PROJECT SEA DRAGON
STAGE 1 LEGUNE GROW-OUT FACILITY
DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1 - PROJECT OVERVIEW
CHAPTER 8 - RISK ASSESSMENT

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 TERMS OF REFERENCE ADRESSED IN THIS CHAPTER

This chapter provides a description of the risk assessment undertaken for the identification, analysis and mitigation of project environmental risks associated with the Stage 1 Legune Grow-out Facility (the Project or Project Area). The risk assessment provides a framework for identifying components of the Project with the potential for greater environmental risk, and highlights areas of focus for environmental impact assessment and project specific control measures to minimise the likelihood and consequence of these identified risks.

Table 1 summarises the requirements from the Terms of Reference for the Preparation of an Environmental Impact Statement (ToR) for the Project and where they have been addressed in this chapter.

TABLE 1 TERMS OF REFERENCE

Terms of Reference		Sections
4	**Risk Assessment**	
	The Environmental Impact Statement (EIS) should be undertaken with specific emphasis on the identification, analysis and mitigation of potential impacts through a whole-of-project risk assessment. Through this process, the EIS will: - identify and discuss the full range of risks presented by the Project - identify relevant potential direct and indirect impacts - quantify and rank risks so that the reasons for proposed management responses are clear - identify levels of uncertainty about estimates of risk and the effectiveness of risk controls in mitigating risk - explicitly identify those members of the community expected to accept residual risks and their consequences, providing better understanding of equity issues - demonstrate that the Project represents best practicable technology.	This chapter and the Socio-economic chapter (Volume 3, Chapter 1)

1.2 RISK ASSESSMENT SCOPE

The scope of this risk assessment was confined to the potential impacts and consequences to environmental and cultural heritage values from the construction and operation of the Project. Impacts to cultural heritage have only been considered in the context of risk of direct impacts to physical sites. Indirect impacts to cultural values such as decreased amenity and changes to access will be dealt with through the Indigenous Land Use Agreement (ILUA) process.

The impacts to the Project from climate change are described in Volume 2, Chapter 12. These impacts were assessed using a risk assessment approach, which is described in detail in Volume 5, Appendix 8. As these risks relate to the impact on the Project itself they are not dealt with in the scope of this risk assessment.

A separate risk assessment was undertaken for the socio-economic risks and is presented in the Socio-economic Chapter (Volume 3, Chapter 1). This allowed for the methodical consideration of the potential social and economic impacts of the Project, many of which are relatively distinct from the potential environmental impacts.

2 METHODS

The methodology employed was a standard semi-quantitative risk assessment consistent with AS/NZS ISO 31000:2009 'Risk Management – Principles and Guidelines'. The risk assessment process is shown in Figure 1 and described in more detail in Sections 2.1 to 2.5.

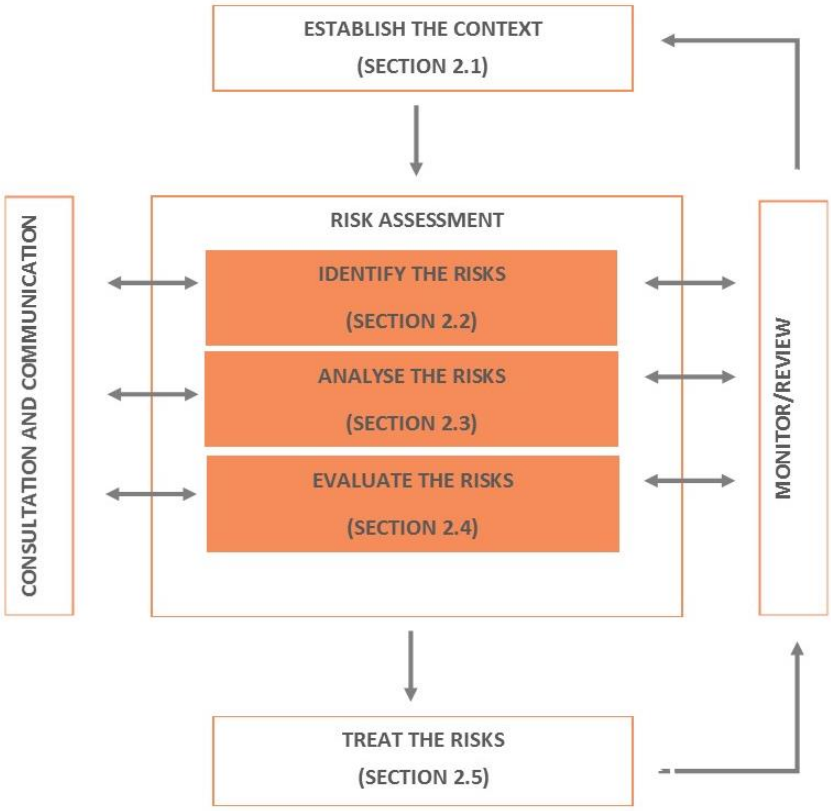

FIGURE 1 RISK ASSESSMENT PROCESS

2.1 CONTEXT ESTABLISHMENT

The first step in the risk assessment process involved establishing the context of the environmental risks. The context of the environmental risks was determined by the environmental setting of the Project and the Project design. A detailed description of the environment in which the Project is located is provided in Volume 2 and Volume 3 of the EIS, and has been informed by numerous technical studies which are included in Volume 5. A description of the construction and operational methods is provided in the Project Description chapter (Volume 1, Chapter 3).

2.2 RISK IDENTIFICATION

The next step in the risk assessment process involved the identification of potential environmental risks associated with the Project. A risk assessment workshop was held with the Project environmental and engineering teams and technical specialists involved in the preparation of the EIS to identify and discuss the full range of environmental risks associated with the Project.

The risk identification process involved the identification of risks on environmental values arising from Project. For the purposes of this risk assessment, the environmental values were referred to as 'consequence aspects' and broadly categorised as:

- general ecological values
- threatened and migratory species
- historic and cultural heritage
- amenity
- land
- marine and estuarine waters
- freshwater streams, rivers and wetlands
- groundwater
- air quality
- human health and safety
- traffic and transport

Risks were systematically identified taking into consideration the full range of Project activities during each phase of the Project (i.e. construction and operations) in relation the consequence aspects listed above.

2.3 RISK ANALYSIS

Once all the potential risks had been identified, initial risk ratings were assessed by assigning a level of consequence in accordance with consequence criteria for the Project (Table 2) and a level of likelihood in accordance with likelihood descriptors (Table 3). The initial risk rating considered the consequence and likelihood of the event occurring without any control measures in place. Following risk treatment (i.e. the implementation of control strategies - Section 2.5) the consequence and likelihood of the event occurring was reassessed.

Consequence criteria (Table 3) were developed for each of the consequence aspects list in Section 2.2 and ranged on a scale of magnitude from ‘very low’ to ‘very high’. Magnitude was considered as a function of the size of the impact, the spatial area affected and expected recovery time.

The level of likelihoods (Table 3) were determined based upon the probability of occurrence, within the context of reasonable timeframes and frequencies given the nature of the anticipated Project life. For many of the risks identified, the conditional probability of the risk occurring was taken into account. The conditional probability is the probability of an event given another event has already occurred. For example, when assessing the likelihood of the intake of water from Forsyth Creek resulting in the mortality of a threatened species (e.g. sawfish), the probability of a. the sawfish being present within Forsyth Creek, b. the sawfish being present within Forsyth Creek at the time the intake pump is operating and c. the sawfish swimming into the zone in which the velocity of the intake exceeds the sawfish's swimming ability, was taken in account when determining the likelihood of this risk occurring.

TABLE 2 CONSEQUENCE SCALE

Consequence aspect	Consequences				
	Very Low	Low	Moderate	High	Very High
General Ecological Values	Insignificant or imperceptible effects.	Minor local resource and/or habitat modification and/or local short-term decrease in abundance of some species with no lasting effect on local population.	Moderate local resource and/or habitat modification and/or local long-term decrease in abundance of some species resulting in some permanent change to community structure.	Moderate resource and/or habitat modification and/or regional decrease in abundance of some species resulting in some changes to community structure.	Substantial regional resource and/or habitat modification and/or loss of numerous species resulting in the dominance of only a few species.
Threatened and Migratory Species	Minor local habitat modification and/or lifecycle disruption for a listed species No discernible decrease in size of populations of conservation significant fauna species.	Moderate local habitat modification and/or lifecycle disruption for a listed species. Minor local decrease in size of populations of species of conservation significance.	Substantial local habitat modification and/or lifecycle disruption for a listed species. Moderate lasting decrease in size of populations of conservation significant species.	Moderate widespread habitat modification and/or lifecycle disruption for a listed species. Substantial local decrease in size of populations of conservation significant species.	Substantial widespread habitat modification and/or lifecycle disruption for a listed species. Moderate or substantial widespread decrease in size of populations of conservation significant species.
Historic and Cultural Heritage	Insignificant impact to site or item of cultural significance.	Reparable minor impact to site or item of cultural significance.	Reparable major damage to site or item of cultural significance.	Irreparable minor damage to site or item of cultural significance.	Irreparable major damage to sites of cultural significance or sacred value.

Consequence aspect	Consequences				
	Very Low	Low	Moderate	High	Very High
Amenity	**Visual:** Changes to landscape as a result of the Project are barely noticeable from key vantage points, publicly accessible areas and areas of significance. **Noise:** Negligible noise level increase at closest affected receiver	**Visual:** Changes to landscape as a result of the Project are visible only from nearby key vantage points, publicly accessible areas and areas of significance, and only occupy a small proportion of the viewshed. **Noise:** Marginal noise level increase at closest affected receiver	**Visual:** Changes to landscape as a result of the Project are visible from most key vantage points, publicly accessible areas and areas of significance, and only occupy a small proportion of the viewshed. **Noise:** Moderate noise level increase at closest affected receiver	**Visual:** Changes to landscape as a result of the Project are visible, occupy a large proportion of the viewshed and may intrude upon the visual amenity of key vantage points, publicly accessible areas and areas of significance across a variety of landscape. **Noise:** Appreciable noise level increase at closest affected receiver.	**Visual:** Changes to landscape as a result of the Project are clearly visible, numerous, continuous and widespread and are likely to be viewed from a number of key vantage points, publicly accessible areas and areas of significance across the landscape. **Noise:** Significant noise level increase at closest affected receiver.
Land	Impacts are localised and confined to near surface soils and are short-term. Easily rectified with no long term impacts.	Localised and medium-term reversible impact. May take up to 1 year to remediate.	Major localised impact or widespread lower impact. Remediation may take months to years.	Impact most likely affecting large areas and/or deep soil profiles leaving long term residual damage. Requires long-term recovery. May take years for full remediation to a point suitable for beneficial uses commensurate with current land uses.	Impact most likely affecting large areas and/or deep soil profiles leaving major residual damage. Requires long-term recovery. May take decades to achieve full remediation to a point suitable for beneficial uses commensurate with current land uses.

Consequence aspect	Consequences				
	Very Low	Low	Moderate	High	Very High
Marine and Estuarine Waters	**Quality:** Minimal near source (at point of discharge) eutrophication, or other water quality change with no significant loss of quality. **Quantity:** Short term minor change in quantity. **Seabed changes:** Insignificant change in bathymetry as a direct result of project activities.	**Quality:** Local short-term eutrophication or other water quality change above approved Water Quality Objectives. **Quantity:** Long term minor change in quantity. **Seabed changes**: Near-source and minor changes in bathymetry as a result of project activities.	**Quality:** Local long-term eutrophication or other water quality change above approved Water Quality Objectives. Short term local changes to water quality as a result of discharge or spillage of chemical or toxicants. **Quantity:** Moderate change in quantity. **Seabed changes:** Local and minor changes in bathymetry as a result of project activities.	**Quality:** Widespread long-term eutrophication or other water quality change above approved Water Quality Objectives. Short term widespread changes to water quality as a result of discharge or spillage of chemical or toxicants **Quantity:** Short term major or long term moderate changes in quantity. **Seabed changes**: Local and substantial changes in bathymetry as a result of project activities.	**Quality:** Long term widespread changes to water quality as a result of discharge or spillage of chemical or toxicants **Quantity:** Long term major changes in quantity. **Seabed changes:** Widespread and substantial changes in bathymetry as a result of project activities.

Consequence aspect	Consequences				
	Very Low	Low	Moderate	High	Very High
Freshwater streams, rivers and wetlands	**Quality:** Minimal contamination or change with no significant loss of quality. **Quantity:** Short term minor change in quantity. **Hydrology**: Insignificant alteration of existing hydrology.	**Quality:** Localised minor short term reduction in water quality. Local contamination or change that can be immediately remediated. **Quantity:** Long term minor change in quantity. **Hydrology**: Localised minor changes to existing hydrology.	**Quality:** Localised, minor long term; or widespread, minor short term; reduction in water quality. Remediation may take weeks. **Quantity:** Moderate change in quantity. **Hydrology:** Localised major or widespread minor changes to existing hydrology.	**Quality:** Localised, major long term; or widespread, major short term; reduction in water quality. Remediation may take months. **Quantity:** Short term major or long term moderate changes in quantity. **Hydrology:** Widespread major changes to existing hydrology.	**Quality:** Widespread major long term reduction in water quality. Remediation may take years. **Quantity:** Long term major changes in quantity. **Hydrology:** Major changes to existing hydrology on a catchment level.

Consequence aspect	Consequences				
	Very Low	Low	Moderate	High	Very High
Groundwater	**Quality:** Impacts are localised and confined to near source and are short-term. Easily rectified with no long term impacts. No impact on beneficial uses or ecological values. **Drawdown:** Insignificant effect.	**Quality:** Localised and medium-term, low level reversible impact. May take up to 1 year to remediate. No impact on beneficial uses or ecological values. **Drawdown:** Near-source minor change in recharge patterns within sub-catchments.	**Quality:** Major localised impact or widespread lower impact. Remediation may take months to years. No impact on beneficial uses or ecological values. **Drawdown:** Near-source major change in recharge patterns within sub-catchments.	**Quality:** Large volumes of or deep-seated contaminants requiring long-term recovery. May take years for full remediation. **Drawdown:** Local major changes in recharge patterns within sub-catchments.	**Quality:** Large volumes of or deep-seated contaminants requiring long-term recovery. May take decades for full remediation. **Drawdown:** Widespread major changes in recharge patterns.
Air Quality	No measurable air quality impacts or exceedance of air quality standards	Near source, short-term, and approaching exceedance of air quality standards	Near source, minor, long-term, or widespread minor short term or minor exceedance of air quality standards	Widespread, major, short-term exceedance of air quality standards	Regional long term change in air quality or exceedance of air quality standards
Human Health and Safety	Low level short term subjective inconvenience or symptoms. Typically first aid and no medical treatment.	Reversible / minor injuries requiring medical treatment, but does not lead to restricted duties. Typically a medical treatment.	Reversible injury or moderate irreversible damage or impairment to one or more persons. Typically a lost time injury.	Single fatality and/or severe irreversible damage or severe impairment to one or more persons.	Multiple fatalities or permanent damage to multiple people.

TABLE 3 LIKELIHOOD CLASSIFICATION

	Likelihood				
	Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
Frequency Interval (multiple events)	1/100 years	1/10 – 1/100 years	1/year – 1/10 years	2/years – 1/year	>2/year
Probability (single events)	<0.1%	0.1%-1%	1%-10%	10%-25%	>25%

2.4 RISK EVALUATION

Once the consequence criteria and level of likelihood had been assigned to each identified risk, the overall risk level was evaluated by using the risk matrix provided in Table 4.

TABLE 4 RISK ASSESSMENT CLASSIFICATION MATRIX

Likelihood	**Consequences**				
	1 – Very Low	**2 – Low**	**3 – Moderate**	**4 – High**	**5 – Very High**
5 – Almost Certain	Medium	Medium	High	Extreme	Extreme
4 - Likely	Medium	Medium	Medium	High	Extreme
3 – Possible	Low	Medium	Medium	Medium	High
2 – Unlikely	Very Low	Low	Medium	Medium	Medium
1 – Rare	Very Low	Low	Low	Medium	Medium

A brief description of each overall possible risk classification is provided below.

Extreme

A ranking of very high represents an unacceptable risk, which is usually critical in nature in terms of consequences (e.g. extensive and long term environmental damage) and is considered possible to almost certain to occur. Such risks significantly exceed the risk acceptance threshold and require comprehensive control measures, and additional urgent and immediate attention towards the identification and implementation of measures necessary to reduce the level of risk.

High

High risks typically relate to significant to critical consequences (e.g. a major amount of environmental damage) that are rated as possible to almost certain to occur. These are also likely to exceed the risk acceptance threshold, and although proactive control measures are usually planned or implemented, a very close monitoring regime and additional actions towards achieving further risk reduction is required.

Medium

As suggested by the classification, medium level risks span a group of risk combinations varying from relatively low consequence / high likelihood to mid-level consequence / likelihood to relatively high consequence / low likelihood scenarios. These risks are likely to require active monitoring as they are effectively positioned on the risk acceptance threshold.

Low

Low risks are below the risk acceptance threshold and although they may require additional monitoring in certain cases, are not considered to require active management. In general such risks represent relatively low likelihood, and low to mid-level consequence scenarios.

Very Low

Very Low risks are below the risk acceptance threshold and would, at the most, require additional monitoring and in many cases would not require active management. These risks can include unlikely to rare events with minor consequences, and in essence relate to situations around very low probabilities of relatively minor impacts occurring.

2.5 RISK TREATMENT

Control measures were developed to further reduce the risk. The risk was then reassessed using the processes outlined in Sections 2.3 and 2.4 to confirm the effectiveness of these control measures. This second rating is known as the residual risk rating and was used as the final risk rating.

The control measures have been used in the development of the Environmental Management Plan (Volume 4, Chapter 3) and will be implemented in the construction and operation of the Project.

3 RISK REGISTER

A risk register was established to document the findings of the risk assessment process. The risk register contains details of the source of impact, the potential consequences and control measures that will be implemented as part of the Project.

The risk register for Project construction is presented in Table 5, while the risk register for operations is presented in Table 6. The two tables combined constitute the risk register for the Project.

TABLE 5 CONSTRUCTION RISK REGISTER

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Site establishment, vegetation clearing and earthworks.	General Ecological Values	Clearing of vegetation results in the change or loss of habitat/biodiversity values for terrestrial flora and fauna.	5	2	M	• Undertake pre-clearance surveys to confirm the presence or absence threatened fauna species. • Utilise spotter catchers to conduct pre-clearance assessments and attend clearing as required. • Minimise vegetation clearance to the smallest extent possible. • Clearly mark out limits of clearing and individuals to retain. • Avoid land clearing during the wet season. • Adhere to buffer widths recommended by the NT Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines. • Install structures that would capture sediment downstream of development. • Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with the erosion and sediment control plan. • Clearing to be undertaken sequentially to encourage fauna to disperse. • Rehabilitate/stabilise cleared land as soon as possible after works have been completed. • Develop and implement vegetation clearing sub-plans which include areas not to be cleared (no-go areas) and make all workers aware of them through environmental management plan and site work briefings. • Development and implement fauna management plan including procedures for managing vegetation clearing operations and any direct fauna impacts (injuries, entrapments etc). • Controlled burns and/or vegetation mulched for re-use where practicable, no disposal of cleared vegetation into waterways or wetlands. • No laydown areas or material storage in wetland areas. • Where practicable, temporary fencing to exclude fauna from vegetation clearing areas.	5	2	M	• As detailed in the Terrestrial Flora chapter (Volume 2, Chapter 5), the dominant community is northern rice grass (*Xerochloa imberbis*) grassland which comprises 47% of the clearing footprint. This community is widespread and common and the clearing represents 8% of the area of northern rice grass grassland on Legune Station.
		Clearing of vegetation results in the mortality or injury of flora species.	5	2	M		5	2	M	
		Clearing of vegetation and/or earthworks results in the mortality or injury of terrestrial fauna or avifauna species.	5	2	M		5	1	M	• Areas to be cleared are largely depauperate of native fauna, having been heavily modified as a result of grazing practices. Furthermore, construction will be undertaken in the dry season when avifauna are largely absent from these areas.
	Threatened and Migratory Species	Clearing of vegetation results in the change or loss of habitat/biodiversity values for threatened and migratory species.	5	2	M		5	1	M	• As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), the area to be cleared for the grow-out ponds is not important dry season habitat for threatened and migratory avifauna. Wet season habitat for these species is widespread. • Clearing for the accommodation village central facilities and service corridors (i.e. roads) comprises of less than 1% of habitat within the surrounding area for the bare-rumped sheath-tail bat and this habitat contains significantly less roosting resources for this species than surrounding non-impacted woodland. • No habitat for other non-avian threatened species to be cleared.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
		Clearing of vegetation results in the mortality or injury of threatened flora species.	1	3	L	• Apply buffers and visual screens between construction areas and migratory and waterbird habitat at the Alligator Creek road crossing. • Retain screening vegetation to waterbird habitat areas as long as possible during construction.	1	2	L	• As detailed in the Terrestrial Flora chapter (Volume 2, Chapter 5), no threatened flora species were recorded during the flora and vegetation surveys and none are predicted to occur.
		Clearing of vegetation and/or earthworks results in the mortality or injury of threatened or migratory terrestrial fauna or avifauna species.	2	3	M	• Soil management procedures to target specific areas subject to salinity, sodicity and enhanced erosion including mitigation, soil amelioration and rehabilitation as required. • Strict controls for waterway crossing works including erosion and sediment controls, defined trafficable areas etc.	2	2	L	• As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), migratory birds unlikely to be affected as clearing will only occur in dry season when there is no migratory bird habitat in the majority of the areas to be cleared. Special care will be taken around Alligator Creek. • Clearing for the accommodation village central facilities and service corridors (i.e. roads) comprises of less than 1% of habitat within the surrounding area for the bare-rumped sheath-tail bat and this habitat contains significantly less roosting resources for this species than surrounding non-impacted woodland.
	Historic and Cultural Heritage	Damage to or destruction of sacred sites or heritage items during vegetation clearing and/or earthworks.	3	5	H	• Undertake pre-clearance surveys to confirm the presence or absence cultural heritage sites and/or objects. • Minimise vegetation clearance to the smallest extent possible.	2	5	M	• Low likelihood of unknown sites due to extensive surveys and consultation undertaken during ILUA process.
		Indirect impacts from site establishment, vegetation clearing and earthworks (e.g. sedimentation and pollution) results in impacts to cultural sites.	2	4	M	• Clearly mark out limits of clearing. • Install structures that would capture sediment downstream of development. • Develop and implement vegetation clearing sub-plans which include areas not to be cleared (no-go areas) and make all workers aware of them through environmental management plan and site work briefings. • Controlled burns and/or vegetation mulched for re-use where practicable, no disposal of cleared vegetation into waterways or wetlands.	1	4	M	• Measures to mitigate potential damage to culturally significant sites will be detailed in the Heritage Management Plan in consultation with Traditional Owners.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	Freshwater Streams, Rivers and Wetlands	Clearing of vegetation near waterways and wetlands leads to bank destabilisation, direct damage, or release of sediments and/or organic matter to waterways which impacts on water quality.	3	3	M	▪ Minimise vegetation clearance to the smallest extent possible. ▪ Clearly mark out limits of clearing and individuals to retain. ▪ Avoid land clearing during the wet season. ▪ Adhere to buffer widths recommended by the NT Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines. ▪ Install structures that would capture sediment downstream of development. ▪ Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with the erosion and sediment control plan. ▪ Rehabilitate/stabilise cleared land as soon as possible after works have been completed. ▪ Develop and implement vegetation clearing sub-plans which include areas not to be cleared (no-go areas) and make all workers aware of them through environmental management plan and site work briefings. ▪ Controlled burns and/or vegetation mulched for re-use where practicable, no disposal of cleared vegetation into waterways or wetlands. ▪ No laydown areas or material storage in wetland areas. ▪ Soil management procedures to target specific areas subject to salinity, sodicity and enhanced erosion including mitigation, soil amelioration and rehabilitation as required. ▪ Strict controls for waterway crossing works including erosion and sediment controls, defined trafficable areas etc.	2	2	L	▪ Limited works near waterways and wetlands. ▪ Erosion and sediment controls will be put in place.
		Site establishment and construction of farms results in the loss of ephemeral wetlands.	5	2	M		5	2	M	▪ Considering much of the Legune floodplain becomes one major water body for months at a time during the wet season, the relatively small loss of ephemeral wetlands it is not likely to have a measurable ecological impact beyond the Project footprint.
	Marine and Estuarine Waters	Clearing of mangroves leading to bank destabilisation, increased erosion and runoff resulting in release of sediments and/or organic matter to waterways impacting water quality.	3	2	M		2	1	VL	▪ Small area of mangroves to be cleared at the intake site only. ▪ Erosion and sediment controls will be put in place. ▪ As detailed in the Marine and Estuarine Water chapter (Volume 2, Chapter 2), the existing estuarine environment is extremely turbid and dynamic.
	Land	Clearing of vegetation and/or earthworks leads to increased erosion and loss of topsoil affecting future land productivity.	4	3	M	▪ Minimise vegetation clearance to the smallest extent possible. ▪ Clearly mark out limits of clearing and individuals to retain. ▪ Avoid land clearing during the wet season. ▪ Install structures that would capture sediment downstream of development.	4	2	M	▪ Topsoil will be used in development of pond and channel walls or stockpiled and stabilised for future use. ▪ Erosion and sediment controls will be put in place.
		Clearing of vegetation and/or earthworks leads to increased salinity.	1	3	L	▪ Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with the erosion and sediment control plan. ▪ Rehabilitate/stabilise cleared land as soon as possible after works have been completed.	1	3	L	▪ Increased salinity due to the removal of vegetation is considered unlikely due to depth of groundwater table and lack of deep rooted woody vegetation. Incidences of sodic soils come from active seawater influence rather than dryland salinity.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
		Clearing and/or working of sodic soils leads to enhanced erosion and soil degradation.	2	3	M	• Develop and implement vegetation clearing sub-plans which include areas not to be cleared (no-go areas) and make all workers aware of them through environmental management plan and site work briefings. • Controlled burns and/or vegetation mulched for re-use where practicable, no disposal of cleared vegetation into waterways or wetlands. • An unexpected findings protocol will be implemented including stop work, containment and remediation actions. • Soil management procedures to target specific areas subject to salinity, sodicity and enhanced erosion including mitigation, soil amelioration and rehabilitation as required. • Rehabilitation and decommissioning plan will be developed.	2	2	L	• As detailed in the Geology, Geomorphology and Soils chapter (Volume 2, Chapter 1), sodic soils have been identified on site. This is from active seawater influence rather than problematic dryland sodic soils. Typically only the surface soils are sodic and no change in saline/freshwater regime anticipated outside of grow-out pond areas.
		Encountering contaminated sites (e.g. cattle dips and landfills) during vegetation clearing or earthworks requiring clean up or remediation to make safe.	2	3	M		2	2	L	• Contaminated land assessment did not identify any contaminated sites within the Project footprint.
Introduction or spread of weeds/pest animals during construction activities (e.g. site establishment, earthworks, movement of heavy machinery).	General Ecological Values	The introduction or spread of weeds/pest animals results in the change or loss of habitat/biodiversity values for terrestrial flora and fauna.	4	4	H	• Weed Management Plan will be implemented, including pre-construction mapping and regular weed inspections. • A Fauna Management Plan will be prepared which will include pest animal eradication and management strategies for construction. • Environmental inductions for workforce to include identification of problem weeds. • Vehicle and equipment wash-down procedures on-site. • Store weed impacted topsoils separately and do not spread around the site. • Implement weed control notification and location recording for weed identified on site. • Weed control monitoring and management practices. • Ensure fire management plan applies to construction and takes into consideration weed impacts following burn offs. • Manage landfill and putrescible waste to control feral and pest animal ingress.	2	2	L	• With mitigation measures in place it is unlikely that any weeds/pest animals will be introduced or spread as a result of Project construction.
	Threatened and Migratory Species	The introduction or spread of weeds/pest animals results in the change or loss of habitat/biodiversity values for threatened flora and threatened and migratory fauna.	4	4	H		2	2	L	

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Burning to clear vegetation	Air Quality	Air emissions from burning of vegetation results in reduced air quality at sensitive receptors.	1	3	L		1	3	L	As detailed in the Air Quality chapter (Volume 2, Chapter 10) there are no nearby sensitive receptors that would be impacted by air emissions from the Project.
	General Ecological Values	Burning extends beyond vegetation clearing zone resulting in the loss of habitat/biodiversity values.	4	3	M	Implement fire management plan to incorporate controlled burns, firebreaks and health and safety protocols including emergency response procedures and personal protective equipment (PPE). Controlled burns will only take place under supervision of appropriately trained personnel.	2	2	M	Through implementation of a fire management plan there will be measures in place to limit the extent of and respond to fire should it extend beyond vegetation clearing zone.
	Threatened and Migratory Species	Burning results in the mortality or injury of threatened flora species.	1	3	L	Utilise spotter catchers to conduct pre-burning assessments and attend clearing as required.	1	3	L	As detailed in the Terrestrial Flora chapter (Volume 2, Chapter 5), no threatened flora species were recorded during the flora and vegetation surveys and none are predicted to occur.
		Burning results in the mortality or injury of threatened or migratory terrestrial fauna or avifauna species.	1	3	L		1	3	L	As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), area to be burnt for the grow-out ponds is not important dry season habitat for threatened and migratory avifauna. Vegetation at the accommodation village, central facilities and service corridors (i.e. roads) will be cleared and therefore is dealt with in the vegetation clearing section of this risk assessment.
	Human Health and Safety	Burning results in injuries or death from smoke inhalation or fire.	3	5	H	Burning to clear vegetation will only take place under supervision of appropriately trained personnel and in accordance with the fire management plan, health and safety protocol including emergency response procedures and PPE. Firebreaks will be established around areas to be burnt.	1	5	M	Burning to clear vegetation will only be undertaken once to facilitate establishment of the grow-out ponds.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Noise generation and vibration impacts from site establishment, vegetation clearing, earthworks and the movement of heavy machinery.	General Ecological Values	Increased noise levels results in the disturbance of terrestrial fauna and avifauna.	5	1	M	• Apply noise barriers between construction areas and migratory and waterbird habitat at the Alligator Creek road crossing. • Retain screening vegetation to waterbird habitat areas as long as possible during construction. • All engine covers will be kept closed while equipment is operating. • The height at which material is dropped into or out of trucks will be minimised as far as possible. • Vehicles should be kept properly serviced and fitted with appropriate mufflers. • The use of exhaust brakes will be minimised, where practicable. • Machines found to produce excessive noise compared to industry best practice will be removed from the site or stood down until repairs or modifications can be made. • All equipment will be selected to minimise noise emissions. Equipment will be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations will be removed from the site or stood down until repairs or modifications can be made.	4	1	M	• As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), noise reduces to below 65 decibels within 100 m of the construction footprint. Noise under 65 decibels is unlikely to cause birds to move away from the site, hence the potential for significant impact is very low. • Project construction will occur in the dry season and during this time there is less likely to be threatened and migratory species present. • The vast majority of the construction footprint is well removed from areas that are likely to be habitat for threatened and migratory species in the dry season. • Mitigation measures are proposed to limit the potential impact from the relatively small amount of works at Alligator Creek for the construction of the Central Services Road.
	Threatened and Migratory Species	Increased noise levels results in the disturbance of threatened and migratory fauna and avifauna.	3	1	L		2	1	VL	
	Amenity	Increased noise levels at sensitive receptors.	1	1	VL	• The above mitigation measures which are proposed to limit increased noise levels on fauna will also generally reduce noise levels for humans in the vicinity (note that this will be construction personnel only who will have an expectation of noise levels during construction and will be wear appropriate PPE if required).	1	1	VL	• As detailed in the Noise and Vibration chapter (Volume 2, Chapter 12), there are no nearby sensitive receptors that would be impacted by noise emissions from the Project.
Noise and vibration during construction of seawater intake pump.	Threatened and Migratory Species	Noise and vibration, particularly during piling operations, results in disturbance to threatened and migratory estuarine megafauna, and terrestrial avifauna.	3	1	L	• Where possible, a 'soft-start' for all pile-driving, slowly increasing intensity of the driving hammer power • Routine maintenance and inspection of all noise-generating equipment to ensure noise is kept to a minimum • Not leaving noise-generating equipment on standby or running mode • If, after works have commenced, marine fauna (large fish, schools of fish, marine mammals and turtles) are observed within 100 m of the noise emitting source, then pile-driving ceases until the animal has passed.	2	1	VL	• Short duration of impact. • Impact restricted to the seawater intake location. • Any threatened and migratory species in the vicinity of the seawater intake pump station may temporarily vacate or avoid the area following the commencement of piling works - soft start would allow them to vacate while impact still minimal. • Threatened and migratory species expected to resume normal behavioural patterns following the cessation of the piling works.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Generation and dispersion of dust emissions from site establishment, vegetation clearing, earthworks.	Air Quality	Dust emissions result in a reduction of air quality at potentially sensitive receptors.	2	2	L	Watering of unsealed road and construction surfaces to reduce dust emissions.	1	1	VL	No nearby sensitive receptors.
	General Ecological Values	Dust emissions result in increased levels of dust deposition on surrounding flora resulting in smothering of vegetation and habitat degradation.	5	1	M	Speed limits will be enforced for all vehicles on unsealed roads. Vegetation clearing will be limited and exposed areas revegetated, where possible. Apply buffers between construction areas and migratory and waterbird habitat at the Alligator Creek road crossing.	5	1	M	Vegetation on-site habituated to already dusty environment. Given the significant rainfall events expected on an annual basis, impacts from dust will be short term and minor at most.
	Threatened and Migratory Species		1	1	VL	Retain screening vegetation to waterbird habitat areas as long as possible during construction. Stabilise stockpile surfaces if inactive for extended periods. Weather reports will be checked daily to enable action to be taken immediately if conditions change. A site 'shut down and cover up' policy will be implemented during periods of extreme weather conditions. Implement erosion and sediment control plans specific to the site.	1	1	VL	As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), no threatened or migratory species expected in the majority of the clearing footprint (i.e. grow-out ponds) during construction. Note that flora and fauna at Alligator Creek habituated to already dusty environment due to adjacent road.
	Freshwater Streams, Rivers and Wetlands	Dust emissions result in increased levels of dust deposition which leads to changes in water quality.	2	2	L	Personnel to wear personal protection equipment appropriate to the task.	2	1	VL	Freshwater environments on-site habituated to already dusty environment. Given the significant rainfall events expected on an annual basis, impacts from dust will be short term and minor at most. The vast majority of the construction footprint is well removed from freshwater environments (construction in the dry season).
	Historic and Cultural Heritage	Dust impacts on sites of cultural significance.	3	2	M		2	1	VL	Dusty conditions already exist on the Project site. Given the significant rainfall events expected on an annual basis, impacts from dust will be short term and minor at most.

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Drawdown of groundwater from excavation and borrow pits.	Groundwater	Groundwater drawdown impacts on groundwater levels.	2	2	L	• A site wide groundwater monitoring program will be initiated to monitor groundwater levels in productive (and saline) aquifers and provide early warning of potential impacts from the Project. This will include monitoring for loss of aquifer level.	2	1	VL	• Shallow saline water table on the estuarine-deltaic plain at ~3m below ground level in the dry season. • Grow-out ponds comprise the majority of the Project footprint. Ponds will formed by excavating a thin layer (nominally 300 mm) to form bund walls and therefore will be unlikely to intersect groundwater. • There is some potential for some smaller Project elements to intersect the shallow groundwater on the estuarine-deltaic plain however this resource is not generally useable, other than in some local recharge areas associated with low hills and rises on the plains. • Aquifers and bores in proximity to the Forsyth Dam borrow pits and the Central Facilities and Accommodation Village borrow pits are identified at or below 22.5m below ground level, and excavations are not proposed to that depth in these areas and hence these aquifers are unlikely to be impacted.
Disturbance of acid sulfate soils (ASS) during earthworks.	Freshwater Streams, Rivers and Wetlands	Disturbance of ASS results in the generation of acid leachate which acidifies runoff and leads to changes in water quality in freshwater streams, rivers and wetlands.	2	2	L	• ASS management plan to be implemented. • Soil investigations for any excavations into potential ASS. • Avoid disturbance and oxidation of ASS or ensure disturbed ASS have sufficient neutralising capacity to permanently avoid oxidation (adding lime if necessary).	2	1	L	• Minimal excavation work near freshwater environments. • Minimal excavation in intertidal zone and specific management measures in place for ASS in intertidal areas. • If encountered ASS can be neutralised. • Acid sulfate soils are only found below 2-3 m. The majority of Project footprint (i.e. grow-ponds) will only excavate to 300 mm.
	Marine and Estuarine Waters	Disturbance of ASS results in the generation of acid leachate which acidifies runoff and leads to changes in water quality in Marine and Estuarine Waters.	3	2	M		2	1	L	
	Groundwater	Disturbance of ASS results in the generation of acid leachate which acidifies groundwater and leads to changes in water quality.	3	2	M		2	1	L	
	Land	Disturbance of ASS leads to acidification of soils and/or continued leachate generation.	3	2	M		2	1	L	

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Spills or leaks of contaminants such as fuel, oils, chemicals or liquid waste.	Land	Spills of contaminants result in contamination of soils.	3	4	M	• Fuel, oil, chemical and liquid waste to be stored in bunded and appropriately contained areas. • Fuel and chemical transfer points to be bunded. • Spill kits and spill management controls utilised at all storage and transfer points. • All waste disposed appropriately offsite or disposed of in the onsite landfill. • Training and incident/notification procedures to be adopted. • An unexpected findings protocol will be implemented including stop work, containment and remediation actions.	2	2	L	• With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
	Freshwater Streams, Rivers and Wetlands	Contaminants enter surrounding waterways and lead to changes in water quality in freshwater streams, rivers and wetlands.	3	3	M		2	2	L	• Minimal construction work will be undertaken near freshwater environments. • With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
	Marine and Estuarine Waters	Contaminants enter surrounding waterways and lead to changes in water quality in Marine and Estuarine Waters.	3	3	M		2	2	L	• Minimal construction work will be undertaken near marine and estuarine environments. • With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
	Groundwater	Contaminants enter groundwater and lead to changes in water quality.	3	3	M		2	1	VL	• With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
	Historic and Cultural Heritage	Contamination results in damage to a site or item of cultural significance.	3	3	M		2	2	L	• With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
Landscape changes from the construction of the Project.	Amenity	Changes to the landscape impact on the visual amenity of the area.	2	2	L	• Project footprint has been designed to avoid cultural sites. • Decommissioning and rehabilitation plan to be adopted. • Non-pastoral use agreement will allow for continuation of pastoral activities on the site.	2	2	L	• As detailed in the Amenity chapter (Volume 3, Chapter 5), Project is remote and unable to be seen from potentially sensitive receptors. • Landscape use is changing from one beneficial use to another (i.e. grazing to aquaculture).
	Land	Changes in the landscape impacts on land use.	5	2	M		5	2	M	

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Increased number of unauthorised visitors to Legune Station following the construction of all-weather access road.	Amenity	Increased numbers of visitors results in disturbance of the natural environment (e.g. through the dumping of rubbish or overfishing) which impacts on the amenity of the area.	3	2	M	• A gate will be installed at the entrance to the Legune Access Road. • Signage to discourage off-road access from possible vantage off road. • Surveillance for trespassers. • Access to Legune Station will only be permitted to authorised personnel.	2	2	L	
	Threatened and Migratory Species	Increased numbers of visitors leads to disturbance of the natural environment (e.g. through the dumping of rubbish or overfishing) which results in a loss or change of habitat/biodiversity values or the mortality or injury of threatened or migratory species.	3	2	L		2	2	L	
	Human Health and Safety	Unauthorised visitors interact or interfere with the Project.	3	4	M		2	4	M	• Positive community support for the Project and unlikely to be the target of negative interference that could cause human health and safety issues.
Traffic movements	Human Health and Safety	Increased traffic movements lead to an increase in vehicle incidents.	3	5	H	• The upgrading of part of Moonamang Road, the Cave Springs Road by the WA and NT governments respectively and the Legune Access Road as part of the Project will ensure that the entire route from Legune Station to Kununurra is of an appropriate standard and capacity to accommodate the needs of the Project. • Vehicles to adhere to site speed limits and road rules. • Personnel operating vehicles must not be under the influence of alcohol or other drugs. • Personnel will be appropriately licenced. • Vehicle inspection checks and services required to be undertaken at regular (appropriate) intervals. • All Project personnel to complete a site and safety induction prior to commencement of work. • Establish, implement and monitor a Driver Safety and Fatigue Management Policy for all employees and contractors.	2	5	M	• As described in the Traffic and Transport chapter (Volume 3, Chapter 4), the projected change in traffic movements as a result of the construction of the Project is negligible and will be within the normal day-to-day variation in traffic volumes.
	Air Quality	Increased traffic results in increased dust emissions from unsealed roads.	3	2	M	• Unsealed roads will be watered to reduce dust emissions.	2	1	VL	
	Land	Increased traffic results in soil compaction, rutting and soil erosion outside of designated traffic areas.	3	1	L	• Vehicles to stay on defined ingress and egress points. • Vehicles to adhere to site speed limits and road rules.	2	1	VL	

Source of Impact	Consequence Aspect	Risk	Initial Risk Rating			Control Strategies	Residual Risk Rating			Evaluation Rationale
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	General Ecological Values	Increased traffic results in the mortality or injury of terrestrial fauna or avifauna species.	5	1	M	▪ Roads will be clearly signposted and designed to minimise potential for roadkill. ▪ A fauna management plan will be developed and implemented and will include procedures for managing traffic incidents involving fauna.	4	1	M	▪ Legune Station supports a very high density of agile wallabies, which are listed by the Department of Land Resource Management (DLRM) as one of the native pest species for the area. Because they are in such large numbers they are currently subject to mortality as a result of pastoral operations. As such it is likely incidents will occur during construction. ▪ Will not constitute a significant impact to the population given the very high density at which they occur on the site.
	Threatened and Migratory Species	Increased traffic results in the mortality or injury of threatened or migratory terrestrial fauna or avifauna species.	2	2	L		2	2	L	▪ The majority of threatened and migratory species known to be present on site are avian and unlikely to inhabit road verges.

TABLE 6 OPERATIONAL RISKS

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Intake of seawater from Forsyth Creek.	Marine and Estuarine Waters	Intake structure alters dynamics of Forsyth Creek changing scour and erosion rates.	4	3	M	◤ Design of the intake minimises impacts to current speeds and direction by using pile structures to access to centre of Forsyth Creek, as opposed to more solid structures. ◤ Monitoring bank erosion and scour rates around piles and instigate rectification works if negative changes are observed.	3	2	M	◤ Bathymetry of the marine and estuarine environment is naturally extremely dynamic. ◤ Design minimises risks of scour and erosion to as low as practicable.
		Intake of water results in a change in the tidal prism of Forsyth Creek which affects tidal water levels or currents.	5	2	M		5	2	M	◤ As detailed in the Marine and Estuarine Water chapter (Volume 2, Chapter 2), the peak rate of extraction represents small percentage of the tidal prism in Forsyth Creek (less than 0.5% during a spring tide and 1.5% during a neap tide). ◤ No follow on consequences for marine fauna or water quality.
	General Ecological Values	Entrainment or impingement in intake structures results in mortality or injury of aquatic fauna.	5	2	M	◤ The area of potential influence in the vicinity of the four bell-mouth intakes is small and represents a very small area of potential impact relative to Forsyth Creek. ◤ The intake is positioned approximately 9 m from the creek bed which will avoid bottom dwelling species. ◤ The intake bell-mouth will be fitted with a 100 mm aperture mesh grille, to exclude all but the small debris and aquatic fauna. ◤ Water will only be drawn from the mid and high tides daily, which allows a 12 hour period each day of no operation. ◤ The bell-mouth design will have a target velocity of <0.4 m/s within 1.0 m radius of the bell-mouth. This target velocity accords with the published data that most fish can swim against a current of 0.4 m/sec. ◤ And the 0.1 m/sec velocity is 1.25 m from the bell-mouth. Published data indicates that all fish can swim against currents of 0.1 m/s.	4	1	M	◤ As detailed in the Marine and Estuarine Ecology chapter (Volume 2, Chapter 7), current velocities in Forsyth Creek are high and therefore resident and transient fish in this area are likely to be able to negotiate these currents. ◤ Juveniles of the threatened species considered possible to occur are relatively large (e.g. sawfish pups > 65 cm and river shark > 50 cm) and therefore they are likely to have a relatively strong swimming ability. ◤ Flatback turtle hatchlings (approximately 6 cm at emergence) can have a swimming speed of >1 m/s. ◤ Adults of the threatened species likely to occur are large and are considered likely to be able to swim away. In any event, the 100 mm aperture mesh grille will exclude any adult threatened species from being entrained.
	Threatened and Migratory Species	Entrainment or impingement of threatened and migratory aquatic fauna in intake structures.	3	2	M		2	2	L	

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Discharge of waste water into Alligator Creek.	Marine and Estuarine Waters	High levels of nutrients in discharge water results in a change in water quality above interim site specific water quality trigger values.	5	3	H	Choice of Project location: - Macrotidal receiving environment increases dilution and flushing. - Largest privately owned dam ensures adequate supply of freshwater which maximises ability to recirculate and therefore minimises discharge. Project design: - Use of freshwater minimises amount of seawater flow-through and therefore discharge. - Maximum water re-use through Internal Farm Recycling Ponds. - Environmental Protection Zone (EPZ) designed to slow water flow and 'polish' discharge water. - Potential for EPZ to be naturally colonised by vegetation to allow for nutrient uptake. - Weirs within the Main Discharge channel (MDC) and EPZ allow for controlled timing, rate and dispersion of discharge. - Farm ponds and IFRP will settle out the bulk of organic material before the EPZ. - A 100 m wide channel has been designed through the centre of the EPZ to keep water moving so it will be unlikely to go stagnant or develop excessive algal blooms (typically observed in still waters). - Location of discharge into Alligator Creek as opposed to a smaller tidal creek with smaller flushing ability and tidal prism. Project operation: - Release of discharge on ebb tide to ensure minimum residency time and scour in Alligator Creek. - No use of antibiotics. - Maximum feed conversion via feed formulation and pond management strategies. - Aerators create pond spoil mound in the middle which is removed at end of harvest (i.e. is not discharged). - Aerators also reduce biochemical oxygen demand. - Annual drainage of ponds and removal of pond waste from the pond floor.	5	1	M	As detailed in the Marine and Estaurine Water chapter (Volume 2, Chapter 2), there will be no exceedances of interim water quality guidelines outside of the mixing zone. The mixing zone at the discharge point (i.e. where the interim site specific water quality trigger values are exceeded) is approximately 200 m either side of the discharge infrastructure.

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
		Discharge water results in scour and/or changes to the bathymetry of Alligator Creek.	3	2	M	All of the above control strategies will apply, in addition to: - Rock armouring of discharge point control bank erosion. - Peak ebb and flood tides in Alligator Creek are higher than the discharge current speeds, hence discharge is likely to have minimal impact on bathymetric and sediment transport processes in comparison to the natural tidal currents.	2	1	VL	- Bathymetry of the marine and estuarine environment is naturally extremely dynamic.
		Discharge of water results in a change in the tidal prism of Alligator Creek which affects tidal water levels or currents.	5	2	M		5	2	M	- As detailed in the Marine and Estuarine Water Quality chapter (Volume 2, Chapter 2), the average daily discharge rate of 420 ML represents small percentage of the tidal prism (less than 0.5% during a spring tide and 1.9% during a neap tide). - No follow on consequences for marine fauna or water quality.
	General Ecological Values	High level of nutrients in discharge water results in changes in water quality which in turn causes a change or loss of habitat/biodiversity values for flora and fauna.	5	3	M	All of the above control strategies for the discharge of water into Alligator Creek will apply.	5	3	M	- As detailed in the Terrestrial Fauna and Avifauna chapter (Volume 2, Chapter 6), there is a low abundance and diversity of shorebirds. This is thought to be a consequence of the low abundance and diversity of benthic infauna in the estuarine environment. - Higher value habitats for threatened and migratory species include Turtle Point and Osmans Lake which will not be impacted by the discharge. - The Marine and Estuarine Water modelling (Volume 2, Chapter 2) shows that there will be no exceedances of interim water quality guidelines outside of the mixing zone. - The ranking of medium post implementation of control strategies is arrived because there is likely to be long term changes. It should be noted however that the mitigation measures provide for a reduction in the size of the mixing zone and therefore area of

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
										impact for benthic infauna.
	Threatened and Migratory Species	High level of nutrients in waste water results in changes in water quality which in turn causes a change or loss of habitat/biodiversity values for threatened and migratory aquatic and avifauna fauna.	3	2	M	All of the above control strategies for the discharge of water into Alligator Creek will apply.	1	2	VL	◤ The receiving environment in Alligator Creek has been identified as being of low importance for threatened and migratory avifauna. This is thought to be a consequence of the low abundance and diversity of benthic infauna in the estuarine environment surrounding the Project Area. ◤ Higher value habitats for threatened and migratory avifauna include Turtle Point and Osmans Lake which will not be impacted by the discharge. ◤ Effects of discharge are confined to Alligator Creek and in particular the mixing zone which extends approximately 200 m either side of the discharge infrastructure. ◤ The threatened marine species likely to present are wide ranging and this area does not represent critical habitat. Furthermore the discharge itself is unlikely to constitute a significant impact to these species. ◤ The potential impact area represents a relatively small proportion of available habitat. There are extensive areas of similar habitat in the region. ◤ Regardless, the discharge itself is considered unlikely to have an impact on individual species if they are to pass through the mixing zone.
Uncontrolled discharges or leaks from grow-out ponds and channels.	Groundwater	Uncontrolled discharges or leaks lead to changes in groundwater quality.	2	3	M		2	3	M	◤ Soils used to construct farm ponds and channels have low permeability. ◤ Groundwater in the area of the grow-out ponds is saline and is not used by any other beneficial user (i.e. for human consumption or stock).

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	Marine and Estuarine Waters	Uncontrolled discharges (e.g. through the overtopping of farm ponds and channels) lead to changes in estuarine and intertidal water quality.	2	1	VL	The Project has been designed so that: In storm events less than a 50 year average reoccurrence interval (ARI) events, flows are captured by a system of swales adjacent to the farm bunds and transported to the main discharge channel (MDC) for planned release to the environment. In extreme rainfall events (> 50 year ARI), uncontrolled releases of water will enter the bio-security zones between farm 1 and farm 2. The excess water will then be channelled along the biosecurity zone and discharged to the tidal floodplain through a culvert under the MDC.	1	1	VL	The inundation extent is limited and depths are shallow. Much of the water released is ponded on the upper tidal floodplain with little interaction with the tidal creeks. This inundation extent is considered insignificant when compared to the likely flooding conditions during a rainfall event that would cause this degree of overtopping.
	Freshwater Streams, Rivers and Wetlands	Uncontrolled discharges (e.g. through the overtopping of farm ponds and channels) lead to changes in water quality in freshwater streams, rivers and wetlands.	2	2	L		1	2	VL	
Escape of prawn stock from grow-out facility.	General Ecological Values	The escape of prawn stock from the grow-out farms leads to changes in aquatic ecology.	2	2	L	All pond outlets will be screened with a mesh of a suitable size to prevent prawns escaping. A cage screened with a mesh of a suitable size will be inserted inside the monk (the outlet structure) during harvesting. A bird predation management strategy will be implemented to prevent birds predating on prawns and potentially removing prawns from the grow-out ponds. The grow-out facility will be stocked with post-larvae that are bred from Specific Pathogen Free (SPF) prawn stock. A biosecurity plan has been developed for the Project and will operate across the entire grow-out facility to prevent the introduction and spread of diseases through pathways such as staff and equipment movements. In addition to the biosecurity plan, a health monitoring and surveillance program will be implemented to identify any disease outbreaks. If a disease is identified, immediate steps will be taken to contain the disease to the pond(s) in which it has been identified.	1	1	VL	The grow-out facility will be stocked with black tiger prawns (*Penaeus monodon*) which are native to the Joseph Bonaparte Gulf. The founder stock which will be used to establish the breeding program for the Project will be sourced from wild populations of black tiger prawns from the waters around the Northern Territory and Western Australia.
Use of helicopters and/or drones for bird predation management.	General Ecological Values	The use of helicopters and/or drones to manage bird predation negatively impacts on non-predatory bird species (i.e. those birds that do not feed on prawns).	3	2	M	Experimental trials will be undertaken during the 2018/2019 wet season to assess responses of non-predatory birds. A primary objective of this work will be to investigate practical flight protocols for future operations. Protocols are likely to include: Low altitude helicopter movements (i.e. <450m above ground level) will be restricted to airspace above the farm footprint. When transiting between farms, constrain routes to airspace above the Project footprint.	2	1	VL	Non-predatory birds are unlikely to be affected by the use of helicopters and drones as they are unlikely to be attracted to the grow-out farms.
	Threatened and Migratory Species	The use of helicopters and/or drones to manage bird predation negatively impacts on non-predatory threatened and migratory birds (i.e. those birds that do not feed on prawns).	3	2	M		2	1	VL	

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	Threatened and Migratory Species	The use of helicopters and/or drones to manage bird predation negatively impacts on predatory threatened and migratory birds.	3	2	M	When transiting from the farm complex to other parts of the site, or off-site, maintain an altitude of >450m above ground level and restrict movement to airspace above the Project footprint (e.g. infrastructure corridor). When transiting between farms or from the farm complex to other parts of the site, or off-site, operate flights procedures which minimise the incidence and duration of rotor blade slap noise. The operation of helicopters/drones for the Project will comply with the relevant Civil Aviation Authority of Australia (CASA) regulations.	2	2	L	The likelihood of negative impacts is reduced through the implementation of control strategies.
	Human Health and Safety	Accident involving a helicopter results in serious injury or death.	3	5	H		2	5	M	
Spills of contaminants such as fuel and/or chemicals.	Land	Spills of contaminants result in contamination of soils.	3	4	M	Fuel, oil, chemical and liquid waste to be stored in bunded and appropriately contained areas. Fuel and chemical transfer points to be bunded. Spill kits and spill management controls utilised at all storage and transfer points. All waste disposed appropriately offsite or disposed of in the onsite landfill. Training and incident/notification procedures to be adopted.	2	2	L	With mitigation and management measures in place spills are unlikely and procedures are in place to rectify them immediately.
	Freshwater Streams, Rivers and Wetlands	Contaminants enter surrounding freshwater waterways and lead to changes in water quality in freshwater streams, rivers and wetlands.	3	3	M		2	2	L	
	Marine and Estuarine Waters	Contaminants enter surrounding freshwater waterways and lead to changes in water quality in Marine and Estuarine Waters.	3	3	M		2	2	L	
	Groundwater	Contaminants enter groundwater and lead to changes in water quality.	3	3	M		2	1	VL	
	Historic and Cultural Heritage	Contamination results in damage to a site or item of cultural significance.	3	3	M		2	2	L	
Release of waste water from waste water treatment plant (WWTP)	Land	Soil contamination resulting from inappropriate disposal of waste water.	3	2	M	The Wastewater Treatment Plant (WWTP) will be sized appropriate to the load, suitable to the soil types and climate. The WWTP will be designed with alarms and other safeguards to avoid overflow. A Wastewater Works Design Approval will be obtained and the WWTP will be managed in accordance with state and national codes and guidelines, including the Guidelines for Wastewater Works Design Approval of Recycled Water Systems.	1	1	VL	With mitigation and management measures in place the impacts from the WWTP are considered to be very low.
	Freshwater Streams, Rivers and Wetlands	Inappropriate disposal of waste water results in a change in water quality of freshwater streams, rivers and wetlands.	3	2	M		1	1	VL	
	General Ecological Values	Inappropriate disposal of waste water results in a change in freshwater quality which in turn causes a change or loss of habitat/biodiversity values for flora and fauna.	2	2	L		1	1	VL	

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	Threatened and Migratory Species	Inappropriate disposal of waste water results in a change in freshwater quality which in turn causes a change or loss of habitat/biodiversity values for threatened and migratory flora and fauna.	1	1	VL		1	1	VL	With mitigation and management measures in place the impacts from the WWTP are considered to be very low. There are no known threatened or migratory aquatic species within the freshwater environments of Legune Station.
Modification of surface water flows from the modification of existing infrastructure, including bunds and embankments, and development of Project infrastructure including ponds, channels and roads.	Freshwater Streams, Rivers and Wetlands	Modification of surface water flows results in altered hydrology of freshwater streams, rivers and wetlands.	4	3	M	To the greatest extent practical, direct impacts on water bodies and major drainage lines have been avoided. Strategic placement of culverts around grow-out farms and channels, access and service roads to allow for surface water flows. 	2	2	L	As detailed in the Freshwater chapter (Volume 2, Chapter 3), the floodplain hydrological conditions have already been substantially modified over time by the instatement of various bunds, embankments to support roads and the establishment of ponded pastures.
	General Ecological Values	Modification of surface water flows results in a change or a loss of habitat/biodiversity values for flora and fauna.	3	3	M	To the greatest extent practical, direct impacts on water bodies and major drainage lines have been avoided. Impacts of waterway barriers will be minimised by appropriately placed and designed culverts and channel works on infrastructure that reduce upstream ponding and flow conveyance, and the inclusion of drainage infrastructure to ensure connectivity.	2	2	L	
	Threatened and Migratory Species	Modification of surface water flows results in a change or a loss of habitat/biodiversity values for threatened and migratory species.	3	3	M		2	2	L	
	Historic and Cultural Heritage	Modification of surface water flows results in an impact on a cultural site.	3	3	M	To the greatest extent practical, direct impacts on water bodies and major drainage lines have been avoided. Strategic placement of culverts around grow-out farms and channels, access and service roads to allow for surface water flows.	2	2	L	
Cessation of annual releases of dam water to create ponded pastures	Freshwater Streams, Rivers and Wetlands	The cessation of the annual releases of dam water reduces the extent of freshwater streams, rivers and wetlands in the dry season.	5	2	M		5	2	M	Based on the analysis detailed in the Freshwater chapter (Volume 2, Chapter 3), the effect of ceasing water flows from the annual release of Forsyth

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
during the dry season.	General Ecological Values	The cessation of the annual releases of dam water results in a change or loss of habitat/biodiversity values for flora and fauna in the dry season.	4	2	M		4	2	M	Dam in the dry season is a short term decrease in the extent of surface water for 4 to 8 weeks. Water will persist in the upstream sections of Alligator Creek in the dry season. This would be similar to natural conditions prior to the construction of Forsyth Creek Dam. Bird species whose abundance was seen to increase with the inundation are known to move annually in response to the availability water.
	Threatened and Migratory Species	The cessation of the annual releases of dam water results in a change or loss of habitat/biodiversity values for threatened and migratory species in the dry season.	4	1	M		4	1	M	
Contact with crocodiles	Human Health and Safety	Contact with crocodiles results in injury or death.	3	4	M	All personnel will be made aware of the dangers of crocodiles in the Project Area. Appropriate signage will be installed around the Project Area to remind personnel of the potential presence of crocodiles. All sightings of crocodiles in and around the Project Area will be immediately reported to the farm manager. Access will be restricted to any area that is known to be inhabited by a crocodile until the crocodile has been moved on or relocated from the area. Personnel will be required to observe waterbodies and surrounding areas for crocodiles prior to working near the water's edge. Vegetation surrounding waterbodies will be maintained in as low in height as practical to enable easy observation of the area. Any work required to be undertaken on water (e.g. boat activities) will always be conducted by multi-person work crews with one person acting as an observer at all times. When a crocodile has taken up residence within the Project Area, the NT Parks and Wildlife Commission or other such authority will be notified and a request to trap and relocate the crocodile will be submitted. Only trained, competent and authorised persons will attempt to move, relocate, capture or otherwise handle a crocodile.	2	4	M	
Meteorological Events	Human Health and Safety	Injuries or fatalities of personnel as a result of a cyclone.	3	5	H	All buildings will be designed to withstand a Category C cyclone wind loading (i.e. wind speeds of up to 252 km/hour). The central mess area (located in the central facilities area) will be designated as the emergency response centre where all personnel will	3	2	M	

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
						assemble in the event of a cyclone warning being issued for the site. The central mess area will be appropriately provisioned with emergency equipment and supplies (e.g. potable water, torches and batteries, first aid kit, radio and communication devices, tarps, ropes and non-perishable foodstuffs). Generators and emergency response plant and equipment (e.g. chainsaw, tractor, front-end loader etc.) will be kept onsite and in serviceable condition. Fuel stores sufficient for one week's operation of generators and emergency response plant and equipment will be kept on site. All personnel will be adequately briefed and practiced in what to do in the event of a cyclone or severe storm. A register of all personnel and next of kin contact details will be established and maintained. A climate change plan will be developed.				
		Injuries or fatalities of personnel as a result of bushfires.	3	4	M	A bushfire management plan will be developed for the Project in consultation with the relevant authorities and Traditional Owners. All buildings will be constructed in accordance with Australian Standard (AS) 3959-2009 - Construction of Buildings in Bushfire-prone Areas. Firebreaks up to 30 m wide will be established and maintained around the central facilities and accommodation village. A fire truck equipped with the appropriate firefighting equipment will be stationed at the central facilities. All personnel will be adequately briefed and practiced in what to do in the event of a bushfire.	3	2	M	
		Dehydration and heat stroke from extreme temperatures.	3	4	M	All personnel working outdoors will be required to wear long sleeved shirts and hats to help reduce sun exposure. Sunscreen will also be made available to all personnel. All personnel will be made aware during induction training of the signs and symptoms of overexposure to heat and its effects, including dehydration. Drinking water will be made readily available onsite.	3	2	M	
Operation of boats	General Ecological Values	Mortality or injury of aquatic fauna from boat strike.	3	1	L	Boat crew to maintain a look out for aquatic fauna during all operations. If a boat approaches aquatic fauna (or vice versa), the vessel will take all care to avoid collisions, including stopping, slowing down and/or steering away.	2	1	VL	Boats will only be used during the construction of the seawater intake pump and then intermittently during operations (e.g. for water quality
	Threatened	Mortality or injury of threatened or	3	1	L		2	1	VL	

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	and Migratory Species	migratory aquatic fauna from boat strike.								sampling).
	Human Health and Safety	Injuries or fatalities of personnel resulting from the operation of boats.	3	4	M	• Personnel responsible for the operation of the boats will hold appropriate licences. • All personnel on the boat must be fit for work and not under the influence of alcohol or other drug. • Any boat activities will always be conducted by multi-person work crews with one person acting as an observer at all times. • Boat ramps will be constructed where required to assist in the launching or retrieval of boats from the water. • All boats will be adequately sized and equipped with life vests, first aid kit, emergency position indicating radio beacon (EPIRB), fire extinguisher and emergency provisions (e.g. water, food and insect repellent). • All personnel on the boat are to wear life vests at all times. • All boats are to be fitted with a working means of communication (e.g. a two way radio and/or satellite phone). • Tides and weather conditions will be consulted and a journey management plan prepared prior to operating a boat in the waterways surrounding the Project site.	2	3	M	
Traffic movements	General Ecological Values	Increased traffic movements as a result of the Project results in the mortality or injury of terrestrial fauna or avifauna.	5	1	M	• Roads will be clearly signposted and designed to minimise potential for roadkill. • A fauna management plan will be developed and implemented and will include procedures for managing traffic incidents involving fauna.	4	1	M	• Legune Station supports a very high density of agile wallabies, which are listed by DLRM as one of the native pest species for the area. Because they are in such large numbers they are currently subject to mortality as a result of pastoral operations. As such it is likely incidents will occur during operations. • Will not constitute a significant impact to the population given the very high density at which they occur on the site.
	Threatened and Migratory Species	Increased traffic movements as a result of the Project results in the mortality or injury of threatened or migratory terrestrial fauna or avifauna species.	2	2	L		2	2	L	• The majority of threatened and migratory species known to be present on site are avian and unlikely to inhabit road verges.

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
	Human Health and Safety	Increased traffic movements lead to an increase in vehicle incidents.	3	5	H	The upgrading of part of Moonamang Road, the Cave Springs Road by the WA and NT governments respectively and the Legune Access Road as part of the Project will ensure that the entire route from Legune Station to Kununurra is of an appropriate standard and capacity to accommodate the needs of the Project. Vehicles to adhere to site speed limits and road rules. Personnel operating vehicles must not be under the influence of alcohol or other drugs. Personnel will be appropriately licenced. Vehicle inspection checks and services required to be undertaken at regular (appropriate) intervals. All Project personnel to complete a site and safety induction prior to commencement of work. Establish, implement and monitor a Driver Safety and Fatigue Management Policy for all employees and contractors.	2	5	M	As described in the Traffic and Transport chapter (Volume 3, Chapter 4), the projected change in traffic movements as a result of the operation of the Project is negligible and will be within the normal day-to-day variation in traffic volumes.
Power generation	Air Quality	Emissions from power station impact on air quality at sensitive receptors.	2	1	VL	The Project was designed to ensure the power station was located away from any sensitive receptors.	2	1	VL	As detailed in the Air Quality chapter (Volume 2, Chapter 10) there are no nearby sensitive receptors that would be impacted by air emissions from the Project.
Noise generated during operations (e.g. operation of pumps, traffic movements etc)	Amenity	Increased noise levels at sensitive receptors.	2	1	VL	All equipment will be selected to minimise noise emissions. Equipment will be fitted with appropriate silencers and be in good working order. All engine covers will be kept closed while equipment is operating. The height at which material is dropped into or out of trucks will be minimised as far as possible. Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes will be minimised, where practicable. Machines found to produce excessive noise compared to industry best practice will be removed from the site or stood down until repairs or modifications can be made. To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) will be used for site equipment.	2	1	VL	As detailed in the Noise and Vibration chapter (Volume 2, Chapter 12), there are no nearby sensitive receptors that would be impacted by noise emissions from the Project.
	Threatened and Migratory Species	Increased noise levels results in the disturbance of threatened and migratory fauna and avifauna.	2	1	VL		2	1	VL	Operational noise will be consistent year-round, but typically peak at 55 dB(A), which is in the realms of normal ambient noise. Operational noises will be longer term, but are modelled to be quieter (<55 dB), more regular, predictable, and more localised than construction operations noise.

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
Biting Insects	Human Health and Safety	The Project results in the creation of areas of mosquito breeding habitat which results in the transmission of diseases or nuisance problems.	3	3	M	▪ The slope of the embankments for the farm ponds, settlement ponds, main feeder canal and main discharge channel will be no flatter than 1V:3H. ▪ Ponds will be aerated when in use. ▪ The farm pond floors will be contoured to allow the ponds to completely drain and dry out when not in use. ▪ Culverts and spoon drains will be installed to drain the areas in between the farms and prevent the inadvertent ponding of water in these areas. ▪ Culverts will be installed where required along the central service road and Legune Access Road to allow the natural flow of water and prevent the shallow impoundment of water. ▪ Where possible, borrow pits will be rehabilitated to be free draining when no longer required. ▪ Any equipment such as tanks, drums, buckets, machinery items and other receptacles sourced from North Queensland will be inspected for water ponding or evidence of previous water ponding (water stains) to prevent the potential introduction of the dengue mosquito, Aedes aegypti, from North Queensland as larvae or desiccation resistant eggs. ▪ Personnel wear light coloured, long sleeved shirts and mosquito repellent. ▪ Installation of low intensity yellow lighting in outside areas, where possible, to minimise attracting insects. ▪ The Project Area will be kept as clean as possible with artificial receptacles stored undercover away from rain where possible or stored in a manner that prevents the ponding of water and creation of mosquito breeding habitat.	2	3	M	▪ Legune Station already contains extensive areas of mosquito breeding habitat. ▪ The accommodation camp and central facilities where the majority of Project personnel will work and live has been sited away (approximately 20 km to the south) from the grow-out centre.
Introduction or spread of weeds/pest animals during	General Ecological Values	The introduction or spread of weeds/pest animals results in the change or loss of habitat/biodiversity values for terrestrial flora and fauna.	4	4	H	▪ Weed Management Plan will be implemented including regular weed inspections. ▪ A Fauna Management Plan will be prepared which will include pest animal	2	2	L	▪ With mitigation measures in place it is unlikely that any weeds/pest animals will be introduced or spread as a result of Project operations.

Risk			Initial Risk			Control Strategies	Residual Risk			Evaluation Rationale
Source of Impact	Consequence Aspect	Consequence	Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level	
operations.	Threatened and Migratory Species	The introduction or spread of weeds/pest animals results in the change or loss of habitat/biodiversity values for threatened flora and threatened and migratory fauna.	4	4	H	eradication and management strategies for operations. • Environmental inductions for workforce to include identification of problem weeds. • Vehicle and equipment wash-down procedures on-site. • Implement weed control notification and location recording for weed identified on site. • Weed control monitoring and management practices. • Ensure fire management plan applies to construction and takes into consideration weed impacts following burn offs. • Manage landfill and putrescible waste to control feral and pest animal ingress.	2	2	L	

4 RISK ASSESMENT RESULTS

The environmental risk assessment identified 51 construction related risks and 49 operational risks.

The majority of residual risks identified and assessed for construction had a low risk rating (23 - Figure 1). For operations, there were similar numbers of risks that had a medium risk rating (19) as very low risk ratings (17) (Figure 3).

There were no risks identified and assessed during construction or operations that had an extreme risk rating. Five construction related risks and six operational risks were initially rated as high. These risks were associated with:

- Risks to general ecological values and threatened and migratory species as a result of the introduction and/or spread of weeds and pest animals during construction and operations.
- Risks to cultural heritage sites during construction works.
- Risks to marine and estuarine water quality as a result of the discharge into Alligator Creek.
- Risks to human health and safety as a result of vehicle incidents and meteorological events (i.e. cyclones and bushfires).

Through the application of controls measures however, these risks were able to be reduced. As such there are no residual risks with a high risk rating.

The risk profile for each consequence aspect across the construction and operational phases of the Project are presented in Table 7 and Table 8. This shows that the highest number of risks for both construction and operational phases are associated with threatened and migratory species. The majority of these risks to threatened and migratory species, however, are rated low or very low.

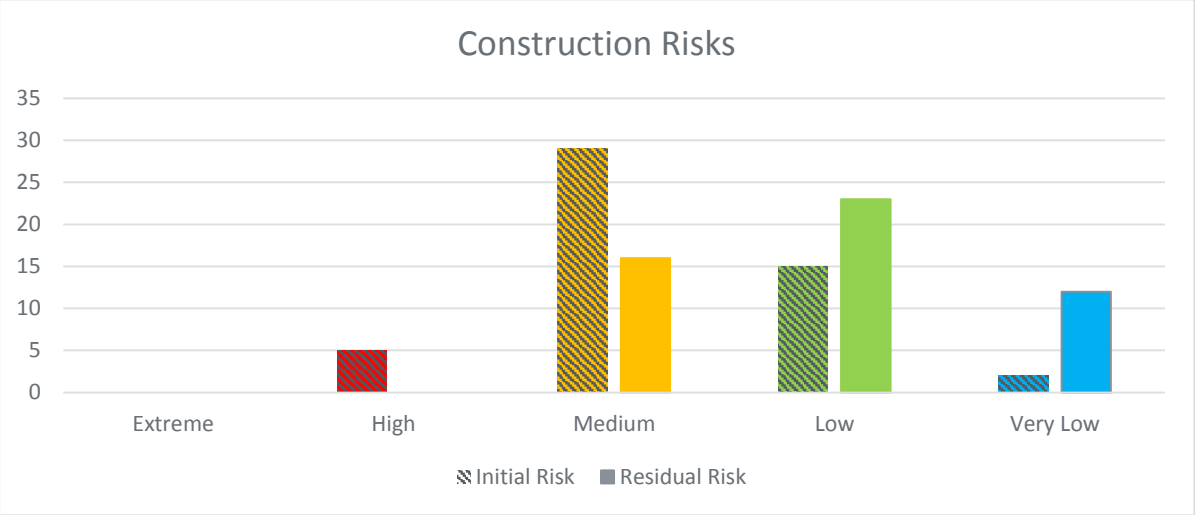

FIGURE 2 CONSTRUCTION RISK RATINGS

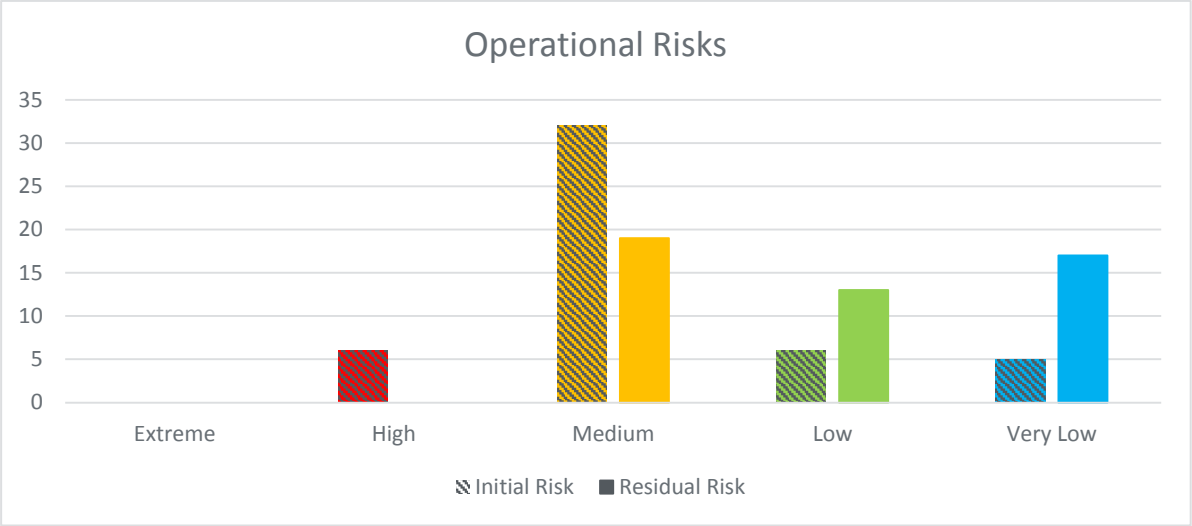

FIGURE 3 OPERATIONAL RISK RATINGS

TABLE 7 SUMMARY OF RESIDUAL RISK RATING BY CONSEQUENCE ASPECT - CONSTRUCTION

Consequence Aspect	Risk Rating					
	Extreme	High	Medium	Low	Very Low	Total
General Ecological Values	0	0	7	1	0	**8**
Threatened and Migratory Species	0	0	1	7	3	**11**
Historic and Cultural Heritage	0	0	2	1	1	**4**
Amenity	0	0	0	2	1	**3**
Land	0	0	2	5	1	**8**
Marine and Estuarine Waters	0	0	0	2	1	**3**
Freshwater Streams, Rivers and Wetlands	0	0	1	3	1	**5**
Groundwater	0	0	0	1	2	**3**
Air Quality	0	0	0	1	2	**3**
Human Health and Safety	0	0	3	0	0	**3**

TABLE 8 SUMMARY OF RESIDUAL RISK RATING BY CONSEQUENCE ASPECT - OPERATIONS

Consequence Aspect	Risk Rating					
	Extreme	High	Medium	Low	Very Low	Total
General Ecological Values	0	0	4	2	4	**10**
Threatened and Migratory Species	0	0	1	5	5	**11**
Historic and Cultural Heritage	0	0	0	2	0	**2**
Amenity	0	0	0	0	1	**1**
Land	0	0	0	1	1	**2**
Marine and Estuarine Waters	0	0	4	1	2	**7**
Freshwater Streams, Rivers and Wetlands	0	0	1	2	2	**5**
Groundwater	0	0	1	0	1	**2**
Air Quality	0	0	0	0	1	**1**
Human Health and Safety	0	0	8	0	0	**8**

5 MITIGATION AND MONITORING

There were no risks identified and assessed during construction or operations that had an extreme or high risk rating. All residual risks were either rated medium, low or very low. These risks are considered able to be successfully managed and mitigated through inclusion of the identified control measures into the Environmental Management Plan (EMP) procedures and relevant management plans (Volume 4, Chapter 3).

Ongoing monitoring and management will be undertaken to test the effectiveness of the nominated controls, audit their implementation and identify other measures or different approaches that may be required to achieve and maintain acceptable risk levels. Measures to do so are outlined in the EMP for the Project.

6 CONCLUSION

A risk based approach was adopted to identify and assess potential environmental impacts associated with the Project. The methodology employed was a standard semi-quantitative risk assessment consistent with AS/NZS ISO 31000:2009 'Risk Management – Principles and Guidelines'.

Initial risk ratings were assessed for each risk identified taking into account the consequence and likelihood of the risk occurring without any control measures in place. Control strategies were then identified for each risk, and the risk rating reassessed. All risks identified during the risk assessment process are considered to be able to be successfully managed and mitigated through the implementation of control strategies, and there are no residual risks that have an extreme or high risk rating.

The control measures identified in the risk assessment process have been used in the development of the Environmental Management Plan (Volume 4, Chapter 3) and will be implemented in the construction and operation of the Project.