Technical Appendix 1

Sustainability Assessment and Risk Assessment

January 2021

Palm Island

Decarbonisation of Great Barrier Reef Islands – Whole of Community Pilot Project

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GLOSSARY

Table 1: Acronyms

Acronym	Definition
ABS	Australian Bureau of Statistics
ABIS	Aboriginal Business, Industry and Service
AC	Air conditioning
ATM	Automatic teller machine
CDP	Community Development Program
CEC	Clean Energy Council
DES	Department of Environment and Science
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DHPW	Department of Housing and Public Works
EV	Electric vehicle
FTE	Full-time equivalent
FY	Financial year
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GHG	Greenhouse gas
ILUA	Indigenous Land Use Agreements
LED	Light-emitting diode
LPG	Liquefied petroleum gas
NA	Not applicable
PCYC	Police Citizens Youth Club
PHES	Pumped Hydro Electric Storage
PIASC	Palm Island Aboriginal Shire Council
PICC	Palm Island Community Company
QTIC	Queensland Tourism Industry Council
RCD	Residual current devices
RCP	Representative concentration pathways
RES	Regional Economic Solutions
SCADA	Supervisory control and data acquisition
SES	State Emergency Service
Solar PV	Solar photovoltaic
STP	Sewage treatment plant
WTP	Water treatment plant

Table 2: Units

Measurement	Symbol	Meaning
Area	m^2 km^2 ha	Square metre Square kilometre Hectare
Temperature	°C	Degrees Celsius
Carbon Emissions	tCO_2-e $kgCO_2$-e	Tonne of Carbon dioxide equivalent Kilogram of Carbon dioxide equivalent
Energy	MJ GJ TJ kWh MWh	Megajoule Gigajoule Terajoule Kilowatt hour Megawatt hour
Mass	kg T	Kilogram Tonne
Solar panel power rating	Wp kWp kW	Watt peak Kilowatt peak Kilowatt
Speed	m/s	Meter per second
Volume	L kL ML m^3	Litre Kilolitre Megalitre Cubic metre

Table 3: Terms

Term	Definition
Blackouts	The loss of electrical power to users
Brownouts	Extended drop in energy voltage
Compost	Convert organic material waste into nutrient-rich substance
Decarbonise	Reduce the amount CO2 (or CO2 equivalents) emitted by an activity or a process
Ecosystem	A biological community of interacting organisms and their environment
Energy efficiency	Using less energy to provide products and services
Isolated power supply	A power grid which is not connected to other power systems
Opal fuel	Opal is a variety of low-aromatic 91 RON petrol developed in 2005 by BP Australia to combat the rising use of petrol as an inhalant in remote Indigenous Australian communities
Passive building design	Buildings designed to naturally circulate air and cool during the summer and retain sunlight heat during winter
Per capita	Per capita is equivalent to 365 full person days. This activity measure incorporates only resident populations, sourced from the DATSIP Master Planning Report 2019. It excludes visitors as this data was not available at the time of this report.
Potable water	Water that is safe to drink and use for food preparation
Qualitative data	Can be observed and recorded. It is usually not numerical, and collected through methods of observations, one-to-one interviews, conducting focus groups, and similar methods.
Quantitative data	Information and numbers which describe something in a detailed manner
Recycle	Convert waste into a reusable material
Resilience	The capacity to recover and rebuild after a traumatic event
Severe weather event	Dangerous weather with the potential to cause damage or social disruption
Solar Photovoltaic (PV)	Technology which converts sunlight into electric current
Sustainability	Resources are consumed in a responsible manner and maintained for future generations while ensuring environmental, social and economic balance
Sustainability theme	The five sustainability themes for this project are energy, waste, water, transport and resilience
Waste stream	Flows of specific kinds of waste from the source to recycling or disposal (burial/incineration)
White goods	Large electrical domestic goods (refrigerator, washing machine, etc.)

PALM ISLAND SUSTAINABILITY AND RISK ASSESSMENT

EXECUTIVE SUMMARY

The sustainability assessment represents the first phase of the Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project, as presented in Figure 1Figure 1: Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project Phases. The project is funded by the Queensland Government Department of Environment and Science. The aim of this project, run by EarthCheck in partnership with Arup, Regional Economic Solutions (RES) and Queensland Tourism Industry Council (QTIC), is to provide Palm Island with community-led contextually and culturally appropriate project options for decarbonisation and resilience-building.

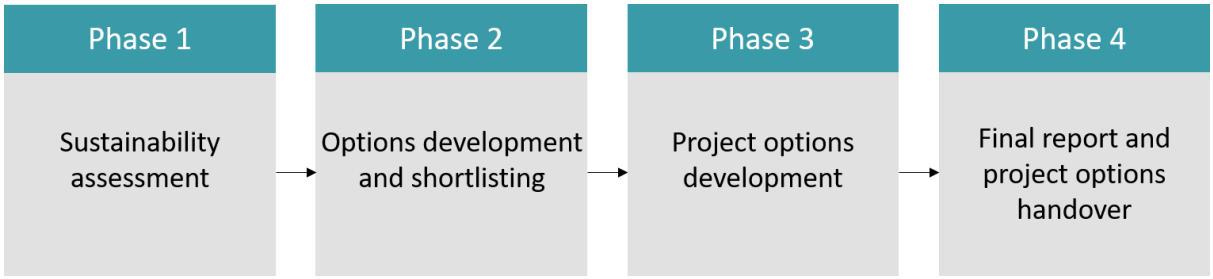

Figure 1: Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project Phases

The sustainability assessment phase commenced on the 24th of June 2019 and was carried out in the following order:

- Project preparation and planning;
- Desktop research on Palm Island;
- Engagement with key contacts (on and off-island);
- Island visit (26th, 27th and the 28th of August 2019);
- Data assessment; and
- Sustainability reporting (this report).

The sustainability assessment focussed on developing a whole-of-community sustainability profile across the five key areas of energy production and efficiency, water and wastewater use, waste management, transport and resilience. Based on these findings, the whole-of community carbon emissions profile was developed as a benchmark for Palm Island.

The findings from this sustainability assessment helped to identify opportunities for decarbonisation and resilience-building. The results from this first project phase were used to inform the development of a preliminary long list of emission reduction options. Further community consultation, options analysis and the gateways process tested these options to identify projects with the highest feasibility and likelihood of success, which were developed into final project options.

Sustainability Assessment Key Findings

Community members are eager to see more sustainable practices implemented on Palm Island. There is a strong will to align projects and investments with a tangible increase in community and economic development for the island. Decarbonisation and resilience-building efforts must sensitively balance traditional and cultural knowledge in order to bolster

community economic participation which appropriately harnesses modern day technologies while maintaining and solidifying the connection to land and culture.

For projects to be successful, decarbonisation and resilience-building efforts need to generate tangible and proven results in terms of quality of life improvements, economic development and the bolstering of the cultural connection between the Palm Island community and their land and seas.

The whole of community emissions profile*:* carbon emissions are calculated as **6,530t CO_2-e** for the Palm Island community for an average year[1]. This equates to per capita emissions of **1.63t CO_2-e** per year.

Energy

- ***Community sentiment:*** Energy plays a central role in the community's livelihoods, as it is used for water treatment and distribution, to power homes, air conditioning and many other purposes. The high cost of energy has been identified as a key issue and an obstacle to community economic development.
- ***Energy generation:*** Energy is produced by a recently refitted Ergon Energy 3.56MW isolated diesel generator power station. There are also 162.2kW of solar PV installations on Palm Island, but only half of these are functional or connected.
- ***Solar PV:*** There have been significant investments in solar energy infrastructure across the island on council and government buildings, but many of these assets are not being used due to damage or lack of grid penetration capacity. Solutions are currently being investigated by Palm Island Aboriginal Shire Council (PIASC).
- ***Solar hot water:*** Almost all homes on Palm Island are equipped with solar hot water systems. The hot water supply has been identified as insufficient for the community, potentially due to aging systems and/or their insufficient size combined with large households (estimated at 8 persons per household on average). Metal grids cover all systems to protect from vandalism.
- ***Energy consumption:*** Overcrowding in homes contributes to an increase in per-household energy usage compared to the state average.
- ***Power cards:*** Community members pay for energy with a power card on a "pay-as-you-use" basis. Cards can be issued to individuals or to a specific address. These cards can be refilled at various locations around the island including the Aboriginal Business, Industry and Service (ABIS) shop, the chip shop as well as the service station.
- ***Cost of energy:*** The cost of energy is a burden for the community. Different community organisations provide power cards to people in need, but residents can often be left without energy.
- ***Building types and design:*** Most homes have limited or lack of insulation, natural lighting, shading and air circulation, and other energy efficiency considerations. This jeopardises the comfort of the residents and contributes to high energy costs.

[1] *An average year for carbon emissions is the modelled year based on a combination of components (i.e. electricity, transport and waste) calculated using different timeframes dependent on the data that was available at the time of writing this report. This will be further broken down in subsequent sections.*

The total energy consumption for the Palm Island community including electricity, solar power, LPG usage and energy associated with transport, was evaluated at **73,447GJ** per annum based on an average year[2] or **18.36GJ** per capita.

Water

- ***Community sentiment:*** Community members identified access to clean potable water as well as sufficient reserves as the most important issues for Palm Island.
- ***Water supply***: Water for the community comes from two dams (Solomon and Francis Creek) and is stored in tanks which provide 3 days of reserves. This has been identified as a key risk for the community.
- ***Water quality:*** The island has been experiencing significant water quality issues for years (discoloration and sediment) accompanied by water boiling alerts. This has forced many Islanders to boil water, use filters or purchase bottled water at great expense.
- ***Wastewater treatment:*** The existing wastewater treatment plant is nearing capacity (5,000 people). Wastewater biosolids are a potential contamination issue as they are currently disposed of on-island and have accumulated overtime.
- ***Water usage and efficiency:*** The community is supplied with treated water free of charge without the use of water meters. Bottled water is used extensively throughout the island, often associated with affluence.
- ***Communications and education:*** Based on community testimony, there is a lack of communication and education around water quality, usage and efficiency measures on Palm Island.

The total water consumption for the Palm Island community was estimated at **547,500kL** per annum[3] or **136.9kL** per capita[4].

Waste

- ***Community sentiment:*** Community members identified waste management as one of the most important issues for Palm Island, specifically plastic pollution across the island as well as the lack of recycling services.
- ***Waste management:*** Waste management is expensive for PIASC, specifically due to the lack of a functional waste compactor resulting in uncompacted waste being barged off the island. Council is currently billed by volume by the barge company.
- ***Green waste:*** All green waste is currently incinerated at the waste transfer station on the island.
- ***Waste transport:*** All general waste is barged to the mainland five days a week to be sent to landfill (Hinchinbrook Shire Council). The supply barge transports waste on return trips.

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[2] *An average year for energy consumption is the modelled year based on a combination of components (i.e. electricity, LPG, solar and transport) calculated using different timeframes dependent on the data that was available at the time of writing this report. This will be detailed further in the Energy section.*

[3] *Based on average daily demand of 1.5 megalitres* (GANDEN Engineers and Project Managers, 2014)

[4] *This includes residential and non-residential water usage such as visitors, council, and commercial usage, as no portioned water usage is measured on Palm Island.*

- ***Waste transfer station:*** The available space is limited at the waste transfer station, restricting the capacity to stockpile and effectively manage waste. Poor security on the premises results in disorganised and illegal disposal, increasing costs for the council.
- ***White goods:*** White goods are stockpiled at the waste transfer site. Refrigeration units (air conditioners and fridges) are not treated, resulting in significant environmental contamination risks.
- ***Existing actions to reduce waste:*** There is currently no recycling occurring on Palm Island. Community reuse many different materials such as pallets, wood, pipes, etc. There is a small-scale container collection project being run by the local pub, but most containers are currently sent to landfill.

The total waste disposed to landfill for the Palm Island community was estimated at **3,477m^3** per annum[5] or **0.87m^3** per capita.

Transport

- ***Community sentiment:*** Transport and accessibility is an issue for the community on Palm Island, especially for the elderly, ill and mobility impaired. Pedestrian safety is a concern for residents, due to the lack of streetlighting between community hubs and degraded roads.
- ***On-island transportation****:* Transportation on the island is mainly achieved by foot, car, bicycle or horse. There are approximately 337 cars registered on Palm Island, equating to approximately 0.6 per household.
- ***Public transport:*** There is no public transportation system on Palm Island, but there is a private shuttle/taxi service. Organisations such as health services, schools and community groups often have their own vehicles or buses to promote community participation and access to their services.
- ***Air transport:*** Palm Island is serviced by 57 return flights to Townsville per week. The bulk of the passengers are estimated to be workers flying in from Townsville to work on the island.
- ***Barge:*** The community is concerned about the lack of competition in barge services driving up prices. This has been flagged as an important obstacle for economic development.
- ***Ferry:*** The high cost of ferry tickets as well as the safety of passengers waiting on the jetty are concerns to the community. The jetty is currently being upgraded to increase the safety of travellers.

Resilience

- ***Community sentiment:*** Economic opportunity and upskilling were identified as critical to elevate the community's quality of life and community resilience by diversifying activities and income streams. Becoming more self-sufficient in terms of energy production, food production and access to potable water were raised as key resilience issues for Palm.
- ***Fossil fuel dependence:*** Community resilience and self-sufficiency on Palm Island is closely tied to energy security and fuel supply, due to:

[5] *Landfilled waste per annum collated 2018* (A. Prince Consulting, 2019)

    - Heavy reliance on the barging of goods and supplies from the mainland, as there is no food production on the island. The island can become isolated from the mainland during severe weather events.
    - Diesel generators provide all electricity and operate the water treatment plant and the pump system for potable water supply.
- ***Housing***: The government housing is reportedly not suitable for the average household size of 8 persons per house. There is also a long wait list for housing on the island. Combined with high interior temperatures caused by lack of air-conditioning and ill-adapted housing design, this causes stress on the community's health. It is estimated that 18% of homes were built before 1982 and thus not designed to meet Queensland Government cyclone building standards and have no records demonstrating compliance.
- ***Environment***: A range of invasive species such as wild pigs and weeds (*Triumfetta rhomboideo* or *Chinese burr*) apply pressures on native flora and fauna, significantly impacting the ecosystem on the island.
- ***Climate change and severe weather events:*** Severe weather events have caused damage to coastal areas, property and infrastructure on the island such as road damage and sand accumulation. Climate change is likely to increase the severity and/or frequency of these events and resultant damage. There is currently no cyclone shelter on the island and the current disaster management plan prepares for community evacuation to the mainland.
- ***Telecommunications:*** Telstra is the only cellular/internet provider with coverage on Palm Island. Cellular reception covers approximately 60% of the island and most of the population hubs, though connection is unreliable and can be very slow. Connectivity issues have been identified as an obstacle to community development as well as to timely and effective response in emergency events.
- ***Island mode:*** It has been identified by multiple community stakeholders that the main limiting factor related to the community's capacity to operate independently from the mainland is the potable water reserve. When full, the town reservoir is estimated to hold 3 days' worth of water. Another key issue is the lack of any food production on the island.

1. SUSTAINABILITY ASSESSMENT METHODOLOGY

Figure 2 below illustrates the main steps included in the sustainability assessment. The five themes of energy generation and efficiency, water, waste, transport and resilience were assessed.

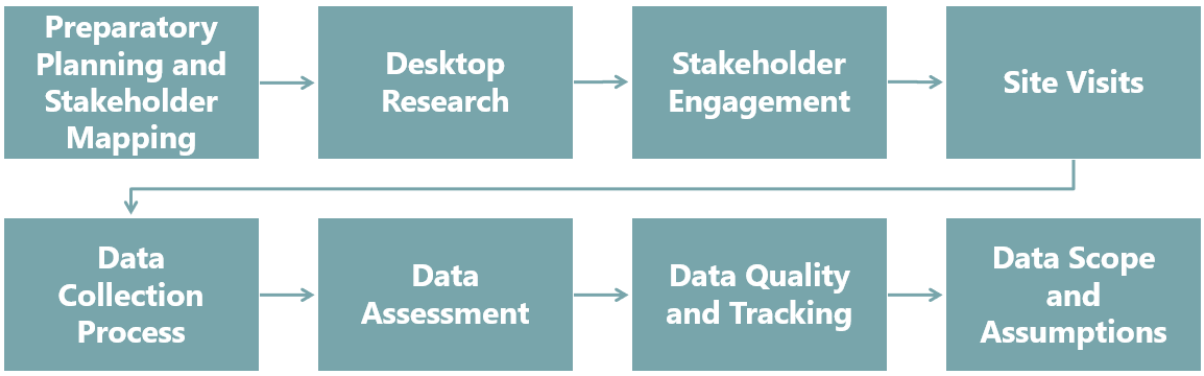

Figure 2: Sustainability Assessment Methodology

1.1. Preparatory Planning and Stakeholder Mapping

The project team defined the scope and method to assess the five key themes of energy, waste, water, transport and resilience. During the preparatory planning and stakeholder mapping steps, the project team identified stakeholders and groups to engage with. These were captured in the stakeholder register (containing names, organisations, positions, email addresses, phone numbers as well as a communication log) which was updated throughout the project to account for evolving relationships and changes (see Appendix 1: Palm Island Communication and Engagement Plan).

A wide-ranging and flexible data collection strategy was essential to collect the required primary and secondary data. This approach effectively captured input from the high number and variety of stakeholders involved throughout the sustainability assessment and relevant to the project. For this reason, a combination of data collection methods were applied that were deemed most appropriate for this project, which are defined in Table 4.

Table 4: Data collection methods for sustainability assessment

Data collection method	Approach and sustainability assessment outcome
Third party reports and data	Operational data, statistics, reports, etc., were obtained from a range of stakeholders including PIASC, Ergon, SeaLink, Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) and other key contacts. This also included research papers and publicly available documents. This information was gained through information requests sent to the concerned parties alongside desktop research.
Community meetings and discussions	Attending pre-existing community groups' meetings was a key community engagement approach. This allowed the project team to present the project to a wider range of individuals and gain community understanding and context. The groups visited include the PIASC, the

	Community Development Program (CDP), Palm Island Community Company (PICC), the Men's Shed and the Women's Group.
Online survey	A survey targeting the project's five key themes was distributed to the Palm Island community before the second visit (November 2019). Key contacts included the PIASC staff, SeaLink, CDP and Saint Michael's Catholic School. Only approximately 15 respondents participated in the survey for Palm Island. These results were discounted due to not being statistically significant for a population of approximately 4,000. However, individual testimonies and commentaries from the surveys were used as anecdotal evidence to inform the sustainability assessment. For survey responses, please contact EarthCheck directly. Potential reasons for the low response rate are lack of communication and promotion with the community, competing priorities in the community, restricted internet access (for internet format) and/or survey format (length and complexity). Cultural context around the provision of personal information to government is also a key consideration.
Interviews	Interviews consisted of one-on-one or small group discussions and focused on the five sustainability themes. Information was captured by note-taking. All field notes were collated in a central sustainability assessment OneNote document.
Drop-in sessions	Drop-in sessions allowed the project team to meet community members and other stakeholders, build relationships and promote the project. The project's key themes were the focus of the conversations with the community. One all-day drop-in session was held on the island on 27 August 2019. Drop-in sessions were also held on the 5, 6 and 7 of November 2019 covering activities for both phase 1 (sustainability assessments) and phase 2 (options longlist). Further detail and information for the sustainability assessment was collected during this visit.
On-island visits	On-island visits allowed the project team to collect detailed qualitative and quantitative information on the project's five key themes. Buildings, infrastructure, equipment, etc. were visited during an island-wide tour conducted by PIASC. All field notes were collated in a central sustainability assessment OneNote document.
Photographs	Photographs were taken during island visits to provide context to the collected data. Photographs of private property and people were only taken where permission was granted.

1.2. Desktop Research

A desktop research and literature review were undertaken to develop understanding around the history, culture, demographics, infrastructure, facilities and future development of Palm Island including previous climatic events and impacts, future climate projections and existing preparation and recovery documentation.

The review encompassed secondary information including reports, existing data and previous studies conducted on the island and the region as well as other publicly available information to inform the following steps of the assessment.

The desktop research provided context and acted as a foundation for the key theme areas of the sustainability assessment.

Among others, key documents included in the literature review were:

- Palm Island Community Prioritisation Plan (Flanagan Consulting Group)
- Palm Island Enterprise Strategy (Vital Places)
- Palm Island Local Disaster Management Plan (PIASC)
- Coastal Management Strategy
- Palm Island – Place of Refuge Feasibility Study Evacuation and Shelter (Mullins Consulting)
- Master Plan for Palm Island (DATSIP)
- Transport Infrastructure Assessment and Access Strategy (AECOM)
- Housing Conditionality, Indigenous lifeworlds and policy outcomes – Palm Island case study (Shaneen Fantin)
- Palm Island Readiness and Resilience Program (Townsville Enterprise)
- Deadly Innovation Strategy (Queensland Government)

1.3. Stakeholder Engagement

The project team was introduced to key state government contacts from DATSIP by DES. DATSIP then introduced the team to local council contacts and other key on and off-island contacts, including local government contacts from PIASC, SeaLink, Ergon Energy and other community organisations.

RES led the project team with the engagement of First Nation communities (those with Historical Association) and the Traditional Owners of Palm Island. RES's approach involved reaching out to community members, elders and community leaders (by phone or face-to-face) through family connections or acquaintances to build trust-based relationships with community. In some instances, RES established contact with local communities while on other business near the islands. This process enabled project knowledge and buy-in to be developed prior to the sustainability assessment visit, not only accelerating the consultation process, but displaying respect and due process for First Nation community engagement. The relationships between the project team and the island community were developed and strengthened throughout the various project phases and island visits. The RES multi-layered engagement approach rested on local knowledge, community-based networking and relationship building. Following-up and staying in touch with key members of the community was essential to maintaining project engagement and aimed to ensure participation in the upcoming phases.

A local operational team was established to help the project progress in a pertinent and impactful manner, promote local ownership of the project, and ensure strategic alignment with other programs. A balanced team consisting of native Palm Islanders and workers from the mainland was imperative for this team to support project success and accurately represent the Palm community.

The operational team was constituted of the following representatives:

- Allison Rossetto (PIASC)

- Janelle Whitehead (CDP)
- Nerida King (CDP)
- PIASC water treatment officer
- Men's Shed representative
- Elder representative
- Traditional Owner representative
- Community representative
- Vitali Belokoskov (Energy Queensland)
- Zoe Burns (Energy Queensland)

Due to community constraints, availability issues, and external issues complicating the engagement process, the Palm Island operational team was not fully implemented. A first meeting was held in January 2020, but as no community members could attend, subsequent meetings were not held. Other considerations complicating engagement included Sorry Business in the community in the first two months of 2020, the 2020 local government elections and then the COVID-19 pandemic temporarily shutting down the island.

Alternatively, frequent and maintained communications between RES and key community stakeholders ensured continued community engagement. Key community contacts were provided project documentation and given the opportunity to input.

1.4. Site Visits

The project team visited Palm Island to collect quantitative and qualitative data on the 26, 27, and 28 of August 2019. To complete the sustainability assessment and address any remaining information gaps, further data collection was conducted during the second island visit between 5, 6 and 7 of November 2019. A third visit was conducted on the 2, 3 and 4 of March 2020 in order to gain further information around the proposed project options.

Community engagement activities were held during all three island visits. Table 5 below lists the type of engagement activity, dates, location as well as an approximation of persons engaged during each activity.

Table 5: Community engagement activities and persons engaged

Date	Location	Activity	Persons engaged
27.08.2019	Indigenous Knowledge Library Mall	Community Meeting (Sustainability Assessment)	10
4.11.2019	Mall	Community drop-in session and BBQ (Options Longlist)	40
5.11.2019	Mall	Community drop-in session	30
6.11.2019	Men's Shed	Community drop-in session	15

		(Options Longlist)	
2.03.2020	Mall	Community drop-in session and BBQ (Options Shortlist)	40
3.03.2020	Mall	Community drop-in session and BBQ (Options Shortlist)	60
4.03.2020	Men's Shed	Men's Shed meeting (Options Shortlist)	20

In preparation for each of the island visits, posters advertising the project purpose and drop-in session schedule were circulated throughout the community via PIASC, DATSIP and DPHW. These were printed by on-island contacts and displayed in key areas (the council office, office noticeboard). Additionally, project flyers presenting the methodology (different project phases and scope) were used as a presentation tool to guide discussions. These were printed out and distributed during drop-in sessions.

Once on-island, RES led community engagement and held multiple meetings and informal conversations with the Palm Island community. This process involved RES leading casual conversations with community members. This personal relationship building was critical to constructive community engagement and overall project success.

During the island visits, PIASC took the project team around the pertinent facilities and infrastructure on-island. Council provided the project team with relevant information regarding infrastructure under the various themes. The sites visited included:

- Wastewater treatment facility;
- Water treatment facility;
- Water storage reservoir;
- Waste transfer station;
- Dams (3);
- Ergon energy generation plant;
- Old recycling plant (chicken farm);
- Airport;
- Local businesses (bar, restaurant, market, gas stations, motel);
- Council main office;
- Community associations (CDP, PICC, Men's shed); and
- State government offices (Department of Housing and Public Works, health services).

The consultation process on Palm Island also involved arranging multiple meetings and discussions with stakeholders around the island.

1.4.1 Island Infrastructure

Energy, water, waste, and transport infrastructure have been mapped in Figure 3. The main town area includes the ferry and barge terminal as well as the service station. On the south part of the island is the airport and runway. Water infrastructure includes the water storage dams (Francis Creek and Solomon), the onsite wastewater treatment plant, the water treatment plant and the two water reservoirs at Butler Bay and Kalkadoon Road. Other infrastructure includes the waste transfer station and the isolated power station. The locations of the community consultation meetings have also been illustrated including the Men's Shed and Mall. As illustrated in Figure 3, almost all settlements are concentrated in the western portion of Palm Island, the rest of the island is mainly uninhabited and undeveloped.

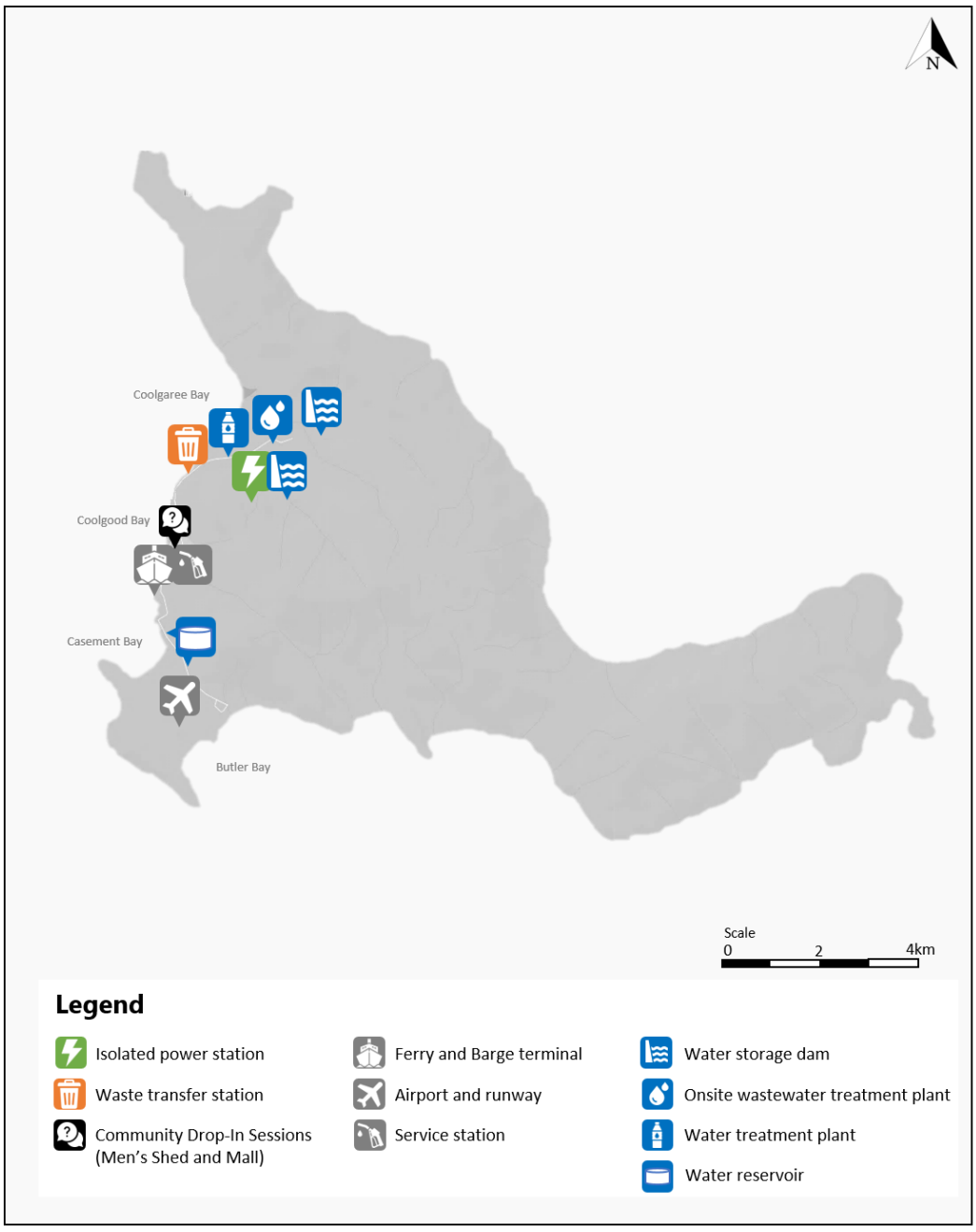

Figure 3: Palm Island Infrastructure Map

1.5. Data Collection Process

The sustainability assessment data collection process was led by EarthCheck (supported by RES and QTIC) and targeted the five key areas of energy (generation and efficiency), water (supply and treatment), waste, transport (inter and intra-island), and resilience to the effects of climate change. All data and information were collected through one or many of the data collection methods outlined in Table 6.

Table 6: Data collection methods

Sustainability Theme	Description
Energy	**Consumption and Generation** The energy data scope relates to on-island energy production (non-renewable and renewable) as well as energy usage. Electricity production figures (FY 2015-2016 and 2016-2017) for the diesel genset as well as the domestic/organisational split in energy consumption numbers were obtained through Ergon Energy. The data obtained from Ergon Energy was used to develop energy demand graphs to illustrate monthly energy demand as well as over a 24-hour period. No energy consumption data was obtained from the community, as they employ rechargeable electricity cards and do not possess detailed information around energy usage. The information garnered around this was a broad estimate of how long a $20 or $50 charge would last a family. See energy efficiency section for more detail. Energy data was measured and collected in a range of units and figures therefore it was converted into GJs for presenting all results, performance measures and comparisons (except for demand which is presented in kW). **Energy Efficiency** The energy efficiency data relates to energy reduction systems and initiatives as well as energy consumption behaviours. Information around this theme comprised of project team observations during the site visits, conversations and meetings with stakeholders, and community input provided during the drop-in sessions. Very little to no quantitative data was obtained or available for this theme, as it is not documented or measured. The energy efficiency data which was obtained was measured and collected in a range of units and figures were converted into GJs for presenting all results, performance measures and comparisons (except for demand which is presented in kW).

Water	This key area addressed potable water treatment, sewerage treatment/management, water consumption as well as water usage reduction/efficiency measures and practices. Data around potable water production and wastewater management was obtained through PIASC, who manage the infrastructure. Information around water consumption and water usage reduction/efficiency measures and practices was obtained through third party reports and data, interviews, the drop-in sessions as well as the project team observations during site visits. There is no water metering on Palm Island for homes and buildings. Water consumption was measured in kilolitres (kL) of water.
Waste	The waste management data relates to on-island waste generation, waste management as well as recycling and materials re-use initiatives. Waste data relating to waste streams and quantities were obtained through PIASC as well as the consultants running a DES waste program in Indigenous communities. Waste transport data was obtained through the barge operator servicing Palm Island. The carbon footprint of waste disposal was evaluated based on the EarthCheck Benchmarking software using general waste sent to landfill benchmark data. Waste production was measured and reported in cubic meters (m^3).
Transport	The transport sustainability assessment targeted three main transport types: on-island transport (including vehicles, walking and alternative transport methods), marine transport (including barges and ferries) as well as air transport. On-island transport data was obtained through Australian Bureau of Statistics (ABS) data on vehicle registrations, council information, information from interviews with community members during the drop-in sessions as well as project team observations during the site visits. Air transport data was obtained through a desktop review of flight schedules and benchmark fuel consumption statistics as well as guidance from the scheduled flight operator (Hinterland Aviation). Data for the marine transport (barges and ferry) was obtained from the service operators servicing Palm Island (Palm Island Barge, SeaSwift and SeaLink). Transport data was measured and collected in a range of units and was converted into litres for presenting all results, performance measures and comparisons.

Resilience	For the purpose of this project, the community's resilience was evaluated through a climate resilience and self-sufficiency lens. Essentially, the climate and weather-related risks were assessed and compared to the community's preparedness, in terms of infrastructure, emergency planning and mitigation measures. This information, mostly qualitative in nature, was collected by the project team during the site visits through discussions with community stakeholders. All the data collection methods described in Table 4 were employed. The sustainability assessment findings allowed the project team to assess the community's preparedness to severe weather events and climate change, estimate the capacity to operate in island-mode, as well as provide the context for the developed project options.

1.6. Data Assessment

The quantitative sustainability assessment data collected was assessed using EarthCheck's proprietary benchmarking software, to catalogue, organise and contextualise the information. Detailed profiles were developed for each of the key themes. The use of the benchmarking tool allowed for the modelling of the island's approximate greenhouse gas emissions on a whole-of-island/whole-of-community level as well as for each of the five project themes.

The qualitative data collected as part of the sustainability assessment informed and contextualised the current situation on Palm Island around energy, water, waste, transport and resilience. This assessment set the foundation for the options identified by the project team, community and other key stakeholders, and supported the risk assessment.

1.7. Data Quality and Tracking

Throughout the project, ensuring data quality, traceability, and shareability were key. A data repository and assumptions log (spreadsheet) were used for the collection of all sustainability assessment data. This consisted of a table including the obtained data divided by key area, the data source, as well as accompanying assumptions relating to the information.

All third-party sources (reports, studies, emails, etc.) were collated in a document register to ensure data tracking, identification of knowledge gaps and assumptions as well as facilitation of information sharing through the project team.

1.8. Data and Scope Assumptions

Several informed assumptions defined the scope of the sustainability assessment throughout the report as are outlined in Table 7 below. Other assumptions specific to each theme are included in the relevant sections below.

Table 7: Scope and data assumptions

ACTIVITY MEASURE	ASSUMPTION	SOURCE
Community	It is assumed there are 4,000 residents on Palm Island as per the 2019 DATSIP Master Planning Report.	Department of Aboriginal and Torres Strait Islander Partnerships and PIASC.
Residential properties	It is assumed there are 530 residential dwellings on Palm Island as per the data provided by Ergon Energy, current as of 2019.	Ergon Energy.
Average household size	It is assumed Palm Island has 8 persons per household and Queensland has 2.6 persons as per the 2016 census.	Department of Aboriginal and Torres Strait Islander Partnerships (2019 Master Planning Report – Palm Island data). Australian Bureau of Statistics (QLD data).

2. CARBON EMISSIONS

Total carbon emissions were calculated as **6,530t CO2-e** for an average year[6].

The Palm Island emissions profile includes several emissions sources including electricity generation, waste sent to landfill, liquefied petroleum gas (LPG) usage, onsite wastewater treatment and transportation (land, marine and air) (Figure 4). The following section provides a summary of the composition of the carbon emissions, with more detailed information and context provided in the individual theme sections.

Palm Island is provided electricity through Ergon diesel generators that are located on-island. Diesel fuel combustion contributes to a significant release of greenhouse gas emissions but is continuously relied upon in remote communities due to government energy provision entities favoring diesel's relatively low prices and the reliability of the generation method. Electricity generation by Ergon's isolated network on-island is the single largest producer of emissions, representing 28% of Palm Island's total carbon emissions. The carbon emissions are directly linked to the use of diesel to power the generators. In addition, LPG emissions related to cooking contribute 5% to the total emissions.

The second biggest emitter is on-island transport, with motor vehicles using Opal fuel emitting 14% and motor vehicles using diesel emitting 9% of Palm Island's carbon emissions. This includes all vehicles, personal and non-residential (diesel and Opal fuel).

All general waste is barged to the mainland five days a week to be sent to landfill in Hinchinbrook Shire. Waste sent to landfill is the third largest source of carbon emissions, contributing 20% to Palm Island's carbon emissions.

Palm Island is located 60km North-East from Townsville and approximately 35km from Lucinda. SeaLink operates a ferry service between Townsville and Palm Island. The Palm Island Barge Company operates a freight service between Lucinda and Palm Island. Ergon Energy transport diesel from Cairns to Palm Island using a SeaSwift barge. These marine activities make up approximately 9% of Palm Island's total carbon emissions. Palm Island also has air transport connecting the island to Townsville. Hinterland Aviation conducts multiple flights a day to the island, corresponding to 9% of the island's carbon emissions.

Onsite wastewater treatment makes-up the 6% of remaining emissions. These emissions are associated with the electricity needed, the transport of and disposal of the sludge produced from wastewater treatment.

[6] *An average year for carbon emissions is the modelled year based on a combination of components (i.e. electricity, transport and waste) calculated using different timeframes dependent on the data that was available at the time of writing this report. For emissions relating to electricity, see section 3. For emissions relating to waste, see section 5. For emissions relating to transport, see section 6.*

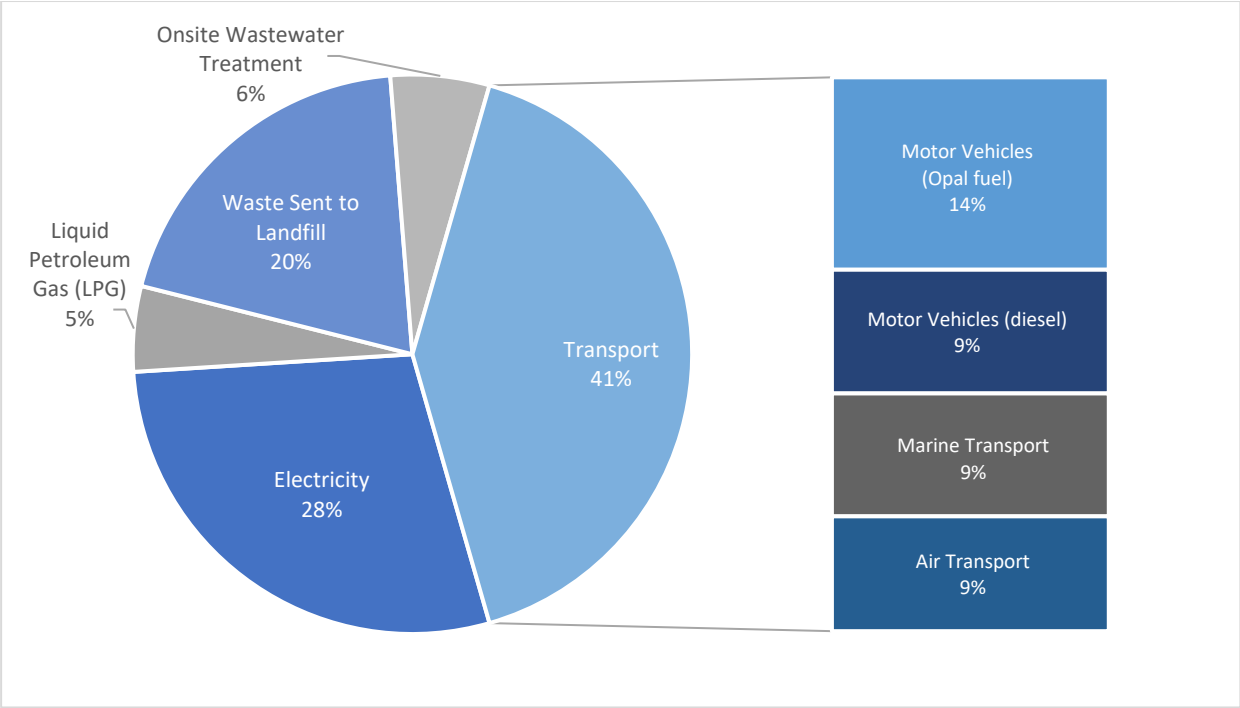

Figure 4: Palm Island's carbon emissions profile

3. ENERGY

3.1. Energy Generation and Consumption

The following sections provide an overview and background on energy generation and consumption on Palm island, including the solar profile.

3.1.1. Overview of Energy Generation and Consumption

Energy plays a central role in the lives of local people, as it is used for water treatment and distribution, to power homes, air conditioning and many other purposes. On Palm Island, electricity is produced by diesel generators (operated by Ergon) as well as some solar photovoltaic systems (PV). Included in Palm Island's solar profile are multiple solar hot water systems. Out of the total 530 homes on Palm Island, all the 486 social housing homes on Palm Island are equipped with solar hot water systems at construction. These systems are typically both solar and electrical to provide hot water in all types of weather and when supply runs out. The rest of the homes are for government workers and are owned by different government agencies. No data on their water heating was able to be obtained.

Residents use a card system to pay for energy on the island. This card is charged at different points on the island (ABIS shop, chip shop and service station) and can be personal (used at any address connected to the Palm grid) or associated with a specific property (used by anyone but for only one address). It has been raised by community members that this pay card system distances residents from a detailed financial understanding of their overall energy consumption profile. This system makes it difficult for community to understand total monthly or annual energy costs, as they mostly function on a pay-as-you-go basis.

It must be highlighted that access to continuous energy is a struggle for a significant portion of the Palm Island community. Though energy supply in remote communities is heavily subsidised by the Queensland Government, the effective cost of energy as well as the heightened energy needs associated with living in tropical Queensland conditions have been identified as significant financial strains on the Palm Island community. This is also exacerbated by Palm Island having an average household income well below the state average, which increases the relative costs of energy for the community.

According to the Department of Housing and Public Works (DHPW) and community testimony, the main uses for electricity in the Palm Island community are lighting, cooking (including boiling water for consumption), refrigeration, cooling and entertainment (this includes stereos and televisions). The project team understands that this high-level assessment around energy consumption habits and patterns of the Palm Island community remain poorly understood.

Residents on Palm can be left without access to electricity due to blackouts (Ergon generator or powerline issue) or not being able to pay for a refill on their power card. It is understood that groups within the community (mobs) will share power cards and will maintain energy connection in homes with the most need. This could be a home with elderly residents or young children.

Blackouts are rarely experienced, but based on community testimony, occasional events can occur once or twice a year. The community have not raised brownouts occurring on Palm Island. Blackouts are a risk for the community in terms of health (interior temperature), safety as well as a financial burden relating to food waste due to lack of refrigeration. This also highlights the vulnerability of the community in the event of fuel shortages. This is further discussed in the resilience section.

The energy consumption for Palm Island, for residential and non-residential use is presented in Figure 5. Residential consumption makes up a higher proportion of the energy consumed on-island. Non-residential energy consumption includes the council offices, schools, hospital, community organisations, restaurants, and council infrastructure such as the water and wastewater treatment plants and their respective pump systems.

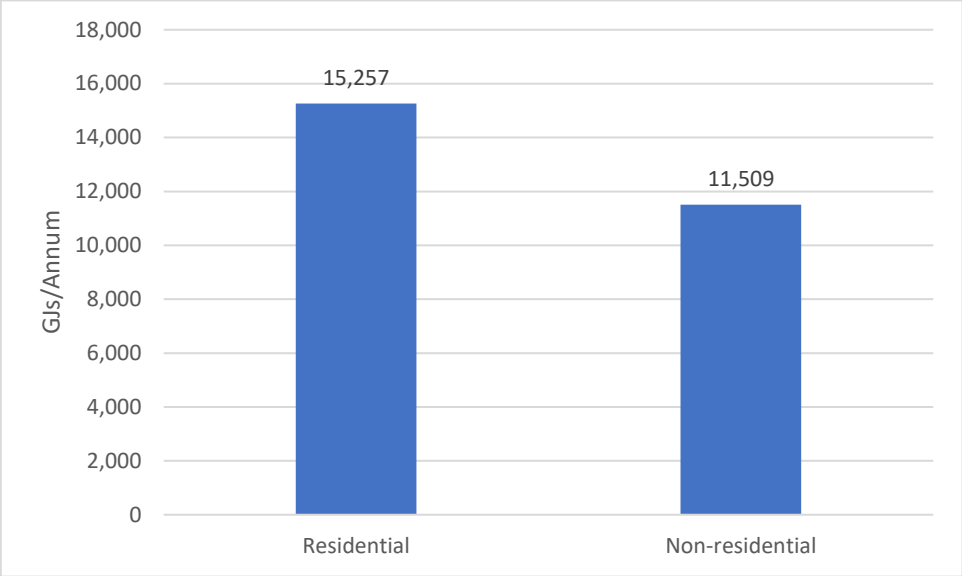

Figure 5: Comparison of electricity consumption between residents and businesses based on an average year (average of 2015/16 FY and 2016/17 FY)[7]

Beyond the energy associated with electricity production and consumption, multiple other operational facets of the community contribute to the island's overall energy profile. The energy profile of Palm Island is broken down into the categories outlined in Figure 6. Stationary energy contributes to 46% of the island. The remaining 54% of energy consumed is via road, marine and air transport, which is covered separately in section 6 on transport.

[7] *An average year for electricity is based on averaging two previous consecutive financial year data (2015/16 FY and 2016/17 FY – more recent data was either incomplete or unavailable). The percentage of usage attributed to residents compared with non-residents was provided by Ergon Energy, current as of 2019.*

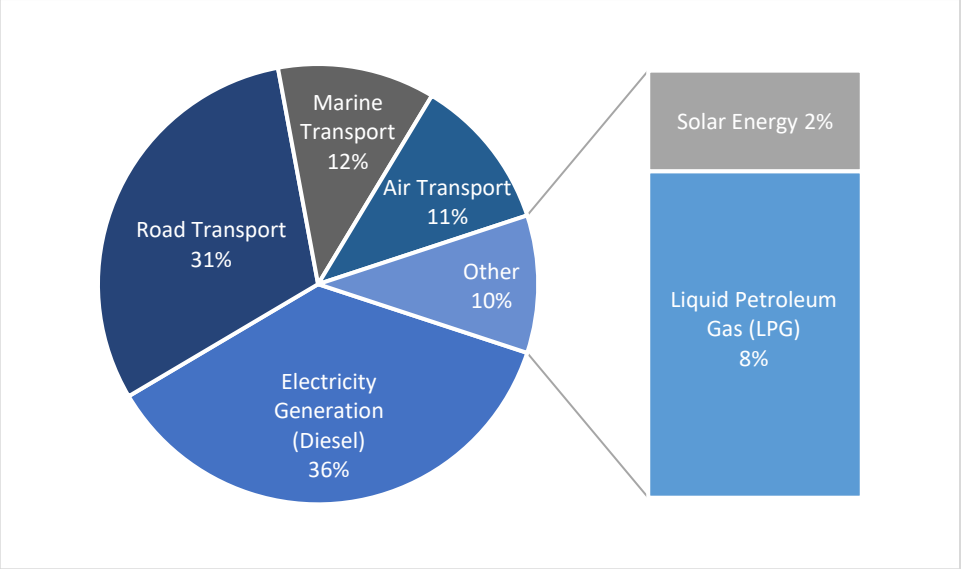

Figure 6: Palm Island energy profile based on an average year[8]

3.1.2. Energy Generation

Electricity is supplied to Palm Island by Ergon on behalf of the State Government. It is sourced from a 3.56MW isolated power station located at Farm Road. The power station was refitted in 2017 at a cost of $8 million, installing three new diesel generators. Electricity is generated by operating the generators in shifts of three at a time (total of six), to allow for system maintenance between shifts. The Palm Island diesel power station was the favoured energy supply option over an undersea cable from the mainland, which was deemed too expensive and non-profitable[9].

The upgraded power station accommodates increased energy production capacity and reduces the risks of the old plant failing. The plant was upgraded in 2017 to meet increased demand and increase the potential renewable energy penetration into the grid. This Ergon Energy diesel power station is also equipped to be able to integrate up to 20% renewable energy penetration (equating to 712kW of potential input) when/if renewable energy is further developed on Palm Island[10].

There are occasional power blackouts on Palm Island. A council employee evaluated the power outages to occur approximately every 2 months and lasting for up to 2 days. According to the DHPW, these events usually occur over the Christmas holiday period, impact specific sectors at a time (never the whole island) and are usually resolved after an hour. Reportedly, power line issues (human error, line breakages due to falling branches, wildlife damage) are the issue rather than generator breakdowns or larger-scale infrastructure breakdowns.

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[8] *An average year for the energy profile is based on a combination of aspects (i.e. electricity, solar, transport and LPG) that were calculated on the basis of different timeframes from different sources as this was the data that was available at the time of writing this report. Electricity was calculated based on previous financial years. Solar energy is based on the average number of sunlight hours a year and the current kW of solar systems on the island. For more details on transport related energy, see section 6.*

[9] (Nugent, 2015)

[10] (Ergon Energy, 2018)

The energy plant (automated diesel generator) at the Palm Island hospital has recently been upgraded. In addition, the local SES base, the council offices, the general store, and the chicken farm (CDP base) all reportedly have diesel generators. The exact age and size of these systems and how frequently they are used is not known[11].

The island has its own qualified electrician who has taken on some commercial contracts, HPW maintenance as well as assisting with fit outs for new properties. Palm Island does not however have a Clean Energy Council (CEC) accredited electrician, needed to maintain and repair the multiple defective solar panel installations on the island[12]. Ergon has some maintenance crew on the island. They have resources that can repair the poles and power lines, but more complex issues require personnel to be flown in.

3.1.3. Solar Profile

3.1.3.1. Solar Hot Water Systems

Almost all the houses on Palm Island are equipped with a solar hot water system and all DHPW homes are equipped with one at the time of construction. Most systems observed by the project team during on-island visits were similar to the Solarhart brand, with a dual collector roof top system. These systems can typically hold approximately 300 litres of hot water. It was reported by members of the community that the newer solar hot water systems can operate solely on solar energy, whereas the older systems require connection to grid energy to function.

Access to sufficient quantities of hot water has been raised as an important issue throughout the Palm Island community. Many residents perceived hot water to be expensive, however, over 90% of houses have solar hot water systems and residents do not pay for water usage. The expense related to hot water is most likely tied to defective solar systems or the need for larger quantities of hot water than the systems can produce due to the reported overcrowding, resulting in the use of the electric booster system. During discussions with multiple members of the Palm Island community, there have been repeated mentions of a booster button that is used/needed to provide an energy surge to the hot water system to heat the water. Based on community testimony, the reported costs of using this function range between $4 and $9. The reported expense of the booster function, coupled with the reported overcrowding, has the potential to deter the use of hot water.

This situation can be linked to a variety of different causes. Firstly, some solar hot water systems may be nearing end of life. The DHPW is currently running a $1.7m program to replace old solar hot water systems, which have a lifespan of 12 to 15 years. The Department has replaced approximately 40 systems in the financial year of 18/19 (they usually replace approximately 50 systems annually[13]). Peak demand (typically occurring during evenings) on these systems may not align with peak productivity (maximum solar energy) meaning that when the hot water reserves are used-up in the evenings, there is not sufficient solar energy to heat the water back up. Finally, the hot water systems provided within public housing may

[11] *Multiple requests for this information were made however no data was available at the time of publication.*
[12] (Tropical Energy Solutions, 2018)
[13] (Australian Bureau of Statistics, 2018)

be insufficient for the overcrowding situation on Palm Island (an average of 8 persons per house and up to 14 has been reported to the project team).

3.1.3.2. Solar Electricity Generation

In terms of solar electricity generation on Palm Island, there are multiple PV systems distributed throughout the community. During the island visits, the project team learnt that many systems were not functional, not connected to a "behind the meter" system or not connected to the grid at all. Behind the meter signifies that the system does not feed into the grid, but directly powers energy-using equipment in a closed system. According to a 2018 audit of council PV installations, council owns the solar PV installations around the island listed in Table 8.

Table 8: Council PV installations

Location	Load (kW)	Status
Council Office	27.7	Not operational
Airport	5	Not operational
Aged Care Facility	20	Operational, pending Ergon approval
Motel	20	Operational
Water treatment plant (WTP)	29.7	Operational, pending Ergon approval
Coolgaree Bay Hotel	10	Operational
Bakery	15	Operational
Sewage treatment plant (STP)	29.9	Unknown
Workshop	5	Operational

There is a total capacity of 162.2kW, which is exposed to approximately 3,000 hours of sunlight per annum, corresponding to a maximum potential of 486,600kWh per annum. These numbers are also obtained through Ergon Energy.

3.1.3.3. Solar Infrastructure

There are challenges when installing solar infrastructure. Most of the solar powered lights along the island foreshore were observed to be broken due to vandalism. In addition, solar hot water systems and PV systems are installed with cages to protect them from vandalism. This was an issue observed throughout the Palm community and great effort is invested into protecting equipment and material from abuse. These efforts include caged garages for vehicles to be stored overnight to protect from thrown rocks, grills over solar hot water systems as well as reinforced streetlights to protect them from projectiles and other forms of vandalism.

A 2018 Solar Audit conducted by PIASC on its solar infrastructure states that many systems on the island have been damaged from abuse and that maintenance or repairs by a CEC

accredited electrician are necessary for many of these systems to be connected to the grid. This audit recommended that approvals for connection be requested to Ergon. It is unclear if this has been actioned and how far the process has progressed within council and Ergon.

3.1.3.4. Future Solar Developments

In terms of future developments, PIASC are eager to install solar PV systems at the new shopping centre which is currently equipped with a standalone generator system (size unknown). It was raised by multiple PIASC employees that Ergon have historically not always been consulted on compatibility before solar PV systems were installed by contractors. This has resulted in Ergon not being engaged in the process, creating uncertainty around the status of the solar PV systems and the remaining renewable energy penetration the grid can support.

PIASC have been seeking greater Ergon engagement in renewables in the Palm community with little results. Based on community testimony, the Palm Island community feel disappointed by Ergon and that they were cheated from the benefits of the investments they have made in solar infrastructure. PIASC and the Palm Island community strongly feel that Ergon should be more involved in the community. Based on conversations with community members and council members, there are doubts about the veracity of the actual capacity for the renewable energy penetration potential at the power plant. This lack of trust around this issue may be due to the perceived lack of solar infrastructure, a lack of communication, understanding or trust between Ergon Energy and the community.

3.1.4. Energy Consumption

Energy consumption on Palm Island fluctuates over 24 hours as depicted in Figure 7, with peak demand occurring around 9am and remaining elevated until 8pm.

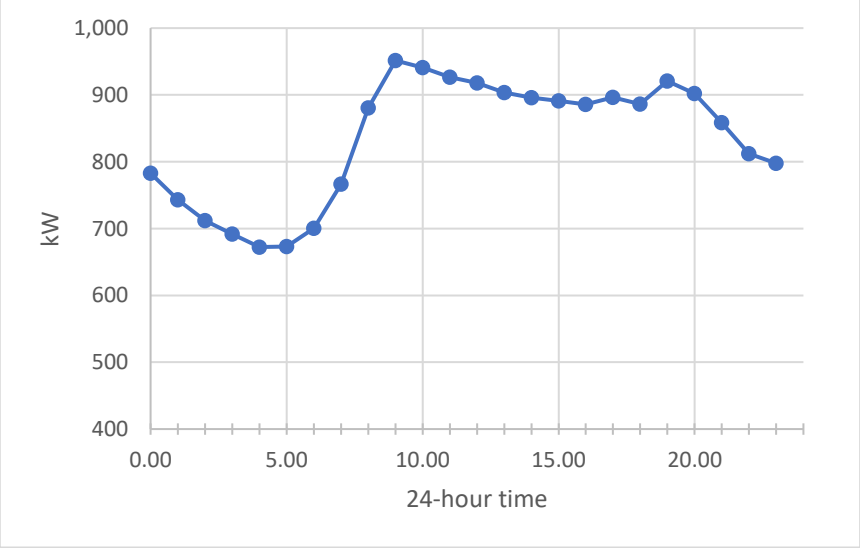


Figure 7: Daily energy demand over an average 24-hour period[14]

Energy consumption on Palm Island also varies throughout the year, as depicted in Figure 8. Fluctuation of grid energy peaks during February and March. The average daily energy demand is 828.51kW.

[14] *Energy demand data provided by Ergon Energy, current as of 2019.*

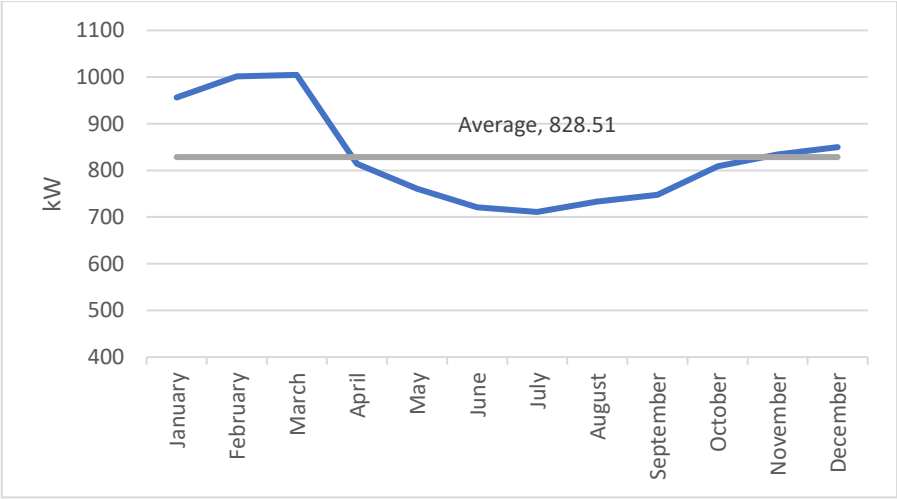
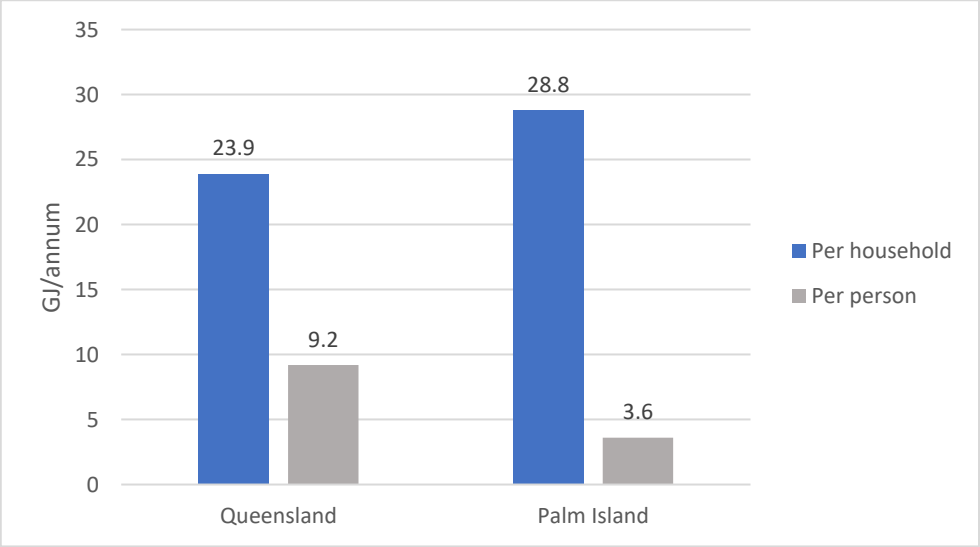


Figure 8: Average daily energy demand per month[14]

Total electricity consumption for Palm Island was 26,766GJ based on an average of previous financial years (2015/16 FY and 2016/17 FY) which corresponds to 0.01% of Queensland's total electricity consumption[15].

In terms of residential energy consumption, data reveals that the average household on Palm Island uses more energy than the Queensland average, as shown in Figure 9: Electricity consumption on Palm Island compared with the Queensland average [16]. Per person energy consumption on Palm Island is comparatively low when considering the average household size (8), which is over three times the state average (2.6)[17]. In fact, when considering the discrepancy in household size, per capita energy consumption is 240% higher in the average Queensland home than for Palm Island homes. This difference may be even greater with homes across the state using behind the meter solar PV energy.



[15] (Australian Energy Regulator, 2020)
[16] (Australian Bureau of Statistics, 2013)
[17] (Australian Bureau of Statistics, 2017)

Figure 9: Electricity consumption on Palm Island compared with the Queensland average

3.2. Energy Efficiency

3.2.1. Overview of Energy Efficiency

The following section provides an overview and background to energy efficiency on Palm Island, including the cost of energy as well as building types and design.

3.2.2. Cost of Energy

The cost of energy is a heavy burden for the community, though the Community Service Obligation ensures similar pricing to the rest of the state. This means that energy prices are maintained at the same level, whether in Brisbane or on Palm Island. The issue for the Palm Island community is that the lower socio-economic profile of the population results in energy costing proportionally more than for more affluent regions of the state. The proportional cost of energy for the community has an impact on the quantity of energy consumed as well as how it is consumed.

The Bwgcolman Supermarket sells smaller appliances such as fridges and freezers that can be purchased by the community to supplement those already in their homes. Based on team observations during the site visits, these are all one or two energy stars (low energy efficiency) and are sold for higher prices than they would be on the mainland.

The Department of Housing and Public Works estimates that 60% of government-provided houses have gas ovens and cooktops. Residents purchase 45kg LPG tanks at a price of $240. These contain approximately 2205MJ of energy and, based on anecdotal evidence, will last two people six months. Specific models and energy efficiency numbers are unknown and may greatly vary from home to home. It is not properly understood if, how often and for how long community members go without gas. As mentioned earlier, it is also important to consider that more traditional ways of cooking may be used by the community. The frequency of use of these alternative fuel types or the quantities used are unknown.

Residual current devices (RCD) have been installed throughout the island to deal with 'dirty power' which was previously damaging appliances and equipment and to support the roll out of light-emitting diodes (LED's) in residences.

3.2.3. Building Types and Design

The houses on Palm Island are approximately 90% state-owned community housing, meaning that the homes are supplied with standardised designs and specifications. The DHPW has a stock of 486 homes on the island, which meet the Queensland construction codes and standards at the time of construction. According to DATSIP and DHPW representatives, local councils may have a substantial input into the design and specifications of the housing provided to them, though the level of input and community consultation varies throughout communities. It is not properly understood how much input PIASC have had into housing design and specifications over the years.

According to the DATSIP Masterplan, DHPW homes have an average of 2.9 bedrooms and an average of 8 persons per dwelling. In comparison, average Queensland homes have 3.2 bedrooms per dwelling and 2.6 persons per dwelling[17]. As outlined above, increased

household size results in increased per household consumption of energy even though per capita consumption remains low compared to the Queensland average.

Cooling buildings with air conditioning is also a significant energy consumption source on Palm Island. The project team observed that many non-residential buildings were fitted with air-conditioning systems (council offices and other buildings such as the motel, government services buildings, the men's shed, both schools, etc). According to the DHPW, approximately 10% of homes on Palm Island are equipped with air conditioning systems. This equates to approximately 50 homes (DHPW house stock on Palm Island is 486 as of 2019). The exact number and size of the systems is not known, though discussions with PIASC have led the project team to understand that the "box-type" air conditioners that are used are not the most efficient, consume high amounts of electricity and are quite noisy. The use of air-conditioners is most likely a major contributor to the increased use of energy during the summer months.

Though the home specifications change over time (government policy, contractor, etc), it has been observed (anecdotal evidence) that most homes on Palm Island have limited insulation and consideration for natural lighting, shading and air circulation. Furthermore, according to PIASC, most homes have dark green Colourbond metal roofs, which can cause the interior temperature of the homes to reach higher temperatures, creating uncomfortable living conditions and/or requiring more intensive use of air-conditioning. There seems to be limited consideration of passive building design in the housing on Palm Island.

There is a concern in the community that houses on Palm Island are restricted in size due to having to be built to be resistant (to a certain degree) to cyclones and high winds. During on-island visits, it has been raised that this consideration limits the possibility of building larger homes that can accommodate the larger rates of occupancy (over 7 people per household). Based on the Palm Island – Place of Refuge Feasibility Study Evacuation and Shelter report findings, homes on Palm Island vary from two to seven bedroom-homes, with the average being three bedrooms per home[18].

[18] (Mullins Consulting, 2018)

4. PROFILE OF WATER USE AND WASTEWATER TREATMENT

The following sections provide an overview and background on water use and wastewater treatment on Palm Island, water infrastructure, water quality and wastewater management.

4.1. Overview of Water Treatment

Water supply and quality have been issues on Palm Island for many years (on and off for 18 months before June 2019 based on latest council communications). This has been linked to different causes including limited resources, a dated and damaged reticulation system as well as high demand on the water treatment infrastructure, which is typical for tropical non-urban communities. In 2017, a new water treatment plant was installed to address the issue of poor water quality, but poor water quality continues to impact the community. There is currently a major water infrastructure project underway to address this.

4.2. Water Infrastructure

There are two dams on the island that contain the drinking-water for the island's communities: Solomon dam (469 ML) and the Minggudjamba Banbarribarra dam (746 ML). There is also a third dam higher up in the hills (centre of the island), though it is not currently connected to the water supply system. The DATSIP Masterplan evaluated the sustainable yield of the two water-supplying dams to be a combined total of 900 ML per annum. With current population growth numbers, it is estimated that this quantity of water will be sufficient for the next ten years, eventually requiring input from another source of raw water. As the reservoirs are mainly supplied by rainwater, both dams were critically low in 2017 due to drought but are now close to capacity having been replenished by rainfall. Neither of these dams are fenced, which would keep the wild animals from contaminating the water. Water from both dams is fed to the water treatment plant via 250mm diameter mains.

In terms of rainwater capture, not many properties were observed to have rainwater and/or grey water tanks. Based on discussions with government officials from DATSIP, the low number of rainwater tanks is due to maintenance issues and difficulties related to these systems, as is the case across multiple communities across Australia. These issues have resulted in DHPW removing rainwater tanks from their design standards across the state.

There are multiple natural wells spread throughout the mountains. At least one of the wells was observed during the sustainability assessment visit. According to community members, wells were traditionally used by residents for drinking water, but are no longer used today. It is unknown how many wells there are, how much water they produce, how much of the dam water supply is due to well-water or what the quality of the water is. A study conducted by CDM Smith consultants for the Department of Infrastructure, Local Government and Planning found that groundwater could be utilised to provide up to a third of the community's water supply, though further testing and investigations are needed to fully assess the potential for developing a viable groundwater supply to supplement the existing Palm Island public water supply[19].

Rainfall runoff from lots and the different roads is discharged into the ocean via underground water pipes. No treatment to remove nutrients and other contaminants is provided to this

[19] (CDM Smith, 2020)

water. The storm water drains were cleaned of weeds under a previous project. The need for upgrades and better maintenance of the drainage system was discussed during island visits. In these discussions, non-return valves and overflow traps in the reticulation system were raised as being a potential solution to this issue by a council worker. It was estimated that these could help reduce sewage spillage during flooding which can occur during heavy rain events. This suggestion has been included as a recommendation in the final report.

In terms of upcoming water infrastructure projects, council have obtained AUD $1.2 million in funding and commissioned a new water Splash Park. According to the DATSIP Masterplan, this installation will have an area of 1,249m^2 and will be located just north of the helipad near the Coolgaree Bay Hotel. It will be comprised of a zero-depth splash park with water fountains and play equipment. This project will not only provide a safe place for different families and children to socialise and play together, the park is expected to boost attendance at the schools through a 'no school, no water park' policy. It is not known how much water will be used by this facility, but it is understood that water will be recycled to reduce the strain on the mains.

4.3. Potable Water Treatment

A new water treatment plant located at 480 Wallaby Point Road has been operating since 2017. This new plant replaced the old plant which has been decommissioned but is still standing due to the high costs of demolition. The plant has faced several operational and technical difficulties (lack of manuals, no spares, limited access to system software), compromising the town's water supply. The plant is currently running at 100% capacity, as it produces just enough water for the community, based on current consumption practices. The plant is kept running at this maximum capacity because it effectively plays the role of water pump for the community. It takes several weeks to fill up the 4.55ML water reservoir, as only the small amounts of excess water which is not used by the community makes its way to the tank. This high-intensity usage of the plant is causing premature wear on the equipment. The water treatment plant uses coagulant, dissolved air treatment, chlorine treatment and filters. The plant also has the capacity to add fluoride to the water supply, but this is not currently operational. PIASC regularly monitor the treated water from the plant, which they report to be of high quality (only occasional sediments due to maintenance or low dam levels). The hospital and health care centres on the island are required to have their own water treatment facilities to provide additional security in access and quality of water. The hospital and health care centre systems include filters and chlorination for an extra level of water quality.

The treated water is sent to the 4.55ML concrete reservoir located on Kalkadoon road. This is done via a 250mm diameter water main which also acts as the delivery/reticulation main. It is estimated by PIASC that this water reservoir holds approximately 3 days of water supply. The amount of water stored in this main tank at any given moment represents the reserves for the whole community, as power is required to treat the water and pump it to this main reservoir.

There are also 2 smaller reservoirs near the Butler Bay and Reservoir Ridge development to provide water to these neighbourhoods. These reservoirs are fed by the main water reservoir and require electric pumps to fill. There are no back-up generators for the pumps for these two smaller water reservoirs. Because of this, during power outages, water cannot be delivered to these reservoirs, cutting the neighbourhood from water supply. This has been identified as a fundamental aspect of the island's vulnerability.

Palm Island's potable water treatment cost council approximately $700 per property in 2016-2017 (state median was $573), approximately $480 per property in 2017-2018 (state median was $638) and approximately $400 per property in 2018-2019 (state median was $632). These numbers show a decrease in the reported operational costs of the potable water treatment on Palm Island since 2016[15].

There have been significant capital expenditures on Palm Island concerning potable water since 2016. In 2016-2017, $4,000 per property was invested (state median was $224) and in 2017-2018, capital expenditure per property was slightly over $1,000 per property (state median was $279). In 2018-2019, the capital expenditure per property was slightly above the state median of $316[20].

The possibility of adding a desalination plant to Palm was investigated by the engineering firm GANDEN in 2016 to provide a temporary solution to water supply shortages. The option was not implemented, as the drought subsided, and the dams were replenished[21].

4.4. Water Consumption

Water is provided to the Palm Island community free of charge by PIASC. There are no records or data relating to the quantities of water treated at the water treatment plant. As such, the most accurate water demand figures available to the project team came from a 2014 GANDEN report: The Palm Island Water Supply Network Review[22].

Based on water readings from the plant operator logs between February 2013 to December 2013, the daily average water demand for the whole island is approximately 1.5ML per day with peak usage reaching 2.5ML per day[22]. This corresponds to an average usage of 137kL per person per year and 375L per person per day and a peak of 228kL per person per year and 625L per person per day (using the DATSIP estimated population of 4,000 residents).

All official buildings and households on Palm Island are connected to the mains water reticulation network. The family camps and settlements spread around the island are not connected to the mains water reticulation network. Most residential dwellings include a bathtub, but some members of the community have reported these are used infrequently due to various concerns including water safety and water scarcity.

Even during drought periods, there are no enforced water usage restrictions on Palm Island. It was raised by PIASC that the community continue to use water for washing driveways, watering lawns and various other uses during water shortage periods. It was suggested by community members that the installation of water meters or any type of usage restriction would be very poorly received by the Palm Island community. PIASC have raised that communication and education around water usage and management is lacking.

Due to the historic lack of reliability and quality of the water supply, purchased bottled water is used to supplement supply, or in some cases, completely replace it (see Figure 10). There is a widespread community distrust in the water supply (Indigenous and non-Indigenous). Purchasing bottled water is estimated to cost the community approximately $300,000 per

[20] (qldwater, 2011)
[21] (Cella, 2016)
[22] (GANDEN Engineers and Project Managers, 2014)

annum[23]. It is understood that PIASC purchase a high proportion of this water and local organisations also import their own bottled-water supplies. Residents may purchase bottled water at the grocery store. Discussions with the community highlighted the fact that this was a highly contested issue and problem for many. There is also significant plastic waste generated due to the containers, this is further detailed in the waste section. There is a sentiment within the community that there is an unfair distribution of the bottled water. Based on discussion with different community groups on Palm Island, it seems that the more affluent portion of the community consume bottled water and the poorer portion of the community consume tap water.

Figure 10: Reserves of bottled water on Palm Island

Non-urban, remote, and isolated Indigenous communities typically have a high per capita water consumption. As shown in Figure 11, Palm Island households use approximately 1033kL per annum[24] compared with the Queensland average of 203kL per annum[25]. On a per capita base, Palm Islanders consume on average 137kL per annum compared to 78kL per annum for the rest of Queensland.

[23] Colin Saltmere, The Myuma Group (CDP), consultation on the 27th August 2019.

[24] *This includes residential and non-residential water usage such as visitors, council, and commercial usage, as no portioned water usage is measured in Palm. Based on an average daily demand of 1.5 megalitres per day* (GANDEN Engineers and Project Managers, 2014)

[25] (Australian Bureau of Statistics (ABS), 2019)

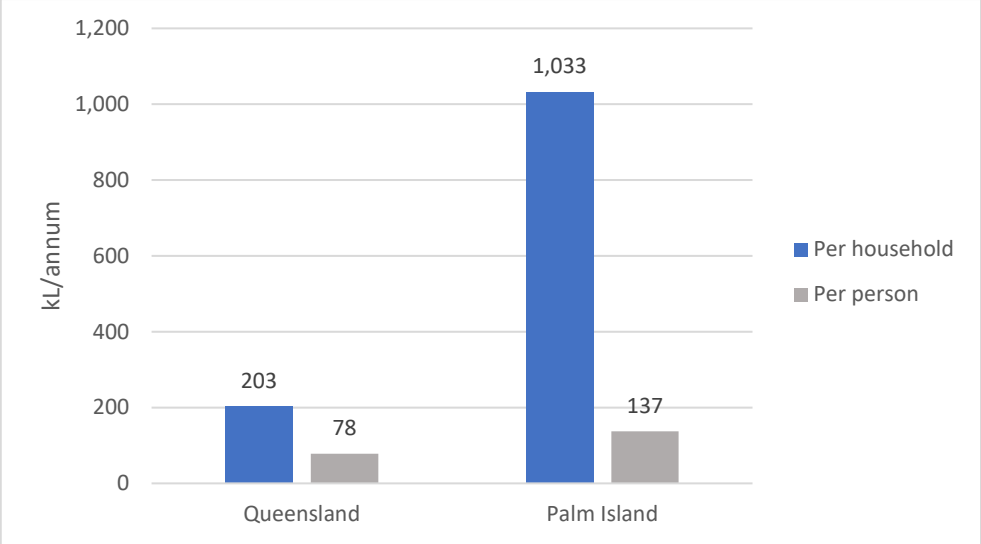


Figure 11: Average annual water consumption on Palm Island per household and per person compared with the Queensland average (2016/17 FY)

4.5. Potable Water Quality

There are widespread concerns about the quality of potable water on Palm Island. In early 2019, a plant pressure sensor failed which caused $40,000 of damage and an extended reduction in water quality. This resulted in a water boiling alert, which lasted for most of the year. Potable water quality has also been an issue for Palm Island for multiple years. Though PIASC regularly test the potable water from the treatment plant, council has multiple hypotheses on the causes of the poor water quality from residents' taps. These include old bi-directional flow of water in the reticulation system, ill-maintained equipment, faulty and ill-designed reticulation system, infrastructure maintenance and cleaning causing sediments in the water as well as low water levels in the dams, resulting in increased sediments in the water.

The water main connects the treatment plant and the main water reservoir. The community is provided potable water from a network branching directly out of this main. Treated water exiting the plant is pumped towards the reservoir, but only the portion not consumed by the community makes it to the reservoir. When the water demand surpasses the plant's production capacity, flow into the reservoir is reversed, providing a supplementary water supply.

It is assumed that the change in water flow direction between the water treatment plant and the reservoir can cause sediment to be disturbed, contaminating the water supply. Deposits in the reticulation network has also been identified as a possible cause for sediments in the water supply. PIASC have removed high amounts of deposits from the main water reservoir in the last year. It was also found that the treated water holding tanks at the new water treatment plant were used as raw water holding tanks for the previous plant. These tanks previously held the untreated raw water from the dams before treatment, but now hold the treated water to be sent out into the network. During a clean in 2019, up to 40mm of sludge was discovered in these tanks, which was highlighted as another potential source of contamination to the water supply.

Furthermore, it was raised by PIASC that repairs and alterations on the mains and reticulation network are not documented in any way, new pipes are simply added to the existing network

on a when-necessary basis. This makes leaks or breaks in the system near impossible to identify, though PIASC claim the network is leak-free.

In July 2019, the Department of Local Government provided $6.1M funding to the PIASC to improve the water treatment and wastewater treatment infrastructure by:

- Installation of a supervisory control and data acquisition (SCADA) system to the WTP;
- Internal cleaning, roof replacement and vermin proofing of the 4.5ML main drinking water storage reservoir;
- Decommission of two undersized WTP reservoirs and replacement with a larger 3ML treated water tank to increase capacity of treated water storage;
- Installation of additional backwash and sludge tanks and pump; and
- Installation of a new raw water line from Solomon Dam to WTP and from WTP to main reservoir (5km)[26].

Though this is the original scope of the grant, it is understood that most of the funds will be invested in the potable water supply system. The main projects undertaken will be a new main connecting the treatment plant and the water reservoir, enabling unidirectional flow in the reticulation network. GANDEN Engineers and Project Managers have been engaged by PIASC for this project.

To bolster community confidence in the water supply and collect more data on water quality, PIASC offer a water sampling program where residents can have their water samples tested for quality. PIASC also have access to six different sampling points across the island. Council raised that more sampling on private properties would be beneficial and allow for a more detailed assessment of water quality variations across the network. Community pushback on PIASC sampling on private property has hindered this option. Nevertheless, multiple community members have stated that even though this service is offered by the council, the distrust towards council compromises the perceived legitimacy of the test results.

Water filters are used by most organisations and some residents on Palm Island. The exact number of water filters on Palm Island is not known. Members of the community raised that council as well as the different government agencies on the island have equipped buildings and facilities with filters, while most of the community do not have filters installed in their homes and to drink unfiltered water, deepening the feeling of mistrust and even resentment towards council and government agencies.

4.6. Wastewater Management

4.6.1. Wastewater Treatment Plant

The wastewater treatment plant has a capacity of 9,000kL and operates by aeration and chemical dosage, which is just barely sufficient for current population levels (up to 5,000). The plant's capacity is a limitation for future growth and tourism development. There is no further tracking of the wastewater quantities received, treated or emitted. The waste material is stored on-island and a solution to remove this to a site on the mainland is yet to be determined. The liquid effluent generated by the plant is quite clear and is disposed of in Francis Creek, as permitted by current licenses. PIASC have a license to discharge 700kL to 900kL of STP effluent

[26] (Queensland Government, 2019)

in Francis Creek a day, though, based on PIASC testimony, it is highly likely that their discharges exceed this amount.

The current plant manager has been working on the plant since early 2019. Based on his own testimony, when he first started operating the plant he received no induction, training or proper handover. The operator learnt how to operate the plant on his own. He is still learning how the whole system works. Furthermore, there were no spare parts and no maintenance procedures for the plant. These have since been put into place by PIASC employees and the plant operator. However, the contractors who built the plant in 2017 never provided PIASC with the system codes, inhibiting the plant running on automatic mode and from receiving alerts for system errors. PIASC are in the process of obtaining these codes.

4.6.2. Sewerage Treatment Plant

The reported operating costs per property for sewerage on Palm Island have varied significantly over recent years. Based on the Queensland Water Annual Reports[27], the reported operating costs per property for Palm Island varied from approximately $575 (State average of $323) in 2016-2017 to over $1000 (State average $393) in 2017-2018 and then to $400 (State average of $389) in 2018-2019[28]. It is understood by the project team that the household size is different between the State average (2.6 persons per household[17]) and Palm Island average (8.1 persons per household), contributing to higher per household operational costs. Furthermore, the conditions specific to Palm Island such as remoteness, topography, the small size of the system, and the low population density could also be contributing factors to higher operational costs. The underlying causes of the variations in operational costs per property on Palm Island over recent years are not properly understood. Based on project team observations, these causes could be related to reporting errors, varying loads on the system or variations in operator manipulations.

A gravity sewage system is used on Palm Island, which transports sewage from the buildings to the waste treatment plant using six submersible pump stations. According to the DATSIP Masterplan, some of these pumps have generators in order to remain functional during a power outage. It is not known which pumps or how many are equipped with generators. There were twice the number of sewer main breaks and chokes reported per 100km of sewer mains during 2017/18 for Palm Island than the State-wide median, potentially indicating that sewerage infrastructure is ageing and in poor condition[21]. The community reported that there is a collapsed sewage main, which could be draining onto the beach. The PIASC have been informed of this issue.

As is the case with the new water treatment plant, the upgraded STP is still surrounded by the old plant's infrastructure. The older non-operational drying pits have been decommissioned and are thought to be too expensive to remove.

The collapsed sewage main and old infrastructure to be removed have been noted and addressed as a recommendation in the final report.

[27] (Queensland Water Directorate, 2019)
[28] (qldwater, 2011)

5. WASTE AND RECYCLING

The following sections provide an overview and background on waste and recycling on Palm Island, including waste disposal, and re-use and recycling.

5.1. Overview Waste Management

High costs to transport waste off-island, faulty equipment and limited council resources have created a complex waste management situation for the Palm Island community. Waste management is expensive for PIASC specifically due to the lack of an operational waste compactor resulting in uncompacted waste being barged off the island (billed by volume).

A total of 3,476.6m^3 of waste was generated on Palm Island in 2018[29]. All waste is sent to landfill with 91% of this being residential waste. It is estimated that the waste sent to landfill equates to 1,289.8tCO_2-e per annum. This number excludes the emissions associated with barging the waste off the island, as the emissions associated with the barge are already incorporated in transport-based emissions. The barge delivers goods to Palm Island and returns to Lucinda with the waste.

The breakdown of waste into the different measured classifications is shown in Figure 12[29].

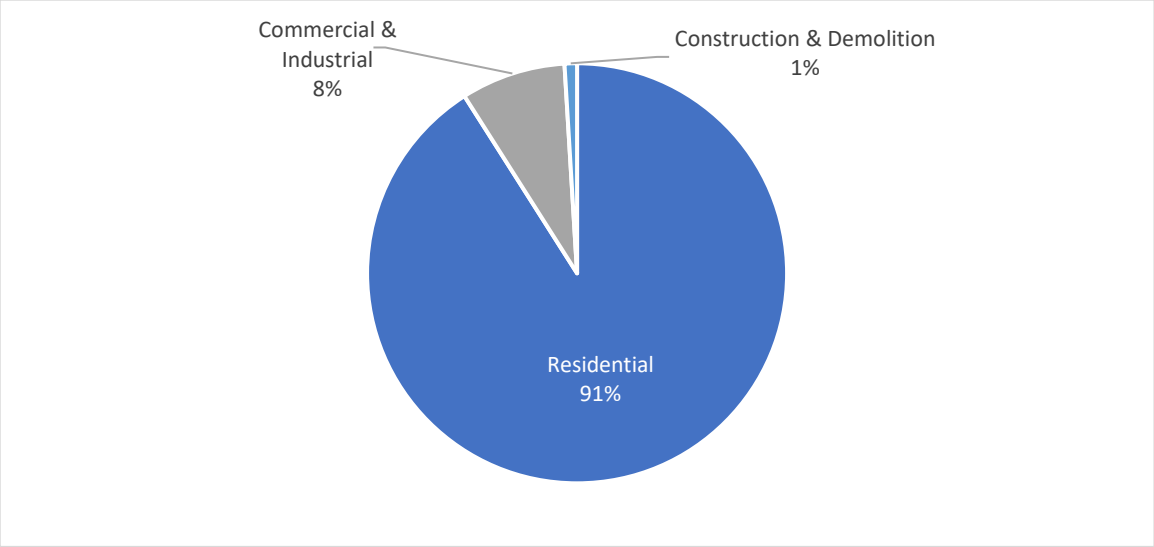


Figure 12: Waste disposed to landfill profile (2018)

As illustrated in Figure 13, the average annual household waste production for Palm Island is significantly lower than the Queensland average. For an average year, Palm Island produces 0.87m^3 per person per year compared to the Queensland average of 1.9m^3 per person per year[30]. This difference in waste per capita production between Palm Island and Queensland aligns with the existing correlation between socioeconomic profile and waste production, where lower socioeconomic communities produce less waste than higher socioeconomic counterparts[31]. The difference in waste production is exacerbated by Palm Island being a

[29] (Palm Island Aboriginal Shire Council, 2019)
[30] (Queensland Government, 2020)
[31] (The World Bank, n.d.)

remote community on an island, likely making the supply of all goods more expensive and therefore less accessible.

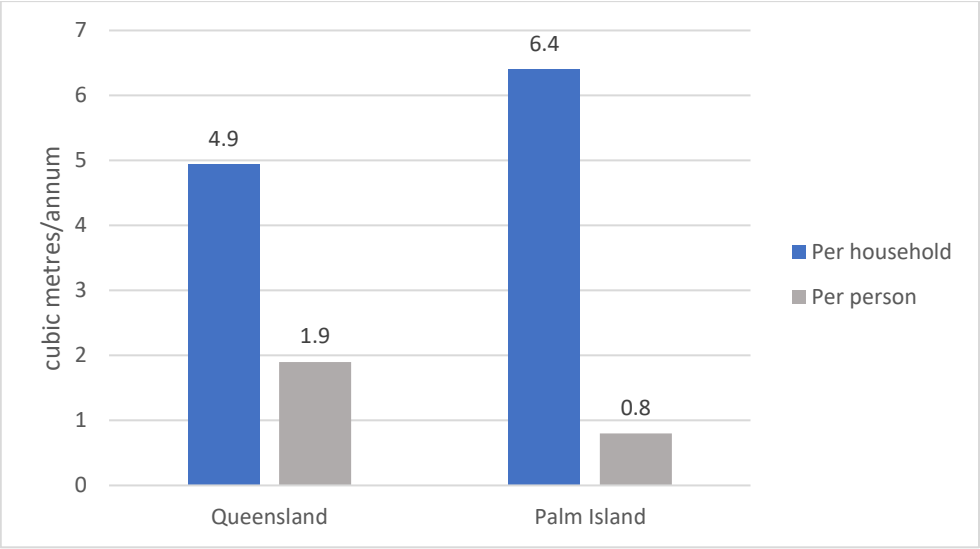


Figure 13: Waste disposed of on Palm Island compared with the Queensland average (2016/17 FY)

5.2. Waste Disposal

5.2.1. Waste Transfer Station

Waste management has been raised as a critical issue for Palm Island by the community as well as the local council. High costs related to off-island transport of waste, faulty equipment and lack of council resources have created a complex waste management situation. Waste management on Palm Island is managed by PIASC, who collect waste daily in different areas of the island. The previous landfill site on Manbarra Road was capped approximately 20 years ago as it did not meet the Great Barrier Reef Marine Park Authority (GBRMPA) regulations. Today, this site is still used by some.

The transfer station, which is currently used for waste management by the council site is semi-fenced and consists of different areas for different waste streams to be stored (see Figure 14). It includes a compacting and loading bay and small worker's cabin which are both currently unused (see Figure 15). It was reported by community and PIASC staff that the new waste collection trucks are too large for the old compactor hangar, which poses further complications for waste compaction.

Figure 14: Waste transfer station general waste area

Figure 15: The faulty compactor and skip bin at the waste transfer station

Due to lack of resources, there is no surveillance or controlled access to the waste transfer station. The lack of surveillance has also led to disposing of waste around the site, not in the dedicated perimeters for specific waste streams. This results in waste being dispersed around the site and the island due to the elements and the wild horses frequenting the site foraging for food. Based on-island observations by the project team, wrappers, bottles, plastic bags, bikes, tyres as well as various forms of metal waste are the most common forms of waste found around the island. Critically, refrigeration systems are not appropriately disposed of, resulting in environmental contamination risks.

The transfer station's location appears to pose significant risk of polluting the Great Barrier Reef during severe weather events. PIASC has no immediate plans to move or process these forms of waste which are accumulating at the transfer station site. In addition, PIASC have indicated concern around the behaviour of some contractors visiting the island, who are believed to be disposing of project waste, including asbestos contaminated waste. Increasing the volume and complexity of waste management has a direct impact on cost, which is currently borne by PIASC. This should be the responsibility of contractors through their own project costs. PIASC has not yet found a solution to these challenges.

5.2.2. Waste Removal

The Palm Island Barge Company provides barging services to the Palm Island community, including barging waste off the island. Waste is barged off the island to Lucinda (then on to Hinchinbrook for landfill) five times a week. This service is currently costing PIASC approximately $90,000 per month. There is no business competition, as the Palm Island Barge Company is the only provider of this service.

Based on the recommendations of a previous contractor, PIASC purchased a used waste compactor to replace its previous compactor, which was deemed faulty by the contractor. This equipment has never been used as the machine was not fit for purpose, being meant for cardboard and not general waste. This compactor is currently sitting in the transfer station unused, exposed to the elements and deteriorating. The old compactor was scrapped and is currently sitting in the waste transfer station. Uncompacted waste is therefore barged off the island by the Palm Island Barge Company five days per week at a substantial cost. Furthermore, the carbon footprint of each ton of uncompacted waste is higher than compacted waste, due to the increase in barge trips required to transport the same amount of waste off the island. General waste compactors can decrease the volume of solid waste by 3 to 6 times, greatly increasing the quantities of waste that can be moved off the island per dollar spent[32]. Council estimated that obtaining a new compactor would cost approximately $230,000. The current monthly barge fees are estimated at $90,000 and with this high recurring cost, PIASC cannot afford to remove waste off the island without a compactor for much longer. PIASC does not currently have the resources to apply for funding for a new waste compactor either.

Waste removal rates with the Palm Island Barge Company are for volume, whereas the Queensland waste levy is per ton. The council must pay the new Queensland waste levy, however, based on discussions with PIASC, due to the size of their operation (under 2,000t per annum) they are not entitled to any grants and subsidies.

To offset the costs of transporting waste, skips of aggregate are barged to the island for general council use, filled with waste and returned to the mainland. It is unclear how much this saves PIASC annually. PIASC has also trialled reducing the number of waste removal trips per week to reduce costs but this resulted in waste accumulating at the transfer station and was criticised by community.

Metal waste, such as cars, solar panels and old equipment, are collected and stored outside the waste area, with no immediate plans for removal due to the high costs of shipping, which constitutes a significant barrier to appropriately manage this type of waste (see Figure 16 and Figure 17). PIASC receives some funding for metal waste removal, however, this funding is not sufficient and does not extend to removing larger items such as car waste off the island. This results in substantial metal/car waste left on properties and around the island. However, there is a PIASC project underway to address this issue.

[32] (Redling, 2018)

Figure 16: Scrap metal at the waste transfer station on Palm Island

Figure 17: Car bodies at the waste transfer station on Palm island

Finally, council would like to extend the wharf to enable more effective waste removal, however they have some regulatory hurdles which make this project challenging. GBRMPA requires 18 years of tidal patterns and other data to prove that such an extension has no impact on the Great Barrier Reef however, council does not have such data, which is inhibiting this project from going ahead.

5.3. Re-Use and Recycling

There is no recycling program on Palm Island. All waste is collected from houses in a single wheelie bin. Some waste separation/sorting occurs at the transfer station for general, green and white goods/electronic waste. However, substantial contamination by other materials and hazardous waste remains due to the lack of management and control of disposing. For example, there are barrels of used engine oil which are affected by rust and risk contaminating the soil.

The pub offers small scale container collection and refund scheme, but this is not widely used by the community due to reported accessibility issues (transport of containers to the location). The CDP have previously undertaken metal waste separation and container recycling at a site near the water treatment plant (chicken farm), but they do not have the tools and resources to continue this. The change in management halted operations due to the necessary tools

being removed. Children from the schools are also reportedly keen to get involved in recycling and composting.

There is no council-operated composting scheme on Palm Island, though some members of the community compost food scraps and garden waste. The extent of this practice is not known. Based on discussions, the community are enthusiastic at the idea of using green waste and the abundant horse manure to generate compost and fertiliser. Currently, the council and the CDP workers burn the green waste at the transfer station. The CDP workers identified that a mulcher would be greatly beneficial for composting as well as generating mulch that could be used for a variety of uses such as garden beds.

The issue of concrete and construction waste was also raised by PIASC. All structural waste is disposed at the tip and left to accumulate or is barged off the island at great expense. The council identified a rock crusher as a potential option to recycle building materials by making sand, aggregate or other usable materials.

Residents on Palm Island often reuse and repurpose materials such as wood, metal, old boats, buoys etc. The Men's Shed also repurpose a great deal of materials on the island to make garden beds, shelters, sculptures, furniture and other objects.

6. TRANSPORTATION

The following sections provide an overview and background on transportation on Palm Island, including on-island transport, ferries and barges, and air travel.

6.1. Overview of Transportation

Based on census data, residents travel to work either by walking only (42%), driving (30%), as a car passenger (20%) or by shuttle bus (3%) or other (0.6%)[33] (see Figure 18).

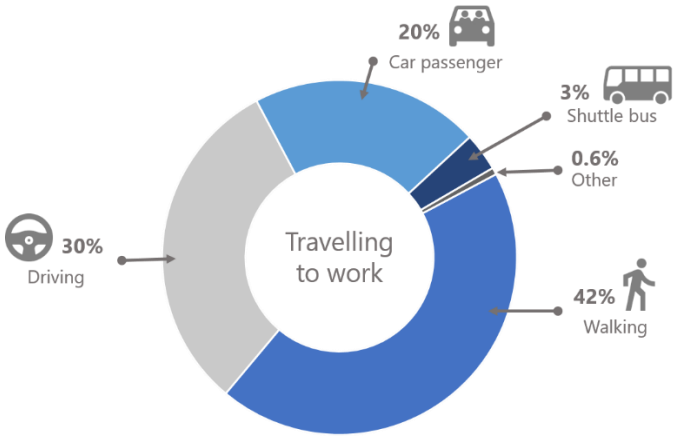


Figure 18: Transport method employed to get to work (2016)

The ABS census only provides data around transportation to and from work. Due to the high unemployment rate on the island (70%), this portrait of transportation habits is limited. During island visits, the project team noted that many community members walked to their destinations such as grocery shopping or appointments, sometimes long distances and on steep and ill-maintained roads. It was observed during site visits that some community members, reportedly the younger demographic, utilise horses as a mode of transport. The exact numbers around modes of transportation are not known.

As seen in Figure 19, driving a motor vehicle is the most fuel intensive (in terms of energy) transport activity on Palm Island, corresponding to 35% of total fuel usage for petrol and 22% of total fuel usage for diesel[34]. The next most significant fuel consumption category is marine transport between the mainland and the island which represents 22% and includes the ferry services and barges[35]. Following this, air transport between the mainland and the island represents 21% of total usage[36].

[33] (Australian Bureau of Statistics, 2017)

[34] *Based on average annual fuel usage data provided by a Palm Island Service Station representative and council fuel usage for a 6-month period in 2019.*

[35] *Data for the SeaSwift barge was provided by an Ergon Energy representative including average trip details, current as of 2020. Data provided by Palm Island Barge Co included average trip details and fuel consumption, current as of 2019. Data for the SeaLink ferry obtained from 2019 timetables and consultation with a SeaLink representative, current as of 2019.*

[36] *Data provided by Hinterland Aviation including average flight patterns and fuel consumption, current as of 2019.*

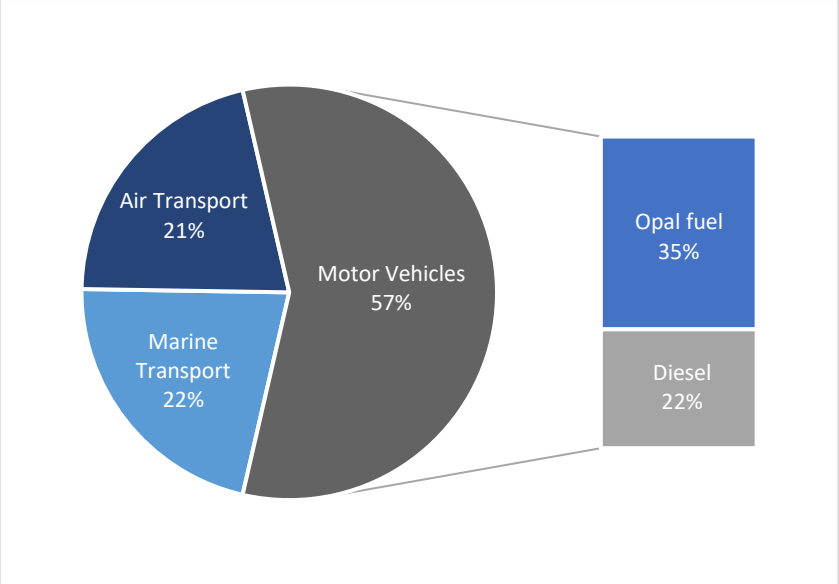


Figure 19: Transport fuel usage profile[37]

6.2. On-Island Transport

Based on discussions with the community and project team observations during site visits, the predominant modes of transport on the island include walking, cycling, cars (personal and commercial), carpooling and horseback riding. More detailed information around the different modes of transport used by the community was not available. For example, it has been reported by several parties that horses are used as a means of transport by some members of the community, but reliable numbers of persons using this form of transport or distance travelled were not available. Based on conversations with various members of the Palm Island community, walking is the most common form of transportation as it is used to reduce costs (as opposed to driving or using the shuttle service).

There is no public transport system operating on Palm Island, though most organisations own their own small bus for transporting people. PIASC, PICC, both schools as well as the health services and other government services were observed operating small buses (12-seater Toyota HiAce or similar). It is understood that these are used not only to pick up staff from the airport, but to provide transportation for community members. This bolsters access to services and community participation in various health and community organisations, which was identified as a challenge on Palm Island.

There is a privately-owned taxi/shuttle mini-bus business: The Palm Island Shuttle. This family-owned and run business operate two vehicles, one small bus and one minivan. The service costs a flat rate of $15 per person to get from one point to another. It costs $5 to add stops to a trip. There is also a family price of $20 for two adults and any number of children (17 and under). The business operator has no figures on number of annual passengers, distance covered, or fuel consumption. This service is considered prohibitively expensive by the

[37] *An average year for the transport profile is based on a combination of transport modes calculated using assumptions dependent on the data and sources that were available at the time of writing this report. See footnotes on the previous page as well as the following pages for details. Barges includes the barge for usual supplies, as well as the barge used by Ergon Energy for fuel transport.*

community, resulting in it mostly being used by contractors and government workers working on the island.

The limited transport options result in community connectivity restrictions as the different suburbs are located up to 4km from the town centre, on difficult and steep terrain as well as deteriorated roads.

There are approximately 337 cars registered on Palm Island, corresponding to 0.6 cars per household. As shown in Figure 20, 54% of dwellings do not own a registered vehicle – residents often pool resources and ride share[38]. During the sites visits, it was observed that family groups or mobs use a single car to move multiple people around the island.

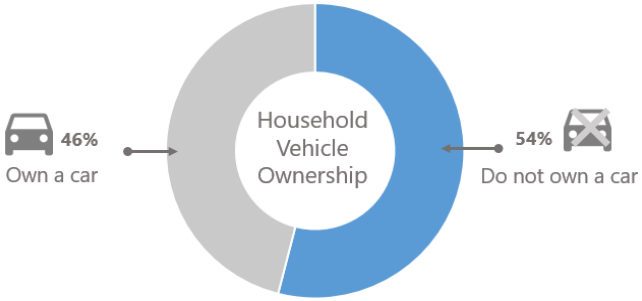


Figure 20: Palm Island household vehicle ownership (2016)

Vehicle age influences efficiency and maintenance cost. On Palm Island, 15% were less than 5 years old, 23.6% were 5 to 10 years old and 61.2% were over 10 years old[13]. It is not known how many unregistered or non-functional car bodies are on the island, but multiple car bodies are accumulating around the island and waste transfer station (see Figure 17). There is a car mechanic shop on Farm Road[39] which is run by PICC. The shop has limited capacities in the service it offers. For example, the Palm Island Shuttle Company's bus had a broken windshield which meant the bus had to be barged to the mainland, repaired then barged back. This incurred costs of over $3,000.

PIASC own and operate a fleet of 22 light diesel vehicles (utes/cars), 8 light plant diesel plant (genset /fork lift), 49 heavy plant diesel (trucks/excavator), 10 light petrol vehicles (utes/cars) as well as 8 light plants (ride on mower/plant trailers).

Fuel (opal and diesel) fluctuates around the $2.50/L mark, significantly more than prices on the mainland which fluctuate around $1.20/L (technical working group estimate). The high fuel price has been identified as a significant barrier to community and economic development. Petrol and diesel are provided by Opal Fuels at two different locations on the island. Community members raised on multiple occasions that the fuel sold is "no good" and damages the motors. The hypothesis of watering down the fuel was presented by community members, however, no data was available to verify these claims. Fuel consumption by fuel type is presented in Figure 21 below. Petrol (Opal fuel) accounts for 64% of fuel usage by volume on Palm Island and diesel accounts for 36%.

[38] (Australian Bureau of Statistics, 2017)
[39] (Palm Island Community Company, n.d.)

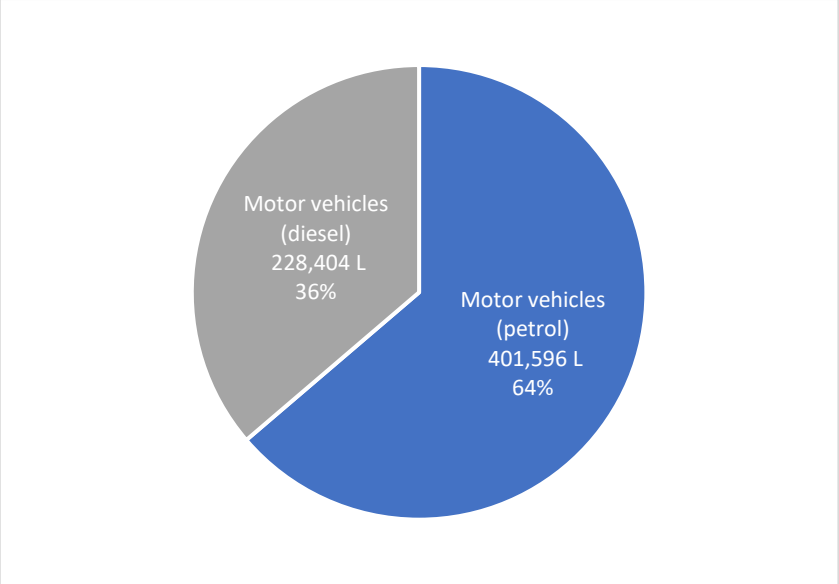


Figure 21: Fuel consumption (L) related to on-island transportation based on an average year[40]

The Men's Shed is building walking tracks and revegetating areas of the island. This initiative has been taken over by the young ranger program. It is understood that these tracks are for on-island transport (walking/cycling) but are also a potential tourism product for Palm Island.

6.3. Ferries and Barges

Palm Island is located 60km north-east off the coast of Townsville and 35km Southeast of Lucinda. Transport to and from Palm Island is by air or by barge/ferry.

The Palm Island Barge Company operates a service every weekday from Lucinda, transporting goods (vehicles, food supplies, aggregate, building supplies, fuel (Opal and diesel), LPG etc) as well as passengers to and from the island as well as the council waste. This service runs five days a week[41]. This is the main barge and freight service connecting Palm Island to the mainland. This has been linked to inflated prices for the service and the community considering the cost of barge transport to be too high. There is no fixed rate for the barge service which varies with weight and volume depending on the goods transported on a case by case basis. For example, a community member reported that the cost to barge a lounge from Townsville equalled 100% of the cost of the lounge. These transport costs are prohibitively expensive for the community on Palm Island. Ergon Energy use a separate barge owned by SeaSwift to transport diesel from Cairns to Palm Island every 6 weeks on average.

SeaLink operates a round-trip ferry service between Palm Island and Townsville. The trip takes approximately 1.75 hours and the service runs five days a week (excluding Tuesdays and Wednesdays)[42]. SeaLink also offers some small freight transport (trolleys and small boxes). The

[40] *An average year for motor vehicles is calculated based on a combination of assumptions dependent on the data and sources that were available at the time of writing this report. Fuel usage is based on consultation with the Palm Island Service Station owner.*
[41] (Palm Island Local Disaster Management Group, 2013)
[42] (SeaLink Queensland, n.d.)

costs for the ferry tickets are $69.70 for an adult return ticket and $34.85 for student and children return tickets[43].

Safety concerns around the jetty have been raised by the Palm Island community and council, as tickets for the ferry can only be purchased onboard the SeaLink ferry, creating safety issues in an overcrowded jetty area. Funding has been secured for a project to improve the wharf area with separate areas for passengers and loading bays for equipment. This project is currently underway as of early March 2020. This project includes increased shading around the jetty, parking spaces as well as public bathrooms.

6.4. Air Travel

Hinterland aviation operates the only air service to and from the island. Hinterland Aviation operates approximately 13 flights a day from Monday to Friday to and from Townsville City airport, amounting to 57 return trips per week. Palm Island is a 20-minute flight from Townsville Airport.

A single propeller Cessna Grand Caravan is used (15 seats). Hinterland Aviation estimates servicing approximately 26,000 return passengers per annum. PIASC estimates that 15% of the total annual return trip passengers are Palm Islanders, the others mostly being workers and contractors. The airport on Palm Island has a sealed 1,137 metre runway located near Butler Bay. The airport infrastructure is owned by PIASC and the terminal is leased out to Hinterland Aviation.

There is also a helipad on the island, located directly next to the Coolgaree Bar Hotel which is used for the Queensland Health helicopters. No fuel is stored on island and the frequency of the trips is not known and are dependent on the needs of the community[44].

[43] (SeaLink Queensland, n.d.)

[44] *Estimations of figures were provided, and the project team made attempts to confirm these numbers, however at time of publication, no confirmation could be made.*

7. RESILIENCE AND SELF-SUFFICIENCY

The following sections provide a background and assessment on resilience and self-sufficiency of Palm Island, including current climate, climate change projections, projected climate change impacts, experienced events, resilience and island infrastructure, and community preparedness and self-sufficiency.

Because of the wide-reaching scope and implications of resilience, the term and its significance in this project had to be adequately framed in consideration of each island community. For Palm Island, resilience and self-sufficiency also hinges on the community's capacity for risk management around the current climate, climate change projections and associated impacts, experienced events, resilience of island infrastructure, community preparedness as well as self-sufficiency. Furthermore, throughout the project lifecycle, community and economic development, community health as well as tradition and culture quickly came to the forefront as critical aspects to consider in the development and the support of a resilient, healthy and thriving community.

The following sections provide an overview and background on resilience and self-sufficiency on Palm Island.

7.1. Overview of Resilience

Traditional knowledge and practices relating to a long history of occupying and managing the land bolster the Palm Island community's resilience and self-sufficiency capacities. Their way of life, culture and traditions are intimately tied with occupying and caring for their country. In this way, cultural and traditional knowledge equip the community with information and practices to manage difficult times, periods of stress and how to overcome them. Cultural and traditional knowledge, developed through millennia of occupying and fostering country, is finding that changes to the environment and the climate are occurring at an increasingly rapid pace and have a profound impact on the flora and fauna. As the longest running scientists and science practitioners in the world, First Nations peoples hold significant knowledge around the natural world and are uniquely positioning to identify changes in patterns in both flora and fauna.

Over time, community have adapted to the limited financial resources in the community and found ways to manage. Developed community networks and kinship groups, cultural and traditional knowledge, sharing and support systems as well as some level of capacity to rely on the bush (bush tucker) and the natural environment during periods of need, which underpins the community's resilience capacities.

From a western governance and climate change perspective, the community on Palm Island is faced with multiple resilience issues. These multiple risks and challenges (energy security, clean water supply, resources, telecommunications, infrastructure, roads, etc.) are considered critical. The main concerns raised by the Palm community relating to resilience and self-sufficiency include potable water, access to energy, infrastructure damage, isolation during severe weather events as well as environmental degradation (invasive species such as weeds and wild pigs). Chinese Burr (*Triumfetta rhomboidei*[45] was observed to be extremely abundant

[45] (Queensland Government, n.d.)

on Palm Island[OBJ]. Reportedly, its spread around the island is accelerated via horses, which spread the burrs (and thus the seeds) wherever they go.

These issues, combined with a heavy dependence on government funding, the lack of economic activity and a raft of social and health issues present a uniquely challenging situation on Palm Island. Combined, these issues can hinder the Palm Island community's capacity to rapidly and effectively react to an emergency, stand in the way of community and economic development as well as negatively impact community health.

7.2. Current Climate

Palm Island is located in the North Queensland Dry Tropics Regional Natural Resource Management body, but in the Wet Tropics Bioregion and in the Herbert Biogeographic sub-region[46]. Palm Island experiences a humid and high-temperature climate with rainfall concentrated in the summer months. The island is subject to tropical cyclones and heavy rains between October-April each year. The average annual rainfall on the island is 1056mm, daytime average temperatures vary between 22 and 27 degrees for most of the year and the prevailing winds are north easterly during summer and south easterly during winter. Palm Island harbours multiple vegetation types. The island contains small areas of mesophyll, notophyll and palm-leaf rainforests as well as larger areas of notophyll and microphyll thickets. A large portion of the island is occupied by eucalyptus and melaleuca forests and woodlands with a small portion occupied by grasslands[47]. Palm Island also contains estuarine habitats such as mangroves or related tree communities as well as a small amount of salt flats and saltmarshes. There are a substantial number of wild horses which roam the island, a legacy from cattle grazing.

PIASC has identified that its territory is currently susceptible to the natural hazards listed in Table 9.

Table 9: Palm Island Natural Hazard[48]

Palm Island natural hazards	Occurrence
Earthquake	Low
Tsunami	Low
Wildfire	Low-medium
Extreme or major flood	Medium
Cyclone	Medium (December to May)
Severe thunderstorm	Medium
Storm surge	Medium

As identified in Table 9, Palm Island is susceptible to impacts from storm surges. According to PIASC, these surges can reach heights of up to 6m and cause severe damages to exposed coastal areas, homes and infrastructure. PIASC has identified the high-risk storm surge areas

[46] (Queensland Government Department of Environment and Science, n.d.)
[47] (Wet Tropics Management Authority, 2009)
[48] (Palm Island Aboriginal Shire Council, 2019)

on Great Palm Island in which council infrastructure could be affected. See the high-risk surge areas impacting council infrastructure in Figure 22 below[49].

Figure 22: High Risk Storm Surge Impacts to PIASC Infrastructure

7.3. Climate Change Projections

Estimations of changes to the current climate of Palm Island include slight declines in spring rainfalls, but higher intensity rainfall events over the next 50 years[50]. The same pattern is estimated for severe weather events: less frequent, but more severe (higher intensity rainfall and winds). Furthermore, for Palm Island and the North Queensland Region, a sea level rise of 0.8m by 2100 is estimated. This will most likely lead to more frequent sea level extremes and inundation[51]. Limited conclusions can be made regarding tropical cyclone frequency and intensity in the Australian region prior to 1981, due to limited data for this timeframe. However, a long-term decline in tropical cyclone numbers on the Queensland coast has been suggested[52].

The figures below show climate change projections for the Palm Island region from 2030 to 2090 (data derived from the Queensland Future Climates Dashboard using scenario representative concentration pathways (RCP) 8.5) and are based on long-term regional changes over the reference period of 1986-2005[53].

[49] (Palm Island Council)
[50] (Queensland Government, 2019)
[51] (Queensland Government, 2019)
[52] (CSIRO, 2015)
[53] (Queensland Government, 2018)

7.3.1. Hot days

Projections indicate an increase in mean temperature by 0.68°C by 2030 and 1.25°C by 2050. This leads to an increase in the number of hot days by 1 day per annum by 2030 and 7 days per annum by 2050, which is illustrated in Figure 23.

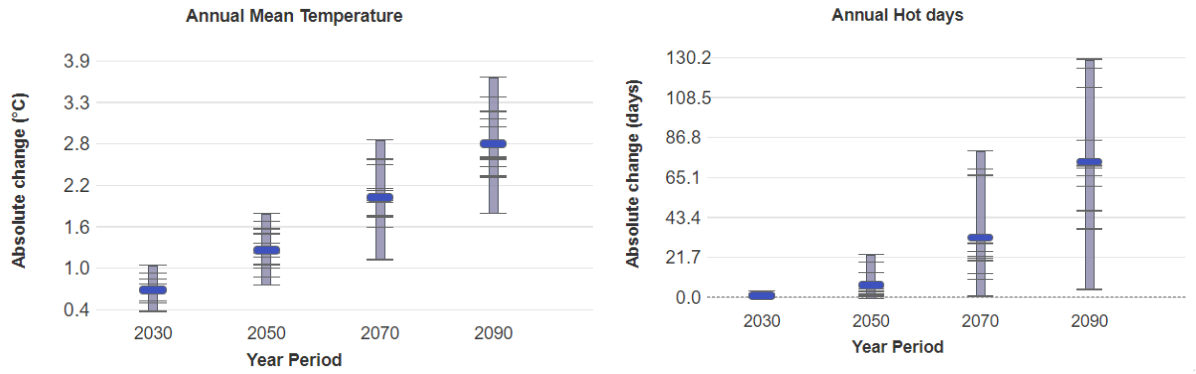


Figure 23: Projected Changes in Annual Mean Temperatures and Annual Hot Days for the Palm Island Aboriginal Shire Local Government Area

7.3.2. Precipitation

Figure 24 shows that precipitation patterns for the region are projected to change, resulting in a reduction in annual precipitation of 5% by 2030 particularly during the traditional wet season. The range of potential change varies greatly, resulting in a high level of uncertainty around the projections. The drought events are projected to increase moderately both in frequency and duration. This will likely add strain on water supply levels in the future.

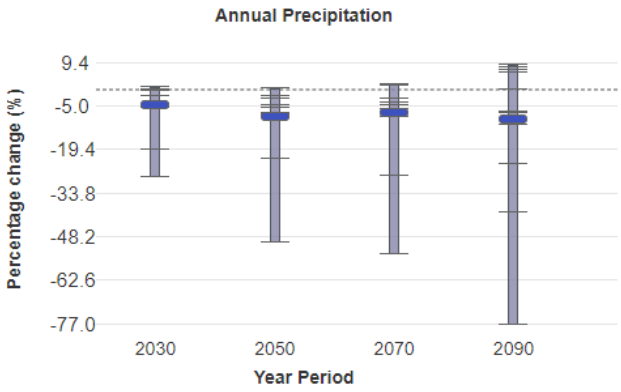


Figure 24: Projected Changes in Annual Precipitation for the Palm Island Aboriginal Shire Local Government Area

7.3.3. Heatwaves

As illustrated in Figure 25, heatwaves are projected to occur approximately 26% more frequently in 2030 and 67% more frequently by 2050 and last for longer periods of time. By 2030, it is predicted that heatwaves may increase by up to 13 days and by 2050, it is predicted that heatwaves may increase by up to 45 days.

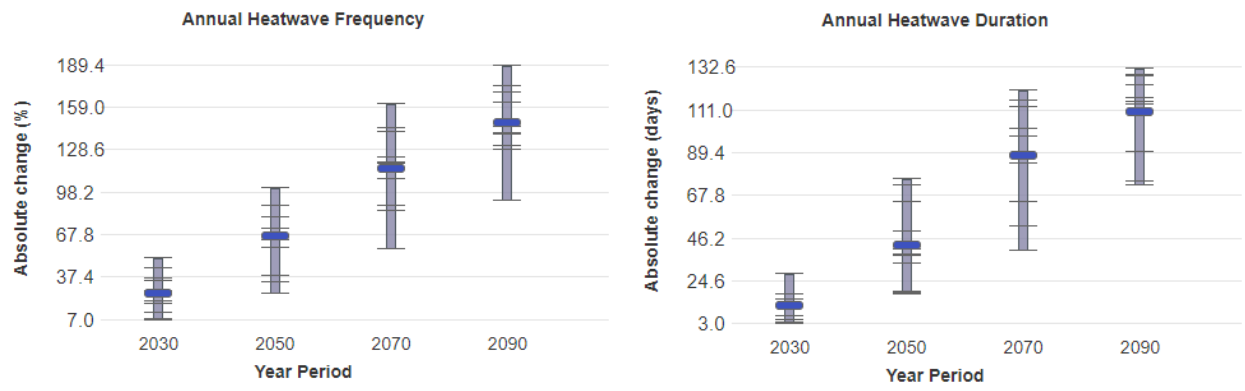


Figure 25: Projected Changes in Frequency and Duration of heatwaves for the Palm Island Aboriginal Shire Local Government Area

7.3.4. Floods

As illustrated in Figure 26, the frequency and duration of floods is projected to slightly increase until 2030, however, decrease from 2050 to 2090.

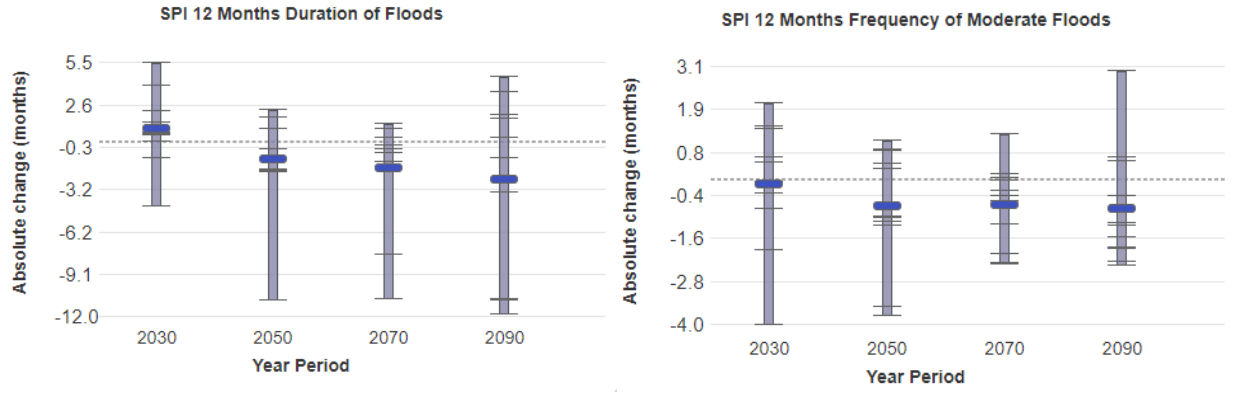


Figure 26: Projected Changes in Frequency and Duration of floods for the Palm Island Aboriginal Shire Local Government Area

7.4. Projected Climate Change Impacts

The PIASC planning scheme overlays, prepared as part of the development of Palm Island Master Plan in October 2019, identified the areas at risk from coastal hazards, bushfires and risk associated with dam failures (dam failures are not likely to be related to climate change, but have still been identified as a risk to the community). Additionally, and as part of this process, Cardno prepared an assessment of overland flow for Butler Bay on Palm Island. A summary of the climate risks for various land use areas and critical infrastructure from these reports is presented in Table 10 below.

Table 10: Climate Risks identified in the Palm Island Master Plan 2019

Location and infrastructure	Sea Level Rise and Erosion Prone Areas	Storm Tides	Overland Flow	Bushfire	Dam Failure
Wallaby Point Road - Residential areas - Light Industry - Landfill - Water Treatment Plant - Sewage Treatment Plan - Pump Station - Water Supply	Sea level rise and erosion prone	High	Unknown	Medium to high potential bushfire risk	Substantial impact area from Dam Failure
Bwgcolman Town Centre - Central Business District - Residential - Cultural precinct - Jetty - Pump Stations	Sea level rise and erosion prone	Medium	Unknown	High to very high potential bushfire risk	None
Butler Bay - Existing and future sewerage lines - Existing and future residential area - Family camp precinct - Pump Stations - Airstrip	Erosion prone	Medium	Potential for significant flood risk under 1% AEP	High to very high potential bushfire risk	None

7.5. Experienced Events

Severe weather events are thought to be occurring more frequently but are often unpredictable. As seen below in Table 11 Palm Island has been impacted by several recent climate extreme events including the 2019 North and Far North Queensland Monsoonal Trough, Tropical Cyclone Debbie in 2017 and Tropical Cyclone Ita in 2014.

These events caused a range of impacts for the community on Palm Island, including storm damage, floods and storm surges.

Table 11: Palm Island Recent Disasters[54]

Date	Disaster Type	Name
Jan 2019	Flood, Storm	North and Far North Queensland Monsoon Trough
Feb 2018	Storm, Flood	North and Northwest Queensland Low
Mar 2017	Cyclone, Flood, Storm surge	Tropical Cyclone Debbie and associated rainfall and flooding
Apr 2014	Flood, Rainfall, Cyclone	Tropical Cyclone Ita and associated rainfall and flooding
Jan 2014	Cyclone	Tropical Cyclone Dylan
Jan 2013	Flood, Rainfall, Cyclone	Tropical Cyclone Oswald and associated rainfall and flooding
Mar 2012	Flood, Rainfall	Northern and Far Northern Queensland heavy rainfall and flooding
Feb 2011	Cyclone	Tropical Cyclone Yasi
Oct 2010	Flood	Queensland Floods Nov 2010 to Feb 2011

In addition to these more severe disasters, smaller more frequent events cause repeated inundation. The sawmill on Butler Bay road and surrounding areas experience sea level inundation during high tides and storm surges. Several local bridges are cut-off in flood events, specifically the bridge on Kalkadoon Road near the sawmill. Community members commented that rock walls need replacing and improving to reduce flooding at local schools and on local roads.

Furthermore, increased levels of sand deposition around the creek mouth near the jetty are thought to have a negative impact on the reef habitat, which previously came right up to the beach. Community members also raised that the disappearance of mangroves around the town area due to development and the construction of the seawall could be a cause for this increased sand accumulation

Finally, there are regular fires throughout the island. Based on discussions with PIASC and other community organisations, there is no local fire management plan or strategy to manage bushfire risks on Palm Island. There are some residents who have reported burning parts of the island in attempts to manage the land and promote healthy regrowth.

A range of adaptation measures have been adopted including the construction of a revetment wall adjacent to the town centre in 2017 for a project cost of $12.5M. These revetment walls

[54] (Australian Government, n.d.)

were constructed following Cyclone Yasi to protect foreshore areas. There is sand accumulation adjacent to the revetment walls (see Figure 27).

Figure 27: Sand accumulation at the revetment wall near the town centre

Insurance premiums in northern Queensland are much greater than other parts of Australia due to the region's exposure to severe weather events and rebuilding costs, which are up to 42% higher than in the south[14]. Median insurance premiums range between $1,020 and $4,438 per annum, a high variance due to the variation in the high risk of flood and cyclones on Palm Island[55]. Since 2011, the costs of disaster reconstruction for North Queensland are $951 million[13]. This does not seem to be an issue for community members on Palm Island, as DHPW arranges insurances on government housing. This situation may increase costs for DHPW or make homes uninsurable.

Total reconstruction costs for Palm Island following severe weather events are unknown. The costs specifically associated with reconstruction related to severe weather events cannot be isolated from the cost of maintenance and repair from other damage sources. Costs incurred through extreme weather events are also associated with disruptions from airport and ferry service closures, loss of income to residents and businesses, and impacts to community safety and wellbeing, but these have not been quantified for Palm Island.

7.6. Resilience of Island Infrastructure

7.6.1. Housing

The majority of houses on Palm Island are social housing homes provided to the community by the Department of Housing and Public Works (DHPW). As of December 2019, there were 486 DHPW homes on Palm Island with the remaining homes being for government workers. There is one home on a 99-year lease, approximately 10 council-owned and maintained dwellings as well as approximately 30 homes for government workers (healthcare providers, teachers and school staff, housing service providers as well as police). Additionally, it has been reported that there are up to 120 family camps that are scattered around the island and the coast. Some of these are occupied full-time by families who cannot or decide not to access

[55] (Australian Government, 2019)

government-provided housing. These are typically self-constructed structures or camps that families will occupy during holidays[56].

The government housing on Palm Island is reportedly not suitable for the average household size of approximately 8 persons per house. The houses on Palm Island have an average of 3 bedrooms per house (ranging from 2 to 7 rooms) for over 486 DPHW homes. There is a long wait list for housing on the island, with people having to wait without a house, sharing homes, in camps or on the mainland for many years[57]. This exacerbates overcrowding in homes, which can be linked to the high per-household energy consumption on Palm Island as well as negative impacts on community health.

Furthermore, based on project team observations and community testimony, the social housing design on Palm Island is not always designed with energy efficiency at the forefront of considerations. Almost all homes have dark-coloured Colourbond roofs, small windows with no considerations for local conditions such as natural shade and air circulation. Furthermore, based on conversations with the local housing officer, only approximately 10% of homes on Palm Island have an air-conditioning unit (DHPW). It is also understood that many of these systems are "box air conditioners", which are noisy, not very powerful and energy consuming. All of this creates situations where the houses supplied to the community are ill-adapted to the hot conditions of the dry-tropics and create uncomfortable, potentially unhealthy, conditions for residents, especially the more vulnerable. This already difficult situation is obviously exacerbated by the severe overcrowding situation on Palm Island.

In terms of housing and severe weather vulnerability, the 2018 Palm Island – Place of Refuge Feasibility Study (Mullins Consulting) estimates there are 101 houses considered vulnerable to severe weather events (constructed prior to 1982 or not built to comply with current design standards and structural certification). The majority of the island's housing and critical infrastructure are located on or near the coastline. It is widely recognised that climate change induced sea-level rise and storm surges have the potential to significantly impact Palm Island communities[58].

7.6.2. Roads and Infrastructure

A report undertaken by AECOM in 2017 indicated that road conditions varied greatly across the island and that some of the access roads were impacted by saturation and flood damage. It was assessed that bitumen reseals are a much-needed maintenance project throughout Palm Island, though it is understood that local government cannot fund these and will require grant funding. The road to and from the airport was targeted as the top priority for maintenance as it is degraded, not properly drained and does not have continued pedestrian access[59]. This road is one of the most frequented roads on the island, as all workers who fly in and out of the island transit on it. It is a critical community asset which plays an important role in the community's mobility and capacity to evacuate to the mainland in a timely manner as well as access to first response in the event of an emergency.

[56] (Fantin, 2016)
[57] (Mullins Consulting, 2018)
[58] (Mullins Consulting, 2018)
[59] (AECOM, 2017)

Another priority identified in the AECOM assessment is improving airport fencing, which was worked on in 2019 during the project team visits. Finally, it was identified that the barge ramp and the jetty require substantial investment in order to ensure safety of operations, enhance resilience to projected future impacts. It is understood by the project team that PIASC have obtained funding for this but are held back due to Great Barrier Reef regulation issues.

7.6.3. Major Facilities and Buildings

The 2016 Palm Island Retail and Business Centre Assessment from Economic Associates outlines the situation of council-owned buildings on the island and assessed the need for the new Palm Island Town Centre project. This project will increase commercial floor space by approximately 3,680m^2 on the island and is currently under construction[60].

Most of the commercial buildings on Palm Island are currently dated (over 30 years old) or are temporary buildings which do not meet the requirements relative to safety and health, as well as energy and water efficiency. Economic Associates also identified that the lack of sufficient commercial accommodation could inhibit the establishment of more external service providers (if needed) on the island such as financial services (there are currently only 2 Automatic Teller Machines (ATMs) on the island). Finally, PIASC continues to invest in buildings which are nearing the end of their life, which increases operating and maintenance costs.

Based on discussion with the Palm Island community, there is currently no cyclone/hurricane-proof or hurricane rated emergency centre on the island. Depending on accessibility and warning time, residents have different shelter options at their disposal during emergencies. Based on community testimony, during cyclones and severe weather events residents will gather in community members' homes that are constructed with brick, at the Police Citizens Youth Club (PCYC) or the Bwgcolman school. Further community testimony revealed that some community members retreat to family bush camps during cyclones, floods or during power outages, but it remains unclear how many residents participate in this type of evacuation/sheltering.

It is important to consider that both the Police Citizens Youth Club (PCYC) and the Bwgcolamn school have been evaluated as not suitable as an emergency shelter in the 2018 Palm Island – Place of Refuge Feasibility Study by Mullins Consulting[61]. The PCYC does not have any toilets and is made of materials that are not resistant to high winds and debris. The Bwgcolman school is located in a flood zone and was built before 1982, thus likely not conforming with current cyclone resistant construction guidelines. Finally, this report comes to the conclusion that based on the low likelihood of severe weather events and flooding of 5m (1 in 2.4 million) as well as the relatively low number of people requiring evacuation (22% of population), a cyclone shelter was deemed not necessary for Palm Island. See section 7.7.1 Disaster Planning and Evacuation Arrangements for further discussion.

7.6.4. Telecommunications

Telstra is the only cellular services provider with coverage on Palm Island. As presented in Figure 28 (cellular coverage represented in green tint), cellular reception covers approximately

[60] (Economic Associates Pty Ltd, 2016)
[61] (Mullins Consulting, 2018)

60% of the island[62] and most of the population hubs in the western portion of the island, though connection is patchy and can be very slow even with coverage. As visible on the same map, there are multiple cellular blackspots identified in grey, particularly on the Eastern side of the island and around Butler Bay (southwestern corner of the island). The current Telstra tower is located in Freedom P

ark and is not fitted with a backup generator. This means that the main risk related to communications is the loss of energy (see Ergon Energy fuel reserves in section below)[63].

The construction of a new base in Butler Bay, which is anticipated to provide coverage for the Butler Bay area, is planned for 2020[64].

Figure 28: Telstra coverage on Palm Island (coverage represented in green)

There is also community Wi-Fi around the council offices and the town mall, though it is unclear how effective and popular this connection is. Alternative means of communication include an emergency communications system at the Fire Station located on Farm road.

Telecommunications connectivity issues and limited access to the internet have been identified as obstacles to community development. This issue creates another obstacle to community development on Palm Island by reducing access to information, technological literacy and smooth communications within the community as well as with the mainland. In terms of resilience, this also poses an important risk in terms of emergency response by complicating or slowing down communications.

7.7. Community Preparedness and Self-Sufficiency

Community consultation on Palm revealed that there is usually a 72-hour (3 days) turn around after a disaster has occurred before anyone can provide external support. During conversations with community members, it was found that there were episodes when the barge could not access the island for up to five days. During these episodes, water and supplies had to be delivered to the island via air transport.

[62] (Telstra, n.d.)
[63] (Palm Island Aboriginal Shire Council, 2019)
[64] (Palm Island Aboriginal Shire Council, 2019)

Potable water reserves were highlighted as the critical limiting factor for the community's capacity to be isolated from the mainland. The council's main water reservoir has a capacity of 4.55ML and there are two more smaller reservoirs that hold water for the Reservoir Ridge neighbourhood which have a capacity of 304kL and 500kL. It is estimated by PIASC that these volumes of water, if full, can hold approximately 3 days of water based on current usage. These water reserves barely cover the estimated 72-hour response time. The school and the health centre have their own bottled water stocks but reserves for emergency situations are not maintained. The specific quantities of bottled water reserves are not known. No information around water reserves ever being depleted were available.

There is little to no food production on Palm Island. All food supplies are barged over daily via the barge service provider from Lucinda. Some small-scale gardens and fruit trees were observed on private properties, but it is estimated to only make up a small proportion of consumed food on the island. The previous CDP organisation ran a food production operation and there is evidence of previous operations including a poultry farm, a market garden, piggery and oyster farm. However, it was shut down after the change in management. Today, some infrastructure of these operations remains, but the equipment, tools and management capacity required to run such projects were removed. Many community members still hold valuable knowledge around food production, having been involved in previous initiatives.

Fishing constitutes an important food supply for the community on Palm Island. During island visits, many residents, including young children, were observed fishing off the jetty. Fishermen also frequent the nearby reefs and bring back a wide variety of fish to feed their families. There are no commercial fishing licenses on Palm Island, limiting the capacity to sell fish products on the island and on the mainland. Nevertheless, residents trade and sell fish within the community. Furthermore, the access to seafood provides the Palm Island community with a legitimate food source in the event of isolation from the mainland and contributes to increasing community resilience. Nevertheless, it is important to consider that the fish stocks may be impacted by climate change, jeopardising this food source.

The grocery store is state-owned (Community Enterprise Queensland) and considered expensive by the community (20% higher prices than in Townsville), particularly given the socio-economic profile of the island's residents. The store bulk purchases 4-5 months' worth of food in September each year from Brisbane and is kept full throughout the year. This allows for an emergency supply. The size and capacity of these reserves in terms of isolation days is not known.

In terms of energy reserves, Ergon Energy have 370,000L of diesel stored on Palm Island, which corresponds to three to six weeks of reserves, depending on community usage[65].

The estimated baseline for isolated island operations is 3-days, due to the water reserve, which is the lowest common denominator when considering the critical infrastructure.

7.7.1. Disaster Planning and Evacuation Arrangements

The Palm Island community expressed a strong sense of independence and self-sufficiency related to dealing with severe weather events and emergency situations. Multiple residents explained that the community was often left to fend for itself during these situations. It was

[65] (Palm Island Aboriginal Shire Council, 2019)

reported that during storms and other emergencies, family groups gather in homes which are more solidly built (brick), share resources and food and use the land for shelter and supplies.

In 2013, the council published its Local Disaster Management Plan in line with Queensland's Disaster Management Act of 2003, which requires comprehensive disaster management plans to be developed. This plan was updated in December 2019 for the years of 2019 and 2020[66]. The plan aims to protect the people, their property and the environment from the impacts of disaster through risk reduction measures and response recovery strategies, and to work towards increased community resilience.

PIASC maintains its response capability via the Palm Island State Emergency Service (SES) Unit. This unit trains the SES personnel and carries out exercises to prepare for emergency situations (as listed in Table 9). There are approximately 10 active State Emergency Service (SES) workers, training once a month on the island. The SES has access to two fire trucks and two ambulances, which are kept at the SES base.

There is limited emergency infrastructure on Palm Island, consisting of emergency equipment available at the airport, and the jetty. Based on discussions with a local SES member, there are no fire hydrants on the island and there are limited tools to manage oil or fuel spills or leaks.

The 2018 Palm Island – Place of Refuge Feasibility Study by Mullins Consulting evaluated Palm Island's evacuation capacity[67]. There are two main evacuation routes from the town centre, one to the jetty terminal (for evacuation via the ferry) and one to the airport (for evacuation via planes). The report evaluated the evacuation capacity as follows: "The normal route capacity is 2,400 people per hour. This is based upon cars with 4 people travelling with a 6 second separation. That is a separation distance of 33m at 20km/hr and 16m at 10km/hr[67]. The report does not outline which vehicles would be used for this purpose.

For evacuation, it was recommended by Mullins Consulting that the decision to evacuate be made 6 hours before the weather is estimated to disrupt the roads and a minimum of 2 hours before this time (if the community are prepared to evacuate).

A critical issue missing from this report are considerations relating to members of the community with reduced mobility. Community consultations have highlighted that much of the infrastructure does not allow for disabilities or those with mobility issues. Furthermore, communication between the council and the wider community has been shown to be ineffective, hindering the rapid transmission of information necessary for an evacuation as outlined in the report.

7.8. Summary of Resilience and Self-sufficiency

In summary, the climate on Palm is predicted to change over the next 20 to 30 years, potentially exacerbating the impacts of an already challenging situation on Palm Island. The island's ageing and insufficient infrastructure may not be able to handle the increased pressure of increased demand due to normal predicted population growth combined with more violent severe weather events.

[66] (Palm Island Aboriginal Shire Council, 2019)
[67] (Mullins Consulting, 2018)

Furthermore, Palm Island remains relatively isolated from the mainland in terms of visitation and tourism. This is predicted to change with an increasing community appetite for economic development through tourism, the promotion of tourism in the region and on the island as well as with the development of new tourism products (Museum of Underwater Art). It is estimated that this new attraction could lead to 5,000 tourists per annum (pre-COVID assessment). As much as this constitutes an important economic opportunity for the Palm Island community, this growth in visitors and associated pressure on the community, resources, services, and culture is also an important risk to consider in the development of this market.

The community on Palm Island has unique and important strengths which bolster its resilience capacity. The different services provided on the island, such as the Men's and Women's groups, the Youth and Family Centre, TAFE centre, school community and other health service groups provide an important and impactful support network for the community.

8. RISK ASSESSMENT

8.1. Introduction

EarthCheck conducted a high-level Risk Assessment for Palm Island as part of the Decarbonisation of the Great Barrier Reef Island project. The Sustainability Assessment informed the development of the Risk Assessment, which was then in turn considered in the Options Development and consequent project options, as seen in Figure 29.

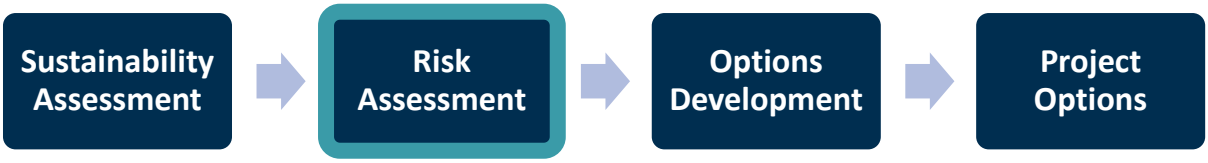


Figure 29: How the risk assessment fits into the project methodology

8.2. Methodology

The following method was applied by EarthCheck to assess the high-level risk of Palm Island against the 13 Key Performance Areas.

The EarthCheck Destination Standard identifies 13 Key Performance Areas for a region which were used as a base to identify risk aspects. To adapt these areas to this project, each of the Performance Areas were allocated to one of the Key Project themes, shown below in Table 12.

Table 12: Key Project Theme's correlation to EarthCheck's Destination Standard Key Performance Areas

Key Project Themes	EarthCheck Destination Standard 13 Key Performance Areas
Energy Production and Efficiency	1. Energy Efficiency, Conservation and Management 2. Greenhouse Gas Emissions
Water and Wastewater	3. Management of Freshwater Resources 4. Wastewater Management, Drainage and Streams
Waste and Recycling	5. Solid Waste Management
Transportation	6. Transport
Resilience and Self-Sufficiency	7. Air Pollution, Noise Control and Light Pollution 8. Ecosystem Conservation and Management 9. Land use Planning and Development 10. Management of Environmentally Harmful Substances 11. Cultural and Social Management 12. Economic Management 13. Resilience

A **Risk** was defined as the chance of an environmental, cultural, social and/or economic impact happening as a result of the activities undertaken by or presence of the community.

An **Aspect** was defined as an element of the community that interacts or has the potential to interact with the environment, cultural/social activities and/or the economy.

Once the key performance areas had been mapped against the key project themes, and risks and aspects were defined, the following steps were followed to identify, define and evaluate the risks:

1. Identify actual and/or potential impacts with regards to aspects. This was informed by the Sustainability Assessment. EarthCheck's proprietary benchmarking software was used to catalogue, organise and contextualise the information.
2. Define categories representing the severity of actual and/or potential impacts (refer to Table 13)

Table 13: Severity Evaluation

Category	Definition
1	**Limited:** impact to a local area but no long-term effects; concern or complaints from neighbours; no injury to people; minor technical nonconformity but no legal nonconformity.
2	**Minor:** Localised short to medium term impact; minor contribution to global warming; minor and reversible human health impacts treatable with first aid; negative publicity from local media; minor breach of legal requirements.
3	**Medium:** Localised medium to long term impact; moderate contribution to global warming; moderate human health impacts requiring medical treatment; regional media attention; moderate breach of legal requirements with fine.
4	**Major:** Widespread, medium to long term impact; serious human health impacts; state-wide or national attention; major breach of legal requirements; major disruption to operations; Destination's reputation badly tarnished.
5	**Catastrophic:** Widespread, irreparable environmental, cultural, social and/or economic damage; loss of human life or long term human health effects; national attention; serious litigation.

3. Define categories representing the likelihood of impacts (refer to Table 14)

Table 14: Likelihood Evaluation

Category	Definition
1	**Rare:** Impact would occur only in exceptional circumstances.
2	**Unlikely/Annually:** Impact could occur but is not expected, or will occur annually.
3	**Possible/Monthly:** Impact could occur, or will occur on a monthly basis.
4	**Likely/Weekly:** Impact will probably occur in most instances.
5	**Certain/Daily:** Impact is expected to occur in most circumstances, or will occur on a daily basis.

4. Define categories representing the risk evaluation (refer to Table 15)

Table 15: Risk Evaluation Matrix

Likelihood	Severity					
	1	2	3	4	5	
1	1	2	3	4	5	Low
2	2	4	6	8	10	Medium
3	3	6	9	12	15	High
4	4	8	12	16	20	Severe
5	5	10	15	20	25	Extreme

5. Determine the severity of potential and/or actual impacts and assign each to a severity category, which was informed by the Sustainability Assessment.
6. Determine the likelihood of potential and/or actual impacts and assign each to a likelihood category, which was also informed by the Sustainability Assessment.
7. Evaluate the risk by using the risk evaluation matrix

8.3. Analysis

In order for the Risk Assessment to be considered as part of the Options Development and consequent project options, the results were plotted. See Figure 30 and Figure 31 which illustrate Palm Island's overall risk profile as well as the number of risks for each risk severity category broken down into the different project themes.

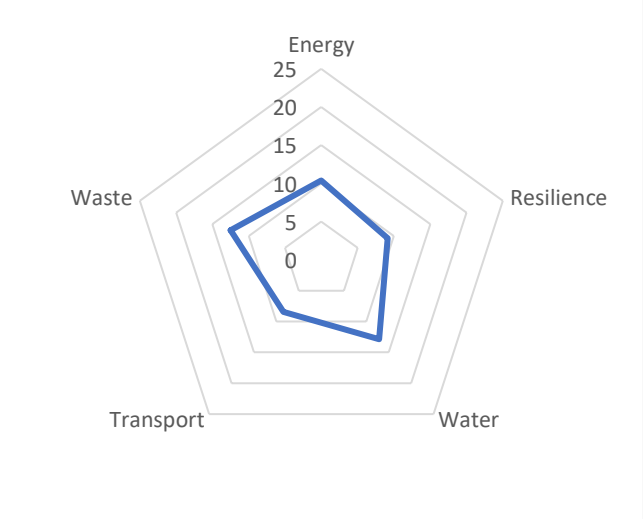


Figure 30: Risk profile for Palm Island

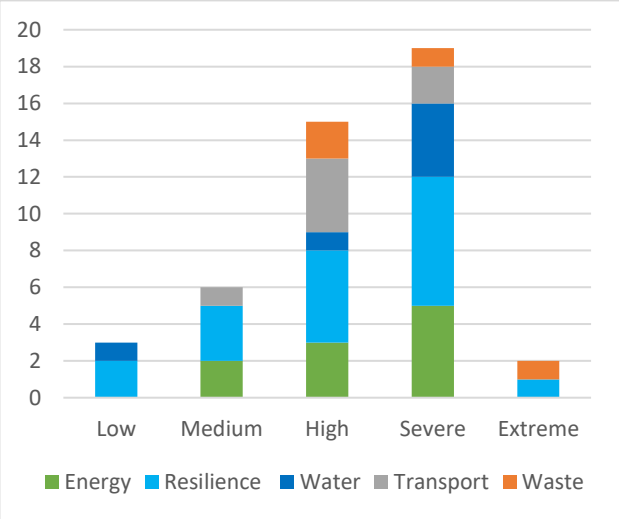


Figure 31: Risk breakdown for Palm Island

Palm Island's risk profile, illustrated in Figure 30, is presented as an average of risk scores by theme. This shows the water and waste themes as having the highest risk profiles, followed by energy, resilience and transport respectively. Figure 31 shows the number of risks in each category and that the "severe" and "high" risk categories are the most represented categories and both include at least one risk from each theme. Only waste and resilience have extreme risks identified by this Risk Assessment.

The Risk Assessment identified if there were current mitigation strategies in place for the risks identified. A summary table (Table 16) has been provided below of potential impacts with little to no current mitigating strategies observed.

The potential impacts identified as having either a high, severe or extreme risk with little to no current mitigating strategies observed, were considered when creating the long list of decarbonisation options in phase two of the project (see Technical Appendix: Options Report). This was done with the aim of providing potential solutions to assist with risk reduction on the island.

Table 16: Summary of Potential Impacts with little to no mitigation strategies observed

Risk Evaluation	**Potential Impact(s)**	**Current Minimisation / Mitigation Strategy Observed**
High	Potential increase in diesel/ petrol cost to affect energy price causing financial accessibility issues for on-island stakeholders.	No current mitigating strategies observed

	Operating costs of inefficient and/or outdated equipment causing financial strain.	No current mitigating strategies observed.
	Use of diesel generators as back-up during peak loads, increasing greenhouse gas (GHG) emissions.	No current mitigation strategies observed.
	Insufficient consideration of climate change risks in land use planning and development causing damage to property and infrastructure.	Insufficient consideration of climate change risks in land use planning and development causing damage to property and infrastructure.
	Dependency on ferry company for waste removal, which if Palm Island is cut off from the mainland leads to an issue in the capacity of the current disposal site.	Limited waste storage capacities at transfer station No current mitigating strategies observed.
	Wild horses damaging local ecosystems through manuring and spreading weeds.	Other than the recent horse cull, no other current mitigating strategies observed.
	High costs associated with removing waste off-island as there is no on-island waste treatment facility.	No current mitigating strategies observed.
	Greenhouse gas emissions from waste from the island sent to landfill on the mainland.	No current mitigating strategies observed.
	High reliance on food delivered from the mainland as limited food grown on Palm Island. High cost of food through the state-owned supermarket.	No current mitigating strategies observed.
Severe	Depletion of natural energy resources through consumption of fuel.	Minimal mitigation strategies in place
	Energy use and costs from inefficient non-functioning equipment including the solar installation on the wastewater treatment plant and council administration building.	No current mitigating strategies were observed to manage the lack of working infrastructure.
	Use of non-renewable fuel consumption in transportation	SeaLink has increased efficiency of vessels but still a heavy reliance on diesel.

	to and from the island contributing to climate change.	
	Potential for ozone depleting substances to release gases harmful to human health (e.g. from fridges, air conditioning equipment etc.).	No current mitigating strategies observed – air conditioning in most houses. Many unmanaged refrigeration units at the transfer stations – white goods potentially managed by DES waste project.
	Sludge is stored onsite as there is no local treatment and the costs of transporting this to the mainland are prohibitive. This is likely to impact local ecosystems and provides further risks in severe weather events.	No current mitigating strategies observed.
	Reliance on external transport providers to bring visitors, workers and local residents on and off the island, including evacuations during severe weather events.	No current mitigating strategies observed.
Extreme	Significant contamination on the waste disposal site (e.g. engine oil, asbestos etc.) with likely soil contamination and opportunity for the rubbish to end up in the ocean during cyclone and flooding events. There is no surveillance, monitoring or management of the waste disposal site on Palm Island, and wild horses frequent the site.	Waste compactor needed but not yet procured No current mitigating strategies observed.

The full Risk Assessment can be referred to in Appendix 2: Palm Island Risk Assessment of this document.

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APPENDIX 1 PALM ISLAND COMMUNICATION AND ENGAGEMENT PLAN

The following pages outlines the Communication and Engagement Plan that has been designed to inform the sustainability assessment, options analysis and project options development. Included in the plan is a cultural engagement strategy for Palm Island.

OVERVIEW

EarthCheck led a team of consultants including ARUP, Regional Economic Solutions (RES) and Queensland Tourism Industry Council (QTIC) to deliver the Decarbonisation of the Great Barrier Reef Islands – Whole of Island Community Pilot Project for Palm Island. This project was carried out for the Department of Environment and Science (DES) in close collaboration with the Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP).

Appropriate and respectful community and stakeholder engagement was key to the successful delivery of the Project and the sharing of community knowledge to understand issues and barriers and identify achievement opportunities for the island.

This Communications and Engagement Plan has been designed to inform the sustainability assessment, options analysis and project options development. Included in this plan is a cultural engagement strategy for Palm Island prepared by RES (with review by QTIC) that:

- Recognises and respects cultural knowledge and experience
- Includes both men's and women's business and perspectives
- Is sensitive to historical and political experiences of First Nation peoples
- Is sensitive to Island specific cultural protocols and socio-economic issues

This plan presents the used engagement approaches and an outline of the communications and engagement with the community and key stakeholders, setting out the roles and responsibilities of players. A list of engaged stakeholders is also included.

1. PROJECT OBJECTIVES

The Project objective was to deliver a Great Barrier Reef (GBR) Decarbonisation Program for the island community of Palm Island. DES is helping GBR Island communities by identifying opportunities and project options to enable transition to low carbon economies and become more resilient to changes in climate. Palm Island presented unique challenges for decarbonisation and resilience with the added opportunity of learning from and incorporating First Nation community knowledge into the decarbonisation and resilience efforts.

The Whole of Island Community Pilot Project worked with the community to identify opportunities for new technologies, innovations and best practices, and ensure community has sufficient information (project options) to seek funding opportunities. These will reduce greenhouse gas emissions and provided additional benefits such as:

- Ownership of projects and input into the work going forward
- Identify opportunities for local employment and economic development
- Identify cluster opportunities for implementing solutions with neighbouring islands and communities

The project was constituted of three phases that led to the presentation of the Final Project options to the island community. These phases were:

1. The Sustainability Assessment

The sustainability assessment involved off-site and on-site data collection on five key areas (energy, waste management, water, transport, and resilience). During the first on-island visit, the team spent three days engaging with the community and key stakeholders, building relationships as well as collecting a range of information (qualitative and quantitative).

2. The Options development

The options development involved compiling a list of options for reducing emissions, increasing resilience to climate change and identifying new opportunities. The impact and feasibility of each of these was evaluated by the project team and a panel of industry experts. During the second on-island visit, the community tailored these options and provided feedback to ensure alignment with key community needs.

3. The Project options development

The project options development involved developing packages for Palm Island. These went through a rigorous cost-benefit analysis which investigated on-island employment opportunities. During the third on-island visit, the community had the opportunity to tailor these project options and provide supplementary feedback to ensure appropriateness and project success.

Each of these phases involved communicating and engaging with key island stakeholders such as local councils, community leaders, as well as organisations and service providers.

2. COMMUNITY AND STAKEHOLDERS ENGAGEMENT METHODOLOGY

Palm Island required a tailored engagement strategy to facilitate communications between the project team and the community. Understanding this for Palm Island and having an adapted stakeholder approach was a key success factor.

The community engagement strategy rests upon the Moon-da-gatta (Yarning Framework) which was used to engage residents and, in particular, First Nations people. This is a cultural tool which was facilitated by RES to share and gather information where the elders, young people and local leaders are respected as knowledge holders in their community.

This was complemented by the widely accepted community engagement techniques as well as cultural engagement tools. The International Association for Public Participation (IAP2) Engagement spectrum which outlines the level of public participation by stakeholder groups depending on their level of interest in the project has guided the engagement techniques developed for the project.

The team used both approaches to communicate and collaborate with key stakeholders and community on Palm Island. These are described further below.

2.1 RES (Moon-da Gatta) Yarning Framework

In collaboration with the local Island community, the project team worked to share principles of engagement from First Nation perspectives. This approach is best practice in relation to place based and healing informed initiatives and will guide engagement and discussions with the

community. This Yarning-up Engagement and Yarning-up Delivery framework defines the cultural and corporate elements of success. This framework helps to identify the community's strengths and works from a position of co-design where the community is central and decision making a fundamental principle.

The strength of the framework is engagement through a First Nation lens that identifies and celebrates the strengths of individuals and the collective through processes of self-disclosure and storytelling. RES's framework empowers participants and provides a platform to self-determination. The model to success is described below.

RES's Yarning Framework Moon-da-gatta is a Bidjara word meaning creator or to create. Moon-da-gatta is a Strength Based process and is the bedrock which sits at the centre guiding our community engagement principles. It is based on respect, responsibility, and relationships. The diagram below (Figure 32) highlights the key milestones of the engagement processes each having a function and deliverable towards self-determination.

Figure 32: The Moondagatta Yarning Framework, RES

1. **Discover**: Appreciating "the best of what is". The physical, geographical, social, emotional and spiritual elements of the area and its people.
2. **Understand**: Dreaming process "What might be" (based on aspirations, individual and community strengths)
3. **Negotiate**: "Yarning to work together" (what processes need to be set up to begin the process of designing and collaborating now and into the future)
4. **Implement**: Recognising assets & gaps. (Project Delivery and communicating the intentions)
5. **Take Stock**: Reviewing milestones previously negotiated
6. **The Future**: What next to self determination

The information and advice identified through the Yarning process informed the content, delivery and implementation methods, expectations and duration of support required resulting in a program that is unique to the community and the diverse cohort.

2.2 IAP2 and General Engagement Techniques

The Communications and Engagement Plan is based on the four pillars of the IAP2 Stakeholder Engagement Spectrum – Inform, Consult, Involve and Collaborate. For this project, the multiple engagement strategies outlined in the IAP2 framework were used as needed to maintain stakeholder engagement.

For the project to provide the most successful and beneficial outcomes, the consultation and engagement process with the stakeholders and communities on-island needed to build trust and gain support for any preferred options. The key stakeholders included the residential community, local councils, business operators, transport providers, state and/or national government departments operating on the island as well as any tangible links to surrounding islands or the mainland. A detailed framework of the IAP2 approach is included in Section 4.

The key engagement tools identified in this framework that are relevant to the project include:

Inform

- Push and pull communications
- Project Website
- Local Media (paper, radio, TV, internet, social media)
- Public displays/exhibitions
- Existing community organisation networks
- Environment, recreation, sport, tourism and business networks
- Council's range of communication channels

Consult/Involve/Collaborate

- Project presentations
- Community forums and workshops
- Face to face meetings
- Surveys
- Community Drop in Sessions
- Emailing feedback
- Key Influencer Engagement
- Industry technical forum

3. COMMUNICATION AND ENGAGEMENT PLAN

The action plan for community engagement for Palm Island was based on the following principles that were used to gain maximum communication and engagement. These principles ensured the community was:

- Advised of the project intent and their thoughts sought
- Engaged in the Yarning Framework to help develop understanding and express their views
- Shown how this project could benefit the community
- Asked if they have had similar initiatives in the community previously
- Asked if there is First Nation cultural knowledge that people would like to share and have recorded

- Engaged in negotiating an engagement and decision-making process throughout the project stages and seek feedback regarding the planning and implementation processes
- Engaged in identifying and reviewing a range of opportunities that consider individual residents, businesses, community organisations and other stakeholder groups
- Provided with updates about the project and progress on milestones
- Advised of previous projects and or studies that have been considered and views or feedback will also be sought to ensure the results continue to be relevant

The following tables present the key communication and engagement considerations for Masig Island throughout the project. Table 1 provides an overview of the key stakeholder groups engaged in the project. Table 2 provides an overview of key actions implemented through each phase of the project.

Table 1: Key stakeholder groups for Palm Island

Community/ Stakeholder	Engagement
Government (State) Level of interest: Likely to be a very high level of interest due to alignment with policy objectives, opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings
Local Council Level of interest: Likely to be a very high level of interest due to alignment with policy objectives, opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Council will have multiple resources involved in the project operational team • Council to take ownership of the project and help guide, support and facilitate project delivery • Council to assist with project-related communications and with venues for meetings and community gatherings (if possible)
Utility providers Level of interest: Likely to be a very high level of interest due to opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings
Community associations Level of interest: Likely to be a medium - high level of interest due to community development outcomes, opportunities for infrastructure	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings

Community/ Stakeholder	Engagement
enhancement and long-term planning and development	• Assist in the dissemination of project-related information throughout respective networks
Businesses (retail, accommodation, transport) Level of interest: Likely to be a medium – high level of interest as an opportunity to reduce business operation costs and support resilience of Island business, tourism and future development	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Traditional Owner representatives Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Lead community input and cultural knowledge into the project • Review and feedback on reports and presentations including providing sign-off on key findings
Community providers (schools, health, churches, sport) Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Residents (those with Historical Association) Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Other stakeholder groups (technology providers, neighbouring Islands) Level of interest: Likely to be a medium level of interest as opportunities identified for these Islands may open be broadened to wider GBR region	IAP2 Spectrum: Inform • Inform

Table 2: Palm Island Communication and Engagement Plan

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
Palm Island Stakeholder groups (Residents, Traditional Owners, Businesses, Community associations, Community providers, Transport operators, Other stakeholder groups)	1 Sustainability Assessment	Island-specific poster detailing project and first visit information such as time and place of drop-in sessions. Shared via following groups: • Council • CDP • Department of Housing and Public Works • PICC	26.08.19	EC	RES, QTIC, Arup, DATSIP, DES, Council	DES	EC, Council, key stakeholders, media
		Island-specific web page presented the project, the timeline, the project team and other important resources (survey, reports, etc.)	26.08.19	EC	RES, QTIC, Arup	DES	EC
		Community drop-in sessions, interviews and casual conversations presented project to community and collected qualitative and quantitative information about the island	26.08.19 27.08.19 28.08.19	EC	EC, RES, QTIC, Arup	none	EC, RES, QTIC
		Indigenous and Traditional Owner groups were met with to develop relationship, project buy-in and contextual information. Steps 1, 2 and 3 from the RES Yarning Framework were employed in this phase (Discover, Understand and Negotiate)	26.08.19 27.08.19 28.08.19	RES	RES	None	RES

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		Online survey to collate island data regarding energy, water, waste, transport and resilience. Distributed in person, through community groups and via email.	26.08.19	EC	RES, QTIC, Arup	DES	EC, Council, Key stakeholder groups, media
		Data requests to key stakeholders to collate information concerning energy, water, waste, transport and resilience. Distributed via phone calls, interviews or email.	Throughout phase	EC	DES, Arup	DES	EC
	2 Options Development	Island-specific poster detailing project and first visit information such as time and place of drop in sessions. Shared via following groups: • Council • CDP • Department of Housing and Public Works • PICC • Island Market	14.10.19	EC	RES, QTIC, Arup, DATSIP, DES, Council	DES	EC, Council, key stakeholders, media
		Flyer presenting project methodology and structure updated for the second visit with key information. Hard copies only.	14.10.19	EC, RES, QTIC, Arup	RES, QTIC, Arup, DATSIP, DES	DES	EC, RES, QTIC, Arup
		Workshop briefing pack prepared attendees for the workshop and guided the discussion	14.10.19	EC, RES, QTIC, Arup	RES, QTIC, Arup	DES	EC, Council, Key stakeholders

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		Indigenous and Traditional Owner groups were met with to further develop relationship, project buy-in and contextual information. Steps 3, 4, 5 and 6 from the RES Yarning Framework were employed in this phase (Negotiate, Implement, Take Stock and The Future)	04.11.19 05.11.19 06.11.19	RES	RES	None	RES
		Led discussions and workshops to present options short list and collect community input on gaps, applicability and other details	04.11.19 05.11.19 06.11.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES to approve content	EC, RES, QTIC, Arup
	3 Project options Development	Island-specific poster detailing project and first visit information such as time and place of drop in sessions. Shared via following groups: • Council • CDP • Department of Housing and Public Works • PICC • Island Market	17.02.20	EC, RES, QTIC, Arup	RES, QTIC, Arup, Council, DATSIP, DES	DES	EC, Council, key stakeholders, media
		Flyer presenting project methodology and structure updated for the third visit with key information. Hard copies only.	17.02.20	EC, RES, QTIC, Arup	RES, QTIC, Arup, DES, DATSIP	DES	EC, RES, QTIC, Arup, Council, Key stakeholders

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		Workshop briefing pack prepared attendees for the workshop and guided the discussion	17.02.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup, DES, DATSIP	DES	EC, Council, Key stakeholders
		Indigenous and Traditional Owner groups were met with to further develop relationship, project buy-in and contextual information. Steps 3, 4, 5 and 6 from the RES Yarning Framework were employed in this phase (Negotiate, Implement, Take Stock and The Future)	02.03.20 09.03.20	RES	RES	None	RES
		Led discussions and workshops to present project options and collect community input on gaps, applicability and other details	02.03.20 09.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES to approve content	EC, RES, QTIC, Arup
	4 Final Report	Due to COVID-19 and related safety concerns related to travel, the final delivery of the reports and project options process was adjusted. These will be distributed electronically and presented virtually to council, key community contacts and project champions	January/ February 2021	EC, RES, QTIC, Arup	RES, QTIC, Arup, Council, DES, DATSIP	DES, Council, Key stakeholders	EC, DES and RES
Palm Island Aboriginal Shire Council	1 Sustainability Assessment	Project summary (4-pager) providing a detailed portrait of the project, the timeline, the project team as well as what councils and key stakeholders can do to help the project succeed	26.08.19	EC, RES	EC, RES, QTIC, DES, DATSIP	DES	EC

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		Online survey to collate island data regarding energy, water, waste, transport and resilience. Distributed in person and/or via email	26.08.19	EC	RES, QTIC, Arup, DES, DATSIP	DES	EC
		Sustainability Assessment Report presenting the findings of the Sustainability Assessment phase and first site visit	23.09.19	EC	RES, QTIC, Arup, Council, DES	DES	EC
	2 Options Development	Workshop briefing pack to prepare attendees for the workshop and guide the discussion	14.10.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC, Council, Key stakeholders
		Led discussions and workshops to present options short list and collect Council input on gaps, applicability, and other details	04.11.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	none	EC, RES, QTIC, Arup
	3 Project options Development	Workshop briefing pack prepared attendees for the workshop and guided the discussion	17.02.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC
		Led discussions and workshops to present project options and collect Council input on gaps, applicability and other details	02.03.20 09.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC, RES, QTIC, Arup
	4 Final Report	Final report and project options presented to council contacts (Remotely, due to COVID-19)	January/ February 2021	EC, RES	EC, RES, QTIC, Arup, Council	DES	EC
		Council meeting to present the project results, hand over the project options and thank the council for their engagement (Remotely, due to COVID-19)	January/ February 2021	EC	EC, RES, QTIC, Arup	none	EC

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
Government and industry experts	2 Options Development	Options briefing pack prepared distribution group for feedback and guided discussions	07.09.19	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
		Materials distributed presented options and collected input on project alignment, gaps, applicability, and other details	17.10.19	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
	3 Project options Development	Project options workshop briefing pack prepared attendees for the workshop and guided the discussion	03.02.20 24.02.20	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
		Workshop / Survey presented project options and collected input on project alignment, gaps, applicability, and other details	03.02.19 24.02.20	EC	EC, Arup, DES, DATSIP	DES	EC
Media	Throughout project	All communications with media were managed by DES. Advice from DES media was that any news outlets should contact DES media at Media@des.qld.gov.au for any inquiries.	All	DES	EC, RES, QTIC, Arup, DES, DATSIP	DES	DES

4. IAP2 APPROACH AND PROJECT ENGAGEMENT TECHNIQUES

IAP2 approach	
Engagement Principles	**Engagement will be inclusive** which means ensuring that everyone who may have an interest in the outcome has an opportunity to participate.
	A **range of engagement techniques** will be employed for industry, community and other stakeholders based on the IAP2 spectrum of inform, consult, involve, collaborate and empower.
	The **timing and purpose** of each stage of engagement is clearly linked to each stage of project options development.
	There is a clear commitment to the provision of **accurate and timely information**, and a process to confirm that feedback is being heard.
	The **diversity of views in the community** will be acknowledged and respected in accordance with relevant procedures and customs for each island.
	Engagement will be **flexible and responsive** community needs to ensure that the process builds buy in and ownership from stakeholders and community.
Engagement Objectives	To **communicate broadly to the community and key stakeholders** to inform them about the development and progress of the Project throughout its life-cycle.
	To **work directly with key stakeholders** to ensure that their aspirations are understood, and their local knowledge and experience is integrated into the project options.
	To **build a strong partnership with the stakeholders** throughout the development of the project options that will enable support and effective implementation.
	Ensure the **diversity of community voices** are reflected in the engagement process, and that **diverse opportunities** are created for the community to be informed about and have input into the development of the project options.
	Provide **clarity and transparency** about how community and stakeholder input has influenced the development of the project options.
Engagement approach	**Informing** This engagement approach focused on getting the message out to the community and key stakeholder groups of the project, that work had commenced, informed them of its priorities, and how and when all parties were able to get involved.

IAP2 approach	
	An Engagement Strategy was implemented for each island. It presented an adapted approach for each island, based on its history, culture, available communications streams and used a range of media channels, potentially including: • Project Website • Local Media (paper, radio, TV, internet, social media) • Existing community organisation networks • Environment, recreation, sport, tourism and business networks • Council's range of communication channels • Community champions Push Communications Information about the project was sent or distributed to relevant stakeholders via a variety of methods. These mainly included e-mails and phone conversations to key stakeholders. Local communications streams were also harnessed to promote project awareness. Notifications were also sent in local media publications. Considerations for each island's communication infrastructure will have to be made. Traditional methods of push communication may not be appropriate or effective. Pull Communications The Project Website Page allowed a wide range of stakeholders to become and stay informed about the project, communicate with the project team as well as provide insight and feedback. The page was added onto the EarthCheck website and presents the project, the project team, the project partners and the project context. A link was made available to stakeholders and partners so they may link to it on their own websites and facilitate the spread of information about the project. Other pull communication methods included publications on local council's websites or notice boards in various key locations on or around each island. Communication Streams This Project employed a variety of communication streams to achieve its IAP2 engagement approach objectives. These were adapted to the needs of the island.
	Consulting The purpose of this engagement approach was to conduct the sustainability assessments and on-site research by successfully gathering high quality consultative input from the identified community and stakeholder groups. On-island and relevant off-island groups were included in this phase.

IAP2 approach	
	Options for consultation could include: • Community forums and workshops; • Face to face meetings; • Project webpages; • Sustainability audits • Online and offline surveys • Feedback register Communities We recognise the importance of developing an approach which provides for as wide a range of inputs as possible. This recognised existing issues for all three islands such as location and socio-demographic groups. Where applicable, community champions were identified and involved to facilitate community engagement and ownership of the project. Presentations Presentations were used in this project to present key project findings, the sustainability options analysis as well as project options to island stakeholders. Furthermore, presentations were also employed to convey information about the project progress and final deliverables to DES. Cultural sensitivities were considered and how to best communicate information to diverse audiences. Industry and Stakeholders Industry stakeholders were identified for each of the islands. Depending on their importance relative to the project, they were directly communicated with or not. These stakeholders are listed in the Stakeholder Register. Council Communication We recognise the importance of generating buy-in and input across senior officers and council teams – all of whom have a role in supporting the project options. Key contact points for the council have been identified in the Stakeholder Register. Broader Industry and Technical Engagement EarthCheck engaged with technical experts, relevant government agencies such as utility providers and relevant industry representatives such as suppliers of remote Island infrastructure in the review and shortlisting of the options and cost benefit analysis of the project options. As part of this process EarthCheck facilitated options review and project options development workshops in Brisbane inviting relevant participants to attend in person or via weblink.

IAP2 approach	
	ARUP also led engagement of technical experts, relevant stakeholders and/or relevant government agencies for pricing information for use in the project options. An upper limit of 10 persons or organisations will be contacted as is appropriate.
	Involving The involving engagement approach focused on maintaining contact with stakeholders throughout the course of the project and fostering continued interest. Given the timescale over which the project options were prepared, this is an important consideration. As such, the project team proposed utilising the extensive network of existing communication channels to industry, stakeholders and community groups to maintain contact and provide regular updates. Options for involving included: • Public displays/exhibitions of appropriate options (online/physical); • Open meetings; • Online feedback through project webpages/social media; • Workshops; • Surveys; and • Direct feedback. <u>Community</u> Maintaining community buy-in and involvement was a key success factor for this project. For this, it was critical that there be an open and maintained communication stream between the project team and its stakeholders. Options for how this was achieved included: • Project Website/social media; • Open meetings; and • The opportunity for email questions and feedback. <u>Local businesses</u> Local businesses can be important players in a community. It was important to provide these stakeholders with a voice and the opportunity to provide feedback. For this, it was again important that there was an open and maintained communication stream between the project team and its stakeholders. Options for how this was achieved included: • Project Website/social media; • Open meetings; and • The opportunity for email questions and feedback. <u>Other Stakeholders</u>

IAP2 approach	
	Feedback from the community and stakeholders from the Options Workshops and the recommended responses was feed into the final project options preparation. Consultation Groups and Workshops Consultation groups and workshops were a critical communication stream and engagement tool for this project. The island was visited to conduct a sustainability assessment as well as during options review workshops and the project options presentations. These involved communicating, working and consulting with the community. Cultural sensitivity was a key aspect of this communication stream. RES and QTIC were heavily involved in this process to ensure culturally appropriate interactions with the many different cultural backgrounds involved in the project. This ensured good working relationships as well as promoted positive project outcomes.
	Collaborating The final and perhaps most important stakeholder engagement approach focused on collaboration – activity which engendered collective ownership of the project options and commitment to being implementation partners. The communication around the final project options provides an ideal opportunity to engender wider understanding and ownership. This was done through: • Council Briefings; • Key Influencer Engagement; and • Integration of feedback into project options.

5. PALM ISLAND STAKEHOLDER REGISTER

This stakeholder register is up to date as of 29.09.2020 Please refer to the project Stakeholder Register for the latest data.

Position	Business/organisation	Category
Store manager	Palm Island Supermarket	Business and the business community
Owner/Manager	Coolgaree Bay Sports Bar And Bistro	Business and the business community
	Sandy Boyd Aged Care Hostel	Business and the business community
	Sibley Petrol Station	Businesses and the business community
CEO	Blue Water Aviation	Businesses and the business community
Administration Manager	Palm Island Barge Company	Businesses and the business community
Coordinator	Beryl Castors Home Care Service	Businesses and the business community
CEO	Townsville Enterprise	Businesses and the business community
Business Development Manager	Container Exchange	Businesses and the business community
	Sunset Snack Bar	Businesses and the business community
	Palm Island Sustainability Hub – Jina Gunduy	Businesses and the business community
	Bwgcolman Supermarket - Palm Island	Businesses and the business community
	Goodoo Day Care Centre	Businesses and the business community
	Klub Kuda	Businesses and the business community
	Palm Island Pharmacy	Businesses and the business community
	Palm Island Shuttle Service	Businesses and the business community
	Palm Island Technologies	Businesses and the business community
	Townsville Enterprise	Businesses and the business community

	Palm Island Motel	Businesses and the business community
	Seventh Day Adventist Community Church	Community Providers
	Palm Island Voice	Community Providers
		Community Providers
	CDP	Community Providers
Domestic Violence Specialist Service	Palm Island Community Company	Community Providers
Director of Nursing	Joyce Palmer Health Service	Community Providers
Back to work youth training officer	Back to work, regional employment package	Community Providers
Executive Manager, Youth & Accommodation	Townsville Aboriginal & Island Health Services	Community Providers
Chairman	Palm Island Community Company	Community Providers
	Palm Island Community Company	Community Providers
	CDP	Community Providers
Operations Manager	Joyce Palmer Health Service	Community Providers
IKC Coordinator	Palm Island Aboriginal Shire Council library services	Community Providers
Principal	St Michael's Catholic Primary School	Community Providers
	Australia Post - Palm Island LPO	Community Providers
	Campbell Page Community Center	Community Providers
	Bwgcolman Community School	Community Providers
Officer in Charge	Queensland Police Service - Palm Island Station	Government (State)
Senior Sergeant	Queensland Police Service - Palm Island Station	Government (State)
Key contact for QPWS	QPWS	Government (State)

Principal Engineer	Department of Local Government, Racing and Multicultural Affairs	Government (State)
Principal Engineer	Department of Local Government Racing and Multi Cultural Affairs	Government (State)
Officer in Charge	Queensland Ambulance Service	Government (State)
	State Energency Services	Government (State)
	Housing and Public Works	Government (State)
Senior Project Officer | Remote Service Delivery	DATSIP	Government (State)
	Palm Island Rural Fire Brigade	Government (State)
Mayor	Palm Island Aboriginal Shire Council	Local Council
Economic development and grants	Palm Island Aboriginal Shire Council	Local Council
Councillor	Palm Island Aboriginal Shire Council	Local Council
Councillor	Palm Island Aboriginal Shire Council	Local Council
Manager STP/WTP	Palm Island Aboriginal Shire Council	Local Council
Councillor	Palm Island Aboriginal Shire Council	Local Council
CEO	Palm Island Aboriginal Shire Council	Local Council
Deputy Mayor	Palm Island Aboriginal Shire Council	Local Council
Director of Works and Facilities	Palm Island Aboriginal Shire Council	Local Council
Personal Assistant	Palm Island Aboriginal Shire Council	Local Council
	Key contact/project champion for Farm	Resident
	Key contact/project champion for Farm	Resident

	Palm Island CDP	Resident
	Key contact for Farm project	Resident
	Key contact/project champion for Farm	Resident
	Jiggas Agora	Resident
	Traditional Owner	Traditional owner representatives
Administration/contact officer	Manbarra Nanggarra Wanggarra Aboriginal Corporation	Traditional owner representatives
Connections Manager Northern	ERGON	Utility providers
Renewable and Strategy Engineer Ergon Energy	Energy Q	Utility providers
Assessment Coordinator Ergon Energy	EnergyQ	Utility providers

APPENDIX 2 PALM ISLAND RISK ASSESSMENT

The assessment on the following pages provides an overview of Palm Island's Risk Assessment, including current observed strategies to mitigate or minimise potential and/or actual impacts with regards to the 13 Key Performance Areas.

KPA	Aspect	Potential Impact(s)	Likelihood	Severity	Risk Evaluation	Current Minimisation/ Mitigation Strategy	Link to Project Option/s
Energy Efficiency, Conservation and Management	**Use of and reliance on fuel**	Depletion of natural energy resources through consumption of fuel.	4 – Likely	4 – Major	16 – Severe	• Small number of solar panel systems and hot water systems on the island, with some diesel back-up.	PO 4: Community Bus Service PO 5: Solar Power on the Ground with Battery PO 10: Improving Walkways Around Palm Island PO 13: Options for Replacing Diesel for the Ferry and Barge Services Rec. E13: Power generation from sewage treatment plant gas supplemented with solar Rec. T1: Pilot research trial for production of diesel from recycled cooking oil and biomass (coconut oil) for local transport use Rec. T4: Electric car hire and charge point program Rec. T11: Increase size and capacity of planes to island to reduce trip frequency

		Reliance on diesel/ petrol delivery from the mainland which may impact on self-sufficiency/ resilience for Islanders.	2 – Unlikely	3 – Medium	6 – Medium	• Back-up reserves of diesel. There is approximately 3 to 6 weeks' worth of fuel on island at any one time. Some redundancy in diesel generators.	
		Potential increase in diesel/ petrol cost to affect energy price causing financial accessibility issues for on-island stakeholders.	3 – Possible	3 – Medium	9 – High	• No current mitigating strategies observed.	PO 4: Community Bus Service PO 10: Improving Walkways Around Palm Island Rec. T4: Electric car hire and change point program
		Residents use LPG or burn fires when they have no power causing a safety issue.	3 – Possible	2 – Minor	6 – Medium	• Fire bans are enforced when water reserves are low and during hot summer months. • There is one fire station on the island with two fire trucks operated by SES volunteers.	

	Inefficient and outdated equipment	Energy use and costs from inefficient non-functioning equipment including the solar installation on the wastewater treatment plant and council administration building.	4 – Likely	3 - Medium	12 – Severe	• Isolated power plant was refurbished in 2017 so equipment working well. • DHPW updating old solar hot water systems (50 per annum) • No current mitigating strategies were observed to manage the lack of working infrastructure.	PO 6: Put Solar Power on the Roof PO 11: Cooling Options for Homes PO 12: Improve Energy Use in Houses
		Operating costs of inefficient and/or outdated equipment causing financial strain.	2 – Unlikely	4 – Minor	8 – High	• No current mitigating strategies observed.	PO 2: Living Better at Home and Saving Money PO 9: New Solar Hot Water Systems PO 11: Cooling Options for Homes PO 12: Improve Energy Use in Houses

Greenhouse Gas Emissions	**Carbon emissions associated with energy use**	Use/reliance on diesel and motor gasoline contributing to climate change.	4 – Likely	3 – Medium	12 – Severe	• Some residents and businesses have installed solar.	PO 4: Community Bus Service PO 10: Improving Walkways Around Palm Island PO 13: Options for Replacing Diesel for the Ferry and Barge Services Rec. T1: Pilot research trial for production of diesel from recycled cooking oil and biomass (coconut oil) for local transport use Rec. T4: Electric car hire and charge point program Rec. T11: Increase size and capacity of planes to island to reduce trip frequency
		Use of non-renewable fuel consumption in transportation to and from the island contributing to climate change.	4 – Likely	3 – Medium	12 – Severe	• SeaLink has increased efficiency of vessels but still a heavy reliance on diesel.	PO 4: Community Bus Service PO 10: Improving Walkways Around Palm Island PO 13: Options for Replacing Diesel for the Ferry and Barge Services Rec. T1: Pilot research trial for production of diesel from recycled cooking oil and biomass (coconut oil) for local transport use

		Potential for ozone depleting substances to release gases harmful to human health (e.g. from fridges, air conditioning equipment etc.).	4 – Likely	3 – Medium	12 – Severe	• No current mitigating strategies observed – air conditioning in most houses. • Many unmanaged refrigeration units at the transfer stations – white goods potentially managed by DES waste project.	PO 11: Cooling Options for Homes PO 12: Improve Energy Use in Houses Rec. E3: Palm Island sustainable building design code for new buildings
	Capacity of renewable energy systems	Use of diesel generators as back-up during peak loads, increasing greenhouse gas (GHG) emissions.	3 – Possible	3 – Medium	9 – High	• No current mitigation strategies observed.	PO 5: Solar Power on the Ground with Battery PO 6: Put Solar Power on the Roof PO 9: New Solar Hot Water Systems Rec. E9: Current of tidal generation/water turbine Rec. E10: Wind turbines Re. E13: Power generation from sewage treatment plant gas supplemented with solar Rec. E14: Pumped hydro storage Rec. T1: Pilot research trial for production of diesel from recycled cooking oil and biomass (coconut oil) for local transport use

Air Pollution, Noise Control & Light Pollution	**Air pollution**	Elevated sound from vehicles and ferries causing noise pollution and negatively impacting human health.	1 – Rare	1 – Limited	1 – Low	• No current mitigating strategies observed.	
		Vehicle emissions causing air pollution and negatively impacting human health.	2 - Unlikely	1 – Limited	2 – Low	• Some people ride share, and the community also travels on-island by foot or horse. • No other current mitigating strategies observed.	
Management of Freshwater Resources	**Water usage**	Depleting limited freshwater resources to water shortages, creating a risk to livelihood, health and liveability.	4 – Likely	4 – Major	16 – Severe	• Limited use of water from wells. • Purchase of bottled water at a cost of approx. $300K per annum.	PO 7: Building Confidence in the Community's Water Supply PO 15: Water and Wastewater Plan
	Water quality	Poor water quality which is exacerbated by the death of wild horses and other animals near/ in water reservoirs impacting availability of water and human health.	4 – Likely	4 – Major	16 – Severe	• In July 2019, Queensland Government announced funding to upgrade the water treatment plant – the extent that the project will improve water quality is unknown.	PO 7: Building Confidence in the Community's Water Supply PO 8: Indigenous Ranger Program PO 15: Water and Wastewater Plan

Wastewater Management, Drainage and Streams	**Stormwater Drainage**	Contamination and blocking of stormwater drains with weeds.	2 – Unlikely	1 – Limited	2 – Low	• A previous project cleared stormwater drains of weeds. • PIASC discussed better upgrades and maintenance of the drainage system. • All the streets in the main business area are sealed, have storm drains, kerbing, channelling and sealing.	
	Wastewater treatment	Wastewater treatment plant is at capacity and unable to service further population growth.	4 – Likely	4 – Major	16 – Severe	• In July 2019, Queensland Government announced funding to upgrade the wastewater treatment plant – unknown whether this project plans to increase capacity and to what extent.	PO 15: Water and Wastewater Plan

		Lack of auxiliary power supply at plant leading to risk of failure should the primary power supply fail.	3 – Possible	3 – Medium	9 – High	• As part of the Palm Island Master Plan a solar farm is being investigated for installation at the wastewater treatment plant.	PO 5: Solar Power on the Ground with Battery PO 6: Put Solar Power on the Roof PO 15: Water and Wastewater Plan Rec. E13: Power generation from sewage treatment plant gas supplemented with solar
		Sludge is stored onsite as there is no local treatment and the costs of transporting this to the mainland are prohibitive. This is likely to impact local ecosystems and provides further risks in severe weather events.	4 – Likely	3 – Medium	12 – Severe	• No current mitigating strategies observed.	PO 15: Water and Wastewater Plan
Ecosystem Conservation & Management	**Ecosystem health**	Wild horses damaging local ecosystems through manuring and spreading weeds.	5 – Certain	2 – Minor	10 – High	• Other than the recent horse cull, no other current mitigating strategies observed.	PO 8: Indigenous Ranger Program
		Impacts to local ecosystems from increased development on the island.	3 – Possible	4 – Medium	12 – Severe	• Environmental impacts assessed in planning and development applications.	PO 16: A Tourism Plan for Palm Island

Land Use Planning and Development	**Coastal vulnerability**	Coastal hazards including cyclones and storm activity causing coastal erosion and damage to buildings and infrastructure.	4 – Likely	4 – Major	16 – Severe	• Flooding hotspots have been identified at the Palm Valley Creek Bridge and the causeway situated at Wallaby Point Road Junction (near water and wastewater treatment plants).	PO 3: Caring for Our Sea Countries Rec. R8: Upgrade river rock walls Rec. R11: Whole of island resilience and self-sufficiency plan
		Insufficient consideration of climate change risks in land use planning and development causing damage to property and infrastructure.	2 – Unlikely	4 – Major	8 – High	• Insufficient consideration of climate change risks in land use planning and development causing damage to property and infrastructure.	PO 2: Living Better at Home and Saving Money Rec. E3: Palm Island sustainable building design code for new buildings
Transport	**Island accessibility**	Dependency on ferry company for waste removal, which if Palm Island is cut off from the mainland leads to an issue in the capacity of the current disposal site.	3 – Possible	3 – Medium	9 – High	• Limited waste storage capacities at transfer station • No current mitigating strategies observed.	PO 14: Waste Management Facility Upgrade Rec. WS9: Waste reduction and management strategy Rec. WS10: Use sewage plant effluent to create compost and fertiliser for use on the island
		Overcrowding of jetty when boarding as tickets can only be purchased on the vessel causing safety issues.	4 – Likely	1 – Limited	4 – High	• Funding approved for Jetty upgrade project but is blocked due to regulatory issues.	N/A Not within project scope

		Port only operates during low tide. It is vulnerable to damage from high seas and closes during cyclone events. This leads to a range of issues including challenges in evacuations for health reasons, imports of food and supplies.	4 – Likely	2 – Minor	8 – High	• Work underway to extend Port.	PO 1: Community Market Garden Rec. R11: Whole of island resilience and self-sufficiency plan
		Reliance on external transport providers to bring visitors, workers and local residents on and off the island, including evacuations during severe weather events.	4 – Likely	3 – Medium	12 – Severe	• No current mitigating strategies observed.	PO 13: Options for Replacing Diesel for the Ferry and Barge Services Rec. T12: Community-run barge Rec. R11: Whole of island resilience and self-sufficiency plan
	On-island transportation	Poor condition of roads and connectivity of roads on the island limiting mobility during severe weather events.	4 – Likely	3 – Medium	12 – Severe	• Road upgrades currently being done (project awarded in 2020)	PO 4: Community Bus Service PO 10: Improving Walkways Around Palm Island
		No public transport on the island and transport is predominantly on foot, horse or by car.	4 – Likely	2 – Minor	8 – High	• Private Taxi/shuttle service on the island. • The Men's Shed are building walking tracks.	PO 4: Community Bus Service Rec. T4: Electric car hire and charge point program

		Current state of on-island transport provides restricted access for those with disabilities (e.g. wheelchairs, elderly) limiting visitation of some people.	2 – Unlikely	3 – Minor	6 – Medium	• No current mitigating strategies observed.	
Solid Waste Management	**Waste storage**	Significant contamination on the disposal site (e.g. engine oil, asbestos etc.) with likely soil contamination and opportunity for the rubbish to end up in the ocean during cyclone and flooding events. There is no surveillance, monitoring of management of disposal site on Palm Island, and wild horses frequent the site.	5 – Certain	4 – Major	20 – Extreme	• Waste compactor needed but not yet procured • No current mitigating strategies observed.	PO 17: Help Community to Stop Using Plastic Items Commonly Found in Rubbish Rec. R8: Upgrade river rock walls Rec. WS9: Waste reduction and management strategy

	Waste disposal	Limited waste separation and contamination of waste streams.	4 – Likely	3 – Medium	12 – Severe	• Green waste and white goods are stored separately, although contamination is present. • Container refund scheme operates on the island. • Metal waste is transported to Hinchinbrook.	PO 14: Improving the Waste Management Site PO 17: Help Community to Stop Using Plastic Items Commonly Found in Rubbish Rec. WS9: Waste reduction and management strategy
		High costs associated with removing waste off-island as there is no on-island waste treatment facility.	4 – Certain	2 – Minor	8 – High	• No current mitigating strategies observed.	PO 14: Improving the Waste Management Site PO 17: Help Community to Stop Using Plastic Items Commonly Found in Rubbish Rec. WS9: Waste reduction and management strategy Rec. WS10: Use sewage plant effluent to create compost and fertiliser for use on the island
		Greenhouse gas emissions from waste from the island sent to landfill on the mainland.	5 – Certain	2 – Minor	10 – High	• No current mitigating strategies observed.	PO 14: Improving the Waste Management Site PO 17: Help Community to Stop Using Plastic Items Commonly Found in Rubbish Rec. WS9: Waste reduction and management strategy

Management of Environmentally Harmful	**Storage of harmful substances**	Costs to dispose of construction and industrial waste is high potentially leading to illegal storage, risks of spills and illegal disposing.	3 – Possible	1 – Limited	3 – Medium	• No current mitigating strategies observed.	
Cultural and Social Management	**Unemployment**	Unemployment rates are higher than the national average leading to community disruptions, poor living conditions and drug/alcohol use. High costs of food and fuel exacerbate this.	5 – Certain	3 – Medium	15 – Severe	• The CDP works on Palm Island to assist job seekers to develop skills and contribute to their community. • Members of the community are hired to work on most projects (roads, maintenance, building).	PO 1: Community Market Garden PO 2: Living Better at Home and Saving Money PO 4: Community Bus Service PO 10: Improving Walkways Around Palm Island Rec. R4: Creation of activities for youth and community fitness programs
	Social Housing	More than 400 people are on the waitlist for social housing exacerbating overcrowding.	5 – Certain	3 – Medium	15 – Severe	• DATSIP Masterplan has identified lots for potential housing development.	N/A *Not within project scope*

	Island Governance	Social unrest and distrust of the police service as a result of the 2004 riot. Community fractions make decision-making on island-wide issues challenging.	4 – Likely	2 – Medium	8 – High	• This project initiated some discussions with TO group around collaboration and a whole-of-island environmental management plan.	PO 1: Community Market Garden PO 2: Living Better at Home and Saving Money PO 4: Community Bus Service PO 7: Building Confidence in the Community's Water Supply PO 8: Indigenous Ranger Program PO 16: A Tourism Plan for Palm Island Rec. T12: Community-run barge
Economic Management	**Social and economic viability**	High cost of insurance premiums in North Queensland increases cost of business impacting returns or means that insurance is unaffordable, and assets are uninsured, leading to greater vulnerability during severe weather events.	5 – Certain	3 – Medium	15 – Severe	• Insurance resilience programs are improving properties to reduce future claims. • QRA leading disaster resilience programs.	N/A *Not within project scope*

		High cost to defend and protect coastal areas and infrastructure leading to allocation of funds to high risk areas (not all assets/ areas can be protected).	5 – Certain	4 – Major	20 – Extreme	• Construction of seawall in 2017 for $12.5M.	PO 3: Caring for Our Sea Countries Rec. R8: Upgrade river rock walls Rec. R11: Whole of island resilience and self-sufficiency plan
		High cost of energy and water reduces business returns and investment.	3 – Possible	1 – Limited	3 – Medium	• No current mitigating strategies observed.	
		Reduced visitor numbers to the island due to negative media stories about severe weather events.	3 – Possible	2 – Minor	6 – Medium	• Other than attempted tourism promoting actions (such as the upcoming Museum of Underwater Art), no other current mitigating strategies are observed to reduce negative media stories.	

Resilience	**Severe weather events**	Severe weather events leading to the island being cut-off from the mainland, and some parts of the community cut-off from the rest. This leads to a range of issues including evacuations for health reasons, access to power, water, roads cut to critical infrastructure, telecommunications etc.	4 – Likely	4 – Major	16 – Severe	• Paper based systems for payment of goods and services. • 3 to 6 weeks' worth of fuel on the island at any one time.	PO 1: Community Market Garden PO 7: Building Confidence in the Community's Water Supply PO 10: Improving Walkways Around Palm Island Rec. R11: Whole of island resilience and self-sufficiency plan Rec. R16: Additional communication systems
		No emergency shelters on the island causing safety risks for the population during an emergency event.	4 – Likely	4 – Major	16 – Severe	• Disaster management plans in place which encourage residents to take certain actions to manage their safety.	Rec. R10: Design and construct a cyclone shelter or identify upgrades to an existing building Rec. R11: Whole of island resilience and self-sufficiency plan
		Increased psychological issues from experiencing severe weather events.	4 – Likely	2 – Minor	8 – High	• Range of community groups to assist. • Well serviced region in Townsville for disaster relief.	N/A *Not within project scope*

	Food availability	High reliance on food delivered from the mainland as limited food grown on Palm Island. High cost of food through the state-owned supermarket.	4 – Likely	2 – Minor	8 – High	• No current mitigating strategies observed.	PO 1: Community Market Garden Rec. R11: Whole of island resilience and self-sufficiency plan
	Climate change	Climate change projections include more hot days and warm spells, an increased intensity of severe rainfall events, continued increases in mean sea level rise, and fewer but more intense tropical cyclones. Theses present risks to the community of Palm Island, and its infrastructure.	4 – Likely	4 – Major	16 – Severe	• Revetment walls were constructed following cyclone Yasi to protect the foreshore areas however, there needs to be ongoing management of the sand accumulation.	PO 3: Caring for Our Sea Countries Rec. R8: Upgrade of river rock walls Rec. R11: Whole is island resilience and self-sufficiency plan