sediment type or bedform.	
ba5.2	Sublittoral sand and muddy sand	Clean medium to fine sands or non-cohesive slightly muddy sands in the near shore zone on open coasts, offshore or in estuaries and marine inlets. Often subject to a degree of wave action or tidal currents which restrict the silt and clay content to less than 15%. Characterised by a range of taxa including polychaetes, bivalve molluscs, and amphipod crustacea. Distinguished at Levels 4 and higher by variability of salinity, surface bedforms like ripples, or by epifaunal structures like burrow mounds.	
ba5.3	Sublittoral mud	Sublittoral mud and cohesive sandy mud extending from the extreme lower shore to offshore, circalittoral habitats. Predominantly found in sheltered harbours, marine inlets and estuaries, and stable deeper/offshore areas. Often by dominated by polychaetes and echinoderms like brittlestars. Seapens such as *Virgularia mirabilis* and burrowing megafauna are common in deeper muds. Estuarine muds often characterised by infaunal polychaetes and oligochaetes. Distinguished at Levels 4 and higher by variability of salinity, surface bedforms like ripples, or by epifaunal structures like burrows.	
ba5.4	Sublittoral mixed sediments	Sublittoral mixed (heterogeneous) sediments found from the extreme low water mark to deep offshore circalittoral habitats, including heterogeneous muddy gravelly sands and mosaics of cobbles and pebbles embedded in or lying upon sand, gravel, or mud. May support a wide range of infauna and epibiota including polychaetes, bivalves, echinoderms, anemones, hydroids and Bryozoa. Mixed sediments with biogenic reefs or macrophyte dominated communities are classified separately. Distinguished at Levels 4 and higher by variability of salinity, dominant sediment or species type.	
ba5.5	Sublittoral rhodolith beds	Beds of rhodoliths (maerl) in coarse clean sediments of gravels and clean sands from the extreme low water mark to deep offshore circalittoral habitats. Distinguished at Levels 4 as either on the open coast or in tide-swept channels of marine inlets (the latter often stony).	
ba5.6	Sublittoral biogenic reefs	Includes polychaete reefs, bivalve reefs (e.g. mussel beds) and cold water coral reefs from the extreme low water mark to deep offshore circalittoral habitats. Communities develop in a range of habitats from exposed open coasts to estuaries, marine inlets, and deeper offshore habitats and in a variety of sediment types and salinity regimes. This	

		does not include tropical coral reefs. Distinguished at Levels 4 and higher by dominant habitat-forming species groups and species.	
ba5.7	Sublittoral seaweed on sediment	Shallow sublittoral sediments which support seaweed communities, including various red and brown seaweeds, particularly fine and filamentous types. The generally sheltered nature of these habitats enables the seaweeds to grow on shells and small stones which lie on the sediment surface. Includes communities developed as loose-lying mats on the sediment surface and also termed drift algal mats. Distinguished at Levels 4 and higher by dominant species groups and species.	
ba5.8	Sublittoral seagrass beds	Beds of submerged marine angiosperms such as in the genera *Cymodocea*, *Halophila*, *Posidonia*, *Ruppia*, *Thalassia*, *Zostera*. Distinguished at Levels 4 and higher by dominant habitat-forming species groups and species.	
ba5.b	Non-reef sediment epibenthos	Mixed sublittoral sediments with a substantial cover of epibenthic biota that are not biogenic reef forming, including scallop beds, seapen beds and low densities of Pyura and other ascidians. Distinguished at Levels 4 and higher by dominant species groups and species.	

8.4 Victorian biounits

The following Tables 33 - 40 are grouped by the bioregions and provide a list of all the biounits in Victoria with the physiographic description and the area in kilometres. The biounits are used to calculate exposure levels in FeAST.

Table 33: Biounit descriptions in the Central Victoria bioregion

Central Victoria		
Biounit	**Physiographic setting description**	**Area (km^2)**
Bellarine-Mornington	Approximately linear coast, partially sheltered from prevailing weather but exposed to westerly swells diffracted up the coast and to easterly swells.	274
Bunurong	Bunurong cliffed coast, Andersons Inlet and sandy beaches and coastal dunes of Venus Bay. Bunurong reefs sheltered from breaking surf but subject to very strong, long-period ground surge.	233
Cape Liptrap	The Arches eroded sedimentary rock outcrops, basaltic headland of Cape Liptrap, moderately sheltered Waratah Bay.	256
Schanck-Woolamai	Basaltic, volcanic sediment and granite headlands incised with beaches. Inshore reefs with southerly aspect and typically shaded in winter by coastal cliffs and bluffs.	352
Surf Coast	Approximately linear coast, with small points and promontories, sheltered from prevailing weather but exposed to westerly swells diffracted up the coast and to easterly swells. Gradient of exposure from south to northern section.	490
Wonthaggi	Linear coast directly exposed to surf waves with gently stepped and sloped reefs and sand patches. Heavily influenced by turbid Western Port waters from the Eastern Entrance.	124

Table 34: Biounit descriptions in the Corner-Nooramunga bioregion

Corner-Nooramunga Region		
Biounit	**Physiographic setting description**	**Area (km^2)**
Corner Inlet	Sheltered embayment with a network of dendritic channels and shallow banks. Includes littoral sediment flats, circalittoral rock and granite islands.	349
Nooramunga	Sheltered embayment and channels with sandy islands and barrier islands.	177

Table 35: Biounit descriptions in the Flinders bioregion

Flinders		
Biounit	**Physiographic setting description**	**Area (km^2)**
Cliffy Group	Isolated group of islands.	193
Wilsons Prom East	Eastern low water clarity portion of the promontory with strong influence of Corner Inlet waters. Sheltered from southwest but exposed to easterlies.	600
Wilsons Prom West	Western high water clarity promontory and island complex. Combines southwest coast with very high exposure and clear waters.	467

Table 36: Biounit descriptions in the Gippsland Lakes bioregion

Gippsland Lakes Region		
Biounit	**Physiographic setting description**	**Area (km^2)**
Gippsland Lakes	System of sheltered embayments with connecting channels and sandy islands.	557

Table 37: Biounit descriptions in the Otway bioregion

Otway		
Biounit	**Physiographic setting description**	**Area (km^2)**
Cape Nelson	Capes, promontories, and islands with extreme to very high exposure to the prevailing weather, including strong winds and swells. Includes submerged volcanic structures and deep low profile reef systems.	698
Cape Otway	Rocky cape ranging from extreme exposure on the western side to high exposure on the eastern side. Has strong tidal currents at the southern tip with high geoform complexity.	252
Discovery Bay	Bight with extreme exposure to the prevailing weather, including strong winds and swells. Influenced by the Bonney Upwelling and moderate to strong tidal streams. Includes coastal lagoons.	269
Glenelg	Bight section with extreme exposure to the prevailing weather, including strong winds and swells. Influenced by the Bonney Upwelling and moderate to strong tidal streams.	134
Shipwreck Coast	Predominantly cliffed coast with stacks, islands, and small bays. Extreme to very high exposure to the prevailing weather with strong winds and swells. Includes	645

	deep reefs with terraces, scarps, and pinnacles as well as low complexity and veneer reef systems.

Table 38: Biounit descriptions in the Port Philip Bay bioregion

Port Phillip Bay Region		
Biounit	**Physiographic setting description**	**Area (km^2)**
Port Phillip Bay	Sheltered embayment. Yarra River plume. Mud sediment basin.	1665
Port Phillip Heads	Tide-swept sediment and rock habitats. Very deep tide-swept canyon system. Flood tide delta system of the Great Sands and adjacent coasts and associated islands.	274

Table 39: Biounit descriptions in the Twofold Shelf bioregion

Twofold Shelf		
Biounit	**Physiographic setting description**	**Area (km^2)**
Cape Conran	Granite point and offshore reef and island system flanked by sedimentary reef systems. North of Bass Canyon.	347
Croajingalong	Linear folded sedimentary coast and sublittoral reef systems punctuated by granite outcrops. Upwelling influence. Coastal inlets.	325
Gabo-Howe	Wave dominated beach and dune systems with low rocky shore at Cape Howe. Sediment beds punctuated by sedimentary, metamorphic and granite outcrops and islands. Upwelling, tidal and water mixing influences. Coastal inlets and lagoons.	192
Hogan Group North	Isolated group of islands.	77
Ninety Mile Beach	Linear exposed ocean beach and dune system with expansive sediment beds and emergent patch reefs.	953
Point Hicks	Point Hicks cape and offshore granite emergent reefs. Upwelling region at the head of the Everard Canyon, which links to the Bass Canyon. Coastal inlets.	159

Table 40: Biounit descriptions in the Western Port bioregion

Western Port Region		
Biounit	**Physiographic setting description**	**Area (km^2)**
Western Port	Sheltered embayment with strong tidal stream influence. Dendritic channels and banks.	650

8.5 Proximity analysis data

The following Tables 41- 48 provides a summary of the features included in the Proximity analysis section of the FeAST report. The features have been categorised and organised by the eight themes, as adopted by

the Feature Atlas on CoastKit. The tables below denotes the number of features in each of the categories and the data source indicating the date the data was published.

Table 41: Conservation and protected area feature data sources

Conservation and protected areas		
Feature category	**Number of features**	**Data source**
Marine National Park	13	Parks Victoria (2015) Marine protected areas and reserves (incomplete). Shapefile supplied by Parks Victoria. Melbourne.
Marine and Coastal Park	6	Parks Victoria (2015) Marine protected areas and reserves (incomplete). Shapefile supplied by Parks Victoria. Melbourne.
Marine Sanctuary	11	Parks Victoria (2015) Marine protected areas and reserves (incomplete). Shapefile supplied by Parks Victoria. Melbourne.
UNESCO Ramsar site	62	DELWP (2013) Ramsar wetland areas in Victoria at 1:20 000 (RAMSAR25/). Victorian spatial Data Directory. Department of Environment Land Water and Planning. East Melbourne.
Shipwreck protected zone	9	Heritage Victoria (2018) Historic shipwreck protected zones. Department of Environment Land Water and Planning. East Melbourne.
ECC special management area	21	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Marine asset areas	150	Commonwealth of Australia (2015) South-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region. Department of Environment. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.

Table 42: Natural environment and biodiversity feature data sources

Natural environment and biodiversity		
Feature category	**Number of features**	**Data source**
Significant seagrass habitat	12	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Significant soft sediment habitat	10	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Significant reef habitat	75	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne. || Edmunds M, Flynn A (2018) Victorian marine biogeographical settings. Australian Marine Ecology Report No. 559 to Department of Environment Land Water and Planning. Melbourne. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of

		Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Significant mangrove habitat	2	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Significant seaweed habitat	42	Edmunds M, Flynn A (2018) Victorian marine biogeographical settings. Australian Marine Ecology Report No. 559 to Department of Environment Land Water and Planning. Melbourne. || Edmunds M, Tran MN, McDonald B (2001) Seaweed Specimen Collection: Identification Resource for Reef Surveys. Australian Marine Ecology Report No. 124 to Department of Natural Resource and Environment. Melbourne. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff. || Thiess Degremont Joint Venture (2010) Victorian Desalination Project: Biology Assessment for Siting and Design. Thiess Degremont Joint Venture. Melbourne. || Wilson JB (1895) List of dredging stations at and near Port Phillip Heads. Proceedings of the Royal Society of Victoria 7, 261-263.
Significant rhodolith bed habitat	4	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Estuary and inlet areas	89	Barton J, Pope A, Quinn G, Sherwood J (2008) Identifying threats to the ecological condition of Victorian estuaries. Deakin University report to Department of Sustainability and the Environment. Melbourne || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Cliffed seascape areas	1	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Headland and cape areas	4	Harris MP, Norman FI (1981) Distribution and status of coastal colonies of seabirds in Victoria. Memoirs of the National Museum of Victoria 42, 89-106
Island areas	35	Harris MP, Norman FI (1981) Distribution and status of coastal colonies of seabirds in Victoria. Memoirs of the National Museum of Victoria 42, 89-106
Significant coastal vegetation habitat	30	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Geological sites	457	Edmunds M, Flynn A (2018) Victorian marine biogeographical settings. Australian Marine Ecology Report No. 559 to Department of Environment Land Water and Planning. Melbourne. || Flynn, A. (2018) Maps of special biotopes in the Rhyll segment of Western Port. Fathom Pacific. Frankston. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff. || OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.

Species distributions and sightings	1	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Important bird areas	1053	A Survey of Colonially-breading Birds on Mud Islands, Port Phillip, Victoria with Annotated List of All Terrestrial Vertebrates || Hansen B, Menkhorst P, Loyn R (2011) Western Port welcomes waterbirds: Waterbird usage of Western Port. Department of Sustainability and Environment. Melbourne. || Harris MP, Norman FI (1981) Distribution and status of coastal colonies of seabirds in Victoria. Memoirs of the National Museum of Victoria 42, 89-106 || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff. || OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Invertebrate records and areas	549	ABRS (2019) Australian Faunal Directory. Canberra. Retrieved from https://biodiversity.org.au/afd/home || Edmunds M (2012) Surveys for Hooded Shrimp Athanopsis australis at Point Wilson, June 2012. Australian Marine Ecology Report No. 498 to AECOM. Melbourne. || Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne. || Edmunds M, Flynn A (2018) Victorian marine biogeographical settings. Australian Marine Ecology Report No. 559 to Department of Environment Land Water and Planning. Melbourne. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff. || O'Hara TD, Barmby V (2000) Victorian Marine Species of Conservation Concern: Molluscs, Echinoderms and Decapod Crustaceans. Parks, Flora and Fauna Division, Department of Natural Resources and Environment. East Melbourne. || SpongeMaps (2019) Sponge Maps. Brisbane. Retrieved from https://www.spongemaps.org/
Bat colony sites	18	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Marine mammal areas	35	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff. || OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Shark areas	3	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
Fish records and areas	2	Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
FFG Act listed species and communities	37	O'Hara TD, Barmby V (2000) Victorian Marine Species of Conservation Concern: Molluscs, Echinoderms and Decapod Crustaceans. Parks, Flora and Fauna Division, Department of Natural Resources and Environment. East Melbourne.

EPBC Act listed species and communities	3	Edmunds M (2012) Surveys for Hooded Shrimp Athanopsis australis at Point Wilson, June 2012. Australian Marine Ecology Report No. 498 to AECOM. Melbourne.
Western Port Bryozoan Reef Community (FFG listed)	25	Flynn, A. (2018) Maps of special biotopes in the Rhyll segment of Western Port. Fathom Pacific. Frankston.
Entrance Deep Canyon marine community (FFG listed)	20	Department of Sustainability and Environment (2013) Flora and Fauna Guarantee Act 1988 - Threatened List: Characteristics of Threatened Communities. Department of Sustainability and Environment. East Melbourne. || Kent J, Jenkins G (2012) Ecological descriptions of the significant marine environmental assets of Victoria: Interim report. Fisheries Victoria Technical Report Series 177. Department of Primary Industries. Queenscliff.
San Remo marine community (FFG listed)	3	Department of Sustainability and Environment (2013) Flora and Fauna Guarantee Act 1988 - Threatened List: Characteristics of Threatened Communities. Department of Sustainability and Environment. East Melbourne.

Table 43: Scientific and heritage area feature data sources

Scientific and heritage areas		
Feature category	**Number of features**	**Data source**
Historic sites	47	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Shipwreck sites	766	Commonwealth of Australia (2019) Australian National Shipwreck Database. Department of the Environment and Energy. Parkes, Canberra. Retrieved from https://dmzapp17p.ris.environment.gov.au/shipwreck/public/wreck/search.do || Edmunds M, Flynn A (2018) Victorian marine biogeographical settings. Australian Marine Ecology Report No. 559 to Department of Environment Land Water and Planning. Melbourne.
Monitoring sites	138	Edmunds M (2017) Victorian Subtidal Reef Monitoring Program: The Reef Biota at Merri Marine Sanctuary, June 2015. Parks Victoria Technical Series 107. Parks Victoria. Melbourne. || Edmunds M, Woods B, Donnelly D (2015) Victorian Intertidal Reef Monitoring Program: Central Victoria Marine Protected Areas, July 2014. Parks Victoria Technical Series. Parks Victoria. Melbourne.
Research areas	18	Commonwealth of Australia (2019) Australia's National Heritage List. Department of the Environment and Energy. Retrieved from http://www.environment.gov.au/heritage/places/national-heritage-list || Wilson JB (1895) List of dredging stations at and near Port Phillip Heads. Proceedings of the Royal Society of Victoria 7, 261-263.

Table 44: Defence and national security feature data sources

Defence and national security		
Feature category	**Number of features**	**Data source**

Naval areas	2	Heritage Victoria (2018) Historic shipwreck protected zones. Department of Environment Land Water and Planning. East Melbourne.

Table 45: Energy generation and resource extraction feature data sources

Energy generation and resource extraction		
Feature category	**Number of features**	**Data source**
Oil and gas platforms and facilities	114	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Oil and gas pipelines	927	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Oil and gas pipe rupture site	1	Hydrographic Service RAN (2018) Marine navigation charts for Victoria (various). Hydrographic Service RAN.
Saltworks area	5	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Sand borrow area	13	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne.
Heat abstraction areas	1	Heritage Victoria (2018) Historic shipwreck protected zones. Department of Environment Land Water and Planning. East Melbourne.

Table 46: Fishing and aquaculture feature data sources

Fishing and aquaculture		
Feature category	**Number of features**	**Data source**
Aquaculture licensed areas	31	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne.
Dive harvesting areas	444	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne. || Fisheries Victoria (2014) Commercial Scallop Dive Fishery (Port Phillip) Survey Results for 2014. Fisheries Victoria. Queenscliff. || McShane PE, Beinssen KHH, Foley S (1986) Abalone reefs in Victoria - a resource atlas. Marine Science Laboratories Technical Report No. 47. Victoria, Australia.
Artificial reef fishing sites	29	OSRA Victoria (2015) Oil spill response atlas of Victoria. Department of Environment Land Water and Planning. East Melbourne. || Victorian Fisheries Authority (2019) Web page: vfa.vic.gov.au. Victorian Fisheries Authority. Melbourne.

Table 47: Marine transport feature data sources

Marine transport		
Feature category	**Number of features**	**Data source**

Vessel shipping lanes	6	Hydrographic Service RAN (2018) Marine navigation charts for Victoria (various). Hydrographic Service RAN.
Vessel anchorage areas	28	Hydrographic Service RAN (2018) Marine navigation charts for Victoria (various). Hydrographic Service RAN.
Past shipping incidents	24	Australian Transport and Safety Bureau (2017) Grounding of Bow Singapore, Port Phillip, Victoria, 19 August 2016. Australian Transport and Safety Bureau. Canberra. || Australian Transport Safety Bureau (2010) Independent investigation into the rupture of a submarine gas pipeline by the Hong Kong registered container ship APL Sydney in Port Phillip, Victoria, 13 December 2008. Australian Transport Safety Bureau. Canberra. || Australian Transport Safety Bureau (2018) Collision between the container ship Glasgow Express and the fishing vessel Mako, 15 NM south of Cape Woolamai, Victoria, 12 August 2017. Australian Transport Safety Bureau. Canberra.
Navigational dredging areas	16	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne. || Hydrographic Service RAN (2018) Marine navigation charts for Victoria (various). Hydrographic Service RAN. || Wilson JB (1895) List of dredging stations at and near Port Phillip Heads. Proceedings of the Royal Society of Victoria 7, 261-263.
Dredge material grounds	11	Hydrographic Service RAN (2018) Marine navigation charts for Victoria (various). Hydrographic Service RAN.

Table 48: Recreation, tourism and leisure feature data sources

Recreation, tourism, and leisure		
Feature category	**Number of features**	**Data source**
Boating and sailing areas	4	Edmunds M (2019) Digitisation of marine features in Victoria. Australian Marine Ecology. Melbourne.
Dive sites	383	O'Toole M, Turner M (1990) Down Under at the Prom. Field Naturalists Club of Victoria and Department of Conservation and Environment. Melbourne. || Parks Victoria (2009) Ex-HMAS Canberra Dive Site. Parks Victoria. Melbourne. || Scuba Doctor (2019) Melbourne Dive Site GPS Marks. Retrieved from https://www.scubadoctor.com.au/melbourne-dive-site-gps-marks.htm.